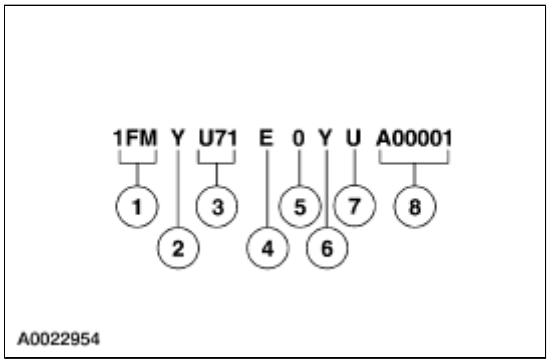
Identification Codes

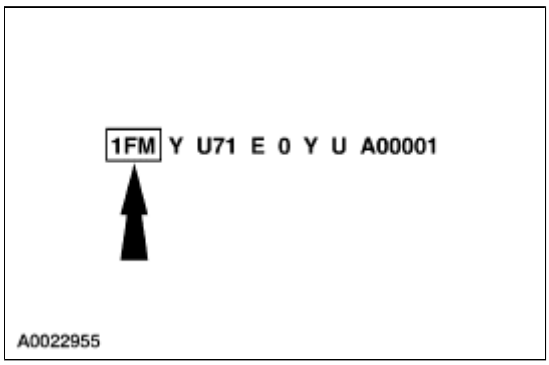
The vehicle identification number (VIN) is a 17-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted on the instrument panel, top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.



Item	Description
1	World manufacturer identifier
2	Brake type and gross vehicle weight rating (GVWR)
3	Vehicle line, series, body type
4	Engine type
5	Check digit
6	Model year
7	Assembly plant
8	Production sequence number

Vehicle Identification Number

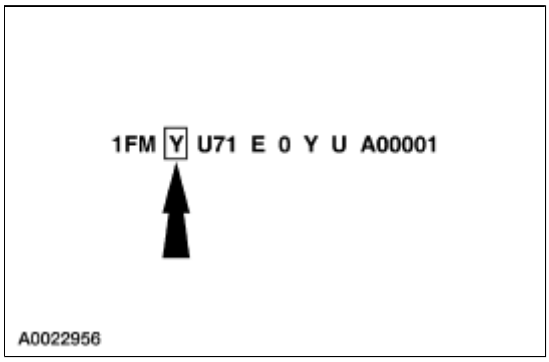
World Manufacturer Identifier



The first three vehicle identification number (VIN) positions are the world manufacturer identifier.

- 1FM — Ford Motor Company, USA, multi-purpose vehicle
- 1FC — Ford Motor Company, USA, stripped chassis
- 4M2 — Mercury, USA, multi-purpose vehicle

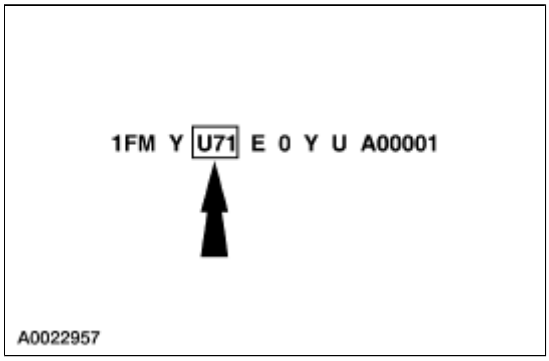
GVWR Code



The fourth VIN position is the vehicle brake type and GVWR code (all vehicles use hydraulic brakes).

- Y — 4,001-5,000 pounds GVWR, Explorer/Mountaineer (less side impact air bags)
- Z — 5001-6000 pounds GVWR, Explorer/Mountaineer (less side impact air bags)
- M — 5,001-6,000 pounds GVWR, US Postal stripped chassis (less air bags)
- C — 4,001-5,000 pounds GVWR, Explorer/Mountaineer (with side impact air bags)
- D — 5,001-6,000 pounds GVWR, Explorer/Mountaineer (with side impact air bags)

Line, Series and Body Type Code

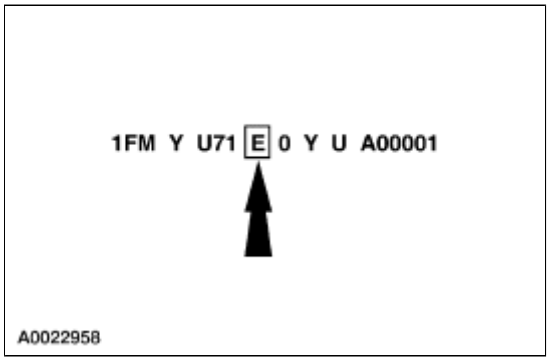


Positions 5 through 7 indicate vehicle line, series and body type.

- U60 — Explorer, 4x2, two-door, Sport
- U70 — Explorer, 4x4, two-door, Sport
- U61 — Explorer, 4x2, four-door, XL
- U71 — Explorer, 4x4, four-door, XL
- U62 — Explorer, 4x2, four-door, XLS
- U72 — Explorer, 4x4, four-door, XLS
- U63 — Explorer, 4x2, four-door, XLT
- U73 — Explorer, 4x4, four-door, XLT
- U83 — Explorer, AWD, four-door, XLT
- U64 — Explorer, 4x2, four-door, Eddie Bauer

- U74 — Explorer, 4x4, four-door, Eddie Bauer
- U84 — Explorer, AWD, four-door, Eddie Bauer
- U65 — Explorer, 4x2, four-door, Limited
- U75 — Explorer, 4x4, four-door, Limited
- U85 — Explorer, AWD, four-door, Limited
- U66 — Mountaineer, 4x2, four-door
- U76 — Mountaineer, 4x4, four-door
- U86 — Mountaineer, AWD, four-door
- U69 — US Postal stripped chassis, RHD

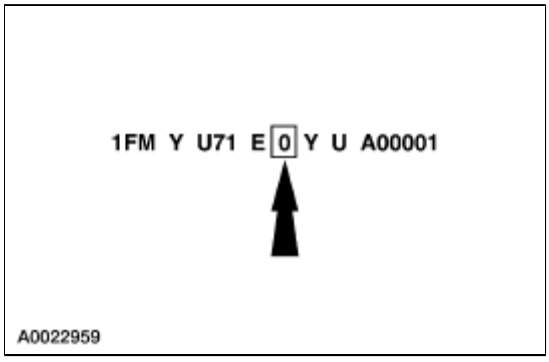
Engine Code



The eighth VIN position is the engine displacement and number of cylinders.

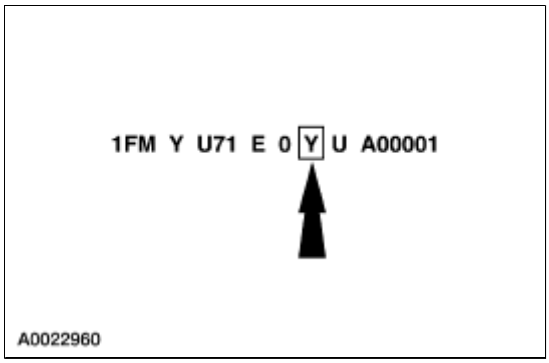
- X — 4.0L, EFI, OHV, six cylinder
- E — 4.0L, EFI, SOHC, six cylinder
- P — 5.0L, EFI, eight cylinder
- K — 4.0L, EFI, SOHC, six cylinder, flex fuel

Check Digit



The ninth VIN position is a check digit.

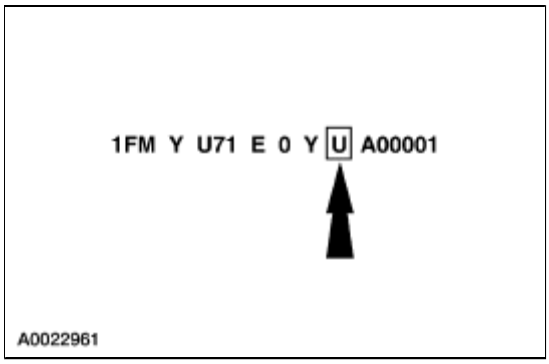
Model Year Code



The tenth VIN position is the model year code.

- Y — 2000

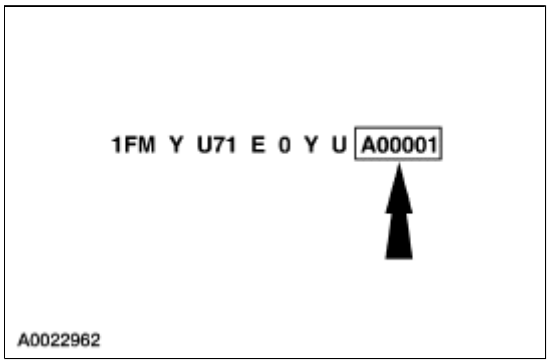
Assembly Plant Code



The eleventh VIN position is the assembly plant code.

- U — Louisville (Louisville, Kentucky)
- Z — St. Louis (Hazlewood, Missouri)

Build Sequence

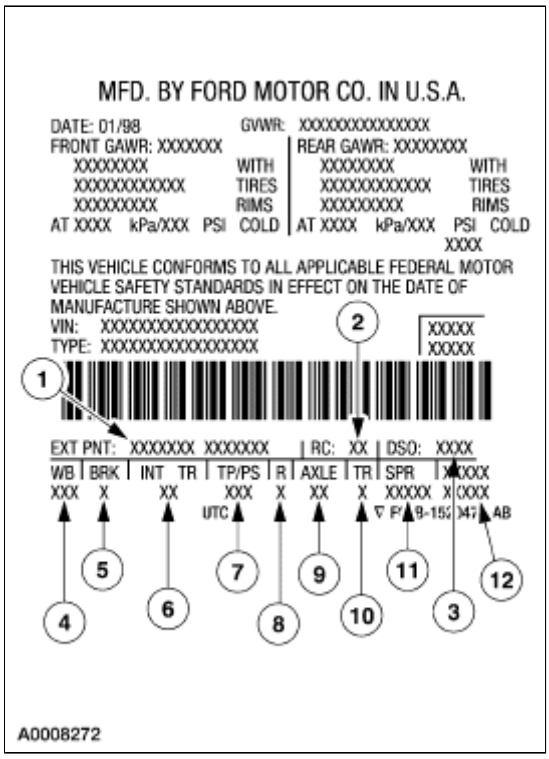


The last six VIN positions are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number.

- A00001-E99999 — Ford Division

- J00001-L99999 — Mercury Division

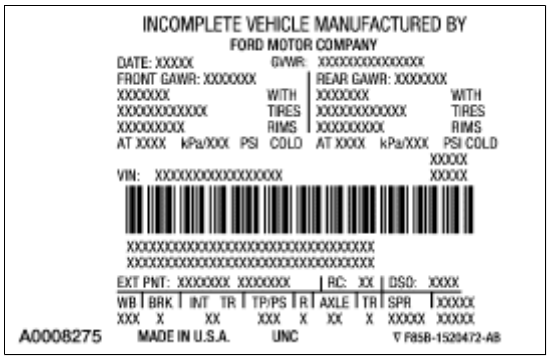
Vehicle Certification (VC) Label



Item	Description
1	Exterior paint code
2	Region code
3	Domestic special order code
4	Wheel base code
5	Brake code
6	Interior trim code
7	Tape/paint pinstripe code
8	Radio code
9	Axle code
10	Transmission code
11	Spring code
12	Powertrain calibration information

The vehicle certification (VC) label contains the manufacturer name, the month and year of manufacture, the certification statement, and the VIN. It also includes gross vehicle weight ratings (GVWR).

Vehicle Certification (VC) Label — Incomplete Vehicle (Typical)



Paint Codes

NOTE: The first set of codes list the primary body color, the second set of codes list the lower body two-tone paint code (if applicable).

The following lists the exterior paint codes:

Primary body color codes

- B2 — Harvest Gold
- B4 — Autumn Brown
- FL — Medium Toreador Red
- FS — Spruce Green
- LD — Medium Wedgewood Blue
- LL — Deep Wedgewood Blue
- SU — Amazon Green
- UA — Ebony
- WF — White Pearl, tri-coat (St. Louis build only)
- YZ — Oxford White

Lower two-tone exterior paint codes:

- RC — Medium Platinum
- BA — Medium Prairie Tan (Mountaineer Appearance Package)
- JL — Dark Toreador Red
- LD — Medium Wedgewood Blue
- ST — Estate Green

Radio Codes

- Y — Delete radio system
- R — Delete radio chassis, all other components installed
- 9 — M100C AM/FM stereo with cassette and clock
- 8 — P100LL AM/FM premium stereo with cassette
- Z — AM/FM stereo with compact disc player
- K — Luxury AM/FM stereo with cassette, compact disc player and digital sound processing (DSP)

Axle Codes

The following lists the gear ratios on axles.

- 41 — 3.27 non-limited slip
- 45 — 3.55 non-limited slip
- 46 — 3.73 non-limited slip
- 42 — 4.10 non-limited slip
- D1 — 3.27 limited slip
- D5 — 3.55 limited slip
- D4 — 3.73 limited slip
- D2 — 4.10 limited slip

Transmission Codes

- D — Five-speed automatic overdrive, A5LDE
- M — Five-speed manual, Mazda
- U — Four-speed automatic overdrive, 4R70W

Spring Codes

The following lists available spring codes.

Front Springs

- B — 5B326 (RH), 5B327 (LH) torsion bar
- D — 5B326 (RH), 5B327 (LH) torsion bar
- E — 5B326 (RH), 5B327 (LH) torsion bar
- F — 5B326 (RH), 5B327 (LH) torsion bar
- G — 5B326 (RH), 5B327 (LH) torsion bar
- H — 5B326 (RH), 5B327 (LH) torsion bar
- J — 5B326 (RH), 5B327 (LH) torsion bar
- L — 5B326 (RH), 5B327 (LH) torsion bar
- 1 — 5B326 (RH), 5B327 (LH) torsion bar
- 2 — 5B326 (RH), 5B327 (LH) torsion bar

Rear Springs

- F — 5560 spring
- H — 5560 spring
- L — 5560 spring

Interior Trim Codes

The following lists the interior trim and interior color codes.

Interior Trim

- A — Vinyl bucket seats
- J — Premium Tweed cloth bucket seats
- Y — Premium Amay cloth bucket seats
- Z — Cloth bucket seats with power

- G — Cloth sport bucket seats
- F— Leather sport bucket seats
- M — Cloth split bench seat
- 1 — Leather sport bucket seats (Limited)
- Blank — No seat installed (US Postal stripped chassis, RHD)

Interior Color Codes

- X — Medium Prairie Tan
- 2 — Medium Graphite
- T — Dark Graphite

Tape Stripe Codes

- L — Light Prairie Tan (Limited)

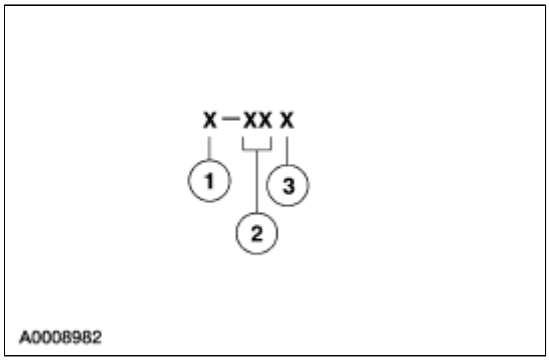
Powertrain Calibration Information

NOTE: Powertrain calibration information is limited to a maximum of five characters per line on the vehicle certification label. Because of this, calibration identification consisting of more than five characters will wrap to the second line on the VC label.

Powertrain calibration information is printed in the lower right corner of the vehicle certification label. Only the base calibration information is printed. Revision levels will not appear, however, they can be found in On Line Automotive Service Information System (OASIS). For the current model year, Ford Motor Company is using three different protocols which describe powertrain base calibration. These protocols are designed to provide worldwide standardization for vehicle calibration. If the electronic calibration strategy has been used since 1998 and carried into the current model year, Protocol 1 will be used. Refer to Protocol 1 below. If the electronic calibration strategy has been used since 1999 and is carried into the current model year, Protocol

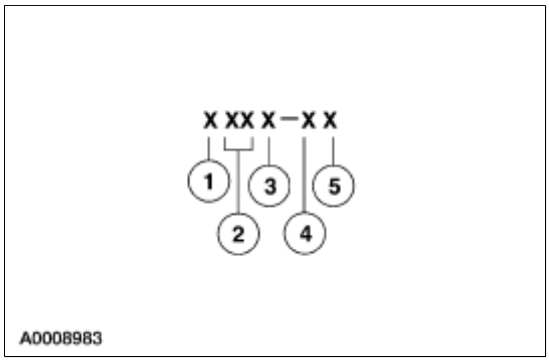
2 will be used. Refer to Protocol 2 below. For new electronic calibration strategies for the current model year, use Protocol 3. Refer to Protocol 3 below.

Protocol 1



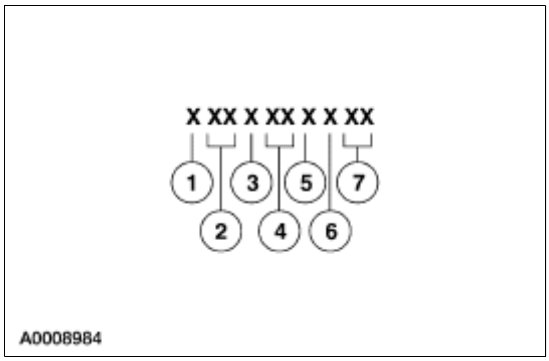
Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Engine revision level

Protocol 2



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Transmission code
4	Emission standard (designates the specific country emission standard)
5	Design level (design level assigned to the engine)

Protocol 3



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Vehicle code
3	Transmission code
4	Unique calibration (designates different hardware to similar vehicles). Example: tires, drive ratios, etc.
5	Fleet code (describes fleet to which the vehicle belongs). Example: 6 – evaporative emissions
6	Certification region (lead region where multiple regions are included in one calibration). Example: A – U.S. federal
7	Revision level (will advance as revisions occur). Not printed on label

Jacking

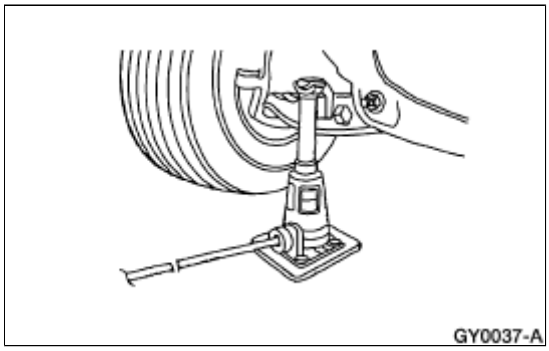
WARNING: Do not run the engine when jacking the vehicle. The wheels contacting the ground could cause the vehicle to move.

WARNING: Make sure the jack and jack stands are properly located to prevent the vehicle from falling.

WARNING: Wheel chocks should be used to prevent the vehicle from rolling and falling off the jack.

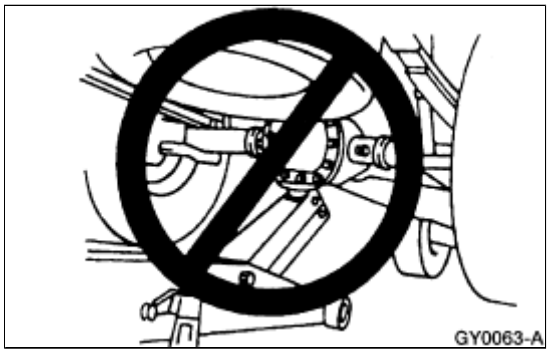
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

Jacking Points — Front



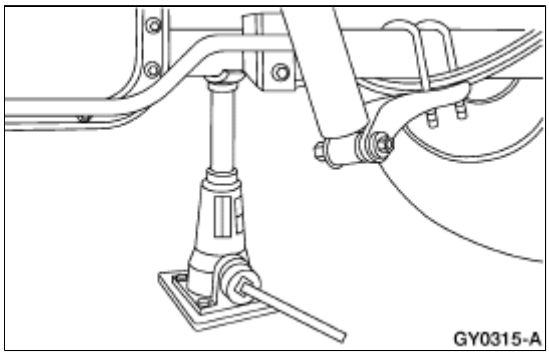
1. The front jacking point is a tab that extends from the lower control arm.

Jacking Points — Rear



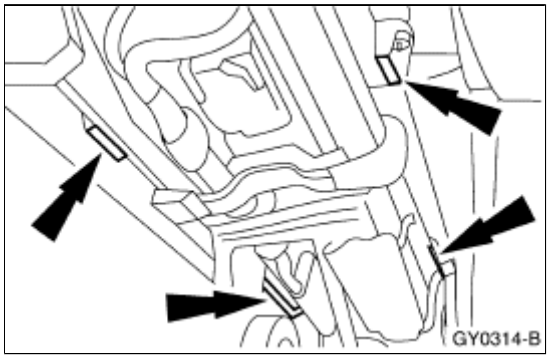
1. **CAUTION: Do not use the differential housing as a lift point. Leaks or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.**

   The rear jacking points are located on the rear axle tube.



Lifting

Lifting Points



1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

   CAUTION: Do not use the differential housing as a lift point. Leaks or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.

   CAUTION: Damage to the suspension, exhaust or steering linkage components may occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.

   Locate front hoist adapters and rear hoist adapters (top of frame arc) as indicated.

Noise, Vibration And Harshness (NVH)

Noise is any undesirable sound, usually unpleasant in nature. Vibration is any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down. Harshness is a ride quality issue where the vehicle's response to the road transmits sharply to the customer. Harshness normally describes a firmer than usual response from the suspension system. Noise, vibration and harshness (NVH) is a term used to describe these conditions, which result in varying degrees of dissatisfaction. Although, a certain level of NVH caused by road and environmental conditions is normal. This section is designed to aid in the diagnosis, testing and repair of NVH concerns.

Acceptable Noise, Vibration and Harshness

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise that is not subject to control. Vibration isolators, mufflers and dampers reduce these to acceptable levels. A driver who is unfamiliar with a vehicle can think that some sounds are abnormal when actually the sounds are normal for the vehicle type. For example, Traction-Lok® differentials produce a slight noise on slow turns after extended highway driving. This is acceptable and has no detrimental effect on the locking axle function. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH concerns and their diagnosis. For example, if the vehicle has automatic overdrive, it is important to test drive the vehicle both in and out of overdrive mode.

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

- system knowledge, including comparison with a known good system.
- system history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of possible sources.
- using a systematic diagnostic method that divides the system into related areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road or system test to determine the exact nature of the concern.
- an analysis of the possible causes.
- testing to verify the cause.
- repairing any concerns found.
- a road test or system test to make sure the concern has been corrected or brought back to within an acceptable range.

Glossary of Terms

Acceleration-Light

An increase in speed at less than half throttle.

Acceleration-Medium

An increase in speed at half to nearly full throttle, such as 0-97 km/h (0-60 mph) in approximately 30 seconds.

Acceleration-Heavy

An increase in speed at one-half to full throttle, such as 0-97 km/h (0-60 mph) in approximately 20 seconds.

Ambient Temperature

The surrounding or prevailing temperature.

Amplitude

The quantity or amount of energy produced by a vibrating component (G force). An extreme vibration has a high amplitude. A mild vibration has a low amplitude.

Backlash

Gear teeth clearance.

Boom

Low frequency or low pitched noise often accompanied by a vibration. Also refer to Drumming.

Bound Up

An overstressed isolation (rubber) mount that transmits vibration/noise instead of absorbing it.

Brakes Applied

When the service brakes are applied with enough force to hold the vehicle against movement with the transmission in gear.

Buffet/Buffeting

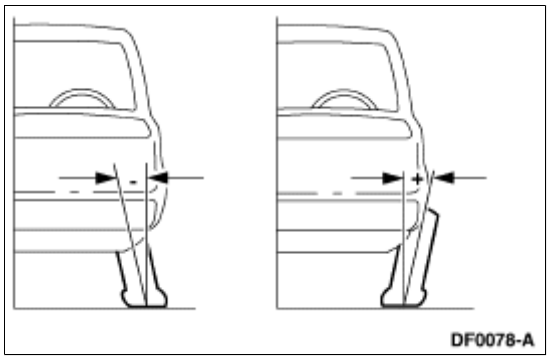
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

A low-pitched sound like (200-5000 Hz) that from a bee. Often a metallic or hard plastic humming sound. Also describes a high frequency (200-800 Hz) vibration. Vibration feels similar to an electric razor.

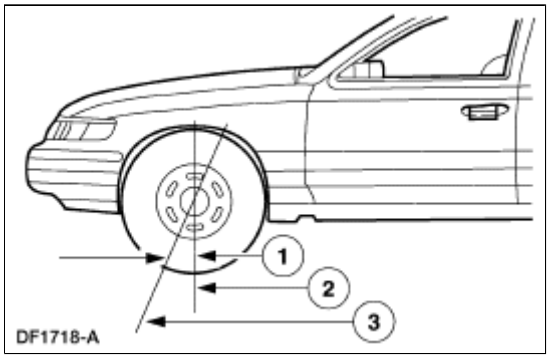
Camber

The angle of the wheel in relation to the true vertical as measured looking from the front of the vehicle. Camber is positive when the wheel angle is offset so that the top of the wheel is positioned away from the vehicle.



Caster

The angle of the steering knuckle in relation to the true vertical as measured looking from the side of the vehicle.



Item	Description
1	Positive caster
2	True vertical
3	Steering axis

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

A short-duration high-pitched noise associated with a slipping drive belt.

Chuckle

A repetitious low-pitched sound. A loud chuckle is usually described as a knock.

Click

A sharp, brief, non-resonant sound, similar to actuating a ball point pen.

Clonk

A hydraulic knocking sound. Sound occurs with air pockets in a hydraulic system. Also described as hammering.

Clunk/Driveline Clunk

A heavy or dull, short-duration, low-frequency sound. Occurs mostly on a vehicle that is accelerating or decelerating abruptly. Also described as a thunk.

Coast/Deceleration

Releasing the accelerator pedal at cruise, allowing the engine to reduce vehicle speed without applying the brakes.

Coast/Neutral Coast

Placing the transmission range selector in NEUTRAL (N) or depressing the clutch pedal while at cruise.

Constant Velocity (CV) Joint

A joint used to absorb vibrations caused by driving power being transmitted at an angle.

Controlled Rear Suspension Height

The height at which a designated vehicle element must be when driveline angle measurements are made.

Coupling Shaft

The shaft between the transfer case and the front drive axle or, in a two-piece rear driveshaft, the front section.

CPS

Cycles per second. Same as hertz (Hz).

Cracks

A mid-frequency sound, related to squeak. Sound varies with temperature conditions.

Creak

A metallic squeak.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Cycle

The process of a vibrating component going through a complete range of motion and returning to the starting point.

Decibel

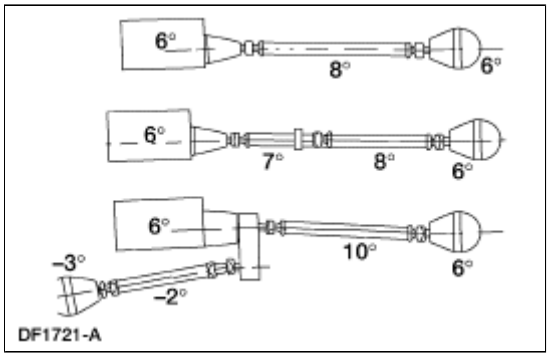
A unit of measurement, referring to sound pressure level, abbreviated dB.

Drive Engine Run-Up (DERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still, the brakes applied and the transmission engaged. This test is used for noise and vibration checks.

Driveline Angles

The differences of alignment between the transmission output shaft, the driveshaft, and the rear axle pinion centerline.



Driveshaft

The shaft that transmits power to the rear axle input shaft (pinion shaft). In a two-piece driveshaft, it is the rearmost shaft.

Drivetrain

All power transmitting components from the engine to the wheels; includes the clutch or torque converter, the transmission, the transfer case, the driveshaft, and the front or rear drive axle.

Drivetrain Damper

A weight attached to the engine, the transmission, the transfer case, or the axle. It is tuned by weight and placement to absorb vibration.

Drone

A low frequency (100-200 Hz) steady sound, like a freezer compressor. Also described as a moan.

Drumming

A cycling, low-frequency (20-100 Hz), rhythmic noise often accompanied by a sensation of pressure on the ear drums. Also described as a low rumble, boom, or rolling thunder.

Dynamic Balance

The equal distribution of weight on each side of the centerline, so that when the wheel and tire assembly spins, there is no tendency for the assembly to move from side-to-side (wobble). Dynamically unbalanced wheel and tire assemblies can cause wheel shimmy.

Engine Imbalance

A condition in which an engine's center mass is not concentric to the rotation center, causing excessive motion.

Engine Misfire

When combustion in one or more cylinders does not occur or occurs at the wrong time.

Engine Shake

An exaggerated engine movement or vibration that directly increases in frequency as the engine speed increases. It is caused by non-equal distribution of mass in the rotating or reciprocating components.

Flexible Coupling

A flexible joint.

Float

A drive mode on the dividing line between cruise and coast where the throttle setting matches the engine speed with the road speed.

Flutter

Mid to high (100-2000 Hz) intermittent sound due to air flow. Similar to a flag flapping in the wind.

Frequency

The rate at which a cycle occurs within a given time.

Gravelly Feel

A grinding or growl in a component, similar to the feel experienced when driving on gravel.

Grind

An abrasive sound, similar to using a grinding wheel, or rubbing sand paper against wood.

Hiss

Steady high frequency (200-800 Hz) noise. Vacuum leak sound.

Hoot

A steady low frequency tone (50-500 Hz), sounds like blowing over a long neck bottle.

Howl

A mid-range frequency (200-800 Hz) noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency (200-800 Hz) steady sound, like a small fan motor. Also described as a howl.

Hz

Hertz; a frequency measured in cycles per second.

Imbalance

Out of balance; heavier on one side than the other. In a rotating component, imbalance often causes vibration.

Inboard

Toward the centerline of the vehicle.

Intensity

The physical quality of sound that relates to the strength of the vibration (measured in decibels). The higher the sound's amplitude, the higher the intensity and vice versa.

Isolate

To separate the influence of one component to another.

Knock

A heavy, loud, repetitious sound, like a knock on the door.

Moan

A constant, low-frequency (100-200 Hz) tone. Also described as a hum.

Neutral Engine Run-Up (NERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still and the transmission disengaged. This test is used to identify engine related vibrations.

Neutralize/Normalize

To return to an unstressed position. Used to describe mounts. Refer to Bound Up.

Outboard

Away from the centerline of the vehicle.

Ping

A short duration, high-frequency sound, which has a slight echo.

Pinion Shaft

The input shaft in a driving axle that is usually a part of the smaller driving or input hypoid gear of a ring and pinion gearset.

Pitch

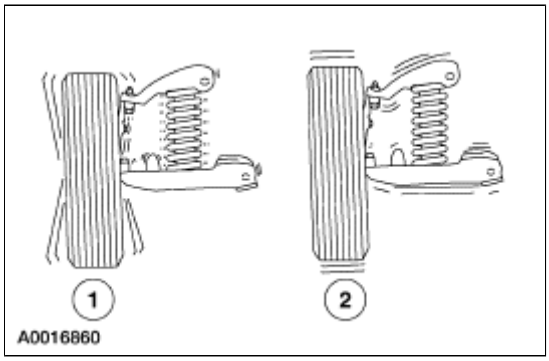
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

Pumping Feel

A slow, pulsing movement.

Radial/Lateral

Radial is in the plane of rotation; lateral is at 90 degrees to the plane of rotation.



Item	Description
1	Lateral runout
2	Radial runout

Rattle

A random and momentary or short duration noise.

Ring Gear

The large, circular, driven gear in a ring and pinion gearset.

Road Test

The operation of the vehicle under conditions intended to produce the concern under investigation.

Roughness

A medium-frequency vibration. A slightly higher frequency (20 to 50 Hz) than a shake. This type of vibration is usually related to drivetrain components.

Runout

Lateral runout means measuring the movement or "wobble" of a wheel or tire at the sidewall. Radial runout means measuring the out-of-round at the tread surface.

Rustling

Intermittent sound of varying frequency (100-2000 Hz), sounds similar to shuffling through leaves.

Shake

A low-frequency vibration (5-20 Hz), usually with visible component movement. Usually relates to tires, wheels, brake drums or brake discs if it is vehicle speed sensitive, or engine if it is engine speed sensitive. Also referred to as a shimmy or wobble.

Shimmy

An abnormal vibration or wobbling, felt as a side-to-side motion of the steering wheel in the driveshaft rotation. Also described as waddle.

Shudder

A low-frequency vibration that is felt through the steering wheel or seat during light brake application.

Slap

A resonance from flat surfaces, such as safety belt webbing or door trim panels.

Slip Yoke/Slip Spline

The driveshaft coupling that allows length changes to occur while the suspension articulates and while the driveshaft rotates.

Squeak

A high-pitched transient sound, similar to rubbing fingers against a clean window.

Squeal

A long-duration, high-pitched noise.

Static Balance

The equal distribution of weight around the wheel. Statically unbalanced wheel and tire assemblies can cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.

Tap

A light, rhythmic, or intermittent hammering sound, similar to tapping a pencil on a table edge.

Thump

A dull beat caused by two items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

A light moaning noise heard during light vehicle acceleration, usually between 40-100 km/h (25-65 mph).

TIR

The acronym for total indicated runout is TIR.

Tire Deflection

The change in tire diameter in the area where the tire contacts the ground.

Tire Flat Spots

A condition commonly caused by letting the vehicle stand while the tires cool off. This condition can be corrected by driving the vehicle until the tires are warm. Also, irregular tire wear patterns in the tire tread resulting from wheel-locked skids.

Tire Force Vibration

A tire vibration caused by variations in the construction of the tire that is noticeable when the tire rotates against the pavement. This condition can be present on perfectly round tires because of variations in the inner tire construction. This condition can occur at wheel rotation frequency or twice rotation frequency.

Transient

A noise or vibration that is momentary, a short duration.

Two-Plane Balance

Radial and lateral balance.

Vibration

Any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down.

Whine

A constant, high-pitched noise. Also described as a screech.

Whistle

High-pitched noise (above 500 Hz) with a very narrow frequency band. Examples of whistle noises are a turbocharger or airflow around an antenna.

Wind Noise

Any noise caused by air movement in, out or around the vehicle.

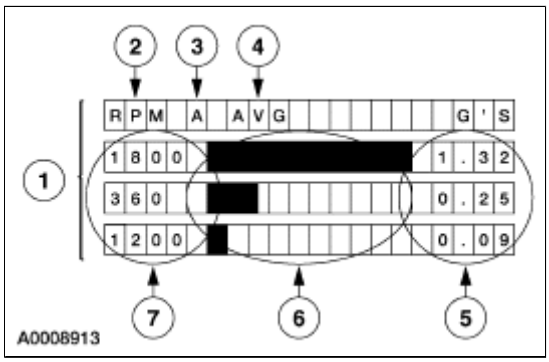
WOT

The acronym for wide open throttle is WOT.

Tools and Techniques

Electronic Vibration Analyzer (EVA)

The EVA is a hand-held electronic diagnostic tool which will assist in locating the source of unacceptable vibrations. The vibration sensor can be remotely mounted anywhere in the vehicle for testing purposes. The unit displays the three most common vibration frequencies and their corresponding amplitudes simultaneously. A bar graph provides a visual reference of the relative signal strength (amplitude) of each vibration being displayed and its relative G force. The keypad is arranged to make the EVA simple to program and use. Some of the functions include the ability to average readings as well as record, play back and freeze readings. The EVA has a strobe balancing function that can be used to detect imbalance on rotating components such as a driveshaft or engine accessories.



Item	Description
1	EVA screen
2	Frequency mode displayed in rpm or Hz
3	Active sensor input (A or B)
4	Current active mode
5	G force indicators or the strongest frequencies in descending strength of each vibration
6	Strength of each vibration
7	Frequency in rpm/Hz of each vibration

The EVA allows for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. For the best results, carry out the test as follows:

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.
    - If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
    - A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.
c. Record the readings. Also note when the condition begins, when it reaches maximum intensity, and if it tends to diminish above/below a certain speed.
    - Frequencies should be read in the "average" mode.
    - Frequencies have a range of plus or minus 2. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.
d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs, and take another reading.
f. Compare the readings.

- A match in frequency indicates the problem component or area.
- An unmatched test could indicate the concern is caused by the engine, torque converter, or engine accessory. Use the EVA in the rpm mode and check if concern is rpm related.
- Example: A vibration is felt in the seat. Place the sensor on the console. Record the readings. Place the vibration sensor on the rear axle. Compare the readings. If the frequencies are the same, the axle is the problem component.

Vibrate Software®

Vibrate Software® (Rotunda tool number 215-00003) is a diagnostic aid which will assist in pinpointing the source of unacceptable vibrations. The engine's crankshaft is the point of reference for vibration diagnosis. Every rotating component will have an angular velocity that is faster, slower, or the same as the engine's crankshaft. Vibrate Software® calculates the angular velocity of each component and graphically represents these velocities on a computer screen and on a printed vibration worksheet. The following steps outline how Vibrate Software® helps diagnose a vibration concern:

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.
- Print a Vibration Worksheet graph. The printed graph is to be used during the road test.
- Road test the vehicle at the speed where the vibration is most noticeable. Record the vibration frequency (rpm) and the engine rpm on the worksheet graph. The point on the graph where the vibration frequency (rpm) reading and the engine rpm reading intersect indicates the specific component group causing the concern.
    - An EVA or equivalent tool capable of measuring vibration frequency and engine rpm will be needed.
- Provide pictures of diagnostic procedures to aid in testing components.

Combination EngineEAR/ChassisEAR

An electronic listening device used to quickly identify noise and the location under the chassis while the vehicle is being road tested. The ChassisEARs can identify the noise and location of damaged/worn wheel bearings, CV joints, brakes, springs, axle bearings or driveshaft carrier bearings.

EngineEAR Basic Unit

An electronic listening device used to detect even the faintest noises. The EngineEARs can detect the noise of damaged/worn bearings in generators, water pumps, A/C compressors and power steering pumps. They are also used to identify noisy lifters, exhaust manifold leaks, chipped gear teeth and for detecting wind noise. The EngineEAR has a sensing tip, amplifier, and headphones. The directional sensing tip is used to listen to the various components. Point the sensing tip at the suspect component and adjust the volume with the amplifier. Placing the tip in direct contact with a component will reveal structure-borne noise and vibrations, generated by or passing through, the component. Various volume levels can reveal different sounds.

Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weather-stripping or other sealing material. It is also used to identify A/C leaks, vacuum leaks and evaporative emission noises. The Ultrasonic Leak Detector includes a multi-directional transmitter (operating in the ultrasonic range) and a hand-held detector. The transmitter is placed inside the vehicle. On the outside of the vehicle, the hand-held detector is used to sweep the area of the suspected leak. As the source of the leak is approached, a beeping sound is produced which increases in both speed and frequency.

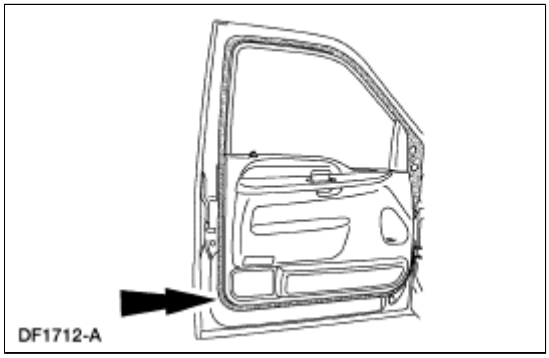
Squeak and Rattle Repair Kit

The squeak and rattle repair kit (Rotunda tool number 164-R4900) contains lubricants and self-adhesive materials that can be used to eliminate interior and exterior squeaks and rattles. The kit consists of the following materials:

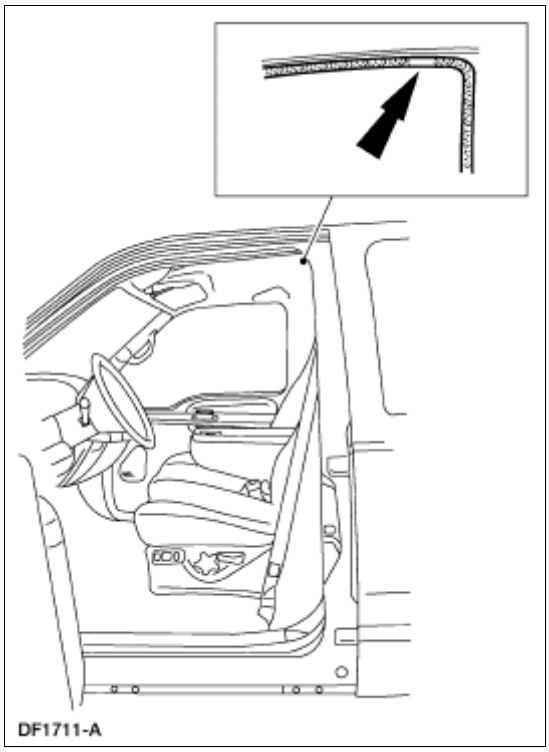
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Tracing Powder

Tracing powder is used to check both the uniformity of contact and the tension of a seal against its sealing surface. These tests are usually done when a suspected air leak/noise appears to originate from the seal area or during the alignment and adjustment of a component to a weatherstrip. Tracing powder can be ordered from Crest Industries as ATR Leak Trace. Carry out the tracing powder test as follows:

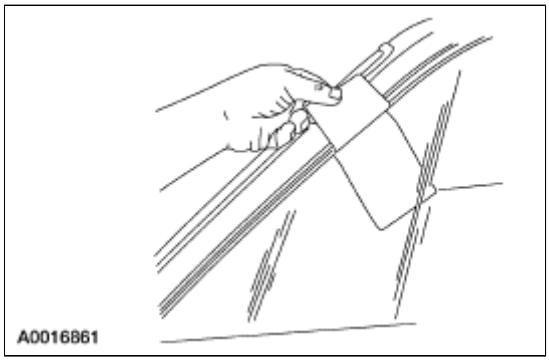


a. Clean the weatherstrip.
b. Spray the tracing powder on the mating surface only.
c. Close the door completely. Do not slam the door.
d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with the weatherstrip.



Index Card

Place an index card or a piece of paper between the weatherstrip and the sealing surface, then close the door. Slowly withdraw the index card or paper after the door is closed and check the amount of pressure on the weatherstrip. There should be a medium amount of resistance as it is withdrawn. Continue around the entire seal area. If there is little or no resistance, this indicates insufficient contact to form a good seal. At these points, the door, the glass, or the weatherstrip is out of alignment.



Noise, Vibration And Harshness (NVH)

Special Tool(s)

ST2048-A	ChassisEAR 107-R2102 or Equivalent
ST2311-A	Vibration Analyzer 100-F027 (014-00344) or Equivalent
ST2312-A	EngineEAR 107-R2100 or Equivalent
ST2314-A	Ultrasonic Leak Detector 134-R0135 or Equivalent

To assist the service advisor and the technician, a Write-up Job Aid and an NVH Diagnostic Guide are included with this material. The Write-up Job Aid serves as a place to record all important symptom information. The NVH Diagnostic Guide serves as a place to record information reported on the Write-up Job Aid as well as data from the testing to be carried out.

To begin a successful diagnosis, fill out the NVH Diagnostic Guide, record the reported findings, then proceed to each of the numbered process steps to complete the diagnosis.

"WRITE-UP" JOB AID

REPAIR ORDER #_____

CUSTOMER CONCERN #_____

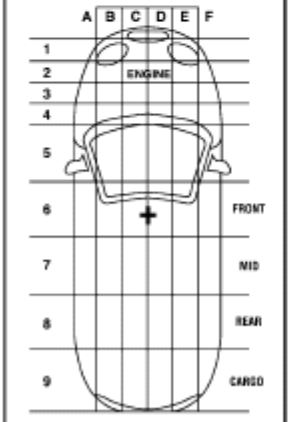
SPECIFIC SENSE IDENTIFICATION AND LOCATION ON VEHICLE OF CUSTOMER SYMPTOM(S)

INSTRUCTIONS: Check below sense affected and location of concern on the generic vehicle illustration (darken the vehicle area). Plus circle appropriate responses to the right.

NOTE: Shaded backgrounds indicate caution areas. Selection of two or more caution areas "flag" difficult repairs. In general, shaded areas are the more difficult to verify and repair, and require all applicable columns to be completed.

SEE YES ☐ | FEEL YES ☐

HEAR YES ☐ | SMELL YES ☐



VEHICLE SYMPTOM AREA	HOW OFTEN?	VEHICLE OPERATING MODE	VEHICLE CONDITIONS	VEHICLE SPEED(mph)	WHEN VEHICLE IS?	AMBIENT CONDITION
Front of Vehicle	Always	Start Up	Accessories On	0	Turning Left	____° Below Zero
Engine Compartment	Daily A.M. P.M.	Idle	(define below)	1-9	Turning Right	Below Freezing (0°-19°)
Dash	Conditional	Gear Selection	Windows Open	10-19	Over Bumps	Below Freezing (20°-32°)
Steering Wheel	Weekly	Accel Light	4x4	20-29	Up Hills	33°-49°
Accelerator Pedal	Monthly	Accel Moderate	Hauling	30-39	Down Hills	50°-69°
Brake Pedal	Intermittent	Accel Heavy	Towing	40-49	Shifting	70°-89°
Clutch Pedal	Unknown	Steady Speed	Snow Plowing	50-59	Parked	90°+
Seat		Deceleration	Other	60-69	In Traffic	Sunny
Rear of Vehicle		Neutral	(define below)	70+		Dry
Top of Vehicle		Reverse		ENGINE TEMP		Windy
Floor Pan		Stopping/Braking				Wet/Humid
Under Vehicle				Cold		Rain
Other (define below)				Normal		Snow
				Hot		Ice

DEALER VERIFICATION	YES	NO
SERVICE ADVISOR	☐	☐
SHOP FOREMAN	☐	☐
SERVICE MANAGER	☐	☐
QC MANAGER	☐	☐
TECHNICIAN	☐	☐
VERIFIED WITH CUSTOMER	☐	☐

WHAT THE CUSTOMER SAID

OASIS SYMPTOM CODE(S)

VIN NUMBER

A0017007

NVH DIAGNOSTIC GUIDE

Dealer: _____ Date: _____

P.A. Code: _____ Order No. _____ Technician: _____

Owner's Name: _____ Address: _____

Phone No. Home: _____ Work: _____

Vehicle Make: _____ Model: _____ Year: _____

VIN: _____ Mileage: _____ Engine: _____ Trans: _____ Axle: _____

OWNER'S DESCRIPTION OF COMPLAINT:

Did Condition Exist When Vehicle Was New? **Yes / No** (circle one)

How Did Condition Begin? Gradually ☐ Suddenly ☐

At What Mileage Did It Occur Or Begin Occuring? _____

Which Driving Conditions Affect The Vehicle?

Light Accel ☐ Closed Throttle Decel ☐ Brakes Applied/Released ☐

Medium Accel ☐ Coast (Float) ☐ Driving The Vehicle: Straight ☐

Heavy Accel ☐ Constant Speed ☐ Cornering ☐

Is Vibration Noticed? If So, Where:

Seat ☐ Steering Wheel ☐ Instrument Panel ☐ Floor ☐ Body Panels ☐ Ft/Rr of Vehicle ☐

Is There Sound Or Sensation Of Sound? **Yes / No** (circle one)

If So, Describe The Sound :

Boom ☐ Hum ☐ Whine ☐ Growl ☐ Other: _____

Drone ☐ Tip-In-Moan ☐ Squeak ☐ Rattle ☐

PREDRIVE CHECKS

Tire Condition/Pressure: _____

Vehicle Body Damage? _____

Other: _____

ROAD TEST:

Vibration/Noise Occurs:

Vehicle Speed _____ Accel _____ Vibration Frequency _____ Hz/RPM

Gear Range _____ Decel/Coast _____ Engine Speed _____ RPM

ENGINE RUN-UP TESTS

Neutral Engine Run-Up (NERU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drive Engine Run-Up (DERU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drivetrain Run-Up (DTRU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Indicate Suspected Area of Concern:

Tire/Wheel/Brakes ☐ Engine/Accessory ☐ Rear ☐

Driveline/Axle ☐ Susp/Steering ☐ Right ☐

Body ☐ Front ☐ Left ☐

Other _____

Equipment Used:

Reed Tachometer ☐ Electronic Noise Detector ☐ Tape ☐

Engine Tachometer ☐ Ultrasonic Leak Detector ☐ Other _____

DF1688-A

WHEEL/TIRE/BRAKES CHECK:

Balance Check **Yes / No**

Maximum Runout Allowed:

Wheel:	Radial		Lateral					
Tire:	Radial		Lateral					

Measured Runout:

Tire/Wheel	Radial:	LF		LR		RF		RR
	Lateral:	LF		LR		RF		RR
Wheel Only	Radial:	LF		LR		RF		RR
	Lateral:	LF		LR		RF		RR

SUSPENSION INSPECTION:

Can Cause:	Shimmy ☐	Clunk ☐	Squeak ☐	Harshness ☐
Suspension Bushings:	Loose ☐	Worn ☐	Missing ☐	OK ☐
Front Upper Control Arm ☐	Stabilizer (sway bar) ☐	Rear Lower Control Arm ☐
Front Lower Control Arm ☐	Rear Upper Control Arm ☐	Rear Upper Control Arm ☐
Other _____		

Suspension/Steering Components:	Loose	Worn	Missing	OK
Ball Joints	☐	Idler Arm ☐	Pitman Arm ☐	
Shock Absorbers F/R	☐	Center Link ☐	Steering Gear ☐	
Springs F/R	☐	Tie Rod Ends/Sleeve ☐	Steering Coupler ☐	

DRIVESHAFT CONDITION: Noise ☐ Vibration ☐

Balance Weights Missing/Other Visual Defects? **Yes / No**

Maximum Allowable Runout: _____				
Actual Runout:	Front _____	Middle _____	Rear _____	
Two-Piece Driveshaft Runout:	Front _____	Rear _____		
Middle Support Bearing:	Loose ☐	Damaged ☐	Worn ☐	Other _____

Suspect Driveshaft Balanced? **Yes / No**

Pinion Angle:	Engine Height:	Specification _____	Actual _____	
	Pinion Angle:	Specification _____	Actual _____	
Driveline Angle - Truck:		Specification _____	Actual _____	

ENGINE/ACCESSORY CHECK:

Visual Inspection for Damage or Grounded Condition:

Powertrain Mounts ☐	Fuel Lines ☐	A/C Lines ☐	Power Steering/Cooler Lines ☐
Air Intake ☐	Accessories ☐	Exhaust ☐	Radiator/Condensor ☐

BODY (NOISE/RATTLE)

Indicate Suspected Area of Concern: Doors ☐ Windows ☐ Dash Panel ☐ Other _____

Tests Used to Isolate

NVH Concern: Vacuum/Leak Detector ☐ Ultrasonic Leak Detector ☐ Tracing Powder ☐

Electronic Noise Detector ☐ Other _____

ROAD/ENGINE RUN-UP TESTS: Improved? **Yes / No** Vehicle Acceptable? **Yes / No**

Comments: _____

A0008914

1: Customer Interview

The diagnostic process starts with the customer interview. The service advisor must obtain as much information as possible about the problem and take a test drive with the customer. There are many ways a customer will describe NVH concerns and this will help minimize confusion arising from descriptive language differences. It is important that the concern is correctly interpreted and the customer descriptions are recorded. During the interview, ask the following questions:

- When was it first noticed?
- Did it appear suddenly or gradually?
- Did any abnormal occurrence coincide with or proceed its appearance?

Use the information gained from the customer to accurately begin the diagnostic process.

2: Pre-Drive Check

It is important to do a pre-drive check before road testing the vehicle. A pre-drive check verifies that the vehicle is relatively safe to drive and eliminates any obvious faults on the vehicle.

The pre-drive check consists of a brief visual inspection. During this brief inspection, take note of anything that will compromise safety during the road test and make those repairs/adjustments before taking the vehicle on the road.

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the NVH Diagnostic Guide. It is important to know the specific concern the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some distance away.
- Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration/noise to emanate from another receiving component (reactor), due to contact with other components (transfer path).
- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- If possible, lower the radio antenna in order to minimize turbulence. Identify anything that could potentially make noise or be a source of wind noise. Inspect the vehicle for add-on items that create vibration/noise. Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect an accurate tachometer to the engine, even if the vehicle has a tachometer. Use a tachometer that has clearly defined increments of less than 50 rpm. This ensures an exact engine speed reading.

4: Verify the Customer Concern

Verify the customer concern by carrying out a road test, an engine run-up test, or both.

The decision to carry out a road test, an engine run-up test, or both depends on the type of NVH concern. A road test may be necessary if the symptom relates to the suspension system or is sensitive to torque. A Drive Engine Run-Up (DERU) or a Neutral Engine Run-Up (NERU) Test identifies noises and vibrations relating to engine and drivetrain rpm. Remember, a condition will not always be identifiable by carrying out these tests, however, they will eliminate many possibilities if carried out correctly.

5: Road Test

NOTE: It may be necessary to have the customer ride along or drive the vehicle to point out the concern. During the road test, take into consideration the customer's driving habits and the driving conditions. The customer's concern just may be an acceptable operating condition for that vehicle.

The following is a brief overview of each test in the order in which it appears. A review of this information helps to quickly identify the most appropriate process necessary to make a successful diagnosis. After reviewing this information, select and carry out the appropriate test(s), proceeding to the next step of this process.

- The Slow Acceleration Test is normally the first test to carry out when identifying an NVH concern, especially when a road test with the customer is not possible.
- The Heavy Acceleration Test helps to determine if the concern is torque-related.
- The Neutral Coast Down Speed Test helps to determine if the concern is vehicle speed-related.
- The Downshift Speed Test helps to determine if the concern is engine speed-related.
- The Steering Input Test helps to determine how the wheel bearings and other suspension components contribute to a vehicle speed-related concern.
- The Brake Test helps to identify vibrations or noise that are brake related.
- The Road Test Over Bumps helps isolate a noise that occurs when driving over a rough or bumpy surface.
- The Engine Run-Up Tests consist of the Neutral Run-Up Test and the Engine Load Test. These tests help to determine if the concern is engine speed-related.
- The Neutral Run-Up Test is used as a follow-up test to the Downshift Speed Test when the concern occurs at idle.
- The Engine Load Test helps to identify vibration/noise sensitive to engine load or torque. It also helps to reproduce engine speed-related concerns that cannot be duplicated when carrying out the Neutral Run-Up Test or the Neutral Coast Down Test.
- The Engine Accessory Test helps to locate faulty belts and accessories that cause engine speed-related concerns.
- The Vehicle Cold Soak Procedure helps to identify concerns occurring during initial start-up and when an extended time lapse occurs between vehicle usage.

Slow Acceleration Test

To carry out this test, proceed as follows:

- Slowly accelerate to the speed where the reported concern occurs. Note the vehicle speed, the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify from what part of the vehicle the concern is coming.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).
- Decelerate in a lower gear.

- The concern is torque related if duplicated while carrying out this test.
- Proceed as necessary.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the concern occurred when carrying out the Slow Acceleration Test.
- Place the transmission in NEUTRAL and coast down past the speed where the concern occurs.
- The concern is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the concern was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the concern is engine speed related.
- Proceed as necessary.

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the concern occurs.
- The concern is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.
- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- Proceed as necessary.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the concern occurs, while making sweeping turns in both directions.
- If the concern goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of 4WD applications), and tire tread wear are all possible sources.
- Proceed as necessary.

Brake Test

To carry out this test, proceed as follows:

- Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50–20 mph) using light braking applications. At highway speeds of 89–97 km/h (50–60 mph), apply the brake using a light pedal force.
- Accelerate to 89–97 km/h (55–60 mph).

- Lightly apply the brakes and slow the vehicle to 30 km/h (20 mph).
- A brake vibration noise can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and diminish when the brake is released.

Road Test Over Bumps

To carry out this test, proceed as follows:

- Drive the vehicle over a bump or rough surface one wheel at a time to determine if the noise is coming from the front or the back and the left or the right side of the vehicle.
- Proceed as necessary.

Neutral Engine Run-Up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.
- Increase the engine rpm up from an idle to approximately 4000 rpm while in PARK on front wheel drive vehicles with automatic transmissions, or NEUTRAL for all other vehicles. Note the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify what part of the vehicle the concern is coming from.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  CAUTION: Do not carry out the Engine Load Test for more than five seconds or damage to the transmission or transaxle can result.

  Block the front and rear wheels.
- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the concern is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- Proceed as necessary.

Engine Accessory Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  CAUTION: Limit engine running time to one minute or less with belts removed or serious engine damage will result.

  NOTE: A serpentine drive belt decreases the usefulness of this test. In these cases, use a vibration analyzer, such as the VA, to pinpoint accessory vibrations. An electronic listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

  Remove the accessory drive belts.
- Increase the engine rpm to where the concern occurs.
- If the vibration/noise is duplicated when carrying out this test, the belts and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install each accessory belt, one at a time, to locate the source.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to three minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the concern temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, anti-lock brake system (ABS) and air suspension system noises.
- Start the engine.
- **CAUTION: Never probe moving parts.**

  Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- Refer to Idle Noise/Vibration in the Symptom Chart to assist with the diagnosis.

6: Check OASIS/TSBs/Repair History

After verifying the customer concern, check for OASIS reports, TSBs and the vehicle repair history for related concerns. If information relating to a diagnosis/repair is found, carry out the procedure(s) specified in

that information.

If no information is available from these sources, carry out the vehicle preliminary inspection to eliminate any obvious faults.

7: Diagnostic Procedure

Qualifying the concern by the particular sensation present can help narrow down the concern. Always use the "symptom" to "system" to "component" to "cause" diagnosis technique. This diagnostic method divides the problem into related areas to correct the customer concern.

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom".
  - If a vibration concern is vehicle speed related, the tire and wheel rpm/frequency or driveshaft frequency should be calculated.
  - If a vibration concern is engine speed related, the engine, engine accessory or engine firing frequencies should be calculated.
- After determining the "system", use the diagnostic tools to identify the worn or damaged "components".
- After identifying the "components", try to find the "cause" of the failure.

Once the concern is narrowed down to a symptom/condition, proceed to NVH Condition and Symptom Categories.

NVH Condition and Symptom Categories

A good diagnostic process is a logical sequence of steps that lead to the identification of a causal system. Use the condition and symptom categories as follows:

- Identify the operating condition that the vehicle is exhibiting.
- Match the operating condition to the symptom.
- Verify the symptom.
- Identify which category or system could cause the symptom.
- Refer to the diagnostic symptom chart that is referred to.

Operating Condition—Vehicle is Not Moving

1. Static operation
   - Noise occurs during component/system functioning. GO to Symptom Chart — Squeak and Rattle .

2. While cranking
   1. Grinding or whine, differential ring gear or starter motor pinion noise. GO to Symptom Chart — Engine Noise/Vibration .
   2. Rattle. Exhaust hanger, exhaust heat shield or A/C line noise. GO to Symptom Chart — Squeak and Rattle .
   3. Vibration. Acceptable condition.

3. At idle

- Idle noise. GO to Symptom Chart — Idle Noise/Vibration .
- Idle vibration or shake. GO to Symptom Chart — Idle Noise/Vibration .

4. During Gear Selection
    1. Vehicle parked on a steep incline. Acceptable noise.
    2. Vehicle parked on a flat surface. GO to Symptom Chart — Driveline Noise/Vibration .
    3. Vehicle with a manual transmission. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .

Operating Condition—Vehicle is Moving

1. Depends more on how the vehicle is operated
    1. Speed related
        - Related to vehicle speed
            - Pitch increases with vehicle speed. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise occurs at specific vehicle speed. A high-pitched noise (whine). GO to Symptom Chart — Driveline Noise/Vibration .
            - Loudness proportional to vehicle speed. Low-frequency noise at high speeds, noise and loudness increase with speed. GO to Symptom Chart — Driveline Noise/Vibration .
            - A low-pitched noise (drumming). GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of acceleration or deceleration. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise varies with wind/vehicle speed and direction. GO to Symptom Chart — Air Leak and Wind Noise .
        - Related to engine speed
            - Noise varies with engine rpm. GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of engine speed (rpm).
    2. Acceleration
        - Wide open throttle (WOT)
            - Engine induced contact between components. Inspect and repair as necessary.
            - Noise is continuous throughout WOT. Exhaust system or engine ground out. GO to Symptom Chart — Engine Noise/Vibration .
        - Light/moderate acceleration
            - Tip-in moan. Engine/exhaust noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Knock-type noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Driveline shudder. GO to Symptom Chart — Driveline Noise/Vibration .
            - Engine vibration. GO to Symptom Chart — Engine Noise/Vibration .
    3. Turning noise. GO to Symptom Chart —Steering Noise/Vibration .
    4. Braking
        - Clicking sound is signaling ABS is active. Acceptable ABS sound.
        - A continuous grinding/squeal. GO to Symptom Chart — Brake Noise/Vibration .
        - Brake vibration/shudder. GO to Symptom Chart — Brake Noise/Vibration .
    5. Clutching
        - A noise occurring during clutch operation. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
        - Vibration. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
    6. Shifting
        - Noise or vibration condition related to the transmission (automatic). GO to Symptom Chart — Transmission (Automatic) Noise/Vibration .

- Noise or vibration related to the transmission (manual). GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .

7. Engaged in four-wheel drive. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
8. Cruising speeds
   - Accelerator pedal vibration. GO to Symptom Chart — Engine Noise/Vibration .
   - Driveline vibration. GO to Symptom Chart — Driveline Noise/Vibration .
   - A shimmy or shake. GO to Symptom Chart — Tire Noise/Vibration .
9. Driving at low/medium speeds
   - A wobble or shudder. GO to Symptom Chart — Tire Noise/Vibration .

2. Depends more on where the vehicle is operated
   1. Bump/pothole, rough road or smooth road. GO to Symptom Chart — Suspension Noise/Vibration .
      - Noise is random or intermittent occurring from road irregularities. GO to Symptom Chart — Squeak and Rattle .
      - Noise or vibration changes from one road surface to another. Normal sound changes.
      - Noise or vibration associated with a hard/firm ride. GO to Symptom Chart — Suspension Noise/Vibration .

Symptom Charts

Symptom Chart — Air Leak and Wind Noise

Condition	Possible Sources	Action
• Air leak around door perimeter	• Loose fit seal.	• PINCH the seal carrier to improve retention on the seal flange.
	• Seal installed incorrectly.	• REINSTALL the seal.
	• Door misaligned.	• REALIGN the door. CHECK door gaps and fit in the door opening and ADJUST as necessary.
	• Scuff plate installed incorrectly.	• REINSTALL the scuff plate.
	• Seal or seal push pins damaged.	• INSTALL a new seal.
• Air leak around glass run	• Door glass misaligned.	• ADJUST the door glass.
	• Glass run installed incorrectly.	• ADJUST the glass run. INSERT foam in the glass run carrier.
	• Leak path behind glass run.	• INSTALL foam rope behind the glass run.
	• Glass run channel spread wide.	• PINCH the glass run channel to reduce the size of the opening.
	• Blow-out clip bent or contacting door glass.	• ADJUST the blow-out clip or INSTALL a new glass

		run/blow-out clip molding assembly.
	• Glass run damaged.	• INSTALL a new glass run.
• Air leak at inner belt line	• Belt line seal installed incorrectly on flange.	• ADJUST the seal. (Do not bend the flange.)
	• Belt line seal integrated with door trim installed incorrectly (no glass contact).	• REINSTALL the door trim.
	• No contact with side glass.	• ADJUST the door glass.
	• No contact with glass runs at both ends of belt line seal.	• ADJUST the belt line seal or ADD foam at the seal ends.
	• Belt line seal damaged.	• INSTALL a new seal.
• Air leak at outer belt line	• Belt line seal installed incorrectly on flange (no glass contact).	• ADJUST the seal.
	• Belt line seal does not contact the glass.	• ADJUST the door glass.
	• No contact with glass runs at both ends of belt line seal.	• ADJUST the belt line seal/ADD foam at the seal ends.
	• Belt line seal damaged.	• INSTALL a new seal.
• Draft at inner door handle/speaker opening	• Hole in watershield.	• SEAL the hole with a suitable tape.
	• Watershield misaligned.	• REALIGN the watershield. INSTALL a new watershield if the pressure sensitive adhesive fails.
	• Exterior door handle seal misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Wind noise from side view mirror	• Outside mirror housing misaligned.	• REALIGN with the edges shingled correctly and no gaps.
	• Mirror sail gasket folded/misaligned.	• REINSTALL with the gasket unfolded and aligned correctly.
	• Mirror housing trim cap installed incorrectly.	• REINSTALL with the edges shingled to the air flow.
	• Air leak through mirror housing hinge.	• Fully ENGAGE the mirror into its operating position/USE foam to block the air path through the hinge.
	• Inner sail trim installed incorrectly.	• REINSTALL the sail trim/ADJUST the door trim.
	• Inner sail gasket/barrier installed incorrectly.	• REINSTALL the trim cover with the gasket/barrier aligned correctly.

	• Air path through wiring bundle/fastener access holes. • Exposed fastener access hole on mirror housing/sail.	• BLOCK the air path(s) with foam/tape. • INSTALL a new cap if it is missing.
• Air leak around perimeter of fixed glass	• Gaps in the sealant bead. • Air traveling up windshield molding along A-pillar. • Windshield/backlite misaligned or not installed correctly. • Rear hood seal at base of windshield misaligned/damaged.	• APPLY approved sealant. • INSTALL foam rope the full length of the A-pillar. • REINSTALL the windshield/backlite. • REALIGN or INSTALL a new seal as necessary.
• Air leak at cowl	• Cowl gasket misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Air leak around liftgate perimeter	• Loose fit seal. • Seal misaligned. • Liftgate misaligned. • Scuff plate misaligned. • Seal or seal push pins damaged.	• PINCH the seal carrier to improve retention on the seal flange or INSERT foam in the carrier. • REINSTALL the seal. • REALIGN the liftgate. CHECK the liftgate fit in the body opening and ADJUST as necessary. • REINSTALL the scuff plate. • INSTALL a new seal.
• Air leak around the liftgate flip window perimeter	• Loose fit seal. • Seal misaligned. • Glass misaligned. • Seal damaged.	• PINCH the seal carrier to improve the retention to the seal flange. • REINSTALL the seal. • REALIGN the glass. • INSTALL a new seal.
• Wind noise from antenna	• Shape of antenna. • Air leak around antenna cable access hole.	• INSTALL an antenna boot or a spiral antenna. • INSPECT the antenna access hole grommet. REPAIR as necessary.
• Air leak from closed roof opening panel	• Seal installed incorrectly. • Roof opening panel glass/door misaligned. • Roof opening panel damaged.	• REINSTALL the seal. • REALIGN the roof opening panel glass/door. • INSTALL a new roof opening panel.

• Buffeting from an open roof opening panel	• Wind deflector inoperative/damaged.	• REPAIR or INSTALL a new wind deflector as necessary.
	• Wind deflector height incorrect.	• ADJUST the wind deflector higher.
• Wind noise created by airflow over or behind body panels	• Fender splash shield misaligned.	• REALIGN the fender splash shield.
	• Body panel misaligned (exposed edge).	• REALIGN the appropriate body panel.
	• Hood misaligned (front margin).	• CHECK hood gaps and fit. ADJUST the hood as necessary.
	• Front grille edge noise.	• APPLY foam in the hollow areas behind the louvers.
• Wind noise created by grille opening panel	• Grille relationship to leading edge on hood.	• ADJUST the grille opening panel forward to eliminate wind noise.
	• Sharp edges due to material imperfections.	• REMOVE the sharp edges (no damage to visible surface).
• Wind noise from air extractor	• Air extractor housing seated incorrectly.	• REINSTALL the air extractor housing.
	• Air extractor housing or flaps damaged.	• INSTALL a new air extractor.
• Air leak at top of A-pillar — vehicles with a convertible top	• Seal at windshield header installed incorrectly.	• REINSTALL the seal.
	• Seal pinched.	• FILL the seal with foam to reshape it.
	• Gap between side rail and header seal at A-pillar.	• ADJUST the J-hook/vinyl top.
• Air leak at rear quarter glass (division bar) — vehicles with a convertible top	• No contact between front side glass and quarter glass division bar.	• ADJUST the front side glass regulator and the rear quarter glass regulator.
• Air leak or wind noise from top of side glass — vehicles with a convertible top	• Gap between side rail and vinyl top.	• ADD additional foam tape to seal between the side rail and the vinyl top.
	• Seal at windshield header installed incorrectly.	• REINSTALL the seal.
	• Seal damaged between side rail and vinyl top.	• INSTALL a new seal.
	• Vinyl top damaged.	• INSPECT the vinyl top.

		INSTALL a new vinyl top as necessary.
• Air leak or wind noise at windshield header — vehicles with a convertible top	• Vinyl top not flush with header. • Seal at windshield header installed incorrectly. • Header seal not flush with header.	• ADJUST the J-hook to lower the top to achieve a flush condition. • REINSTALL the seal. • REINSTALL the seal.
• Convertible top flapping with the top up	• Vinyl top contacting interior headliner.	• Working from front to back, INSTALL a 6.35 mm (0.25 in) foam sheet between the headliner and the vinyl top at the suspected area. Allow a clearance of 50 mm (2 in) - 75 mm (3 in) away from the roof bows and the side rails.
• Noise from roof rack	• Roof rack rails or crossbars loose. • Roof rack fasteners missing. • Roof rack crossbars installed backward. • Roof rack rub strips partially lifting from roof. • Roof rack gaskets loose or misaligned.	• TIGHTEN the fasteners. • INSTALL the approved fasteners. • REINSTALL the crossbars. • REAPPLY adhesive or fasteners or INSTALL new rub strips as necessary. • REINSTALL the gasket.
• Wind noise from bug shield/exterior windshield sun visor	• Turbulence created by location and shape.	• REMOVE per customer direction if it is a dealer installed option.

Symptom Chart—Brake Noise/Vibration

Condition	Possible Sources	Action
• Rattling noise	• Caliper mounting bolts loose.	• CHECK the caliper bolts. TIGHTEN to specifications. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.
	• Damaged or worn caliper pins or retainers.	• CHECK the caliper pins and retainers for lubrication and correct fit. LUBRICATE or INSTALL new components as necessary. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.

	• Missing or damaged anti-rattle clips or springs. • Loose brake disc shield.	• CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for the front disc brakes pads or Section 206-04 for the rear disc brake pads. • TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 .
• Clicking noise—with brakes applied with ABS brakes	• ABS hydraulic control unit.	• Acceptable condition.
• Squealing noise—occurs on first (morning) brake application	• Disc brake pads.	• Acceptable condition. Caused by humidity and low disc brake pad temperature.
• Squealing noise—a continuous squeal	• Disc brake pads or linings worn below minimum thickness.	• INSTALL new disc brake pads. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.
• Squealing noise—an intermittent squeal brought on by cold, heat, water, mud or snow	• Disc brake pad.	• Acceptable condition.
• Groaning noise—occurs at low speeds with brake lightly applied (creeping)	• Disc brake pads.	• Acceptable condition.
• Grinding noise—continuous	• Disc brake pads or linings worn below minimum thickness.	• INSPECT the disc brake pads, brake discs/drums and attaching hardware for damage. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Moaning noise	• Brake linings contaminated with grease or oil.	• INSPECT the brake pads and shoes for contamination. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Brake vibration/shudder—occurs when brakes are applied	• Uneven disc or drum wear. • Uneven disc brake pad or lining transfer. • Suspension components.	• Go To Pinpoint Test A .

• Brake vibration/shudder—occurs when the brake pedal is released	• Brake drag.	• INSPECT the disc brake pads or linings for premature wear. REPAIR or INSTALL a new caliper or wheel cylinder as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

Symptom Chart—Driveline Noise/Vibration

Condition	Possible Sources	Action
• Axle howling or whine—front or rear axle	• Axle lubricant low.	• CHECK the lubricant level. FILL the axle to specification.
	• Axle housing damage.	• INSPECT the axle housing for damage. REPAIR or INSTALL a new axle as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn wheel bearings or axle bearings.	• CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
	• Damaged or worn differential ring and pinion.	• INSPECT the ring and pinion ring for abnormal wear patterns or broken teeth. INSTALL a new ring and pinion as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn differential side or pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn differential side gears and pinion gears.	• DISASSEMBLE the differential carrier. INSPECT the side and pinion gears for abnormal wear patterns or broken teeth. INSTALL new gears as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Driveline clunk—loud clunk when shifting from reverse to drive	• Incorrect axle lubricant level.	• CHECK the lubricant level. FILL the axle to specification.
	• Excessive backlash in the	• CARRY OUT a total backlash check. REFER to Section 205-

	axle or transmission.	00 .
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02 .
	• Damaged or worn universal joints (U-joints).	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Loose suspension components.	• INSPECT the suspension for damage or wear. REPAIR or INSTALL new components as necessary.
	• Broken powertrain mounts.	• INSPECT the powertrain mounts. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. INSTALL new mounts as necessary.
	• Idle speed too high.	• CHECK for the correct idle speed.
• Driveline clunk—occurs as the vehicle starts to move forward following a stop	• Worn or galled driveshaft slip-yoke splines.	• CLEAN and INSPECT the splines of the yoke for a worn or galled condition. INSTALL a new yoke as necessary. REFER to Section 205-01 .
	• Worn or galled driveshaft and coupling shaft splines.	• CLEAN and INSPECT the splines of the driveshaft and coupling shaft for a worn or galled condition. INSTALL a new driveshaft assembly as necessary. REFER to Section 205-01 .
	• Loose rear leaf spring U-bolts.	• CHECK the U-bolts for loose nuts. TIGHTEN to specification. REFER to Section 204-02 .
• Driveline clunk (FWD vehicles)—occurs during acceleration or from cruise to coast/deceleration	• Damaged or worn inboard constant velocity (CV) joint.	• INSPECT the inboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• Driveline clunk (4WD vehicles)—occurs during shift-on-the-fly engagement	• Clutch relay. • Shift motor. • Transfer case. • GEM.	• CHECK the 4WD engagement system. REPAIR or INSTALL new components as necessary. REFER to Section 308-07A or Section 308-07B .
• Clicking, popping or grinding—occurs while	• Inadequate or contaminated	• CHECK the CV boots and joints for wear or damage.

vehicle is turning	lubrication in the (CV) joints.	REPAIR or INSTALL new components as necessary. REFER to Section 205-04 .
	• Another component contacting the halfshaft	• CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary.
	• Brake components.	• INSPECT the front brakes for wear or damage. REPAIR as necessary. REFER to Section 206-03 .
	• Steering components.	• INSPECT the drag link, inner and outer tie-rods or idler arm for wear or damage. REPAIR as necessary. REFER to Section 211-02 .
	• Suspension components.	• INSPECT the upper and lower ball joints for wear or damage. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive.
	• Damaged or worn wheel bearings.	• CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
• Clicking or snapping—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• High pitched chattering—noise from the rear axle when the vehicle is turning	• Incorrect or contaminated lubricant.	• CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). FLUSH and REFILL with the specified rear axle lubricant and friction modifier as necessary.
	• Damaged or worn differential (differential side gears and pinion gears).	• DISASSEMBLE the differential assembly. INSPECT the differential case, pin and gears for wear or damage. REPAIR or INSTALL a new differential as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Buzz—buzzing noise is the same at cruise or coast/deceleration	• Damaged or worn tires.	• CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04 .
	• Incorrect driveline angles.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .

• Rumble or boom—noise occurs at coast/deceleration, usually driveshaft speed related and noticeable over a wide range of speeds	• Driveshaft is out-of-balance.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 .
	• U-joints binding or seized.	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Excessive pinion flange runout.	• CARRY OUT a runout check. REPAIR as necessary. REFER to Section 205-00 .
• Grunting—normally associated with a shudder experienced during acceleration from a dead stop	• Driveshaft slip yoke binding.	• CLEAN and LUBRICATE the male and female splines.
	• Loose rear spring U-bolts.	• INSPECT the rear suspension. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
• Howl—can occur at various speeds and driving conditions. Affected by acceleration and deceleration	• Incorrect ring and pinion contact, incorrect bearing preload or gear damage.	• CHECK the ring and pinion and bearings for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Chuckle—heard at coast/deceleration. Also described as a knock	• Incorrect ring and pinion contact or by damaged teeth on the coast side of the ring and pinion.	• CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Knock—noise occurs at various speeds. Not affected by acceleration or deceleration	• Gear tooth damage to the drive side of the ring and pinion.	• CHECK the differential case and ring and pinion for damage. INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.

	• Excessive axle shaft end play. (Vehicles with integral axles).	• CHECK the axle end play using a dial indicator. INSTALL a new axle shaft or side gears as necessary. REFER to Section 205-02 .
• Scraping noise—a continuous low pitched noise starting at low speeds	• Worn or damaged pinion bearings.	• CHECK the pinion bearings. INSTALL new pinion bearings as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Driveline shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned.	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary.
	• Loose rear spring U-bolts.	• INSPECT the U-bolts. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
	• Incorrect or high CV joint operating angle.	• CHECK vehicle ride height is within limits. REPAIR as necessary.
	• Damaged or worn front suspension components.	• CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• U-joints binding or seized.	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Binding, damaged or galled splines on the driveshaft slip-yoke.	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for a worn, damaged or galled condition. INSTALL a new slip-yoke or driveshaft assembly as necessary. REPAIR as necessary. REFER to Section 205-01 .
• Driveline vibration—occurs at cruising speeds	• U-joints are worn.	• CHECK for wear or incorrect seating. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Worn or damaged driveshaft center bearing support.	• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new center bearing support as

		necessary. Section 205-01 .
	• Loose axle pinion flange bolts	• INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01 .
	• Excessive axle pinion flange runout.	• CARRY OUT a Runout Check. REPAIR as necessary. REFER to Section 205-01 .
	• Driveshaft is out-of-balance.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 . REPAIR as necessary.
	• Binding or damaged splines on the driveshaft slip-yoke	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for wear or damage. INSTALL a new slip-yoke or driveshaft assembly as necessary. REFER to Section 205-01 . REPAIR as necessary.
	• Driveshaft runout.	• CARRY OUT a Runout Check. REFER to Section 205-00 . REPAIR as necessary.
	• Incorrect lateral and radial tire/wheel runout.	• INSPECT the tire and wheels. MEASURE tire runouts. REPAIR or INSTALL new components as necessary. REFER to Section 204-04 .
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Incorrectly seated CV joint in the front wheel hub.	• CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary.

Symptom Chart — Engine Noise/Vibration

Condition	Possible Sources	Action
• Grinding noise—occurs during engine cranking	• Incorrect starter motor mounting.	• INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to Section 303-06 .
	• Starter motor.	• CHECK the starter motor. REPAIR or INSTALL a new starter motor as necessary. REFER to Section 303-06 .
	• Incorrect starter motor drive engagement.	• INSPECT the starter motor drive and flywheel/flexplate for wear or damage. INSTALL a

		new starter motor drive or flywheel/flexplate as necessary.
• Engine ticking noise	• Fuel injector. • Fuel line. • Oil pump. • Valve lifter. • Belt tensioner. • Water pump. • Obstruction of cooling fan.	• Go To Pinpoint Test B .
• Engine drumming noise—normally accompanied by vibration	• Powertrain mount. • Damaged or misaligned exhaust system.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section. • INSPECT the exhaust system for loose or broken clamps and brackets. CARRY OUT Exhaust System Neutralizing in this section.
• Whistling noise—normally accompanied with poor idle condition	• Air intake system.	• CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. REFER to Section 303-12 .
• Clunking noise	• Water pump has excessive end play or imbalance. • Generator has excessive end play.	• CHECK the water pump for excessive end play. INSPECT the water pump with the drive belt off for imbalance. INSTALL a new water pump as necessary. REFER to Section 303-03 . • CHECK the generator for excessive end play. REPAIR or INSTALL a new generator. REFER to Section 414-02 .
• Pinging noise	• Exhaust system leak. • Gasoline octane too low. • Knock sensor operation. • Incorrect spark timing. • High operating temperature.	• INSPECT the exhaust system for leaks. REPAIR as necessary. • VERIFY with customer the type of gasoline used. CORRECT as necessary. • CHECK the knock sensor. INSTALL a new knock sensor as necessary. REFER to Section 303-14 . • CHECK the spark timing. REPAIR as necessary. • INSPECT cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the coolant for the correct mix ratio. DRAIN and

		REFILL as needed. CHECK engine operating temperature is within specifications. REPAIR as necessary.
	• Foul-out spark plug.	• CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary.
	• Catalytic converter.	• Acceptable noise.
• Knocking noise—light knocking noise, also described as piston slap. Noise is most noticeable when engine is cold with light to medium acceleration. Noise disappears as engine warms	• Excessive clearance between the piston and the cylinder wall.	• Engine cold and at high idle. Using an EngineEAR, pull a spark plug or fuel injector connector until the noise goes away. CARRY OUT a cylinder bore clearance to piston check. INSTALL a new piston. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking noise—light double knock or sharp rap sound. Occurs mostly with warm engine at idle or low speeds in DRIVE. Increases in relation to engine load. Associated with poor lubrication history	• Excessive clearance between the piston and the piston pin.	• INSTALL a new piston or piston pin. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking noise—light knocking noise is most noticeable when engine is warm. Noise tends to decrease when vehicle is coasting or in neutral	• Excessive clearance between the connecting rod bearings and the crankshaft.	• Engine warm and at idle. Using an EngineEAR, PULL a spark plug or fuel injector connector until the noise goes away. INSTALL new bearings. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking—deep knocking noise. Noise is most noticeable when engine is warm, at lower rpm and under a light load and then at float	• Worn or damaged crankshaft main bearings.	• CARRY OUT DERU test. CHECK for noise with vehicle at operating temperature, during medium to heavy acceleration. CHECK at idle with injector disconnected, noise does not change. INSTALL new main bearings. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.

• Knocking noise—occurs mostly with warm engine at light/medium acceleration	• Spark plugs.	• CHECK the spark plug for damage or wear. INSTALL new spark plugs as necessary.
	• Carbon accumulation in combustion chamber.	• REMOVE carbon from combustion chamber.
• Whine or moaning noise	• Air intake system.	• CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary.
	• Generator electrical field or bearings.	• CARRY OUT generator load test. REPAIR or INSTALL a new generator as necessary. REFER to Section 414-02 .
• Drone type noise	• Exhaust system.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary.
	• A/C compressor.	• CHECK for noise with vehicle at constant speeds. CYCLE the compressor on and off and listen for a change in pitch. REPAIR as necessary. REFER to Section 412-03 .
	• Powertrain mounts.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section.
• Sputter type noise—noise worse when cold, lessens or disappears when vehicle is at operating temperature	• Damaged or worn exhaust system components.	• INSPECT the exhaust system for leaks or damage. REPAIR as necessary. REFER to Section 309-00 .
• Rattling noise—noise from the upper engine (valve train). Worse when engine is cold	• Low oil level.	• CHECK oil level. FILL as necessary.
	• Thin or diluted oil.	• INSPECT the oil for contamination. If oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter.
	• Low oil pressure.	• CARRY OUT an oil pressure test. If not within specifications, REPAIR as necessary. REFER to Section 303-00 .
	• Worn rocker arms/fulcrums or	• CARRY OUT a valve train analysis. INSTALL new valve

	followers.	train components as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Worn valve guides.	• CARRY OUT a valve train analysis. INSTALL new valve guides as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Excessive runout of valve seats on the valve face.	• CARRY OUT a valve seat runout test. INSPECT the valve face and seat. INSTALL new valves as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Rattling noise—from the bottom of the vehicle	• Loose muffler shields or catalytic converter shields.	• CHECK the exhaust system for loose exhaust shields. REPAIR as necessary.
• Thumping noise—from the bottom of the vehicle, worse at acceleration	• Exhaust pipe/muffler grounded to chassis.	• CHECK the exhaust system to chassis clearance. CHECK the exhaust system hangers for damage. REPAIR as necessary. REFER to Section 309-00 .
• Whoosh—occurs during light vehicle acceleration. Heard inside the vehicle	• Throttling late, creating turbulence transmitted through the plastic manifold.	• CHECK for leaks or missing seal in the dash panel.
• Engine vibration—increases intensity as engine rpm is increased	• Engine out-of-balance.	• CARRY OUT Neutral Engine Run-Up (NERU) Test. ROTATE the torque converter, 120° for 3 bolt and 180° for 4 bolt. INSPECT the torque converter pilot outer diameter to crankshaft pilot inner diameter. REPAIR as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Engine vibration—is felt with increases and decreases in engine rpm	• Strain on exhaust mounts.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary.

	• Damaged or worn powertrain/drivetrain mounts.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Engine or transmission grounded to chassis.	• INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary.
• Engine vibration—vibration felt at all times	• Excessive engine pulley runout.	• CARRY OUT Engine Accessory Test. INSTALL a new engine pulley as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Damaged or worn accessory component.	• CARRY OUT Engine Accessory Test. REPAIR or INSTALL a new component as necessary.
• Accelerator pedal vibration—felt through the pedal as a buzz	• Throttle cable loose or misrouted.	• INSPECT the throttle cable. REPAIR as necessary. REFER to Section 310-02 .
• Engine vibration—mostly at coast/neutral coast. Condition improves with vehicle accelerating	• Combustion instability.	• CHECK the ignition system. INSTALL new components as necessary.
• Engine vibration or shudder—occurs with light to medium acceleration above 56 km/h (35 mph)	• Worn or damaged spark plugs.	• INSPECT the spark plugs for cracks, high resistance or broken insulator. INSTALL a new spark plug(s) as necessary.
	• Plugged fuel injector.	• REPAIR or INSTALL a new injector as necessary.
	• Damaged spark plug wire.	• INSPECT the spark plug wires for damage. INSTALL a new spark plug wire(s) as necessary.
	• Contaminated fuel.	• INSPECT the fuel for contamination. DRAIN the fuel system and refill.
	• Worn or damaged	• CHECK the torque converter.

	torque converter.	INSTALL a new torque converter as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions.

Symptom Chart—Idle Noise/Vibration

Condition	Possible Sources	Action
• Idle air control (IAC) valve moan — occurs on throttle tip-out	• IAC valve is contaminated with oil.	• GO to Component Tests in this section.
• Accessory drive belt chirp — occurs at idle or high idle, cold or hot. Most common occurrence is during humid weather.	• Accessory drive belt worn, or pulley is misaligned or loose.	• INSPECT for loose or misaligned pulleys. CHECK the drive belt for wear or damage. INSTALL new pulley (s)/accessory drive belt, as necessary. REFER to Section 303-05 .
• Accessory drive bearing hoot — occurs at idle or high idle in cold temperatures of approximately +4°C (+40°F) or colder at first start of the day	• Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and bearing race.	• Go To Pinpoint Test C .
• Power steering moan — occurs at high idle and possibly at idle during the first cold start of the day in temperatures of approximately -18°C (0° F) or colder. Noise can even be a severe screech for less than one minute in very cold temperatures of approximately -29°C (-20°F) or colder	• High fluid viscosity, or plugged reservoir screen in power steering reservoir starves pump causing cavitation.	• Go To Pinpoint Test D .
• Generator whine — during high electrical loads at idle or high idle, a high pitch whine or moan is emitted from the generator	• Generator electrical field noise.	• Using an EngineEAR, PROBE near the generator housing. LISTEN for changes in the noise level while changing electrical loads (such as rear defrost, headlamps, etc.). CARRY OUT a generator load test. If the system passes the load test, the noise is from the generator bearings, INSTALL new bearings. If the system fails the load test, INSTALL a new generator. REFER to Section 414-02 .
• Engine-driven cooling	• The viscous	• Go To Pinpoint Test E .

fan moan — occurs during the first start of the day. It is most objectionable near idle speeds up to 2000 rpm. The noise increases with rpm	cooling fan clutch engages until the fluid in the clutch reaches normal operating temperature, causing the fan to fully engage.	
• Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	• Exhaust system vibration excites the body resonances inducing interior noise. • Engine vibration excites the body resonances inducing interior noise.	• Go To Pinpoint Test F .
• Hissing noise — occurs during idle or high idle that is apparent with the hood open	• Vacuum leak or idle air control (IAC) valve flow noise.	• Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component.
	• Vehicles with a plastic intake manifold.	• Acceptable condition. Some plastic manifolds exhibit this noise, which is the effect of the plastic manifold.
• Automatic transmission buzz or hiss	• Incorrect driveline angles.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Worn or damaged main control solenoids or valves.	• Using a transmission tester, activate the solenoids to duplicate sound. INSTALL new components as necessary. REFER to .
• Manual Transmission Clutch throw-out bearing whine. A change in noise pitch or loudness while depressing the clutch pedal	• Worn throw-out bearing.	• INSTALL a new throw-out bearing. REFER to Section 308-01 .
• Heating, vacuum and air conditioning (HVAC) system chirp — most audible inside the vehicle. Listen for a change in noise pitch or loudness while changing the HVAC system blower speed	• Damaged or worn HVAC blower bearing.	• INSTALL a new blower motor. REFER to Section 412-02 .

• Air conditioning (A/C) clutch ticking — occurs when the compressor clutch engages	• Acceptable noise. • Incorrect air gap.	• LISTEN to the clutch to determine if the noise occurs with clutch engagement. A small amount of noise is acceptable. If the noise is excessive, CHECK the A/C clutch air gap. INSPECT the A/C clutch for wear or damage. INSTALL a new clutch as necessary. REFER to Section 412-03 .
• Intermittent rattle, or scraping/rubbing noise	• Loose exhaust heat shield(s). • Wiring, hose or other part interfering with accessory drive, drive belt or pulley.	• INSPECT the exhaust system for loose parts using a glove or clamps to verify cause. REPAIR as necessary. REFER to Section 309-00 . • INSPECT accessory drive system closely verifying there is adequate clearance to all rotating components. REPAIR as necessary.
• Engine ticking or knocking noise — occurs during idle or high idle during the first cold start of the day	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .
• A continuous, speed-dependent rattle from the engine — occurs during idle or high idle during the first cold start of the day and disappears as the engine warms up	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .
• Idle vibration—a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan	• Cylinder misfire. • Engine or torque converter out of balance.	• Using the NGS, CHECK the ignition system. CARRY OUT a cylinder power test. REFER to Section 303-00 . • VERIFY the torque converter to crankshaft pilot clearance is correct, REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 120° on a 3 bolt converter or 180° for a 4 bolt converter. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary. RETEST the vehicle.
• Idle vibration—a high-frequency vibration (20–80 Hz) or buzz, that is	• Exhaust system mounts bound up.	• VERIFY concern occurs at engine firing frequency. CHECK that the exhaust

felt through the steering wheel or seat		system vibrates at the same frequency as the engine. ADD 9–14 km (20–30 lb.) to the tail pipe to test, CARRY OUT Exhaust System Neutralizing in this section.
	• Body mounts loose.	• INSPECT the body mounts. CARRY OUT a Neutral Engine Run-Up (NERU) Test. REPAIR as necessary
	• Power steering lines grounded out.	• INSPECT that the power steering lines are not contacting the chassis or each other. REPAIR as necessary.

Symptom Chart—Squeak and Rattle

Condition	Possible Sources	Action
• Squeak—heard inside the vehicle when closing/opening the door	• Insufficient lubrication on the door hinge or check strap.	• LUBRICATE the hinge or check strap.
	• Internal door components loose, rubbing or misaligned.	• CHECK the inside of the door. TIGHTEN or ALIGN as necessary. USE the Rotunda Squeak and Rattle Kit to isolate any rubbing components.
• Squeak—heard inside the vehicle when closing/opening the window	• Worn or damaged glass run/channel.	• REPAIR or INSTALL a new glass run/channel. REFER to Section 501-11 .
• Squeak—heard outside of vehicle when closing/opening the door	• Exhaust shield rubbing against the chassis or exhaust pipe.	• CHECK the exhaust system. REPAIR as necessary. Section 309-00 .
• Squeak—occurs with initial brake pedal application	• Disc brake pads.	• Under certain conditions, asbestos free pads can generate a squeak noise. This noise is normal and does not indicate a concern.
• Squeak—a constant noise that occurs with brake pedal applications	• Damaged or worn disc brake pads.	• INSPECT the pads for oil, grease or brake fluid contamination. CHECK for glazed linings. A brake disc with hard spots will also cause a squeak type noise. REPAIR or INSTALL new pads as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Squeak—noise occurs over bumps or when	• Worn control arm bushings.	• INSPECT the control arm bushings. Spray with lubricant and CARRY OUT a "bounce test" to determine

turning		which bushing. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive.
	• Worn or damaged shock absorber/strut.	• INSPECT the shock absorber for damage. CARRY OUT a "bounce test" to isolate the noise. INSTALL a new shock absorber/strut as necessary. REFER to Section 204-01A for 2-wheel drive vehicles, Section 204-01B for 4-wheel drive vehicles for the front shock absorber/strut or Section 204-02 for the rear shock absorber/strut.
• Rattle—heard when closing/opening the door or window	• Loose internal door mechanism, bracket or attachment.	• REPEAT the motion or CARRY OUT a "tap test" to duplicate the noise. INSPECT the door for loose components. TIGHTEN loose components or USE the Rotunda Squeak and Rattle Kit to isolate any rattling components.
• Squeak or rattle—heard inside the vehicle over rough roads/bumps	• Misaligned glove compartment door/hinge.	• ALIGN the glove compartment door.
	• Instrument panel trim loose or misaligned.	• INSPECT the instrument panel trim for missing or loose clips or screws. REPAIR as necessary.
	• Loose interior component or trim.	• CARRY OUT a "touch test". ELIMINATE the noise by pressing or pulling on interior trim and components. USE the Rotunda Squeak and Rattle Kit to isolate any rattling/squeaking components.
• Squeak or rattle—noise with a vibration concern	• Damaged or worn body mounts.	• INSPECT the upper and lower absorbers and washers for damage or wear. CHECK the body mount brackets for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.
	• Damaged or worn sub-frame mounts.	• INSPECT the upper and lower absorbers for damage or wear. CHECK the sub-frame for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.

Symptom Chart—Steering Noise/Vibration

Condition	Possible Sources	Action
• Steering grunt or shudder — occurs when turning into or out of a turn at low	• Steering gear or power steering hoses.	• GO to Steering Gear Grunt/Shudder Test component test in this section.

speeds (temperature sensitive)		
• Steering System clonk—hydraulic knocking sound	• Air in the steering hydraulic system.	• CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00 .
• Power steering pump moan — loud humming noise occurs when the steering wheel is rotated to the stop position. Produces a 120-600 Hz frequency that changes with rpm	• Power steering hose grounded out to chassis.	• INSPECT the power steering hoses. REPAIR as necessary.
	• Aerated fluid.	• CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00 .
	• Steering gear isolators.	• INSPECT the isolators for wear or damage. REPAIR as necessary.
	• Low fluid.	• CHECK the fluid level. REFILL as necessary.
	• Power steering pump brackets loose or misaligned.	• CHECK bolts, brackets and bracket alignment. TIGHTEN bolts to specification. REPAIR or INSTALL new brackets as necessary.REFER to Section 211-02 .
• Steering gear clunk — occurs only while cornering over a bump (can be temperature sensitive)	• Steering gear.	• INSPECT the steering gear for loose mounting bolts. TIGHTEN as necessary. REFER to Section 211-02 .
• Feedback (rattle, chuckle or knocking noise in the steering gear) — a condition where roughness is felt in the steering wheel when the vehicle is driven over rough surfaces	• Column intermediate/flexible shaft joints damaged or worn.	• INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
	• Loose, damaged or worn tie-rod ends.	• TIGHTEN the nuts to specification or INSTALL new tie-rod ends as necessary. REFER to Section 211-02 .
	• Steering gear insulators or mounting bolts loose	• TIGHTEN the bolts or INSTALL new bolts as

	or damaged.	necessary. REFER to Section 211-02 .
	• Steering column intermediate shaft bolts are loose.	• TIGHTEN the bolts to specification. REFER to Section 211-04 .
	• Steering column damaged or worn.	• REPAIR or INSTALL a new steering column as necessary. REFER to Section 211-04 .
	• Loose suspension bushings, bolts or ball joints.	• INSPECT the suspension system. TIGHTEN or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive.
• Feedback (nibble at the steering wheel) — a condition where slight rotational movement is felt in the steering wheel when the vehicle is driven over rough or grooved surfaces	• Lateral runout in the tire or wheel.	• GO to Pinpoint Test H .
	• Yoke spring in the steering gear.	• CHECK TSBs for revised yoke spring for applicable vehicles.
• Accessory drive belt squeal/chirp—when rotating the steering wheel from stop to stop	• Loose or worn accessory drive belt.	• ADJUST or INSTALL a new accessory drive belt as necessary. REFER to Section 303-05 .
• Power steering gear hiss	• Steering column intermediate/flexible shaft-to-steering gear is binding or misaligned.	• REPAIR or INSTALL a new intermediate/flexible shaft as necessary. REFER to Section 211-04 .
	• Grounded or loose steering column boot at the dash panel.	• REPAIR as necessary.
	• Damaged or worn steering gear input shaft and valve.	• REPAIR or INSTALL a new steering gear as necessary. REFER to Section 211-02 .
• Steering column rattle	• Loose bolts or attaching brackets.	• TIGHTEN the bolts to specifications.
	• Loose, worn or insufficiently lubricated column bearings.	• LUBRICATE or INSTALL new steering column bearings as necessary. REFER to Section 211-04 .
	• Steering shaft insulators	• INSTALL new insulators.

	damaged or worn.	REFER to Section 211-04 .
	• Intermediate/flexible shaft compressed or extended.	• INSPECT the rubber spider coupling for damage. INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
• Steering column squeak or cracks	• Insufficient lubricated steering shaft bushings. • Loose or misaligned steering column shrouds. • Steering wheel rubbing against steering column shrouds. • Insufficient lubricated speed control slip ring. • Upper or lower bearing sleeve out of position.	• LUBRICATE the steering shaft and shaft tube seals. • TIGHTEN or ALIGN the steering column shrouds. • REPOSITION the steering column shrouds. • LUBRICATE the speed control slip ring. • REPOSITION the bearing sleeves.
• Power steering pump noisy	• Incorrect assembly of components. • Imperfections on the outside diameter or end surface of the power steering pump rotor. • Damaged or worn power steering pump rotor splines. • A crack on the inner surface of the power steering pump cam. • Interference between the power steering pump rotor and cam. • Damaged or worn power steering pump rotor and pressure plates.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
• Power steering pump swish noise	• Power steering fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54°C (130°F).	• Acceptable condition.
• Power steering pump whine noise	• Aerated fluid. • Damaged power steering pump cam. • Damaged valve cover O-ring seal.	• CHECK for a leak in the system. PURGE the air from the system. REFER to Section 211-00 . • REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 . • REPAIR or INSTALL a new power steering pump

		as necessary. REFER to Section 211-02 .
• Power steering pump clicking (mechanical) noise	• Power steering pump rotor slippers too long, excessive rotor slipper-to-slot clearance or damaged or worn rotor assembly.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
• Power steering pump clatter noise	• Damaged corners on the outside diameter or the power steering rotor or distorted rotor slipper ring.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .

Symptom Chart—Suspension Noise/Vibration

Condition	Possible Sources	Action
• Squeak or grunt—noise from the front suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning	• Front stabilizer bar insulators.	• Under these conditions, the noise is acceptable. CHECK TSBs.
• Clunk—noise from the front suspension, occurs in and out of turns	• Loose front struts or shocks.	• INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Clunk—noise from the rear suspension, occurs when shifting from reverse to drive	• Loose rear suspension components.	• INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
• Click or pop—noise from the front suspension. More noticeable over rough roads or over bumps	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Click or pop (FWD vehicles)—noise occurs when vehicle is turning	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary.
• Click or snap—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary.
• Front suspension noise—a squeak, creak or rattle	• Steering components.	• Go To Pinpoint Test H .

noise. Occurs mostly over bumps or rough roads	• Loose or bent front struts or shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control/radius arm bushings. • Worn or damaged stabilizer bar bushings or links.	
• Rear suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Loose or bent rear shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control arm bushings. • Worn or damaged stabilizer bar bushings or links.	• Go To Pinpoint Test I .
• Shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned. • Incorrect or high CV joint operating angle. • Damaged or worn front suspension components.	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary. • CHECK vehicle ride height is within limits. REPAIR as necessary. • CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
• Shimmy—most noticeable on coast/deceleration. Also hard steering condition	• Excessive positive caster.	• CHECK the caster alignment angle. CORRECT as necessary. REFER to Section 204-00 .

Symptom Chart—Tire Noise/Vibration

Condition	Possible Sources	Action
• Tire noise—hum/moan at constant	• Abnormal wear patterns.	• SPIN the tire and CHECK for tire wear. INSTALL a new tire as

speeds		necessary. INSPECT for damaged/worn suspension components. CARRY OUT wheel alignment.
• Tire noise—noise tone lowers as the vehicle speed is lowered	• Out-of-balance tire.	• BALANCE the tire and road test. INSTALL a new tire as necessary. REFER to Section 204-04 .
• Tire noise — ticking noise, changes with speed	• Nail puncture or stone in tire tread.	• INSPECT the tire. REPAIR as necessary.
• Wheel and tire—vibration and noise concern is directly related to vehicle speed and is not affected by acceleration, coasting or decelerating	• Damaged or worn tire.	• Go To Pinpoint Test J .
• Tire wobble or shudder — occurs at lower speeds	• Damaged wheel bearings.	• SPIN the tire and CHECK for abnormal wheel bearing play or roughness. ADJUST or INSTALL new wheel bearings as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	• Damaged wheel.	• INSPECT the wheel for damage. INSTALL a new wheel as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	• Damaged or worn suspension components.	• INSPECT the suspension components for wear or damage. REPAIR as necessary.
	• Loose wheel nuts.	• CHECK the wheel nuts. TIGHTEN to specification. REFER to Section 204-04 .
	• Damaged or uneven tire wear.	• SPIN the tire and CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04 .
• Tire shimmy or shake— occurs at lower speeds	• Wheel/tire out of balance.	• BALANCE the wheel/tire assembly.
	• Uneven tire wear.	• CHECK for abnormal tire wear. INSTALL a new tire as necessary. REFER to Section 204-04 .
	• Excessive radial runout of wheel or tire.	• CARRY OUT a radial runout test of the wheel and tire. INSTALL a new tire as

		necessary. REFER to Section 204-04 .
	• Worn or damaged wheel studs or elongated stud holes.	• INSPECT the wheel studs and wheels. INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.
	• Excessive lateral runout of the wheel or tire.	• CARRY OUT a lateral runout test of the wheel and tire. CHECK the wheel, tire and hub. REPAIR or INSTALL new components as necessary.
	• Foreign material between the brake disc and hub or in the brake disc fins.	• CLEAN the mounting surfaces of the brake disc and hub. CHECK the brake disc fins for material.
• High speed shake or shimmy—occurs at high speeds	• Excessive wheel hub runout. • Damaged or worn tires. • Damaged or worn wheel bearings. • Worn or damaged suspension or steering linkage components. • Brake disc or drum imbalance.	• Go To Pinpoint Test K .

Symptom Chart—Transmission (Manual) and Transfer Case Noise/Vibration

Condition	Possible Sources	Action
• Clutch rattling noise—occurs with clutch engaged, noise changes/disappears with clutch pedal depressed	• Flywheel bolts, clutch housing bolts or clutch pressure plate bolts loose.	• TIGHTEN the bolts to specifications. CHECK the bolts for damage.
• Clutch squeaking noise—noise is heard when the clutch is operated. Vehicle moves slowly or creeps when the clutch is disengaged. Can also be difficult to shift into first and reverse gear	• Pilot bearing seized or damaged.	• INSTALL a new pilot bearing. REFER to Section 308-01 .
• Clutch squeaking noise—occurs with clutch pedal	• Worn clutch pedal shaft or bushings.	• INSPECT the clutch pedal for wear or damage. REPAIR as necessary.

depressed/released		
• Clutch whirring/rattle noise—occurs when clutch pedal is depressed	• Worn, damaged or misaligned clutch release bearing.	• INSTALL a new clutch release bearing. REFER to Section 308-01 .
• Clutch grating/grinding noise—occurs when clutch pedal is depressed	• Clutch pressure plate fingers bent or worn.	• INSPECT the clutch pressure plate release fingers. INSTALL a new pressure plate as necessary. REFER to Section 308-01 .
	• Contact surface of clutch release bearing worn or damaged.	• INSTALL a new clutch release bearing. REFER to Section 308-01 .
• Clutch chatter—a small amount of noise when clutch pedal is released at initial take-off	• Clutch engagement.	• Acceptable operating condition.
• Clutch chatter/grabs—in some cases a shudder is felt. Occurs with clutch pedal depressed/released	• Damaged or worn powertrain/driveline mounts.	• INSPECT the powertrain/drivetrain mounts. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines. INSTALL new mounts as necessary.
	• Binding or dragging plunger of the clutch master cylinder or slave cylinder.	• CHECK the master and slave cylinder operation. INSPECT the components for damage or wear. INSTALL a new master or slave cylinder as necessary. REFER to Section 308-02 .
	• Grease or oil on the clutch disc facing.	• CHECK the input shaft seal and rear main oil seal. REPAIR as necessary. INSTALL a new clutch disc. REFER to Section 308-01 .
	• Clutch disc surface glazed or damaged.	• INSPECT the clutch disc surface for a glazed, hardened or damage condition. CARRY OUT a disc check. INSTALL a new clutch disc as necessary. REFER to Section 308-01 .
	• Damaged or worn clutch pressure plate.	• INSPECT the clutch pressure plate for wear or damage. INSTALL a new clutch pressure plate as

		necessary. REFER to Section 308-01
	• Flywheel surface damaged or glazed.	• INSPECT the flywheel for damage or wear. CARRY OUT a flywheel runout check. INSTALL a new flywheel as necessary. REFER to Section 308-00 .
• Clutch chatter noise—noise when clutch pedal is released at initial take-off. Clutch is hard to engage and disengage	• Pilot bearing worn, damaged or not correctly aligned in bore.	• INSPECT the clutch pressure plate release fingers for uneven wear, clutch components burnt or a seized pilot bearing. INSTALL a new pilot bearing as necessary. REFER to Section 308-01 .
• Clutch vibration	• Loose flywheel bolts. • Damaged or loose clutch pressure plate. • Excessive flywheel runout.	• Go To Pinpoint Test L .
• Transmission rattling/clattering noise—noise at idle or on light acceleration from a stop. Gear selection difficult	• Gearshift lever joint worn or damaged.	• INSTALL a new gearshift lever. REFER to Section 308-03 .
	• Gearshift lever loose.	• TIGHTEN the bolts to specification. REFER to Section 308-03 .
	• Gearshift linkage rods worn or damaged.	• CHECK the linkage bushings for wear. INSTALL new linkage rods as necessary. REFER to the appropriate workshop manual for the service procedures.
• Transmission rattling/clattering noise—occurs in neutral or in gear, at idle	• Incorrect fluid level or fluid quality.	• CHECK that the transmission is filled to the correct level and with the specified fluid. REFER to Section 308-03 .
• Transmission rattling/clattering noise—noise at idle in neutral	• Worn or rough reverse idler gear.	• CHECK the reverse idler gear. REPAIR as necessary. REFER to Section 308-03 .
	• Rough running engine, cylinder misfire.	• CHECK the ignition system. CARRY OUT a cylinder power test. REPAIR as necessary.
	• Excessive backlash in gears.	• CHECK the gear backlash. ADJUST as

		necessary. REFER to Section 308-03 .
	• Worn countershaft gears.	• REPAIR as necessary. REFER to Section 308-03 .
• Transmission whine—a mild whine at extreme speeds or high rpm	• Rotating gears/geartrain.	• Acceptable noise.
• Transmission whine—a high pitched whine, also described as a squeal	• Transmission gears are worn (high mileage vehicle).	• Result of normal gear wear. REPAIR as necessary. REFER to Section 308-03 .
	• Mismatched gear sets.	• INSPECT the gear sets for an uneven wear pattern on the face of the gear teeth. REPAIR as necessary. REFER to Section 308-03 .
	• Damaged or worn transmission bearing.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission growling/humming—noise occurs in the forward gears. The noise is more prominent when the gear is loaded. The problem gear can be located as the noise occurs in a specific gear position	• Gear is cracked, chipped or rough.	• INSPECT the transmission gears for damage or wear. INSTALL new gears as necessary. REFER to Section 308-03 .
• Transmission hissing—noise in neutral or in forward gears. As bearings wear or break up, the noise changes to a thumping noise	• Damaged or worn bearings.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission knocking/thudding—noise at low speeds in forward gears	• Bearings with damaged balls or rollers or with pitted and spalled races.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission rumble/growl—noise at higher speeds in forward gears, more pronounced in a coast/deceleration condition	• Incorrect driveline angle.	• CHECK the driveline angle. REPAIR as necessary. REFER to Section 205-00 .
	• Driveshaft out of balance or damaged.	• CHECK the driveshaft for damage, missing balance weights or undercoating. Using the vibration

		analyzer (VA), CHECK the driveshaft balance. CARRY OUT a driveline vibration test. For additional information, REFER to Section 205-00 . REPAIR as necessary.
• Transmission rumble/growl—noise at all speeds in forward gears, more pronounced in a heavy acceleration condition	• Damaged or worn transmission bearing or gears (high mileage vehicles).	• CHECK transmission fluid for excessive metal particles. REPAIR as necessary. REFER to Section 308-03 .
• Transfer case whine—noise at all ranges	• Incorrect fluid level or fluid quality.	• CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-07B .
	• Worn oil pump.	• DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
	• Under-inflated or oversized tires.	• CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
• Transfer case growl/rumble—noise at all ranges (A small amount of planetary noise can be heard when the transfer case is operated in low range.)	• Damaged or worn bearings or planetary gear.	• DISASSEMBLE the transfer case. CHECK the bearings or planetary gear for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case scraping/grating—noise at all ranges	• Excessively stretched drive chain hitting the case.	• DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at all ranges or high range only	• Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear.	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at low range only	• Worn or damaged intermediate gear and sliding gears (clutch pack).	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .

• Transfer case vibration—vibration felt with vehicle in 4WD	• Transfer case mounting. • Driveshaft out of balance. • Excessive pinion flange runout.	• Go To Pinpoint Test M .

Symptom Chart—Transmission (Automatic) Noise/Vibration

Condition	Possible Sources	Action
• Rattle—occurs at idle or at light acceleration from a stop	• Damaged engine or transmission mounts.	• CHECK the powertrain/drivetrain mounts for damage. INSTALL new mounts as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• A loose front exhaust pipe heat shield.	• REPAIR or INSTALL a new heat shield as necessary.
	• Loose inspection plate or dust cover plate.	• CHECK for loose bolts. TIGHTEN to specifications. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Loose flexplate to converter nuts.	• CHECK for loose nuts. TIGHTEN to specifications. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—pitch increases with vehicle speed. Starts in first and second gear, decreases or goes away at higher gears	• Damaged or worn low one-way clutch. • Damaged or worn intermediate one-way clutch. • Friction elements. • Damaged or worn planetary or sun gear.	• INSPECT the transmission for wear or damage. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—the pitch changes with engine speed	• A worn or damaged accessory drive component.	• CARRY OUT the Engine Accessory Test. REPAIR or INSTALL new components as necessary.
	• Incorrect fluid level.	• CHECK that the transmission is filled to the correct level. ADD fluid as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-

		01B for 5R55E transmissions. REPAIR as necessary.
	• Partially blocked filter.	• INSPECT the filter. CLEAN or INSTALL a new filter as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged front pump.	• INSPECT the front pump. INSTALL a new front pump as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—pitch changes with vehicle speed	• Speedometer cable or gears.	• REPAIR or INSTALL new cables or gears as necessary.
• Whine/moan type noise—pitch increases or changes with vehicle speed	• Damaged engine or transmission mount.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engine, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
	• U-joints worn or damaged.	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Damaged or worn differential ring and pinion.	• INSPECT the differential ring and pinion for damage. CARRY OUT the Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. REPAIR or INSTALL a new differential ring and pinion as necessary. REFER to Section 205-02 for the rear drive axle or Section 205-03 for the front drive axle.
	• Planetary gears nicked or chipped.	• CHECK the planetary gears for damage. INSTALL new components as necessary.

		REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
• Whistle—noise is high pitched, constant. Changes in pitch with throttle position	• Hydraulic pressure in the main control.	• INSPECT the main control. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
	• Incorrect band/clutch apply pressure.	• CARRY OUT the line pressure tests. REPAIR or INSTALL components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Clunk—occurs when shifting from PARK to a drive or reverse position	• Damaged powertrain mounts.	• INSPECT the powertrain mounts for damage. INSTALL new mounts as necessary.
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary.REFER to Section 205-02 for the rear drive axle or Section 205-03 for the front drive axle.
	• Worn or galled driveshaft slip yoke splines.	• CLEAN and INSPECT the splines of the yoke. INSTALL a new slip yoke as necessary. REFER to Section 205-01 .
	• Worn friction elements or excessive clutch pack end plate play.	• INSPECT the transmission for wear. CHECK that all end play and clearances are within specification. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Bump—occurs	• Initial gear engagement.	• Acceptable condition.

when shifting from PARK to a drive or reverse position. Similar to Clunk but with no sound		
• Buzz or hiss	• Incorrect driveline angles. • Worn or damaged main control solenoids or valves.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 . • Using a transmission tester, ACTIVATE the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Vibration—a high frequency (20–80 Hz) that is felt through the seat or gear shifter. Changes with engine speed	• Transmission cooler lines grounded out.	• CHECK the transmission cooler lines. REPAIR as necessary.
	• Flexplate to torque converter nuts loose.	• CHECK the flexplate nuts. TIGHTEN to specification. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Fluid filler tube grounded out.	• CHECK the fluid filler tube. REPAIR as necessary.
	• Shift cable incorrectly routed, grounded out or loose.	• CHECK the shift cable. REPAIR as necessary. Section 307-05 .
• Shutter or chatter—occurs with light to medium acceleration from low speeds or a stop	• Electrical inputs/outputs. • Vehicle wiring harness. • Incorrect inputs/outputs from the powertrain control module (PCM), digital transmission range (TR) sensor, brake pedal position (BPP) sensor, throttle position (TP) sensor, transmission speed sensor (TSS), output speed shaft (OSS) sensor or the torque converter clutch (TCC).	• CARRY OUT a Torque Converter Clutch Operation Test. RUN on-board diagnostics or self-test. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary. CLEAR the DTC's, road test and rerun on-board diagnostics or self–test.

Pinpoint Tests

The pinpoint tests are a step-by-step diagnostic process designed to determine the cause of a condition. It may not always be necessary to follow a pinpoint test to its conclusion. Carry out only the steps necessary to correct the condition. Then, test the system for normal operation. Sometimes, it is necessary to remove various vehicle components to gain access to the component requiring testing. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 ROAD TEST THE VEHICLE—LIGHT BRAKING	
	1 Check that the wheel and tires are correct for the vehicle. Inspect the tires for abnormal wear patterns. 2 Road test the vehicle. Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50-20 mph) using light braking applications. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a light pedal force. • **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?** → **Yes** GO to A4 . → **No** GO to A2 .
A2 ROAD TEST THE VEHICLE—MODERATE TO HEAVY BRAKING	
	1 Road test the vehicle. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. • **Is there a vibration/shudder?** → **Yes** For vehicles with ABS, GO to A3 . For vehicles with standard brakes, GO to A4 . → **No** Vehicle is OK. VERIFY condition with customer. TEST the vehicle for normal operation.
A3 NORMAL ACTUATION OF THE ABS SYSTEM	
	1 During moderate to heavy braking, noise from the hydraulic control unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS system. Pedal pulsation or steering wheel nibble (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component. • **Is the vibration/shudder vehicle speed sensitive?**

	→ **Yes** GO to A5 . → **No** The brake system is operating correctly.
A4 APPLICATION OF THE PARKING BRAKE	
	1 **NOTE:** Begin at the front of the vehicle unless the vibration or shudder has been isolated to the rear. This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89–97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test. • **Is there a vibration/shudder?** → **Yes** GO to A8 . → **No** GO to A5 .
A5 CHECK THE FRONT WHEEL BEARINGS	
	1 Check the front wheel bearings. Refer to Wheel Bearing Check in this section. • **Are the wheel bearings OK?** → **Yes** GO to A6 . → **No** INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.
A6 CHECK THE FRONT SUSPENSION	
	1 Check the front suspension for: • Broken or loose bolts. • Damaged springs. • Worn or damaged upper and lower control arm bushings. • Loose or rough front bearings. • Uneven tire wear. • **Are all the suspension components in satisfactory condition?** → **Yes** GO to A7 . → **No**

	REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A7 RESURFACE THE FRONT BRAKE DISCS	
	1 **CAUTION: Do not use a bench lathe to machine brake discs.** **NOTE:** Follow the manufacturer's instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. Resurface the front brake discs. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?** → **Yes** GO to A8 . → **No** Vehicle is OK.
A8 CHECK THE REAR SUSPENSION	
	1 Check the rear suspension for: • Broken or loose bolts. • Damaged or worn springs or spring bushings. • Worn or damaged upper and lower control arm bushings. • Worn or damaged trailing arms. • Loose or rough rear bearings. • Uneven tire wear. • **Are all the suspension components in satisfactory condition?** → **Yes** GO to A9 . → **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A9 RESURFACE THE REAR BRAKE DISC OR DRUM	
	1 **CAUTION: Do not use a bench lathe to machine brake discs.** **NOTE:** Follow the manufacturers instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. Resurface the rear brake discs or drums. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?** → **Yes**

	CHECK the front suspension for wear or damage, RESURFACE the front brake discs. TEST the system for normal operation. → **No** Vehicle is OK.

PINPOINT TEST B: ENGINE TICKING NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK FOR TICKING NOISE AT THE FUEL RAIL	
	1 Disconnect the first fuel line clip. • **Is the ticking noise gone?** → **Yes** CHECK for TSB for applicable vehicle. REPAIR as necessary. TEST the system for normal operation. → **No** GO to B2 .
B2 CHECK FOR TICKING NOISE AT THE FUEL INJECTOR	
	1 Using an EngineEAR, listen at the fuel injectors by placing a probe on each injector. To isolate the faulty injector, disconnect the injector electrical connector and listen for the noise. • **Is the fuel injector the source of the ticking noise?** → **Yes** INSTALL a new fuel injector. REFER to Section 303-04A for 4.0L push rod engines, Section 303-04B for 4.0L SOHC engines or Section 303-04C firo 5.0L engines. TEST the system for normal operation. → **No** GO to B3 .
B3 CHECK THE BELT TENSIONER FOR TICKING NOISE	
	1 Inspect the accessory drive. Check for the belt tensioner bottoming at end of travel or not at end of stroke. 2 Using an EngineEAR, listen at the belt tensioner. • **Is the belt tensioner the source of the noise?** → **Yes** INSTALL a new belt tensioner. TEST the system for normal operation. → **No** GO to B4 .
B4 CHECK THE WATER PUMP FOR TICKING NOISE	

	1 Using an EngineEAR, listen at the water pump for ticking noise. • **Is the water pump the source of the noise?** → **Yes** INSTALL a new water pump. REFER to Section 303-03 . TEST the system for normal operation. → **No** GO to B5 .
B5 CHECK FOR AN OBSTRUCTION OF THE COOLING FAN	
	1 Inspect the cooling fan for obstructions. 2 Check the cooling fan and shroud for wear or damage. • **Was there an obstruction or does the cooling fan show signs of damage?** → **Yes** REPAIR or INSTALL a new cooling fan. REFER to Section 303-03 . TEST the system for normal operation. → **No** GO to B6 .
B6 CHECK THE OIL PUMP FOR TICKING NOISE	
	1 Check the oil pump using EngineEARs and probe at the oil filter adapter to verify the oil pump as a source. • **Is the oil pump the source of the noise?** → **Yes** INSTALL a new oil pump. TEST the system for normal operation. → **No** GO to B7 .
B7 CHECK VALVE LIFTERS OR LASH ADJUSTERS FOR CORRECT OPERATION	
	1 Check valve lifter/lash adjuster for correct operation, using EngineEARs. • **Are the valve lifters/lash adjusters operating correctly?** → **Yes** VERIFY customer concern. CONDUCT a diagnosis of other suspect components. → **No** INSTALL a new valve lifter/lash adjuster(s). TEST the system for normal operation.

PINPOINT TEST C: ACCESSORY DRIVE BEARING HOOT

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ACCESSORY DRIVE IDLER AND TENSIONER PULLEY BEARINGS	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2	
	3 Place an EngineEAR probe directly on the pulley center post or bolt to verify which bearing is making the noise.
4	
	• **Is either bearing making the noise?**
	→ **Yes** INSTALL a new pulley/idler. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation.
	→ **No** CONDUCT a diagnosis on other suspect accessory drive components.

PINPOINT TEST D: POWER STEERING MOAN

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE POWER STEERING SYSTEM	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2	
	3 Turn the steering wheel while the noise is occurring and listen for changes in sound pitch or loudness.
4	
	• **Does the sound pitch or loudness change while turning the steering wheel?**
	→ **Yes** GO to D2 .

	→ **No** CONDUCT a diagnosis on other suspect accessory drive components.
D2 VERIFY THE SOURCE	
1 	
	2 Place an EngineEAR probe near the power steering pump/reservoir while the noise is occurring. While an assistant turns the steering wheel, listen for changes in sound pitch or loudness.
3 	
	• **Does the sound pitch or loudness change while turning the steering wheel?** → **Yes** VERIFY that the supply tube to the pump is unobstructed. CHECK the fluid condition and level. DRAIN the fluid and REFILL. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation. → **No** Normal system operation.

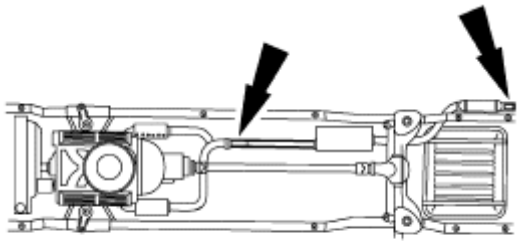
PINPOINT TEST E: ENGINE DRIVEN COOLING FAN MOAN

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE ENGINE DRIVEN COOLING FAN AFTER A COLD SOAK	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2 	
	3 Assess the airflow. 4 Raise the engine speed to 1500 rpm while listening for the moan to increase in proportion to the airflow.
5 	
	• **Does the moan increase in proportion to the airflow?**

	→ **Yes** TEST the fan for normal operation. If the fan tests normal, GO to E2 . Otherwise, REPAIR as necessary. → **No** Normal system operation.
E2 CHECK THE ENGINE DRIVEN COOLING FAN AT NORMAL OPERATING TEMPERATURE	
1 	
	2 Run the engine to normal operating temperature while listening for the moan to stop.
3 	
	• **Does the moan stop?** → **Yes** Normal clutch operation. → **No** INSTALL a new fan clutch. REFER to Section 303-03 . TEST the system for normal operation.

PINPOINT TEST F: DRUMMING NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE EXHAUST SYSTEM	
1 	
	2 Increase the engine rpm until the noise is the loudest. Note the engine rpm.
3 	
4	4 Add approximately 9 kg (20 lb) of weight to the exhaust system. First place the weight at the tail pipe and test, then at the front pipe.



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5

6 Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs.

7

8 Using a vibration analyzer (VA), determine the amount of vibration that occurs with the drumming noise.

- **Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm?**

→ **Yes**
CARRY OUT Exhaust System Neutralizing in this section. TEST the system for normal operation.

→ **No**
GO to F2 .

F2 POWERTRAIN/DRIVETRAIN MOUNT NEUTRALIZING

1 Carry out Powertrain/Drivetrain Mount Neutralizing in this section. Test the system for normal operation.

- **Is the noise reduced or eliminated?**

→ **Yes**
Vehicle OK. TEST the system for normal operation.

→ **No**
CONDUCT diagnosis of other suspect

	components.

PINPOINT TEST G: ENGINE TICKING, KNOCKING OR CONTINUOUS RATTLE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK FOR NOISE AT THE VALVE COVERS AND THE FRONT COVERS (OHC ENGINES)	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2	
	3 **NOTE:** For a short-duration ticking noise, multiple engine starts may be necessary. Using an EngineEAR, listen closely at the valve covers and the front covers (OHC engines) by placing the probe near the surface of the valve cover and then on the surface front cover.
4	
	• **Is the noise source apparent?** → **Yes** REMOVE the appropriate cover and INSPECT for loose, worn/broken components. REPAIR as necessary. TEST the system for normal operation. → **No** GO to G2 .
G2 CHECK FOR NOISE AT THE CYLINDER BLOCK	
1	
	2 Using an EngineEAR, listen closely at the cylinder block by placing a probe on or near each freeze plug.
3	
	• **Is the noise source apparent?** → **Yes**

	REPAIR or INSTALL new components as necessary. → **No** GO to G3 .
G3 CHECK FOR NOISE WHILE DISCONNECTING EACH FUEL INJECTOR ELECTRICAL CONNECTOR, ONE AT A TIME	
1 3 	2 Disconnect each fuel injector electrical connector, one at a time, to decrease piston force and listen for the noise. • **Is the noise reduced or eliminated?** → **Yes** INSTALL a new fuel injector. TEST the system for normal operation. → **No** INSPECT accessory drive or the transmission as a possible source.

PINPOINT TEST H: FRONT SUSPENSION NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 ROAD TEST THE VEHICLE	
	1 Test drive the vehicle. 2 **NOTE:** An assistant will be needed for this road test. During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. • **Is there a squeak, creak or rattle noise?** → **Yes** GO to H2 . → **No** The suspension system is OK. CONDUCT a diagnosis on other suspect systems.
H2 INSPECT THE STEERING SYSTEM	
	1 **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This**

	can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. Raise and support the vehicle. 2 Check the steering system for wear or damage. Carry out a steering linkage test. Refer Section 211-00 . 3 Inspect the tire wear pattern. Refer to Tire Wear Patterns chart in this section. • **Are the steering components worn or damaged?** → **Yes** REPAIR the steering system. INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H3 .
H3 FRONT SHOCK ABSORBER/STRUT CHECK	
	1 Check the front shock absorbers/strut mounts for loose bolts or nuts. 2 Check the front shock absorbers/struts for wear or damage. Carry out a "bounce test". • **Are the front shock absorbers/struts loose or damaged?** → **Yes** TIGHTEN to specifications if loose. INSTALL new front shock absorbers/struts if damaged. TEST the system for normal operation. → **No** GO to H4 .
H4 CHECK THE FRONT SPRINGS	
	1 Check the front spring and front spring mounts/brackets for wear or damage. • **Are the front springs or spring mounts/brackets worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H5 .
H5 CHECK THE CONTROL ARMS/RADIUS ARMS	
	1 Inspect the control arm bushings for wear or damage. 2 Inspect for twisted or bent control arm/radius arm. • **Are the control arm/radius arms damaged or worn?**

	→ **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H6 .
H6 CHECK THE STABILIZER BAR/TRACK BAR	
	1 Check the stabilizer bar/track bar bushings and links for damage or wear. 2 Check the stabilizer bar/track bar for damage. 3 Check for loose or damaged stabilizer bar isolators or brackets. • **Are the stabilizer bar/track bar components loose, worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

PINPOINT TEST I: REAR SUSPENSION NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 ROAD TEST THE VEHICLE	
	1 Test drive the vehicle. 2 **NOTE:** An assistant will be needed for this road test. During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. • **Is there a squeak, creak or rattle noise?** → **Yes** GO to I2 . → **No** The suspension system is OK. Conduct a diagnosis on other suspect systems.
I2 REAR SHOCK ABSORBER/STRUT CHECK	
	1 **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** Raise and support the vehicle.

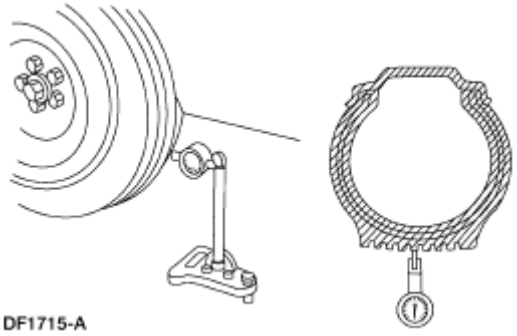
	2 Check the rear shock absorber/strut mounts for loose bolts or nuts. 3 Check the rear shock absorbers/struts for damage. Carry out a shock absorber check. • **Are the rear shock absorbers/struts loose or damaged?** → **Yes** TIGHTEN to specifications if loose. INSTALL new rear shock absorbers/struts if damaged. TEST the system for normal operation. → **No** GO to I3.
I3 CHECK THE REAR SPRINGS	
	1 Check the rear springs and rear spring mounts/brackets for wear or damage. • **Are the rear springs or spring mounts/brackets worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to I4.
I4 CHECK THE CONTROL ARMS/TRAILING ARMS	
	1 Inspect the control arm/trailing arm bushings for wear or damage. Check for loose control arm/trailing arm bolts. 2 Inspect for twisted or bent control arm/trailing arms. • **Are the control arm/trailing arms loose, damaged or worn?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to I5.
I5 CHECK THE STABILIZER BAR/TRACK BAR	
	1 Check the stabilizer bar/track bar bushings and links for damage or wear. 2 Check the stabilizer bar/track bar for damage. 3 Check for loose or damaged stabilizer bar isolators or brackets. • **Are the stabilizer bar/track bar components loose, worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. Test the system for normal operation.

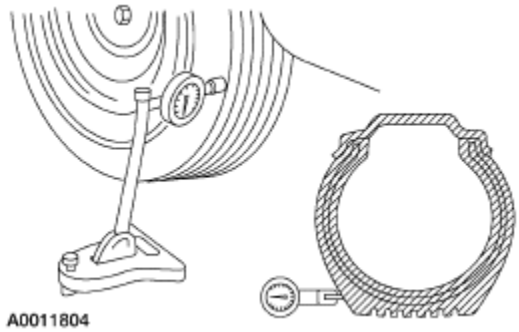
	→ **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

PINPOINT TEST J: WHEEL AND TIRE

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 ROAD TEST THE VEHICLE	
	1 **NOTE:** Wheel or tire vibrations felt in the steering wheel are most likely related to the front wheel or tire. Vibration felt through the seat are most likely related to the rear wheel or tire. This may not always be true, but it can help to isolate the problem to the front or rear of the vehicle. Test drive the vehicle at different speed ranges. 2 During the road test, if the vibration can be eliminated by placing the vehicle in neutral or is affected by the speed of the engine, the cause is not the wheels or tires. • **Is there a vibration and noise?** → **Yes** GO to J2 . → **No** The wheel and tires are OK. CONDUCT a diagnosis on other suspect systems.
J2 CHECK THE FRONT WHEEL BEARINGS	
	1 Check the front wheel bearings. Refer to Wheel Bearing Check in this section. • **Are the wheel bearings OK?** → **Yes** GO to J3 . → **No** INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.
J3 INSPECT THE TIRES	
	1 Check the tires for missing weights. 2 Check the wheels for damage.

	3 Inspect the tire wear pattern. Refer to the Tire Wear Patterns chart in this section. • **Do the tires have an abnormal wear pattern?** → **Yes** CORRECT the condition that caused the abnormal wear. INSTALL new tire(s). TEST the system for normal operation. → **No** GO to J4 .
J4 TIRE ROTATION DIAGNOSIS	
1 DF1713-A 2 DF1714-A	1 Spin the tires slowly and watch for signs of lateral runout. 2 Spin the tires slowly and watch for signs of radial runout. • **Are there signs of visual runout?** → **Yes** GO to J5 . → **No** CHECK the wheel and tire balance. CORRECT as necessary. TEST the system for normal operation.
J5 RADIAL RUNOUT CHECK ON THE TIRE	
1	1 Measure the radial runout of the wheel and tire assembly. A typical specification for total radial runout is 1.14 mm (0.045 in).

 DF1715-A	• **Is the radial runout within specifications?** → **Yes** GO to J8 . → **No** GO to J6 .
J6 RADIAL RUNOUT CHECK ON THE WHEEL	
	1 Measure the radial runout of the wheel. A typical specification for total radial runout is 1.14 mm (0.045 in). • **Is the radial runout within specifications?** → **Yes** INSTALL a new tire. TEST the system for normal operation. → **No** GO to J7 .
J7 CHECK THE HUB/BRAKE DISC OR DRUM PILOT RUNOUT OR BOLT CIRCLE RUNOUT	
	1 Measure the pilot or bolt circle runout. A typical specification for radial runout is: • Pilot runout— less than 0.15 mm (0.006 inch). • Bolt circle runout— less than 0.38 mm (0.015 inch). • **Is the radial runout within specifications?** → **Yes** INSTALL a new wheel. TEST the system for normal operation.

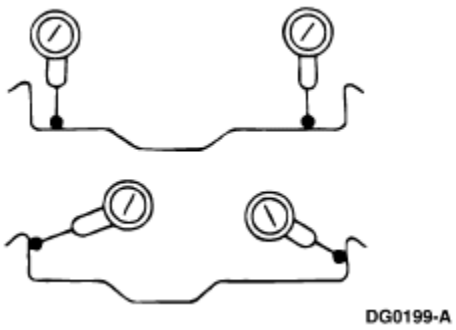
	→ **No** REPAIR or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.
J8 LATERAL RUNOUT CHECK ON THE TIRE	
1  A0011804	1 Measure the lateral runout of the wheel and tire assembly. A typical specification for total lateral runout is 1.14 mm (0.045 inch). • **Is the lateral runout within specifications?** → **Yes** Wheel and tires OK. CONDUCT diagnosis on other suspect systems. → **No** GO to J9.
J9 LATERAL RUNOUT CHECK ON THE WHEEL	
	1 Measure the lateral runout of the wheel. A typical specification for total radial runout is 1.14mm (0.045 inch. • **Is the lateral runout within specifications?** → **Yes** INSTALL a new tire. TEST the system for normal operation. → **No** GO to J10.
J10 CHECK THE FLANGE FACE LATERAL RUNOUT	
	1 Measure the flange face lateral runout. A typical specification for lateral runout is: • Hub/brake disc— less than 0.13 mm (0.005 inch). • Axle shaft— less than 0.25 mm

	(0.010 inch). • **Is the lateral runout within specifications?** → **Yes** INSTALL a new wheel. TEST the system for normal operation. → **No** REPAIR or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY DIAGNOSIS

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK FOR FRONT WHEEL BEARING ROUGHNESS	
	1 Chock the rear wheels. 2 Raise and support the front end of the vehicle so that the front wheel and tire assemblies can spin. 3 Spin the front tires by hand. Refer to Wheel Bearing Check in this section. • **Do the wheel bearings feel rough?** → **Yes** INSPECT the wheel bearings. REPAIR as necessary. TEST the system for normal operation. → **No** GO to K2.
K2 CHECK THE END PLAY OF THE FRONT WHEEL BEARINGS	
	1 Check the end play of the front wheel bearings. Refer to REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles. • **Is the end play OK?** → **Yes** GO to K3. → **No**

	ADJUST or REPAIR as necessary. TEST the system for normal operation.
K3 MEASURE THE LATERAL RUNOUT AND THE RADIAL RUNOUT OF THE FRONT WHEELS ON THE VEHICLE	
	1 Measure the lateral runout and the radial runout of the front wheels on the vehicle. Refer to Pinpoint Test J. • **Are the measurements within specifications?** → **Yes** GO to K4 . → **No** INSTALL new wheels as necessary and BALANCE the assembly. TEST the system for normal operation.
K4 MEASURE THE LATERAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
	1 Measure the lateral runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?** → **Yes** GO to K5 . → **No** INSTALL new tires as necessary and BALANCE the assembly. TEST the system for normal operation.
K5 MEASURE THE RADIAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
	1 Measure the radial runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?** → **Yes** BALANCE the front wheel and tire assemblies. If any tire cannot be balanced, INSTALL a new tire. TEST the system for normal operation. → **No** GO to K6 .
K6 MATCH MOUNT THE TIRE AND WHEEL ASSEMBLY	
	1 Mark the high runout location on the tire and also on the wheel. Break the assembly down and rotate the tire 180 degrees (halfway around) on the wheel. Inflate the tire and

	measure the radial runout. • **Is the runout within specifications?** → **Yes** BALANCE the assembly. TEST the system for normal operation. → **No** If the high spot is not within 101.6 mm (4 inches) of the first high spot on the tire, GO to K7 .
K7 MEASURE THE WHEEL FLANGE RUNOUT	
1  DG0199-A	1 Dismount the tire and mount the wheel on a wheel balancer. Measure the runout on both wheel flanges. Refer to Section 204-04 . • **Is the runout within specifications?** → **Yes** LOCATE and MARK the low spot on the wheel. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists,GO to K8 . → **No** INSTALL a new wheel. CHECK the runout on the new wheel. If the new wheel is within limits, LOCATE and MARK the low spot. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists, GO to K8 .
K8 CHECK FOR VIBRATION FROM THE FRONT OF THE VEHICLE	
WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.	
	1 Spin the front wheel and tire assemblies with

	a wheel balancer while the vehicle is raised on a hoist. Feel for vibration in the front fender or while seated in the vehicle. • **Is the vibration present?** → **Yes** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation. → **No** GO to K9.

K9 CHECK FOR VIBRATION FROM THE REAR OF THE VEHICLE

WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.

	1 Chock the front wheels. 2 Raise and support the rear end of the vehicle so that the rear wheel and tire assemblies can spin. 3 Engage the drivetrain and carefully accelerate the drive wheels while checking for vibration. • **Is the vibration present?** → **Yes** GO to K10. → **No** TEST the system for normal operation.

K10 CHECK THE DRIVETRAIN

WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.

	1 Remove the rear wheel and tire assemblies. 2 Secure the brake drums (if so equipped), by installing wheel hub bolt nuts, reversed. 3 Carefully accelerate the drivetrain while checking for vibration. • **Is the vibration present?**

	→ **Yes** CHECK/TEST the drivetrain and driveline components. TEST the system for normal operation. → **No** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation.

PINPOINT TEST L: CLUTCH VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK ENGINE COMPONENTS FOR GROUNDING	
	1 **NOTE:** Make sure the clutch is the cause of the vibration concern. The vibration should occur during clutch operation. The clutch can also be difficult to engage or disengage. Eliminate all related systems before checking the clutch components. **NOTE:** Check the driveline angles and driveshaft runout before disassembling the clutch system. Refer to Section 205-00 . Check the powertrain/drivetrain mounts, exhaust manifolds or other engine components for grounding on the chassis. • **Are any mounts or engine components grounded?** → **Yes** REPAIR as necessary. TEST the system for normal operation. → **No** GO to L2 .
L2 CHECK THE ACCESSORY DRIVE	
	1 Remove the accessory drive belt. • **Does the vibration stop with the accessory drive belt removed?** → **Yes** DIAGNOSE the accessory drive components. → **No** GO to L3 .
L3 CHECK FOR LOOSE CLUTCH PRESSURE PLATE BOLTS	
	1 Check for loose clutch pressure plate bolts. Inspect the clutch pressure plate for damage or for material between the pressure plate and flywheel. • **Are there any loose bolts or damage?**

	→ **Yes** TIGHTEN the bolts to specifications or if damaged, INSTALL a new clutch pressure plate. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L4 .
L4 CHECK THE CLUTCH DISC SPRINGS	
	1 Check for worn, broken or loose clutch disc springs. • **Are the clutch springs worn, broken or loose?** → **Yes** INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L5 .
L5 CHECK THE CLUTCH DISC SPLINES	
	1 Inspect the clutch disc splines for damage or wear. • **Is there damage or wear?** → **Yes** INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L6 .
L6 CHECK THE FLYWHEEL BOLTS	
	1 Check for loose flywheel bolts. • **Are the bolts loose?** → **Yes** TIGHTEN the bolts to specifications. TEST the system for normal operation. → **No** GO to L7 .
L7 CHECK THE FLYWHEEL SURFACE	
	1 Inspect the flywheel surface for wear or damage. Check the flywheel runout. • **Is there any damage or excessive wear?** → **Yes** INSTALL a new flywheel. TEST the system for normal operation. → **No**

	Clutch system normal. CONDUCT a diagnosis on other suspect systems.

PINPOINT TEST M: TRANSFER CASE VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 INSPECT THE TRANSFER CASE	
	1 **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** Inspect the transfer case for loose or missing mounting bolts. Check for fluid seepage between the transfer case and the transmission. • **Are the mounting bolts missing or loose?** → **Yes** TIGHTEN to specifications or INSTALL new bolts as necessary. TEST the system for normal operation. → **No** GO to M2.
M2 INSPECT THE REAR DRIVESHAFT	
	1 **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned. Inspect the driveshaft for missing weights, damage or undercoating. 2 Inspect the U-joints for freedom of movement. 3 Check driveshaft runout and, if necessary, check the pinion flange runout. • **Is the driveshaft or U-joints worn or damaged or misaligned?** → **Yes** REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. → **No** GO to M3.
M3 CHECK THE DRIVELINE ANGLES	
	1 Measure the rear driveshaft and pinion angles. Refer to Section 205-02. 2 Measure the front driveshaft and pinion angles. Refer to Section 205-00. • **Are the driveline angles incorrect?** → **Yes**

	REPAIR as necessary. TEST the system for normal operation. → **No** GO to M4 .
M4 INSPECT THE FRONT DRIVESHAFT	
	1 **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned. Inspect the front driveshaft for missing weights, damage or undercoating. 2 Inspect the U-joints and slip yoke for freedom of movement. 3 Check driveshaft runout and, if necessary, check the pinion flange runout. • **Is the driveshaft or U-joints worn or damaged?** → **Yes** REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. → **No** GO to M5 .
M5 ROAD TEST WITH THE FRONT DRIVESHAFT ONLY	
	1 **NOTE:** Index mark the driveshaft to the pinion flange and to the output shaft before removal. Remove the rear driveshaft. 2 Plug the transfer case with an output shaft seal plug. 3 **NOTE:** Shift the transfer case into 4WD high so the vehicle is driven by the front driveshaft only. Test drive the vehicle. • **Is the vibration gone?** → **Yes** INSTALL and BALANCE the rear driveshaft. TEST the system for normal operation. → **No** GO to M6 .
M6 ROAD TEST WITH THE REAR DRIVESHAFT ONLY	
	1 **NOTE:** Index mark the front driveshaft to the pinion flange. Remove the front driveshaft. 2 Test drive the vehicle. • **Is the vibration gone?**

	→ **Yes** INSTALL and BALANCE the front driveshaft. TEST the system for normal operation. → **No** GO to M7 .
M7 TRANSFER CASE TAIL SHAFT INSPECTION	
	1 Inspect the splines of the output shaft for wear or damage. 2 Inspect the splines of the driveshaft slip yoke for wear or damage. • **Are the splines worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** The transfer case is OK. CONDUCT a diagnosis on other suspect systems.

Component Tests

Idle Air Control (IAC) Valve

1. Open the hood.
2. **NOTE:** Key symptom is elevated idle speed while noise is occurring.

   NOTE: "Snapping" the throttle can induce the noise.

   Verify the condition by operating the vehicle for a short time.
3. Inspect the IAC valve. If physical evidence of contamination exists, install a new IAC valve.
4. While the noise is occurring, either place an EngineEAR probe near the IAC valve and the inlet tube, or create a 6.35 mm (0.25 in)-12.7 mm (0.50 in) air gap between the inlet tube and the clean air tube. If the IAC valve is making the noise, install a new IAC valve.
5. Test the vehicle for normal operation.

Steering Gear Grunt/Shudder Test

1. Start and run the vehicle to operating temperature.
2. Set engine idle speed to 1200 rpm.
3. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Rotate the steering wheel to the RH stop, then turn the steering wheel 90° back from that position.

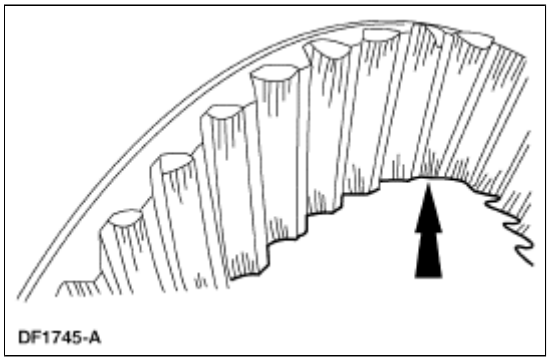
Turn the steering wheel slowly in a 15° to 30° arc.

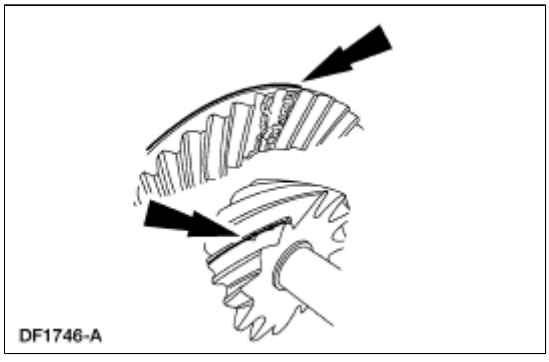
4. Turn the steering wheel another 90°. Turn the steering wheel slowly in a 15° to 30° arc.
5. Repeat the test with power steering fluid at different temperatures.
6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.
7. If a loud grunt is heard, or a strong shudder is felt, fill and purge the power steering system.

Checking Tooth Contact Pattern and Condition of the Ring and Pinion

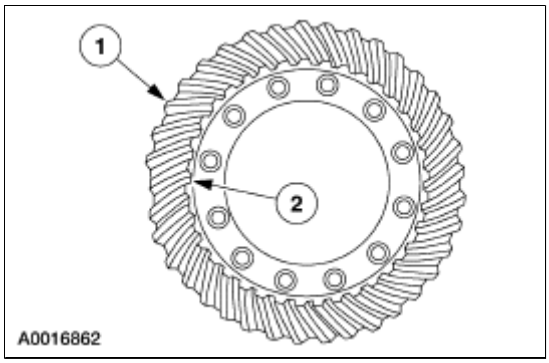
There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains to the mesh pattern of the gear pattern. This gear noise can be recognized as it produces a cycling pitch or whine. Ring and pinion noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the axle lubricant. Refer to Section 205-02 for rear axles or Section 205-03 for front axles.
3. Remove the carrier assembly or the axle housing cover depending on the axle type. Refer to Section 205-02 for rear axles or Section 205-03 for front axles.
4. Inspect the gear set for scoring or damage.





5. In the following steps, the movement of the contact pattern along the length is indicated as toward the" heel" or "toe" of the differential ring gear.

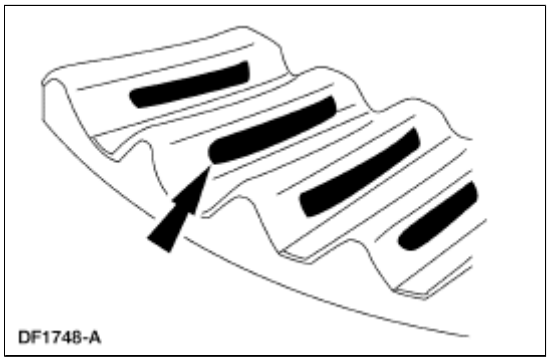


Item	Description
1	Heel
2	Toe

6. Apply a marking compound to a third of the gear teeth on the differential ring gear. Rotate the differential ring gear several complete turns in both directions until a good, clear tooth pattern is obtained. Inspect the contact patterns on the ring gear teeth.

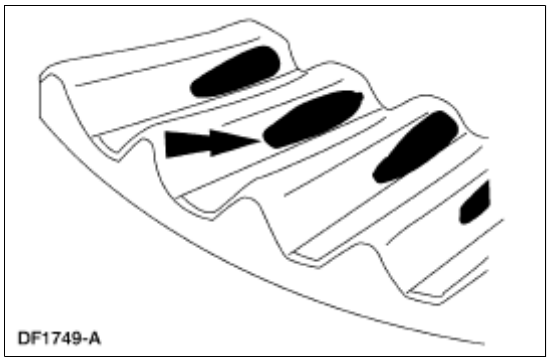
7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

- Tooth contact pattern shown on the drive side of the gear teeth.



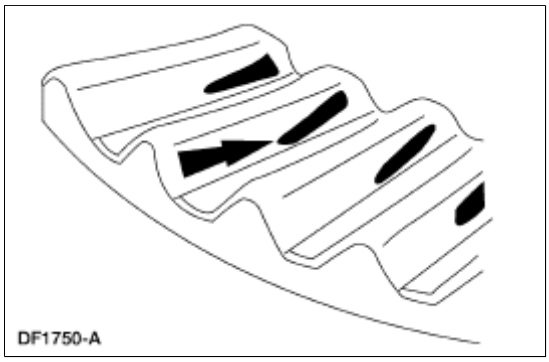
8. A high, thick contact pattern that is worn more toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The high contact pattern indicates that the drive pinion is not installed deep enough into the carrier.
- The differential ring gear backlash is correct, a thinner drive pinion shim is needed. A decrease will move the drive pinion toward the differential ring gear.



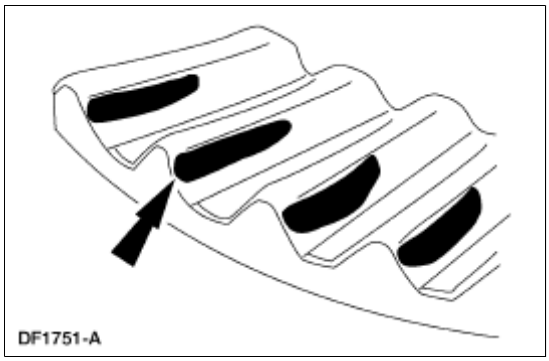
9. A high, thin contact pattern that is worn toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The drive pinion depth is correct. Increase the differential ring gear backlash.



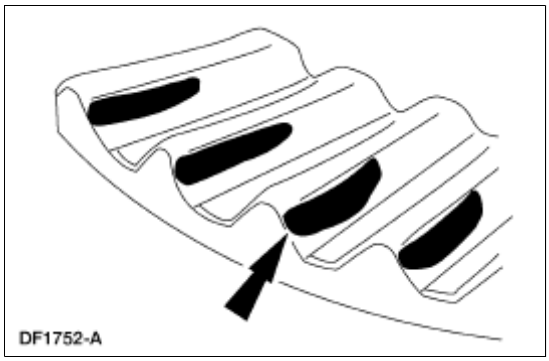
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The low contact pattern indicates that the drive pinion is installed too deep into the carrier.
- The differential ring gear backlash is correct. A thicker drive pinion shim is needed.



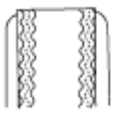
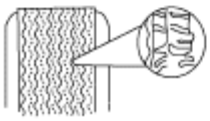
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The pinion gear depth is correct. Decrease the differential ring gear backlash.



Tire Wear Patterns and frequency calculations

Tire Wear Chart

TIRE WEAR	CONDITION	POSSIBLE CAUSES
	• Rapid wear at both shoulders.	• Tires underinflated. • Worn suspension components. • Excessive cornering speeds. • Lack of rotation.
	• Rapid wear at the center.	• Tires overinflated. • Lack of rotation. • Excessive toe on drive wheels. • Heavy acceleration on drive wheels.
	• Wear at one shoulder.	• Toe adjustment out of specification. • Camber out of specification. • Damaged strut. • Damaged lower control arm.
	• Feather edges.	• Toe adjustment out of specification. • Damaged or worn tie rods. • Damaged spindle or knuckle.
	• Bald spots or cupping.	• Unbalanced wheel. • Excessive radial runout. • Worn strut or shock absorber.
	• Tire scalloped.	• Toe adjustment out of specification. • Camber out of specification. • Worn or damaged suspension components.
	• Wear pattern - FWD vehicles.	• Excessive toe on non-drive wheels. • Lack of rotation.
	• Wear pattern - FWD vehicles. Edge of thread blocks worn.	• Excessive toe on non-drive wheels. • Lack of rotation.

DF1717-A

Wheel and tire NVH concerns are directly related to vehicle speed and are not generally affected by acceleration, coasting or decelerating. Also, out-of-balance wheel and tires can vibrate at more than one speed. A vibration that is affected by the engine rpm, or is eliminated by placing the transmission in NEUTRAL is not related to the tire and wheel. As a general rule, tire and wheel vibrations felt in the steering wheel are related to the front tire and wheel assemblies. Vibrations felt in the seat or floor are related to the rear tire and wheel assemblies. This can initially isolate a concern to the front or rear.

Careful attention must be paid to the tire and wheels. There are several symptoms that can be caused by damaged or worn tire and wheels. Carry out a careful visual inspection of the tires and wheel assemblies.

Spin the tires slowly and watch for signs of lateral or radial runout. Refer to the tire wear chart to determine the tire wear conditions and actions.

For a vibration concern, use the vehicle speed to determine tire/wheel frequency and rpm. Calculate tire and wheel rpm and frequency by carrying out and following:

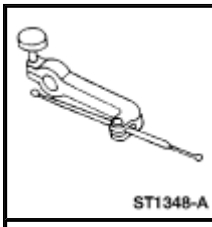
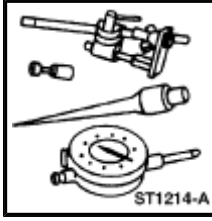
- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
    - If the vehicle speed is not listed, divide the vehicle speed at which the vibration occurs by 16 (km/h (10 mph). Multiply that number by 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60. For example: a 40 mph vibration with 835 mm (33 in) tires. 40 ÷10 = 4. Multiply 4 by 105 = 420 rpm. Divide 420 rpm by 60 seconds = 7 Hz at 40 mph.

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (inch)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1092/18	1274/21
508 (20)	173	865/14	1038/17	1211/20
533 (21)	165	825/14	990/16	1155/19
560 (22)	158	790/13	948/16	1106/18
585 (23)	151	755/13	906/15	1057/18
610 (24)	145	725/12	870/14	1015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15
710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Brake Disc Machining

Special Tool(s)

 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

CAUTION: Do not install brake discs that are less than the minimum thickness specified. Do not machine a brake disc below the minimum thickness specification.

1. Check wheel bearing end-play and correct as necessary.
2. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

   Remove the tire and wheel assembly.
3. Remove the brake caliper and the brake caliper anchor plate. Refer to the appropriate section in Group 206 for the procedure.
4. Inspect the brake linings. Install new brake linings if below specification. For additional information, refer to the appropriate brake section.

5. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc.
    - Do not machine a new brake disc.

6. For vehicles with a two-piece hub and brake disc assembly:
    - Match-mark before disassembly.
    - Remove the brake disc.
    - Clean the hub and brake disc mounting surfaces with metal surface cleaner.
    - Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
    - Align the match-marks and reinstall the brake disc on the hub.

7. **CAUTION: Do not use a bench lathe to machine brake discs.**

    NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 inch). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

    Using an on-car brake lathe, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

8. Using the special tools, verify that the brake disc lateral runout is now within specification. For additional information, refer to Section 206-00 .

9. Remove the special tool hub adapter.

10. Remove any remaining metal chips from the machining operation.

11. For vehicles with a two-piece hub and brake disc assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
    - Apply a liberal amount of lubricant to the hub flange, pilot area and to the brake disc-to-hub mounting surface.
    - Using the match marks, mount the brake disc on the hub.

12. Install the brake caliper anchor plate and the brake caliper.

13. Install the tire and wheel assembly.

14. Test the system for normal operation.

Powertrain/Drivetrain Mount Neutralizing

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle.
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. **CAUTION: Do not twist or strain the powertrain/drivetrain mounts.**

   Move the vehicle in forward and reverse 0.6-1.2 meters (2-4 ft).
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

Exhaust System Neutralizing

WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Repair exhaust system leaks immediately. Never operate the engine in an enclosed area.

WARNING: Exhaust system components are hot.

NOTE: Neutralize the exhaust system to relieve strain on mounts which can be sufficiently bound up to transmit vibration as if grounded.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   CAUTION: Make sure the system is warmed up to normal operating temperature, as thermal expansion can be the cause of a strain problem.

   Raise and support the vehicle.

2. Loosen all exhaust hanger attachments and reposition the hangers until they hang free and straight.

3. Loosen all exhaust flange joints.

4. Place a stand to support the muffler parallel to the vehicle frame with the muffler pipe bracket free of stress.

5. Tighten the muffler connection.

6. Tighten all the exhaust hanger clamps and flanges (tighten the exhaust manifold flange joint last).
   - Verify there is adequate clearance to prevent grounding at any point in the system. Make sure that the catalytic converter and heat shield do not contact the frame rails.
   - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
   - With the exhaust system installed securely and cooled, the rear hanger should be angled forward.

7. Lower the vehicle.

8. Test the exhaust system for normal operation.

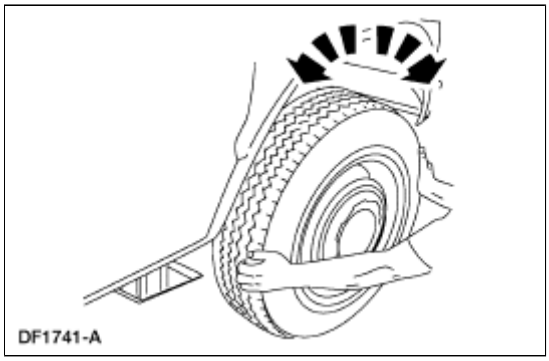
Wheel Bearing Check

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

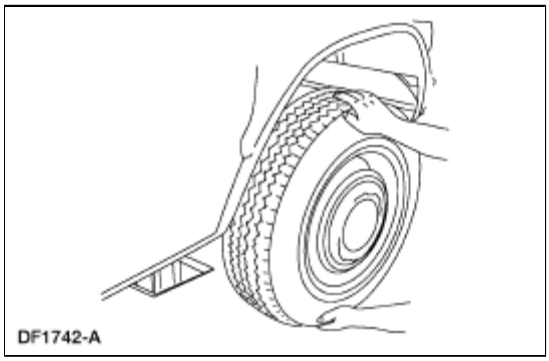
   Raise the vehicle until the front tires are off the floor.
   - Make sure the wheels are in a straight forward position.

2. **NOTE:** Make sure the wheel rotates freely and that the brake pads are retraced sufficiently to allow free movement of the tire and wheel assembly.

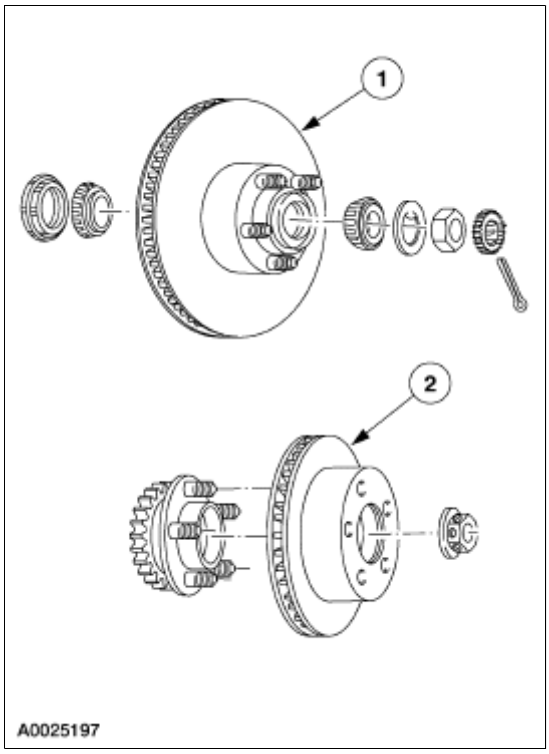
   Spin the tire by hand to check the wheel bearings for roughness.



3. Grip each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.



4. If the tire and wheel (hub) is loose on the spindle, does not rotate freely, or has a rough feeling when spun, carry out one of the following:
   1. On vehicles with inner and outer bearings, inspect the bearings and cups for wear or damage. Adjust or install new bearings and cups as necessary.
   2. On vehicles with one sealed bearing, install a new wheel hub.


1
2
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SPECIFICATIONS

Item	LH	RH	Total/Split
Alignment Specifications — All Vehicles			
Caster — 0° Frame Angle (If vehicle is higher in the rear, add the frame angle to the measured caster. If vehicle is lower in the rear, subtract the frame angle from the measured caster. Compare the total to the specification.)	4.2° - 1.0°	4.2° - 1.0°	-0.7° ± 0.5°
Camber	-0.5° ± 0.5°	-0.5° ± 0.5°	0° ± 0.7°
Toe @ Curb Ride Height (positive value is toe-in, negative value is toe-out)	—	—	0.12° ± 0.25°

General Specifications

Item	Specification
Wheel Track	
Wheel track	0.6 mm (0.02 in.)
Dogtracking	
Dogtracking — maximum (centerline of front tires compared to centerline of rear tires)	30 mm (1.18 in.)
Clear Vision	
Clear vision (negative value is counterclockwise)	-2.4° ± 3.0°
Ride Height — All Vehicles	
Front — new vehicles with less than 500 miles	113 mm ± 11 mm (4.4 in. ± 0.4 in.)
Front — original parts	101 mm ± 11 mm (4.0 in. ± 0.4 in.)
Front — replacement parts	113 mm ± 3 mm (4.4 in. ± 0.1 in.)
Rear — 4 door vehicles without air suspension	128-149 mm (5-5.8 in.)
Rear — 4 door vehicles with air suspension	110-123 mm (4.3-4.8 in.)
Rear — 2 door vehicles	110-123 mm (4.3-4.8 in.)
Ball Joint Radial Play	

Lower ball joint — maximum	0.8 mm (1/32 in.)
Upper ball joint — maximum	0.8 mm (1/32 in.)
Vehicle Lean (Side-to-Side Height Differences)	
Front wheel opening— maximum	16 mm (0.6 in.)
Rear wheel opening— maximum	20 mm (0.78 in.)

Torque Specifications

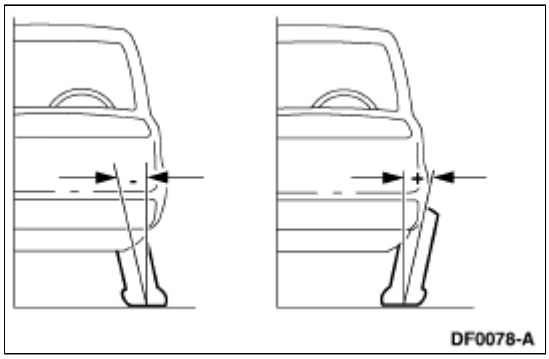
Description	Nm	lb-ft
Caster set jam nuts	175	129
Front suspension upper arm cam nuts	133	98
Toe set jam nuts	80	59

Wheel Alignment Angles

Caster and camber are adjusted by means of eccentric cams on the upper control arm mounting bolts. Toe is adjusted by the use of the front wheel spindle tie-rod (3280).

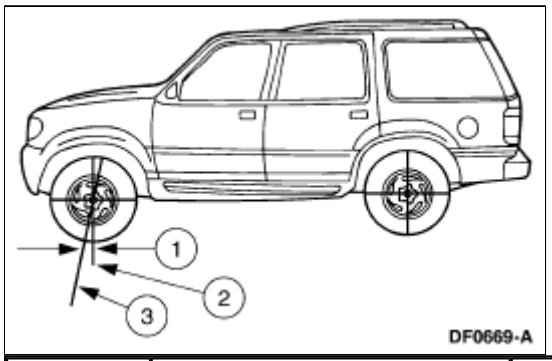
Camber

Negative and Positive Camber



Camber is the vertical tilt of the wheel when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster



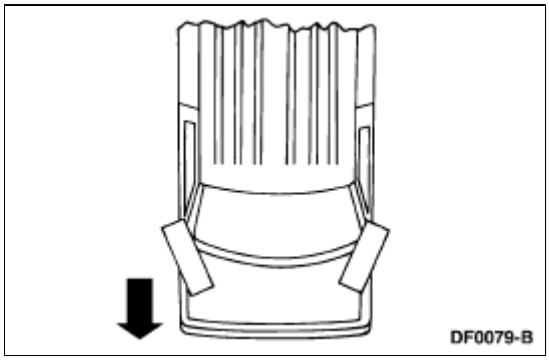
Item	Part Number	Description
1	—	Positive caster
2	—	True vertical
3	—	Steering axis

Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics

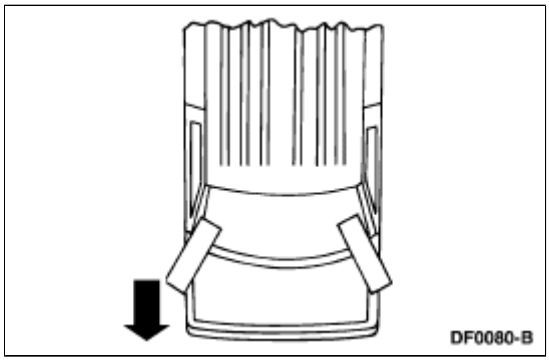
when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)



Negative Toe (Toe Out)

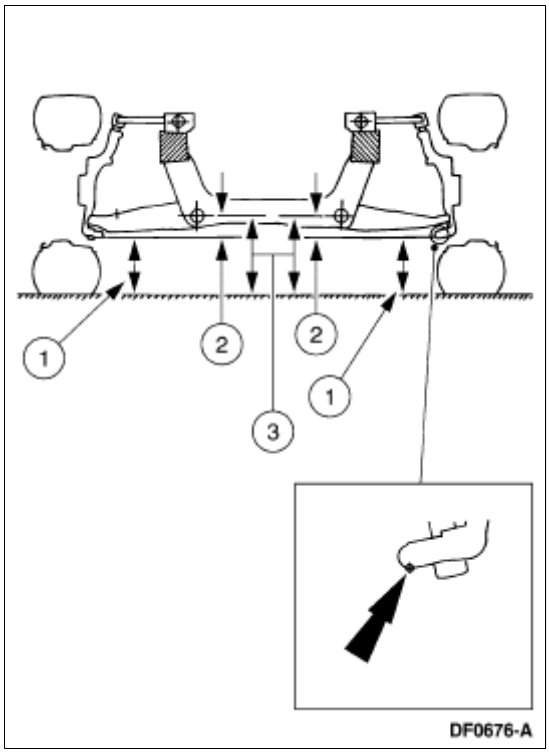


The vehicle toe setting:

- affects tire wear and directional stability.
- must be checked after adding aftermarket equipment, such as a snowplow or body.

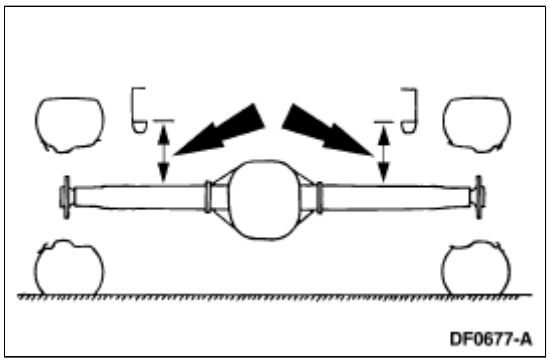
Ride Height

Front Ride Height Measurement

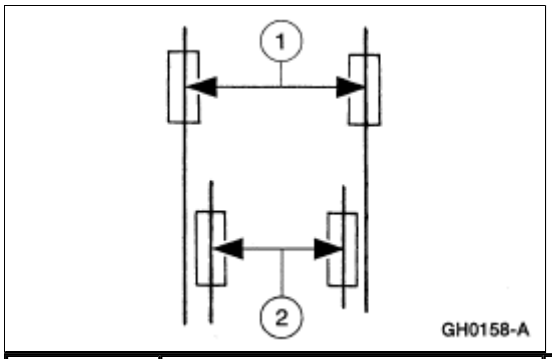


Item	Description
1	Measurement A
2	Ride height = B-A
3	Measurement B

Rear Ride Height Measurement

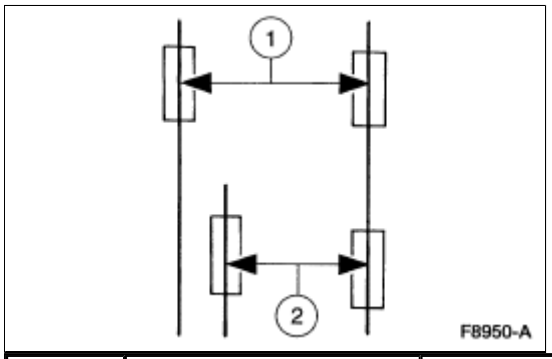


Wheel Track



Item	Part Number	Description
1	—	Front track
2	—	Rear track

Dogtracking



Item	Part Number	Description
1	—	Front track
2	—	Rear track dogtracking

Dogtracking is the condition in which the rear axle is not square to the chassis. Heavily crowned roads can give the illusion of dogtracking.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel (3600) corrections to maintain a straight path down a level road.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road camber).

Poor Groove Feel

Poor groove feel is characterized by little or no buildup of turning effort felt in the steering wheel as the wheel is rocked slowly left and right within very small turns around center or straight-ahead (under 20 degrees of steering wheel turn). Efforts may be said to be "flat on center."

- Under 20 degrees of turn, most of the turning effort that builds up comes from the mesh of gear teeth in the steering gear (3504). In this range, the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch.
- In the diagnosis of a roadability problem, it is important to understand the difference between wander and poor groove feel.

Suspension System

Inspection and Verification

1. Road test.
   - Verify the customer's concern by performing a road test on a smooth road. If any vibrations are apparent, refer to Section 100-04 .

2. Inspect tires.
   - Check the tire pressure with all normal loads in the vehicle and the tires cold. Refer to the vehicle certification (VC) label.
   - Verify that all tires are sized to specification. Refer to Section 204-04 .
   - Inspect the tires for incorrect wear and damage. Refer to Section 204-04 .

3. Inspect chassis and underbody.
   - Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.

4. Inspect for aftermarket equipment.
   - Check for aftermarket changes to the steering, suspension, wheel and tire components (such as competition, heavy duty, etc.) The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

Visual Inspection Chart

Mechanical
• Front wheel bearing(s) • Loose or damaged front or rear suspension components • Loose, damaged or missing suspension fastener(s) • Loose or damaged shackle(s) • Incorrect spring usage • Damaged or sagging spring(s) • Incorrect torsion bar usage • Damaged or sagging torsion bar(s) • Damaged or leaking shock absorber(s) • Worn or damaged suspension bushing(s) • Loose, worn or damaged steering system components • Damaged axle components

5. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.

6. If the fault is not visually evident, determine the symptom and proceed to the following symptom chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Dogtracking	• Excessive rear thrust angle.	• ADJUST as necessary.
	• Front or rear suspension components.	• INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2), or Section 204-01B (4x4 or AWD) or Section 204-02 .
	• Drive axle damaged.	• REPAIR as necessary. REFER to the appropriate section in Group 2.
• Drift/Pull	• Unequal tire pressure.	• ADJUST tire pressure.
	• Excessive side-to-side difference in caster or camber.	• CHECK the wheel alignment. ADJUST as necessary.
	• Tire forces.	• ROTATE tires front to rear.
	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Steering components.	• REFER to Section 211-00 .
	• Brake drag.	• REFER to Section 206-00 .
• Front Bottoming or Riding Low	• Torsion bar(s).	• ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Incorrect torsion bar(s).	• INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Front suspension bumper(s).	• INSTALL new suspension bumper (s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Front shock absorber(s).	• INSTALL new shock absorber(s) as necessary.
	• Suspension load leveling control system.	• REFER to suspension load leveling control system diagnosis and testing in Section 204-05 .
• Incorrect Tire Wear	• Incorrect tire pressure (rapid center rib or inner and outer edge wear).	• ADJUST tire pressure.
	• Excessive front or rear toe (rapid inner	• CHECK the wheel alignment. ADJUST as necessary.

	or outer edge wear). • Excessive negative or positive camber (rapid inner or outer edge wear). • Tires out of balance (tires cupped or dished).	 • CHECK the wheel alignment. ADJUST as necessary. • BALANCE tires.
• Rear Spring Squeak	• Rear spring(s). • Shackle bushing(s).	• INSTALL new rear spring anti-squeak inserts (tip liners). • INSTALL new shackle bushings as necessary.
• Rough Ride	• Shock absorber(s). • Spring(s). • Torsion bar(s).	• INSTALL new shock absorbers as necessary. • INSTALL new spring(s) as necessary. REFER to Section 204-02 . • ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
• Shimmy or Wheel Tramp	• Loose lug nut(s). • Loose front suspension fasteners. • Front wheel bearing adjustment. • Wheel or tire concerns. • Spring(s). • Torsion bar(s). • Loose, worn or damaged ball joint (s). • Loose, worn or damaged steering components. • Front wheel alignment.	• TIGHTEN to specification. REFER to Section 204-04 . • TIGHTEN to specification. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD). • REFER to Wheel Bearing Inspection in this section. • REFER to Section 204-04 . • INSTALL new spring(s) as necessary. REFER to Section 204-02 . • ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD). • GO to the Ball Joint Inspection component test in this section. • REFER to Section 211-00 . • CHECK the wheel alignment. ADJUST as necessary.
• Sticky Steering, Poor Returnability	• Ball joints.	• GO to the Ball Joint Inspection component test in this section.

	• Steering components.	• REFER to Section 211-00 .
• Steering Wheel Off-Center	• Unequal front or rear toe settings (side-to-side). • Steering components.	• CHECK the wheel alignment. ADJUST as necessary. • REFER to Section 211-00 .
• Sway or Roll	• Overloaded, unevenly or incorrectly loaded vehicle. • Loose lug nut(s). • Shock absorber(s). • Loose stabilizer assembly. • Worn stabilizer assembly bushing (s). • Sagging torsion bar (s). • Worn spring(s).	• NOTIFY the customer of incorrect vehicle loading. • TIGHTEN to specification. REFER to Section 204-04 . • INSTALL new shock absorbers as necessary. • TIGHTEN to specification. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new stabilizer assembly bushings as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) Section 204-01B (4x4 or AWD). • INSTALL new as necessary. REFER to Section 204-02 .
• Vehicle Leans to One Side	• Unevenly loaded or overloaded vehicle. • Front or rear suspension components. • Rear spring(s). • Torsion bars. • Incorrect drive axle (s) ride height. Lateral tilt out of specification.	• NOTIFY the customer of incorrect vehicle loading. • INSPECT the front and rear suspension systems. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new spring(s) or components as necessary. REFER to Section 204-02 . • ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD). • INSPECT the front and rear suspension systems. ADJUST, REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01B (4x4 or AWD) or Section 204-

		02 .
	• Suspension load leveling control system.	• REFER to suspension load leveling control system diagnosis and testing in Section 204-05 .
• Vibration/Noise	• Tire and wheel concerns. • Wheel bearings. • Wheel hubs. • Brake components. • Suspension components. • Steering components.	• REFER to Section 100-04 .
	• Worn Kevlar patch on torsion bar adjuster.	• INSTALL a new torsion bar adjuster. REFER to Section 204-01A .
• Wander	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Ball joint(s).	• GO to the Ball Joint Inspection component test in this section.
	• Loose, worn or damaged front wheel bearing(s).	• REFER to Wheel Bearing Inspection in this section.
	• Loose, worn or damaged suspension components(s).	• INSTALL new as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Loose suspension fasteners.	• TIGHTEN to specification. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Steering components.	• REFER to Section 211-00 .
	• Wheel alignment (excessive total front toe out).	• ADJUST as necessary.

Component Tests

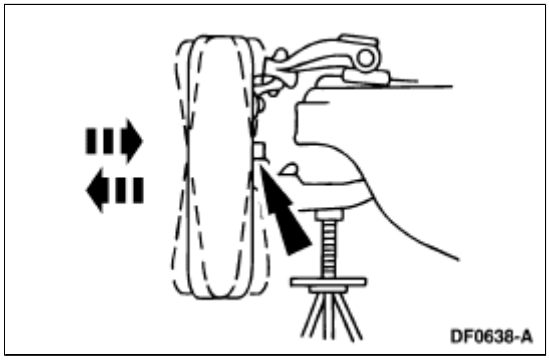
Ball Joint Inspection

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

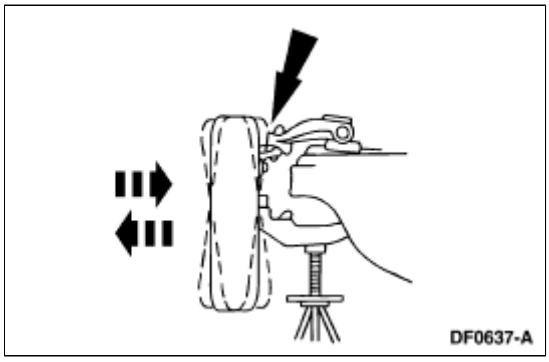
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings (1216).

3. Position a safety stand beneath the front suspension lower arm (3079) to be tested.



4. While an assistant pulls and pushes the bottom of the tire, measure the relative movement between the lower spindle arm and the front suspension lower arm ball joint using a suitable dial indicator. Any movement at or exceeding the specification indicates a worn or damaged lower ball joint. Install a new lower arm as necessary. For additional information, refer to Section 204-01A or Section 204-01B .



5. While an assistant pulls and pushes the top of the tire, measure the relative movement between the upper spindle arm and the front suspension upper ball joint using a suitable dial indicator. Movement at or exceeding the specification indicates a worn or damaged upper ball joint. Install a new upper arm as necessary. For additional information, refer to Section 204-01A or Section 204-01B .

Wheel Bearing Inspection

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle until the tire is off the floor. For additional information, refer to Section 100-02 .

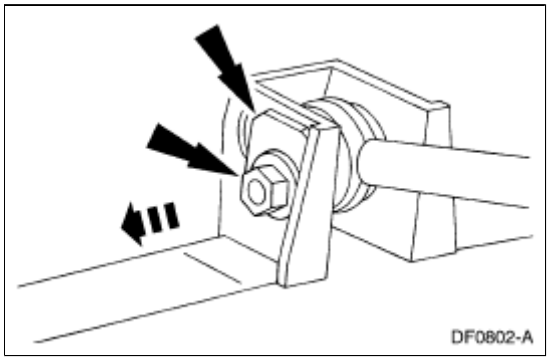
2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

   Grasp each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.

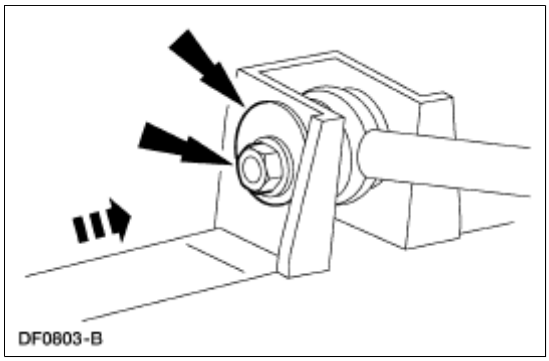
3. If the tire and wheel (hub) is loose on the wheel spindle or does not rotate freely, perform one of the following actions.
   - On 4x2 vehicles, adjust the front wheel bearings. For additional information, refer to Section 204-01A .
   - On 4x4 vehicles, install a new wheel hub (1104). For additional information, refer to Section 204-01B .

Camber and Caster Adjustment

1. Remove the nuts and alignment plates.

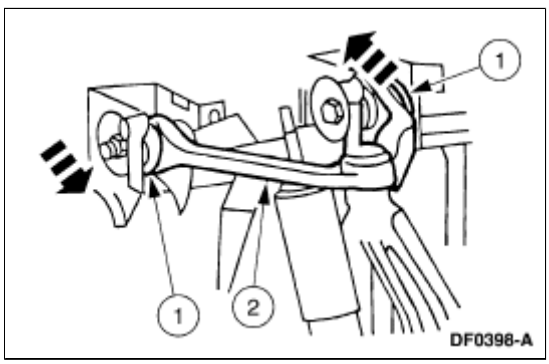


2. Install the cams and the nuts.

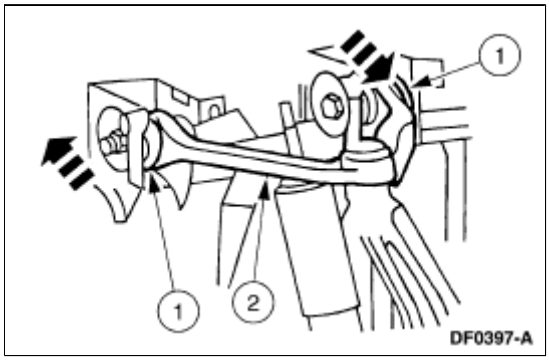


3. **NOTE:** A pry bar can be used between the front suspension arm bushing joint and the frame pocket to aid in moving the arm.

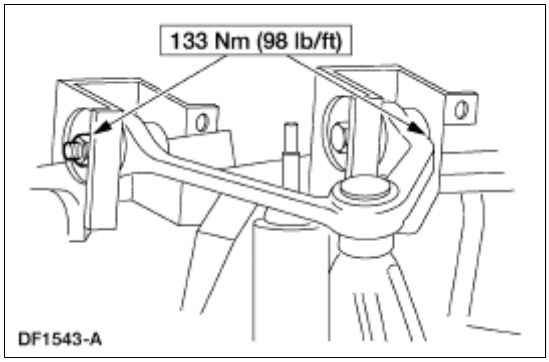
   To increase the LF caster and camber, use the following steps.
   1. To increase caster, move the front of the front suspension arm bushing joint outboard and move the rear of the front suspension arm bushing joint inboard.
   2. To increase camber, move the front suspension arm bushing joint outboard equally.



4. To decrease the LF caster and camber, use the following steps.
    1. To decrease caster, move the front of the front suspension arm bushing joint inboard and move the rear of the front suspension arm bushing joint outboard.
    2. To decrease camber, move the front suspension arm bushing joint inboard equally.

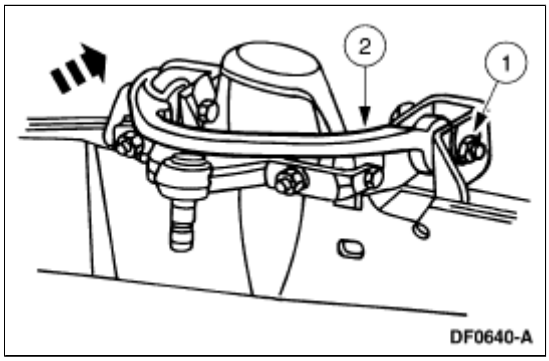


5. Tighten the nuts.

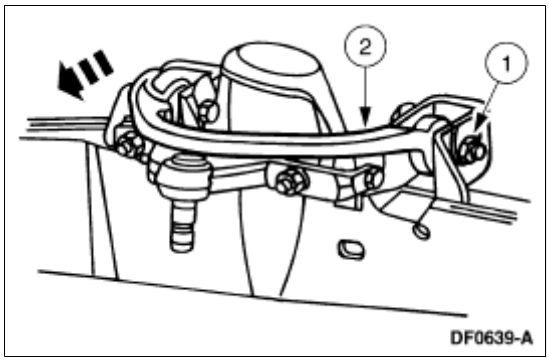


6. **NOTE:** A pry bar can be used between the front suspension arm bushing joint (3084) and the frame pocket to aid in moving the arm.

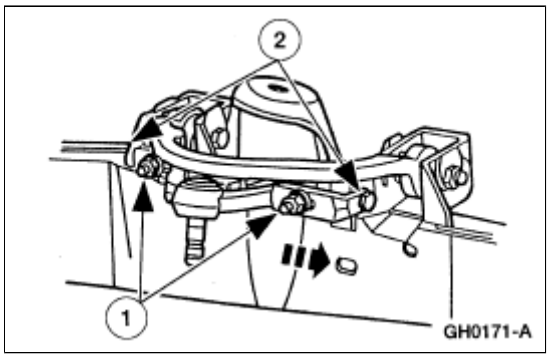
    To increase RF caster and camber, use the following steps.
    1. To increase caster, move the front of the front suspension arm bushing joint outboard and move the rear of the front suspension arm bushing joint inboard.
    2. To increase camber, move the front suspension arm bushing joint outboard equally.



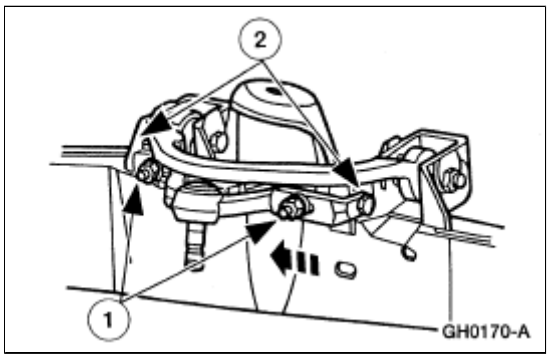
7. To decrease the RF caster and camber, use the following steps.
    1. To decrease caster, move the front of the front suspension arm bushing joint inboard and move the rear of the front suspension arm bushing joint outboard.
    2. To decrease camber, move the front suspension arm bushing joint inboard equally.



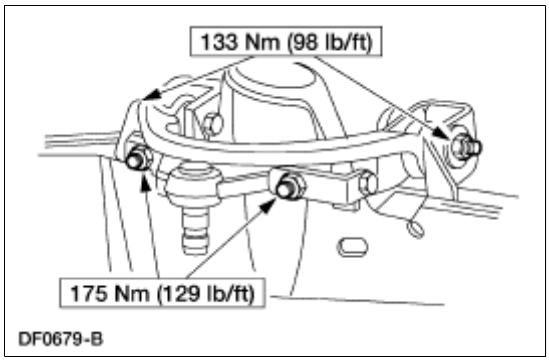
8. Increase the caster split.
    1. Loosen the nuts.
    2. Adjust the caster set bolts forward.



9. Decrease the caster split.
    1. Loosen the nuts.
    2. Adjust the caster set bolts rearward.

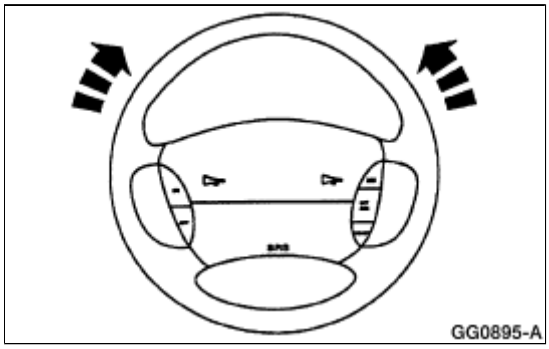


10. Tighten the nuts.


133 Nm (98 lb/ft)
175 Nm (129 lb/ft)
DF0679-B

Toe Adjustment

1. Start the engine (6007) and center the steering wheel (3600).

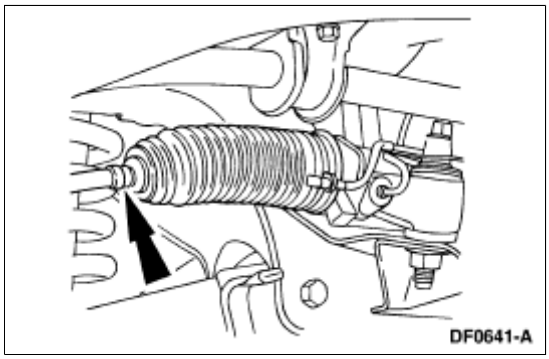


2. Turn the engine off, and hold the steering wheel in the "straight forward" position by attaching a rigid link from the steering wheel to the brake pedal.

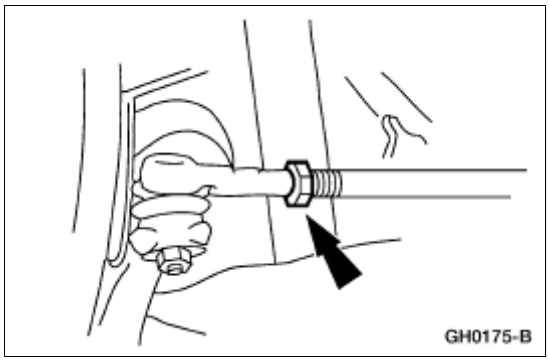
3. Check the toe settings; follow the manufacturer's instructions.

4. **NOTE:** Do not allow the steering gear bellows to twist when the front wheel spindle tie-rod (3280) is rotated.

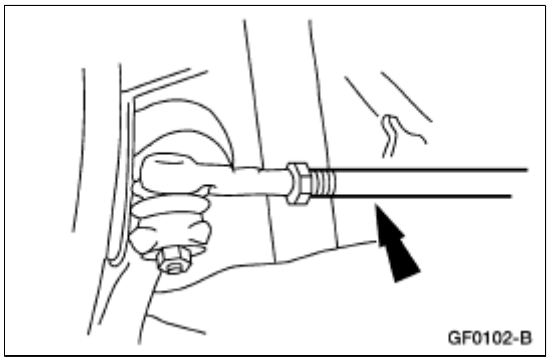
   Remove the clamps.



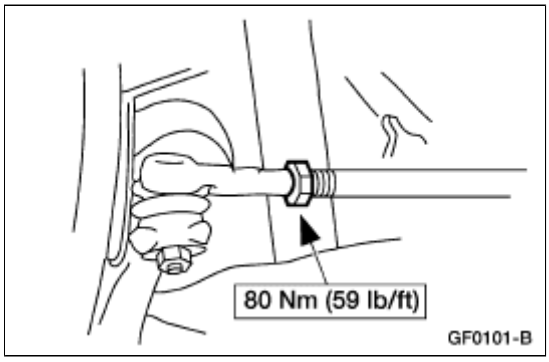
5. Loosen the nuts.
   - Clean and lubricate the nut(s) and front wheel spindle tie-rod threads.



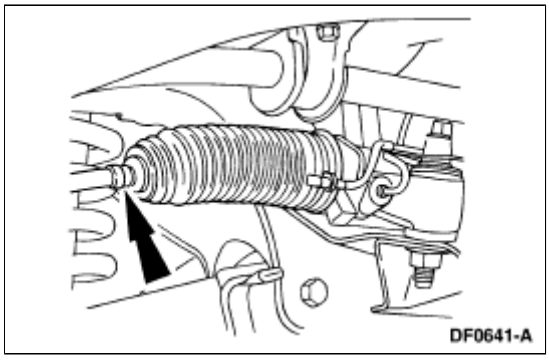
6. Rotate the front wheel spindle tie-rods.



7. Tighten the nuts.



8. Install the clamps.



9. Recheck the toe settings; follow the manufacturer's instructions.

General Specifications

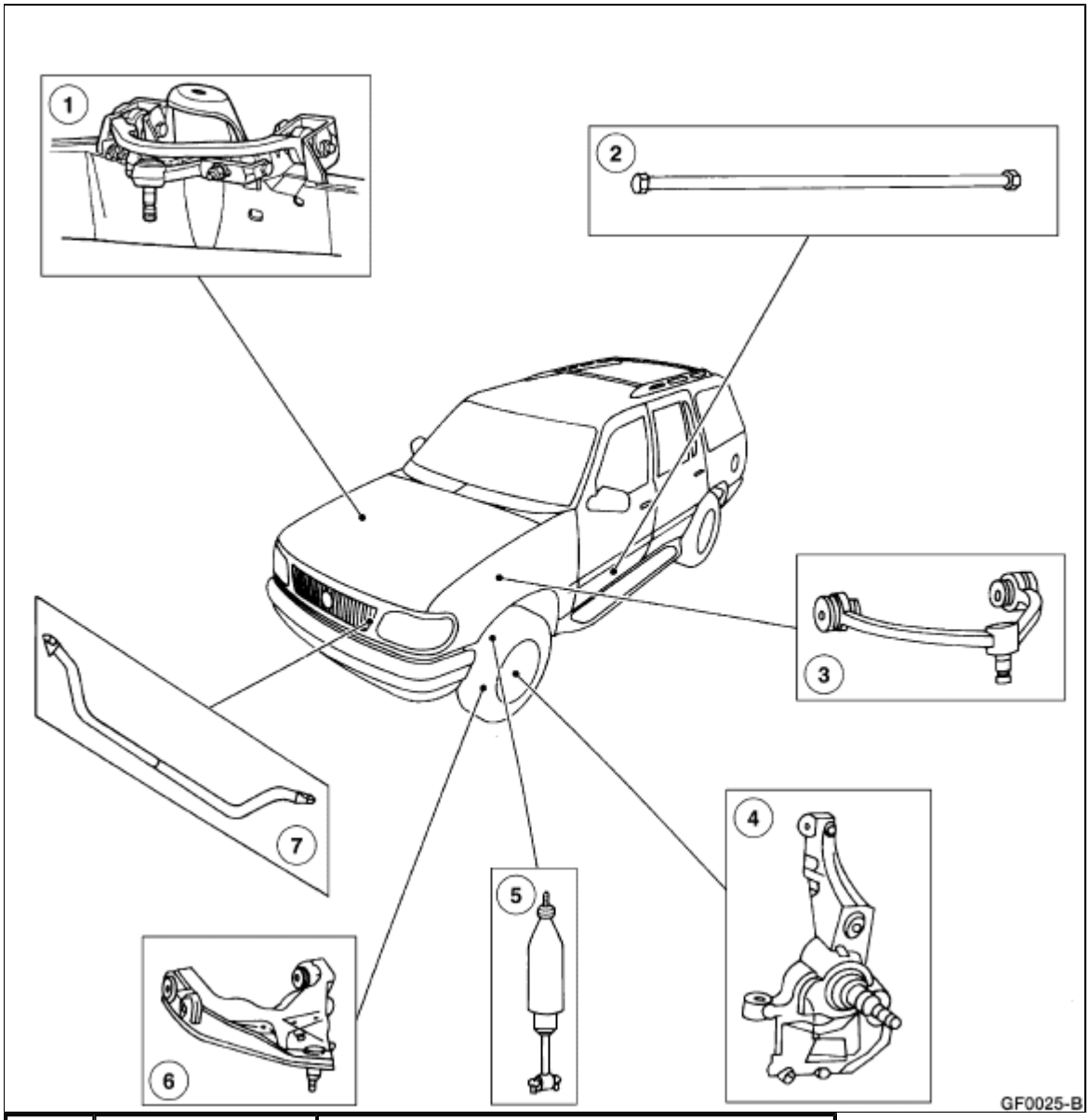
Item	Specification
Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)

Torque Specifications

Description	Nm	lb-ft	lb-in
Front Suspension Lower Arm Pivot Bolts and Nuts	150-200	111-148	—
Front Shock Absorber to Lower Arm Nuts	21-29	15-21	—
Front Wheel Spindle to Lower Ball Joint Nut	113-153	83-113	—
Front Wheel Spindle to Upper Ball Joint Nut	47-63	35-46	—
Front Stabilizer Bar Bracket Bolts	34-46	25-34	—
Tie Rod End Nut	60-80	44-59	—
Front Brake Anti-Lock Sensor Bolt	7-11	—	62-97
Torsion Bar Cover Plate Bolts	47-63	35-46	—
Front Stabilizer Bar Link Nuts	21-29	15-21	—
Front Suspension Upper Arm Bolts and Nuts	113-153	83-112	—
Lug Nuts	135	100	—

Front Suspension

Front Suspension Components



Item	Part Number	Description
1	3084	Front suspension upper arm (RH)
2	5B326/5B327	Torsion bar (RH/LH)
3	3091	Front suspension upper arm (LH)
4	3106	Front wheel spindle (LH)
5	18124	Front shock absorber

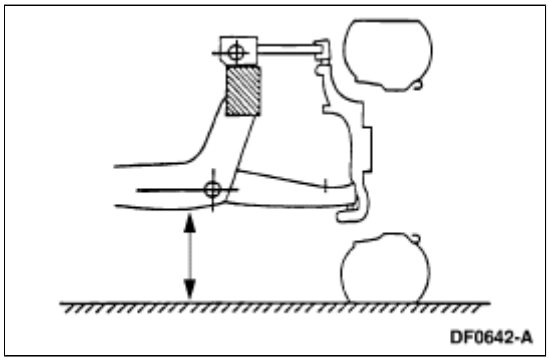
6	3051	Front suspension lower arm (LH)
7	5494	Front stabilizer bar

Front Suspension

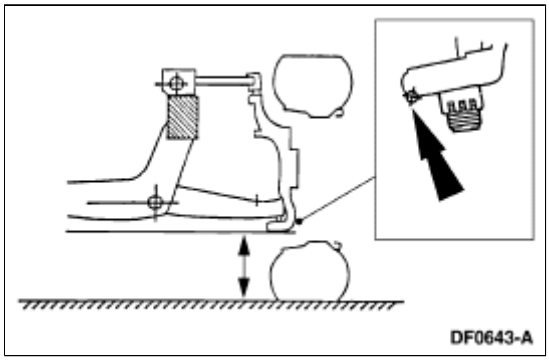
Refer to Section 204-00 .

Ride Height

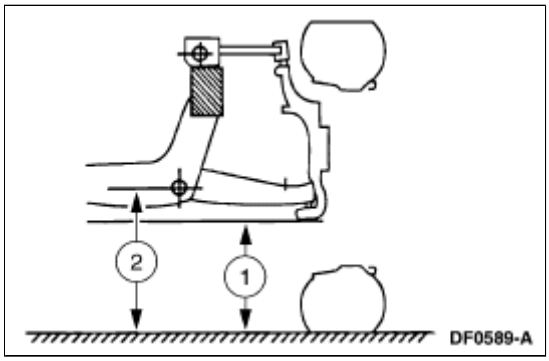
1. Drive the vehicle onto a drive-on lift.
2. Jounce the vehicle's front and rear suspension to normalize the vehicle static ride height.
3. Measure the distance between the center line of the front suspension lower arm bushing bolt and the lift. Record the measurement.



4. Measure the distance between the front wheel spindle (lowest point) and the lift. Record the measurement.

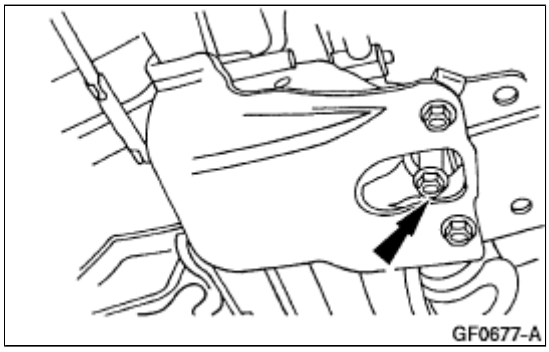


5. Determine ride height.
   - Subtract measurement 1 from measurement 2. This is the ride height.



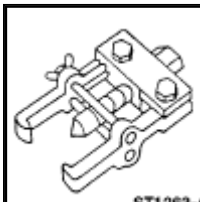
6. **NOTE:** The torsion bar adjusting bolt is coated with adhesive that wears off after disassembly. If the torsion bar system is ever disassembled or the torsion bar adjusting bolt is ever removed, use a new torsion bar adjusting bolt when re-assembling.

   Adjust the torsion bars (height) as necessary by tightening or loosening the torsion bar adjusting bolt.
   - Tighten the torsion bar adjusting bolt to increase the torque or raise the height.
   - Loosen the torsion bar adjusting bolt to decrease the torque or lower the height.



Arm —Lower

Special Tool(s)

 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F)

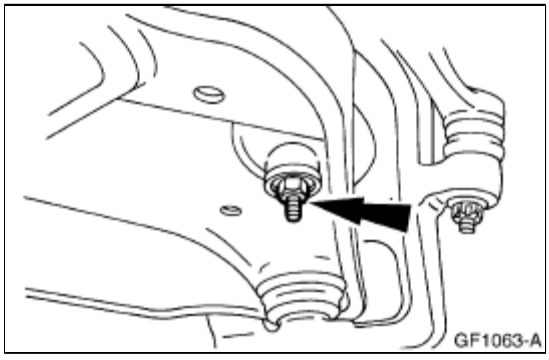
Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

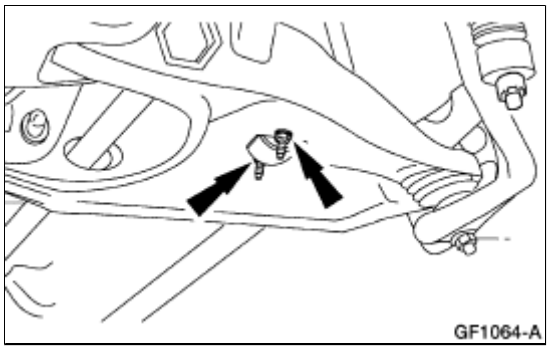
   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly; for additional information, refer to Section 204-04 .

3. Remove the stabilizer link nut, washer and bushing.

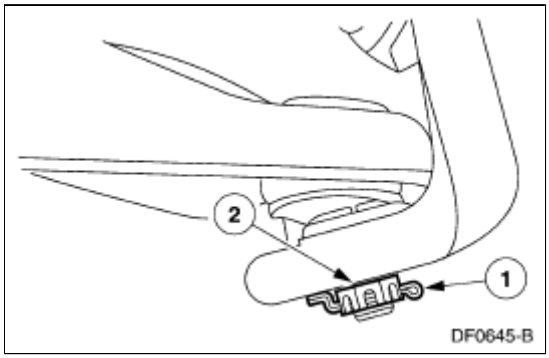


4. Remove the front shock absorber-to-front suspension lower arm nuts.

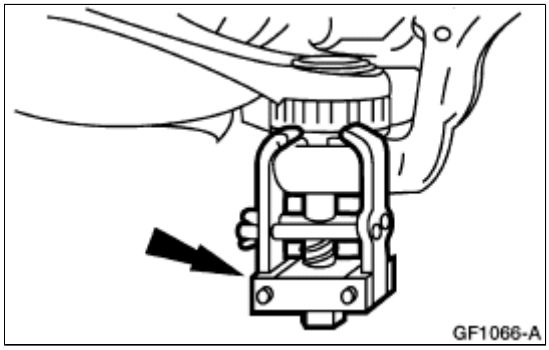


5. Remove the torsion bar; for additional information, refer to Bar—Torsion in this section.

6. Remove the lower ball joint castellated nut.
   1. Remove the lower ball joint cotter pin.
   2. Remove the lower ball joint castellated nut.

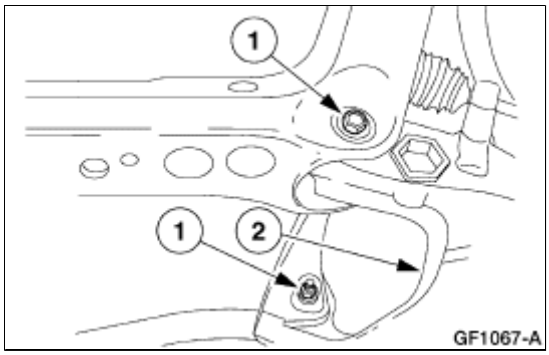


7. Use the Pitman Arm Puller to separate the front suspension lower arm from the front wheel knuckle/spindle.



8. **CAUTION: For 4x4 vehicles, support the front suspension arm bushing joint (3085), axle shaft and front wheel knuckle (3K185) before separating the front wheel knuckle from the front suspension lower arm (3079). Failure to do so can cause damage to the front axle shaft assembly.**

   Remove the front suspension lower arm.
   1. Remove the front suspension lower arm bolts and nuts.
   2. Remove the front suspension lower arm.

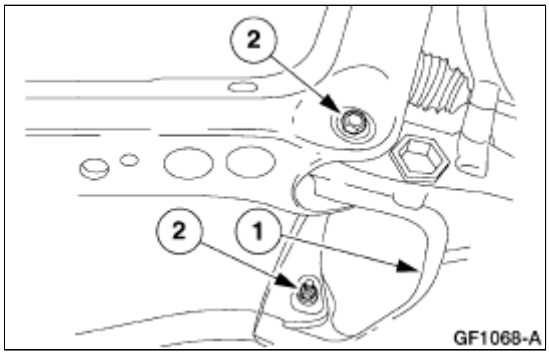


Installation

1. **NOTE:** Tighten the front suspension lower arm pivot bolts and nuts until snug. Do not tighten to specification until the installation procedure is complete.

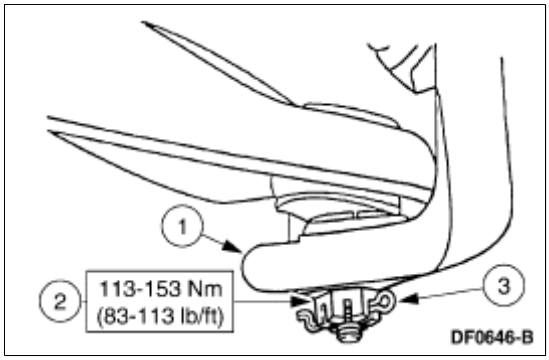
   NOTE: Inspect the front suspension lower arm ball joints (3050) and boot seals for damage.

   Install the front suspension lower arm.
   1. Position the front suspension lower arm to the front suspension crossmember.
   2. Install the pivot bolts and nuts and tighten until snug.

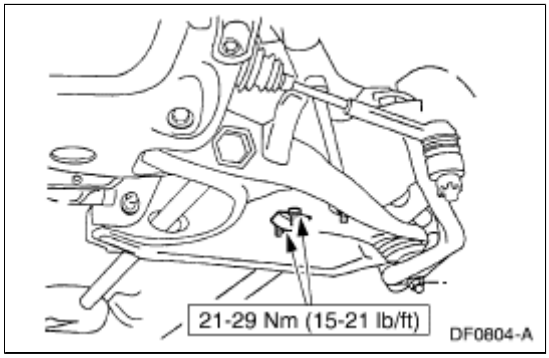


2. **CAUTION: Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so will cause damage to the wheel and tire assembly.**

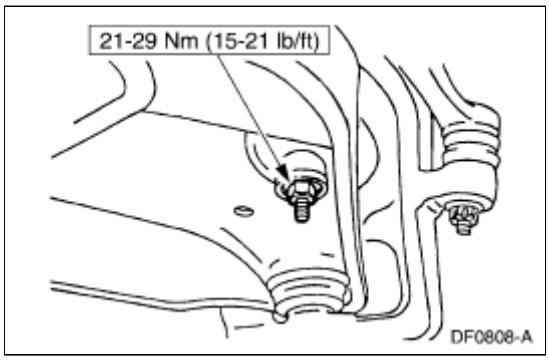
   Connect the front suspension lower arm to the front wheel knuckle/spindle.
   1. Position the lower ball joint into the front wheel knuckle/spindle.
   2. Install the new castellated nut.
   3. Install a new cotter pin.



3. Install the front shock absorber-to-front suspension lower arm nuts.



4. Install the stabilizer link bushing, washer, and nut.



5. **NOTE:** Whenever the torsion bar or torsion bar adjuster is removed, the vehicle ride height must be checked. For additional information, refer to Ride Height in this section.

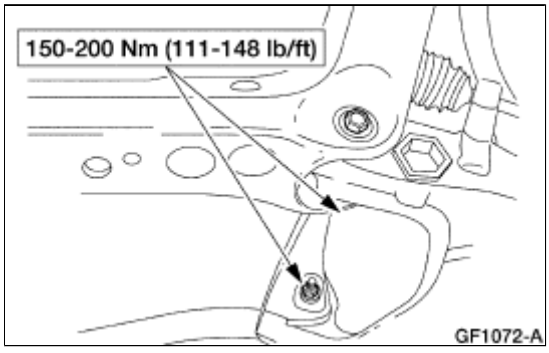
   Install the torsion bar; for additional information, refer to Bar—Torsion in this section.

6. Install the tire and wheel assembly; for additional information, refer to Section 204-04 .

7. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.

8. Tighten the front suspension lower arm nuts.



9. Inspect and adjust the front end alignment; for additional information, refer to Section 204-00 .

Arm —Upper

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

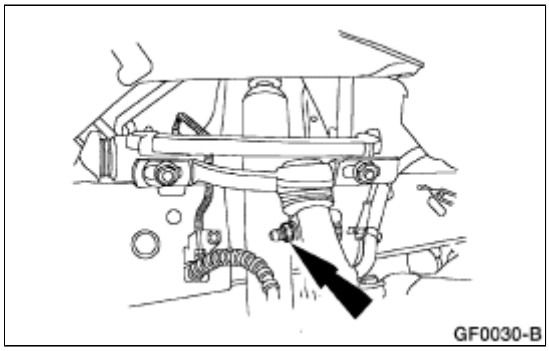
   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly; for additional information, refer to Section 204-04 .

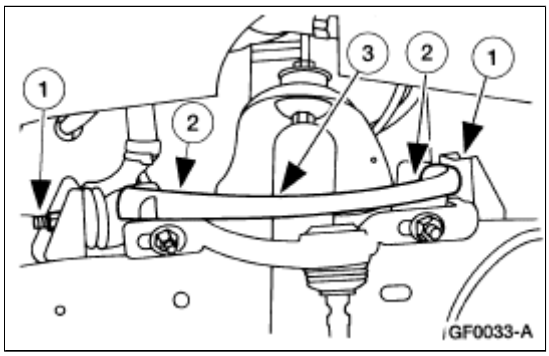
3. Use a suitable jack stand to support the front suspension lower arm (3078).

4. **CAUTION: To avoid possible damage to the front wheel spindle (3105) , secure the spindle to keep it from tilting before removing the pinch bolt and nut.**

   Remove the pinch bolt and nut from the front wheel spindle.

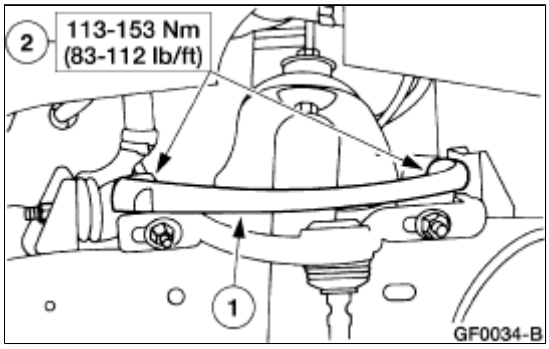


5. Remove the front suspension upper arm.
   1. Remove the two nuts.
   2. Remove the two bolts.
   3. Remove the front suspension upper arm.

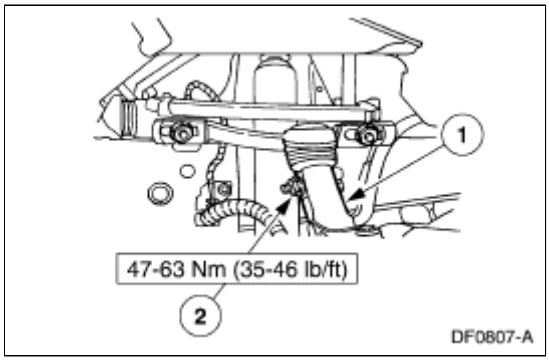


Installation

1. Install the front suspension upper arm.
    1. Position the front suspension upper arm.
    2. Install the two bolts and two nuts.



2. Install the pinch bolt and nut to the front wheel spindle.
    1. Position the front wheel spindle.
    2. Install the pinch bolt and nut.



3. Remove the jack stand from under the front suspension lower arm.
4. Install the tire and wheel assembly; for additional information, refer to Section 204-04 .
5. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.
6. Inspect the front end ride height; for additional information, refer to Ride Height in this section.
7. Inspect and adjust the front end alignment; for additional information, refer to Section 204-00 .

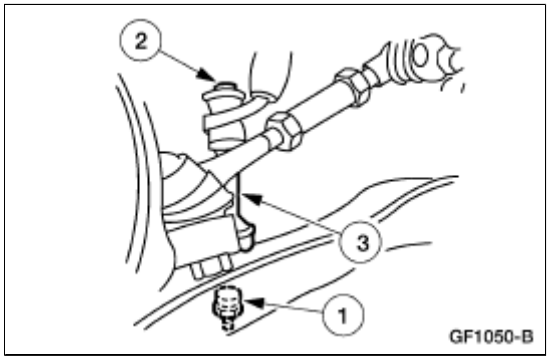
Bar and Link —Front

Removal

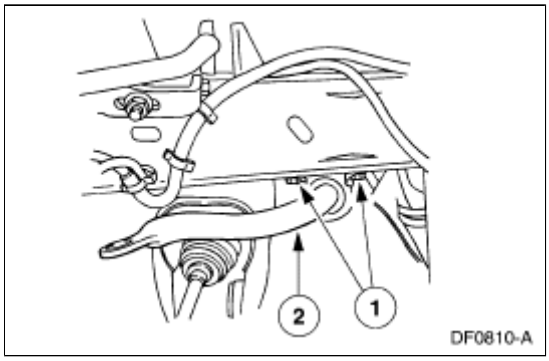
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the front stabilizer bar links.
   1. Remove the front stabilizer bar link nut.
   2. Remove the front stabilizer bar link bolt.
   3. Remove the front stabilizer bar spacer.



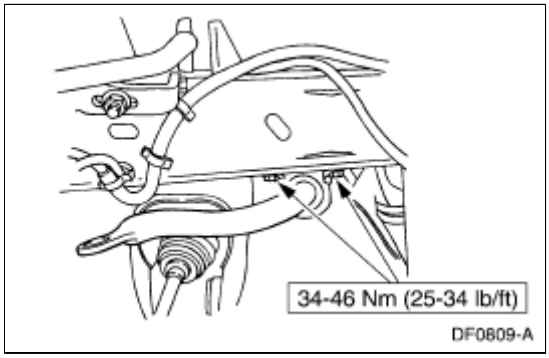
3. Remove the front stabilizer bar (5482).
   1. Remove the four (two each side) stabilizer bar bracket bolts.
   2. Remove the stabilizer bar.

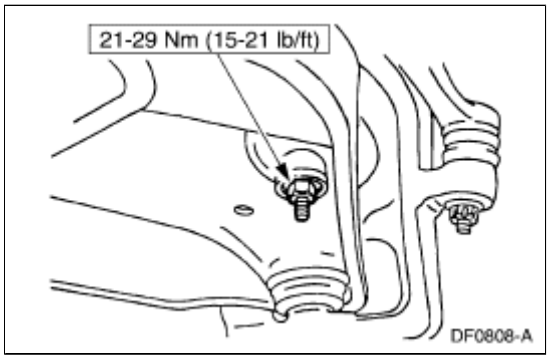


Installation

1. **NOTE:** In the event the self-tapping bolts cannot be installed in the frame, there is a kit available with flag nuts; consult your parts department for further information.

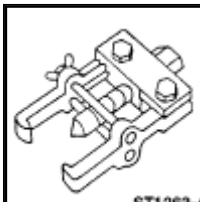
Follow the removal procedure in reverse order.





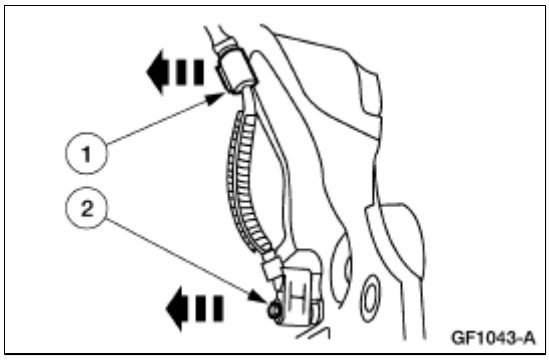
Spindle

Special Tool(s)

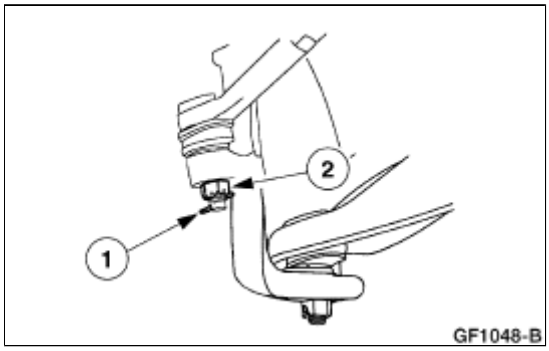
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F)

Removal

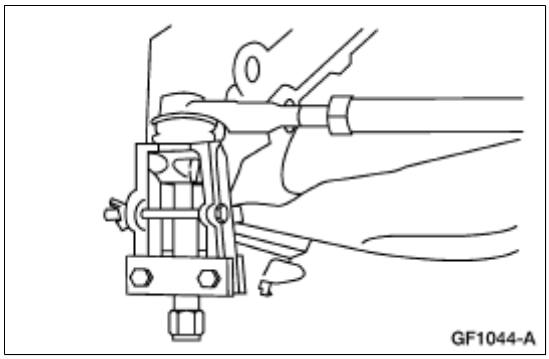
1. Remove the brake disc and hub (1102). For additional information, refer to Section 206-03 .
2. Remove the front brake anti-lock sensor (2C204).
    1. Remove the anti-lock sensor electrical wire from the clamp.
    2. Remove the bolt and position the sensor aside.



3. Remove the tie-rod end castellated nut.
    1. Remove the cotter pin.
    2. Remove the castellated nut.



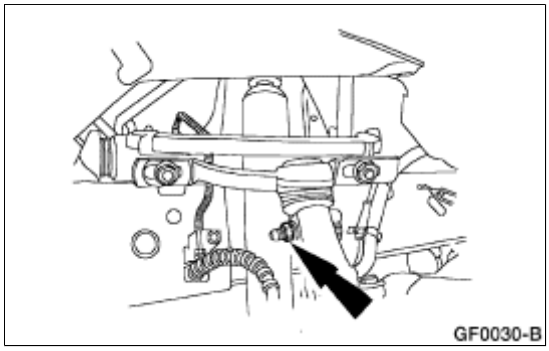
4. Use the Pitman Arm Puller to separate the tie-rod end (3A130) from the front wheel spindle.



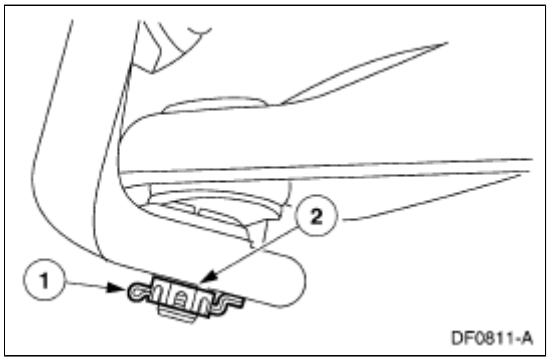
5. Use a suitable jack stand to support the front suspension lower arm (3078/3051).

6. **CAUTION: To avoid possible damage to the front wheel spindle, secure the spindle to keep it from tilting before removing the pinch bolt and nut.**

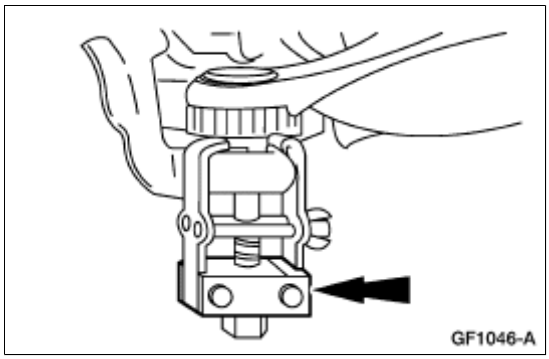
   Remove the pinch bolt and nut from the front wheel spindle.



7. Remove the lower ball joint castellated nut.
   1. Remove the lower ball joint cotter pin.
   2. Remove the lower ball joint castellated nut.



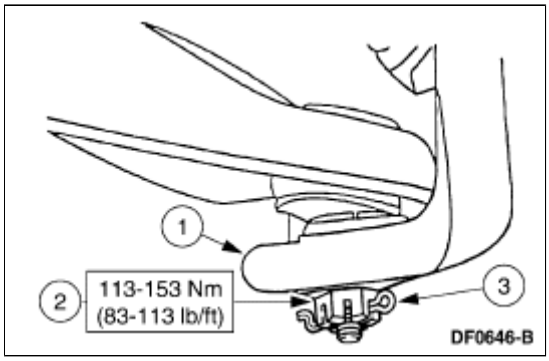
8. Use the Pitman Arm Puller to remove the front wheel spindle.



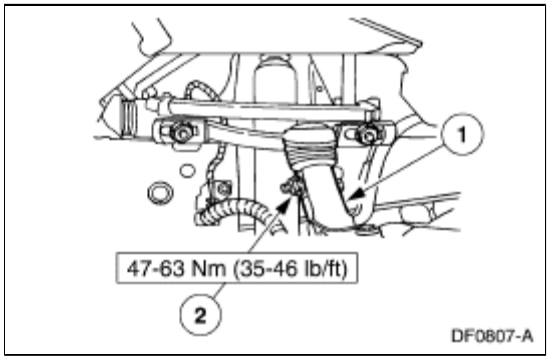
Installation

1. **NOTE:** Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so can cause damage to the wheel and tire assembly.

   Install the lower ball joint castellated nut.
   1. Position the front wheel spindle to the lower ball joint.
   2. Install the lower ball joint castellated nut.
   3. Install a new cotter pin.



2. Install the pinch bolt and nut.
   1. Position the front wheel spindle.
   2. Install the pinch bolt and nut.



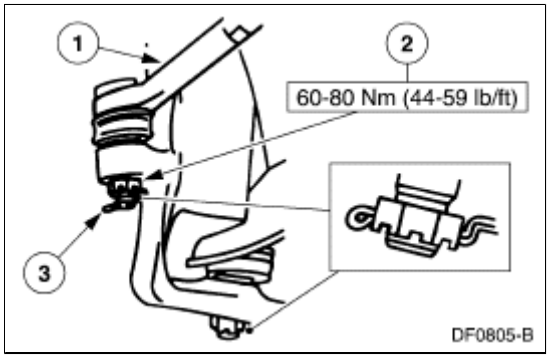
3. Remove the jack from under the front suspension lower arm.

4. **CAUTION: Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so can cause damage to the wheel and tire**

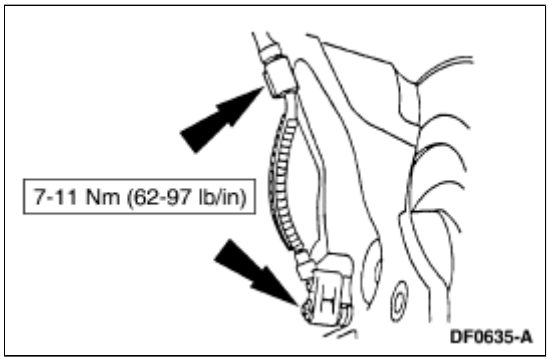
assembly.

Connect the tie-rod end to the front wheel spindle.

1. Position the tie-rod end.
2. Install the tie-rod end castellated nut.
3. Install a new cotter pin.



5. Install the front brake anti-lock sensor and position the anti-lock sensor electrical wire in the clamp.



6. Install the brake disc and hub. For additional information, refer to Section 206-03 .

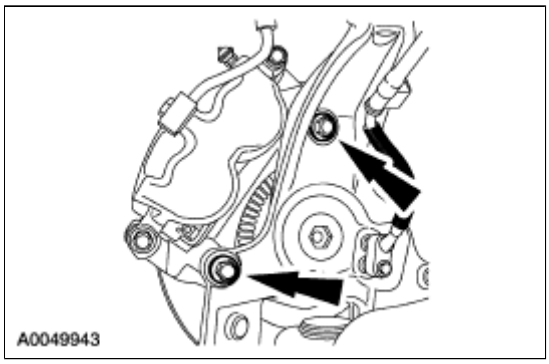
Wheel Studs

Removal

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

2. **CAUTION: When removing the disc brake caliper (2B120), never allow it to hang from the brake hose. Provide a suitable support.**

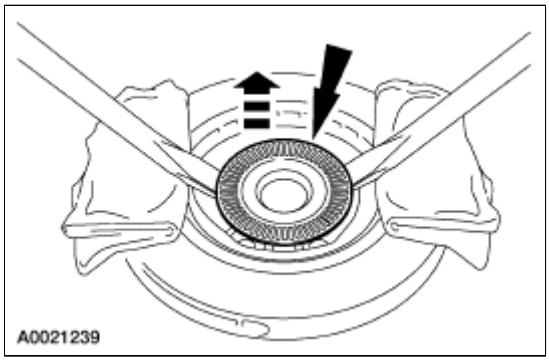
   Remove the brake caliper and anchor plate as an assembly.



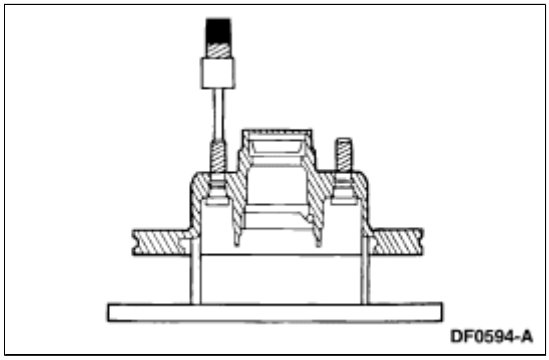
3. Remove the brake disc and hub as follows:
   1. Remove the hub grease cap (1131).
   2. Remove the cotter pin.
   3. Remove the nut retainer.
   4. Remove the spindle nut.
   5. Remove the front wheel outer bearing retainer washer (1195).
   6. Remove the outer front wheel bearing (1216).
   7. Remove the brake disc and hub.

4. **CAUTION: Place shop towels between the pry bars and the brake disc to prevent damage to the disc surface.**

   Using two pry bars, remove the ABS sensor ring.
   - Discard the ABS sensor ring.

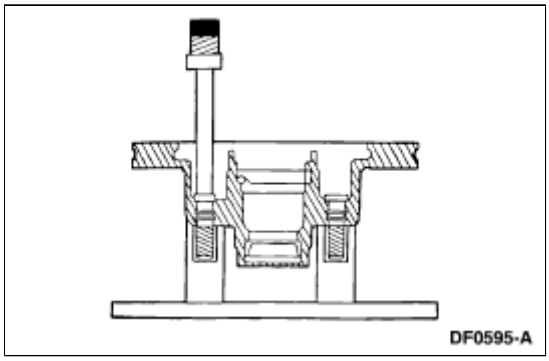


5. Using a suitable press, remove the wheel stud (1107) from the brake disc and hub.



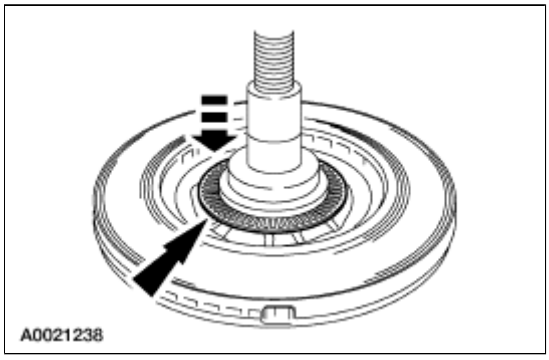
Installation

1. Using a suitable press, install the wheel stud in the brake disc and hub.

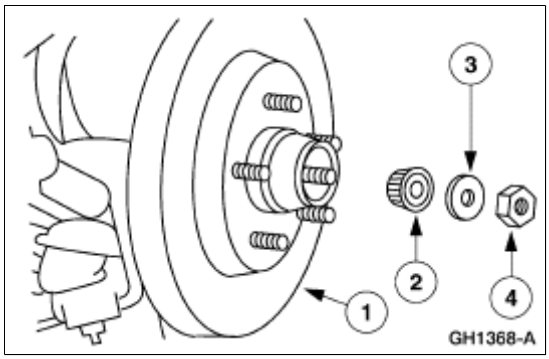


2. **CAUTION: When installing the ABS sensor ring, make sure the sensor ring is pressed on straight.**

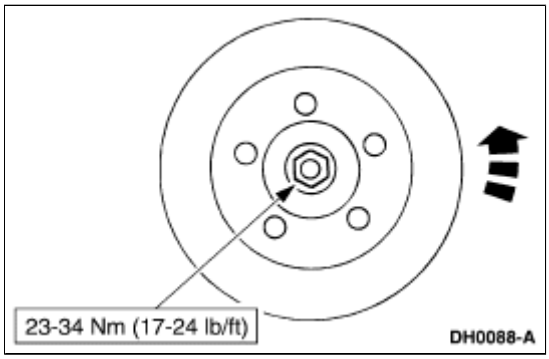
   Position a new ABS sensor ring on the hub. Using a cylinder with 79 mm (3.16 in) inside diameter and 96 mm (3.84 in) outside diameter, press the ring onto the hub until the ring seats against the shoulder in the hub.



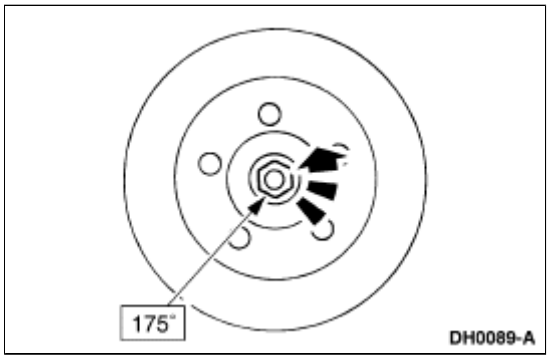
3. Install the brake disc and hub.
   1. Position the brake disc and hub.
   2. Install the outer front wheel bearing.
   3. Install the front wheel outer bearing retainer washer.
   4. Install the spindle nut.



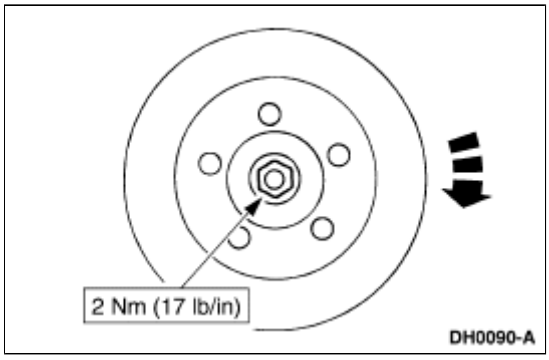
4. Tighten the spindle nut while rotating the brake disc and hub.



5. Loosen the spindle nut.

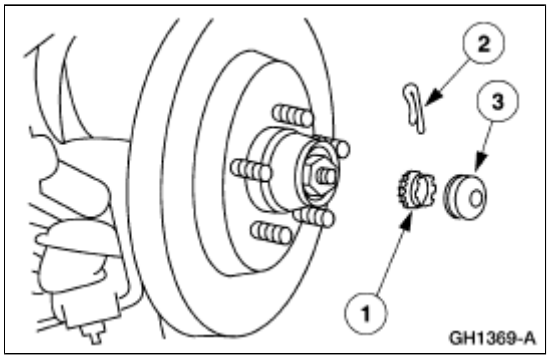


6. Tighten the spindle nut while rotating the brake disc and hub.

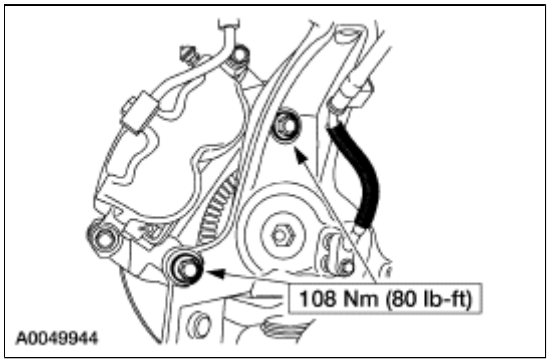


7. Install the following components:

1. Install the nut retainer.
2. Install the cotter pin.
3. Install the hub grease cap.



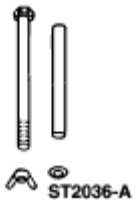
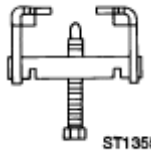
8. Install the caliper and anchor plate assembly.



9. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

Bar —Torsion

Special Tool(s)

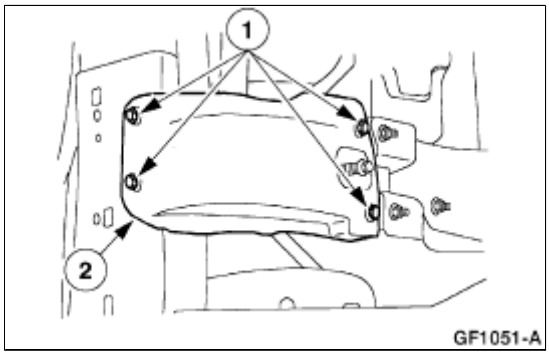
 ST2036-A	Bolt Set T96T-5310-B
 ST1355-A	Torsion Bar Tool T95T-5310-AR

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

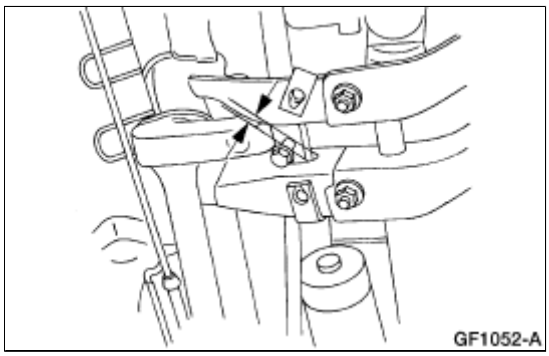
2. Remove the torsion bar cover plate.
   1. Remove the torsion bar cover plate bolts.
   2. Remove the torsion bar cover plate.



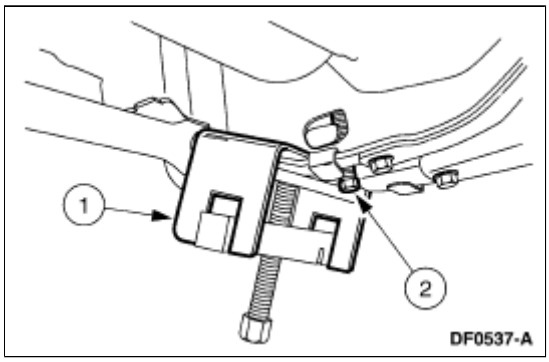
3. **NOTE:** Before relieving the torsion bar tension, measure and record the measurement of the torsion bar adjustment bolt. This measurement will be used as the preset depth for the new torsion bar adjustment bolt during installation.

   Make preliminary adjustment references.

- Measure and record the length where indicated.

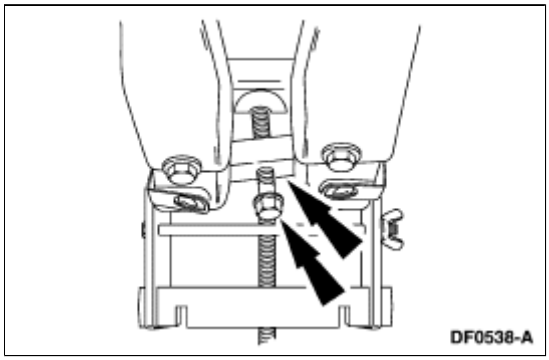


4. Relieve the torsion bar tension.
    1. Position the Torsion Bar Tool and adapters.
    2. Tighten the Torsion Bar Tool until the torsion bar adjuster lifts off the adjustment bolt.

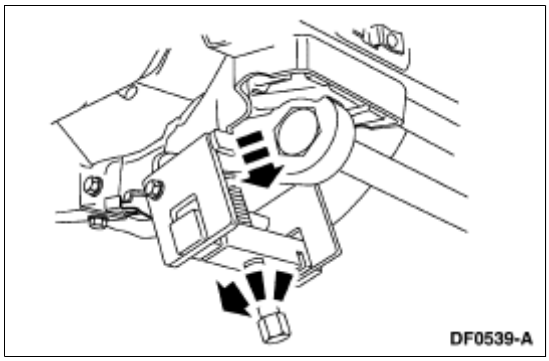


5. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive and must be replaced if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and cause a loss of vehicle alignment.**

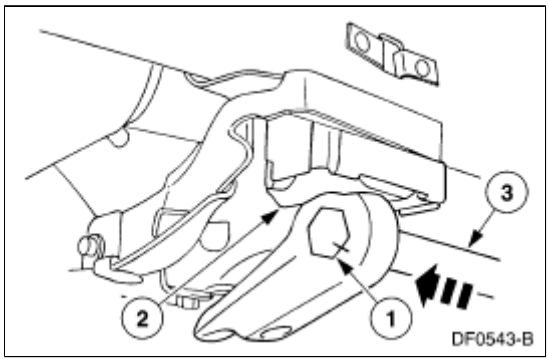
    Remove the torsion bar adjustment bolt and nut.



6. Loosen the Torsion Bar Tool until the tension is removed from the torsion bar.

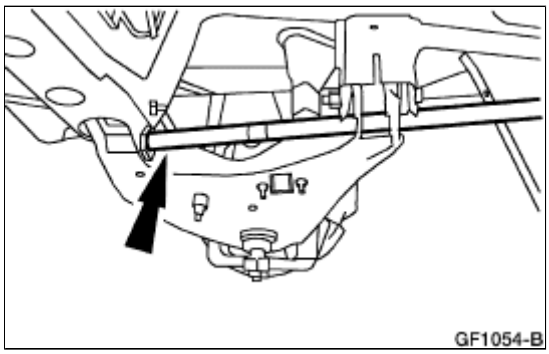


7. Remove the torsion bar.
    1. Mark the torsion bar and the adjuster for proper installation.
    2. Remove the torsion bar insulator.
    3. Grasp the torsion bar and pull it free from the front suspension lower arm.

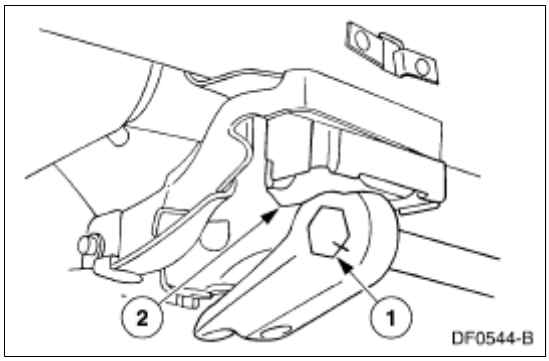


Installation

1. Position the torsion bar and the torsion bar adjuster.

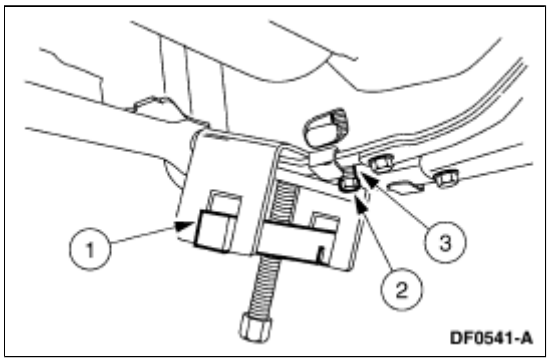


2. Install the torsion bar adjuster.
    1. Align the marks on the torsion bar and the torsion bar adjuster, then install the torsion bar adjuster.
    2. Position the torsion bar insulator.



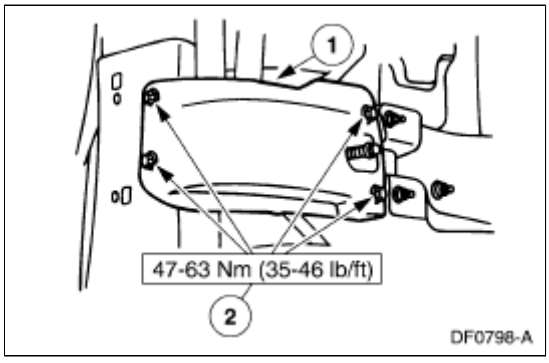
3. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive and must be replaced if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and cause a loss of vehicle alignment.**

   Preload the torsion bar.
   1. Install the Torsion Bar Tool and the adapters.
   2. Tighten the Torsion Bar Tool until the new adjustment bolt and nut can be installed.
   3. Turn the adjustment bolt until the preliminary adjustment measurement (recorded length of the old adjustment bolt) is reached.



4. Remove the tool.

5. Install the torsion bar cover plate.
   1. Position the torsion bar cover plate.
   2. Install the torsion bar cover plate bolts.



6. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Lower the vehicle.

7. Adjust the ride height. For additional information, refer to Ride Height in this section.
8. Check the alignment. For additional information, refer to Section 204-00 .

General Specifications

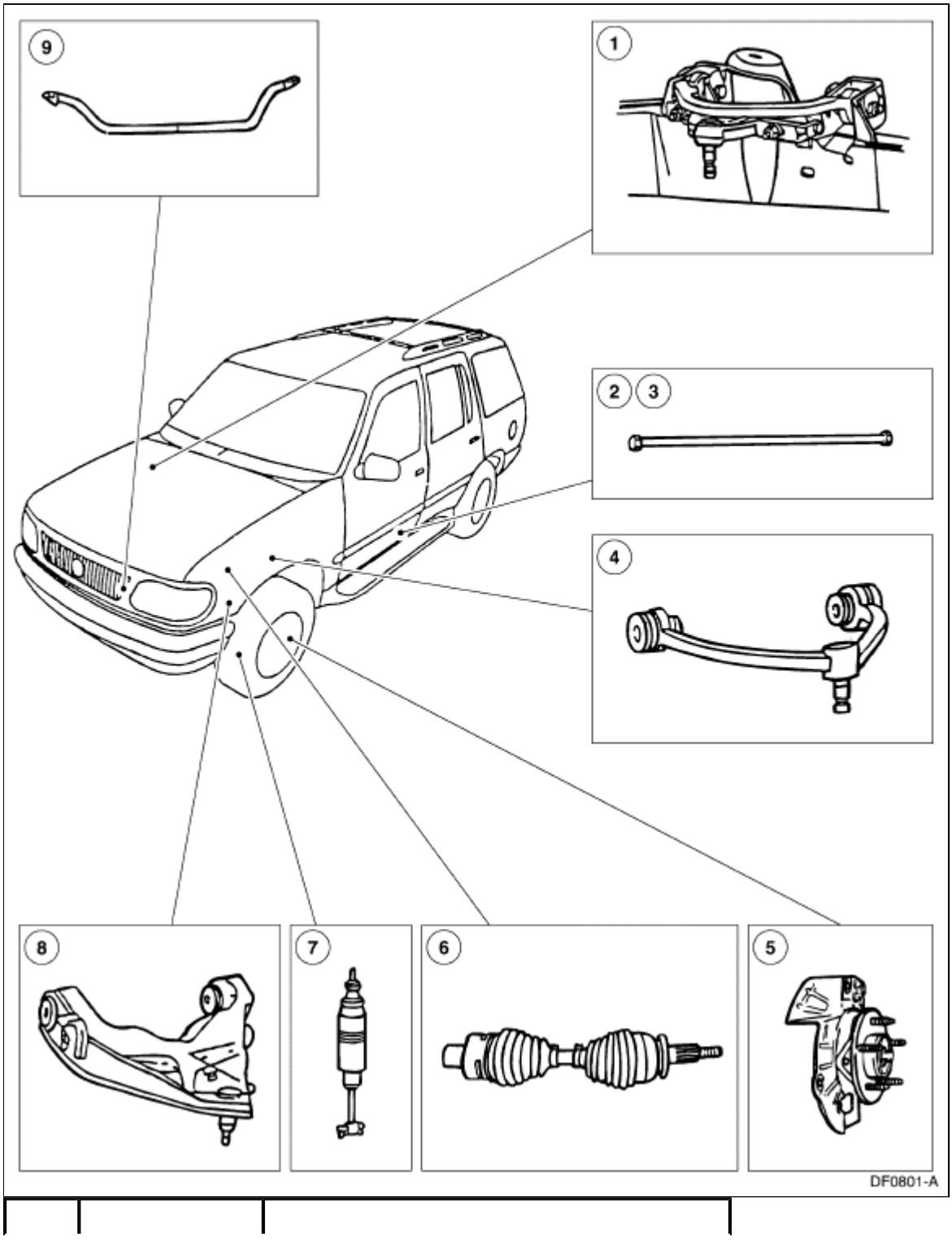
Item	Ride Height
4x4 Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
4x4 Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)
AWD Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
AWD Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)
4x4 w/Automatic Ride Control Ride Height with Original Suspension Components mm (in)	68-90 (2.67-3.54)
4x4 w/Automatic Ride Control Ride Height with New Suspension Components mm (in)	83-89 (3.26-3.5)

Torque Specifications

Description	Nm	lb-ft	lb-in
Dust Shield Bolts	10-14	—	89-124
Front Brake Anti-Lock Sensor Bolt	7-11	—	62-97
Front Shock Absorber to Lower Arm Nuts	21-29	15-21	—
Front Suspension Arm Lower Ball Joint Nut	113-153	83-112	—
Front Wheel Hub to Knuckle Bolts	100-130	74-96	—
Pinch Bolt	47-63	35-46	—
Tie Rod End Nut	60-80	44-59	—
Wheel Hub Nut	212-288	157-213	—
Torsion Bar Cover Plate Bolts	47-63	35-46	—
Upper Control Arm to Frame Mounting Bolts and Nuts	113-153	83-113	—
Lower Control Arm to Frame Mounting Bolts and Nuts	150-200	111-148	—
Front Stabilizer Bar to Frame Mounting Bolts and Nuts	34-46	25-34	—
Front Stabilizer Bar Link to Lower Control Arm Mounting Nut	21-29	15-21	—
Front Shock to Frame Mounting Nut	40-55	30-41	—
Jounce Bumper to Frame Nut	25-35	18-26	—

Front Suspension —AWD (4x4)

Front Suspension Components — AWD (4x4)



Item	Part Number	Description
1	3084	Front suspension upper arm (RH)
2	5B327	Torsion bar (LH)
3	5B326	Torsion bar (RH)
4	3091	Front suspension upper arm (LH)
5	3K207	Front wheel hub and knuckle
6	3B437	Front wheel driveshaft and joint (LH)
7	18045	Front shock absorber
8	3051	Front suspension lower arm (LH)
9	5494	Front stabilizer bar

Front Suspension —4x4

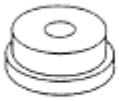
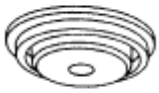
Refer to Section 204-00 .

Ride Height

For additional information, refer to Section 204-01A .

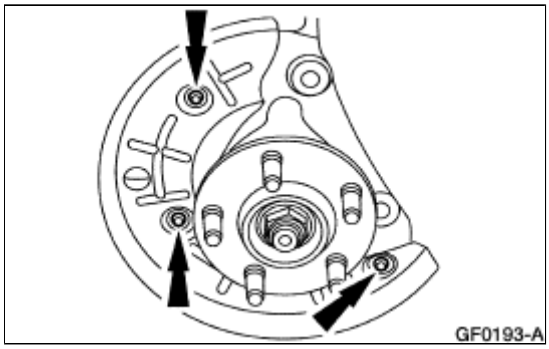
Wheel Hub

Special Tool(s)

 ST1359-A	Hub Bearing Cup Replacer 205-147 (T80T-4000-P)
 ST1153-A	Knuckle Seal Replacer 205-361 (T96T-1175-A)
ST1360-A	Threaded Drawbar 204-029 (T77F-1176-A)

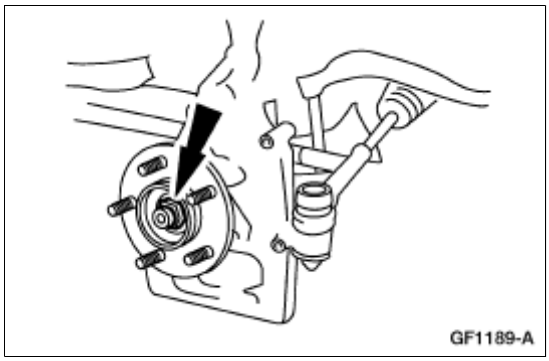
Removal

1. Remove the brake disc (1125). For additional information, refer to Section 206-03 .
2. Remove the three bolts and the dust shield.

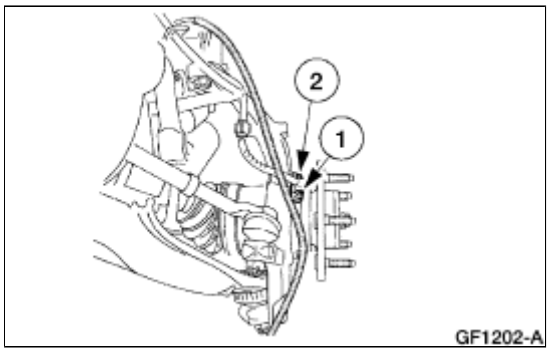

GF0193-A

3. **CAUTION: Discard the wheel hub retainer nut and washer assembly. It is a torque prevailing design and cannot be reused.**

   Remove the wheel hub retainer nut and washer assembly.



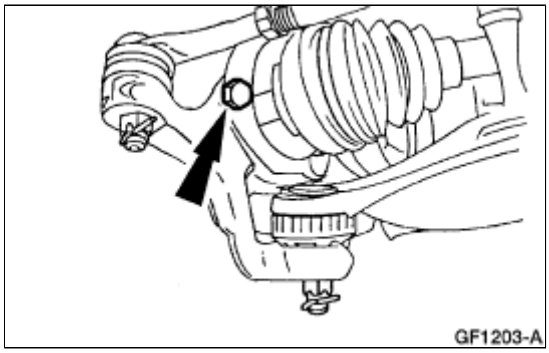
4. Remove the front brake anti-lock sensor (2C204).
    1. Remove the bolt.
    2. Remove the front brake anti-lock sensor.



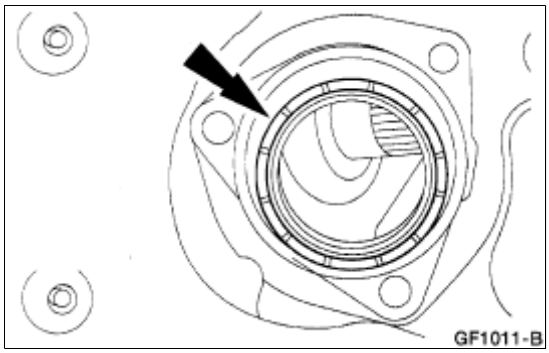
5. **CAUTION: Do not overextend CV joint and boots when removing the hub and bearing assembly.**

    NOTE: The CV joint is a slip fit into the wheel hub and bearing. A puller will not normally be required.

    Remove the three bolts and the wheel hub (1104).

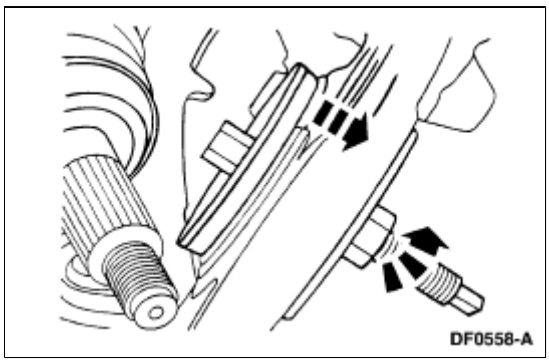


6. Remove the seal.

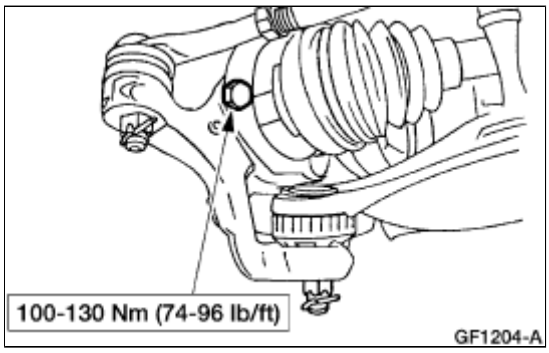


Installation

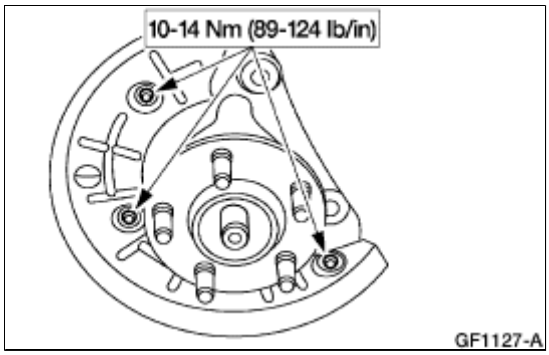
1. Install the seal.
    - Using the Knuckle Seal Replacer, Threaded Drawbar and Hub Bearing Cup Replacer, install the seal.



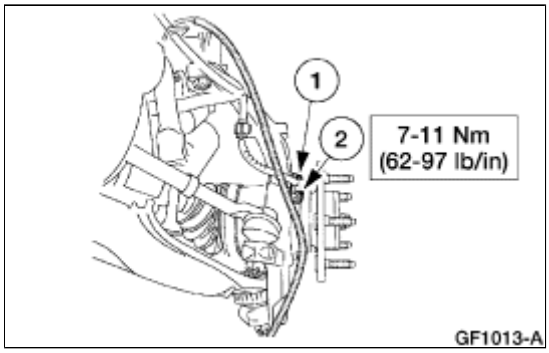
2. Install the wheel hub.
    - Position the wheel hub on the front wheel driveshaft and joint (3B437) and into the front wheel knuckle (3K185). Install the three bolts.



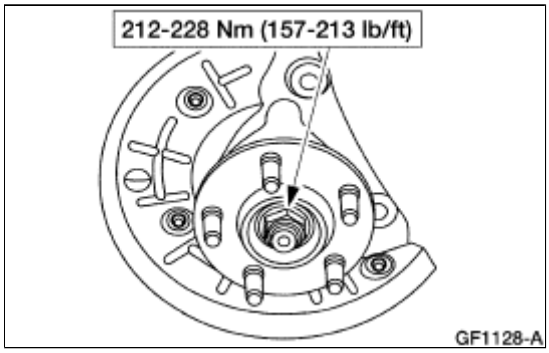
3. Install the dust shield.



4. Install the front brake anti-lock sensor.
    1. Position the front brake anti-lock sensor.
    2. Install the bolt.



5. Install the wheel hub retainer nut and washer assembly.



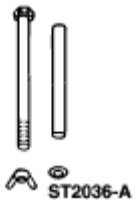
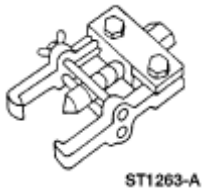
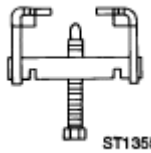
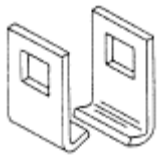
6. Install the brake disc. For additional information, refer to Section 206-03 .

Wheel Studs

For additional information, refer to Section 204-01A .

Wheel Knuckle

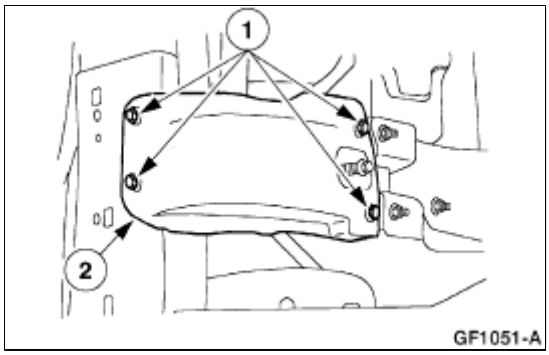
Special Tool(s)

 ST2036-A	Torsion Bar Tool Spacer 204-204 (T96T-5310-B)
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F)
 ST1355-A	Torsion Bar Tool 204-185 (T95T-5310-AR)
 ST1386-A	Torsion Bar Tool Adapters 204-203 (T96T-5310-A)

Removal

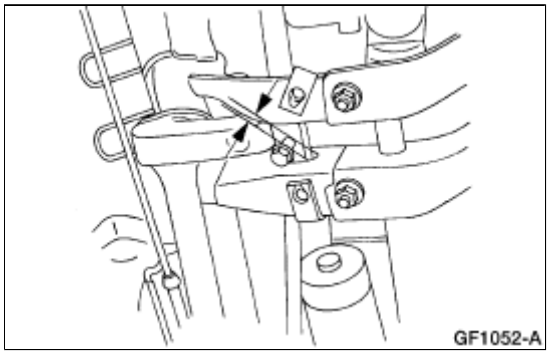
1. Remove the wheel hub (1104). For additional information, refer to Wheel Hub in this section.

2. Remove the torsion bar cover plate.
    1. Remove the retaining bolts.
    2. Remove the torsion bar cover plate.

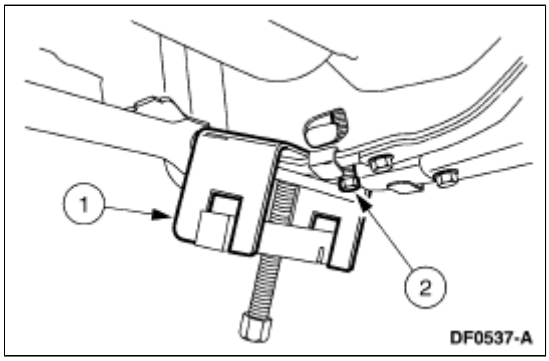


3. **NOTE:** Before relieving the torsion bar tensions, measure and record the measurement of the torsion bar adjustment bolt. This measurement will be used as the preset depth for the new torsion bar adjustment bolt during installation.

   Measure and record the length where indicated.

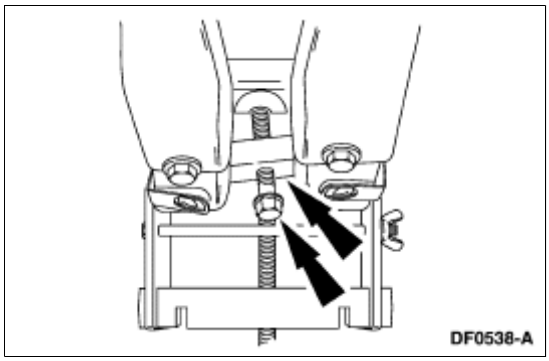


4. Relieve the torsion bar tension.
   1. Position the Torsion Bar Tool and the adapters.
   2. Tighten the Torsion Bar Tool until the torsion bar adjuster lifts off of the adjustment bolt.

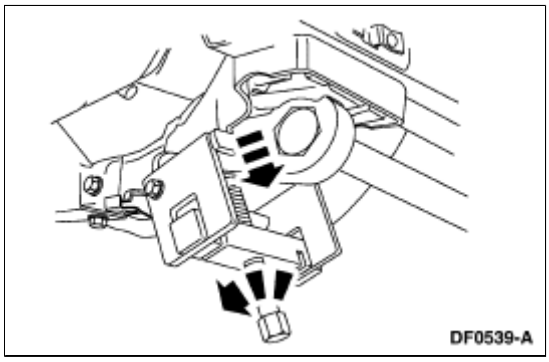


5. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive. A new bolt must be installed if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and result in a loss of vehicle alignment.**

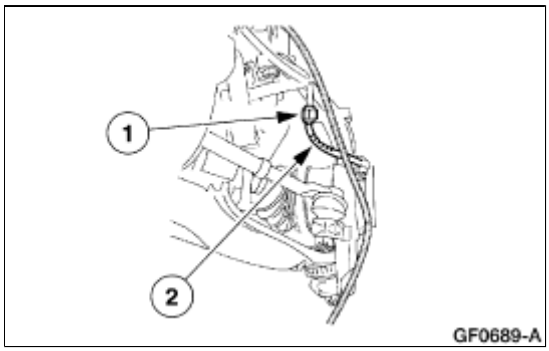
   Remove the torsion bar adjustment bolt and nut.



6. Loosen the torsion bar adjustment tool until the tension is off the torsion bar.



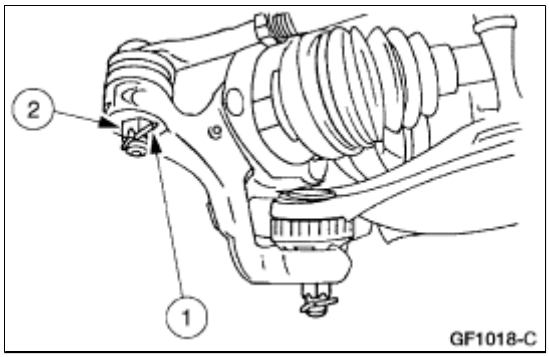
7. Reposition the anti-lock sensor wire.
    1. Remove the front brake anti-lock sensor wire bracket bolt.
    2. Reposition the anti-lock sensor wire.



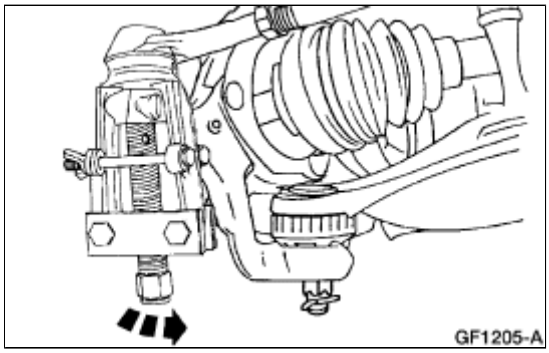
8. **CAUTION: Secure the front axle shaft to prevent it from overextending. Failure to do so can cause damage to the front axle shaft.**

    Suspend the front axle shaft with wire.

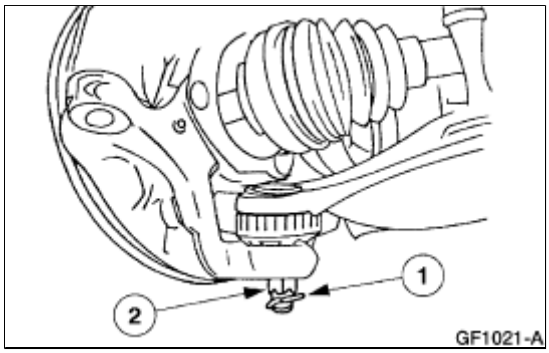
9. Remove the tie-rod end castellated nut.
    1. Remove the tie-rod end cotter pin.
    2. Remove the tie-rod end castellated nut.



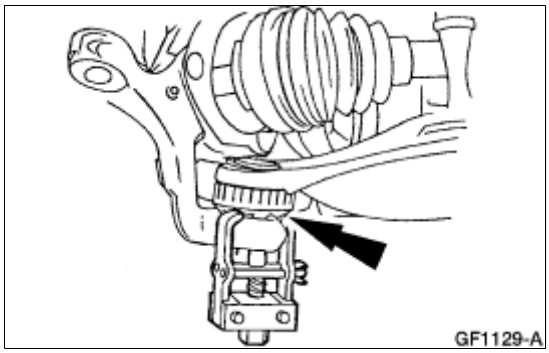
10. Use the Pitman Arm Puller to separate the tie-rod end (3A130).
    - Separate the tie-rod end from the front wheel knuckle (3K185).



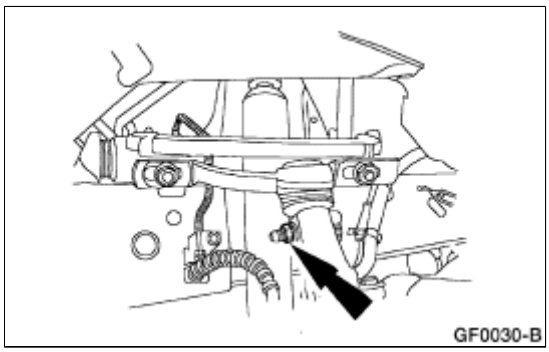
11. Remove the lower ball joint castellated nut.
    1. Remove the lower ball joint cotter pin.
    2. Remove the lower ball joint castellated nut.



12. Use the Pitman Arm Puller to separate the front wheel knuckle from the front suspension lower arm.



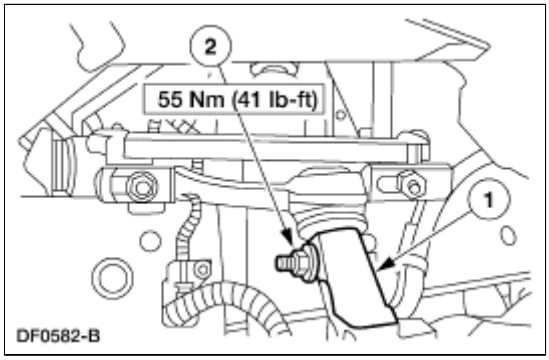
13. Remove the pinch bolt.



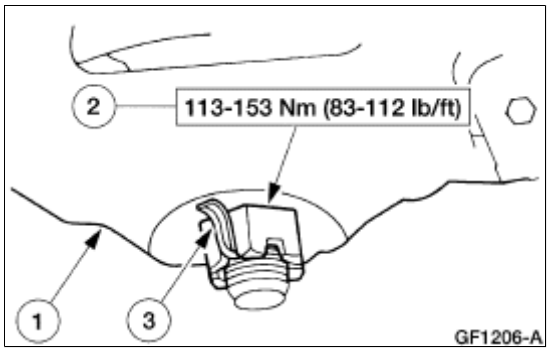
14. Remove the front wheel knuckle.

Installation

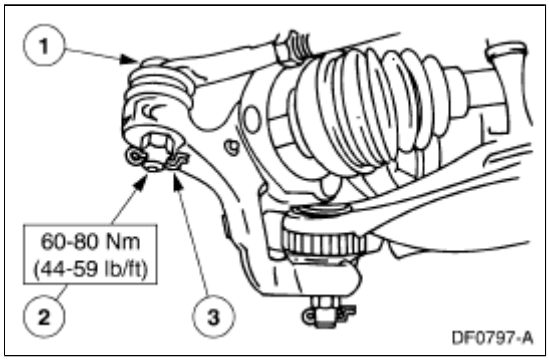
1. Install the front wheel knuckle pinch bolt and nut.
    1. Position the front wheel knuckle on the front suspension upper arm.
    2. Install the pinch bolt and nut.



2. Install the front suspension arm lower ball joint castellated nut.
    1. Position the front wheel knuckle.
    2. Install the castellated nut.
    3. Install a new cotter pin.

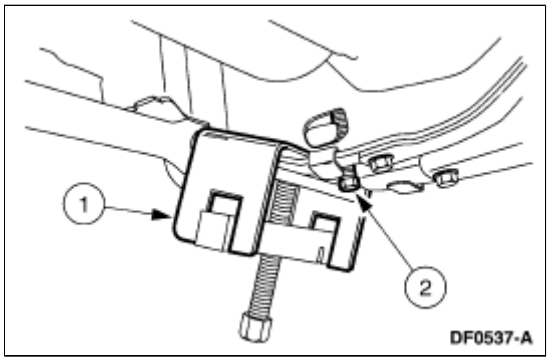


3. Install the tie-rod end castellated nut.
    1. Position the tie-rod end.
    2. Install the tie-rod end castellated nut.
    3. Install a new cotter pin.



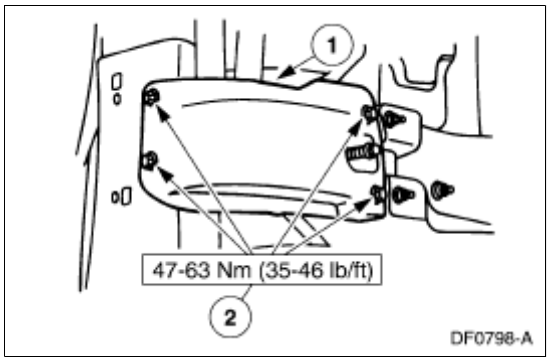
4. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive. A new bolt must be installed if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and result in a loss of vehicle alignment.**

    Preload the torsion bar.
    1. Tighten the Torsion Bar Tool until the new adjustment bolt and nut can be installed.
    2. Turn the adjustment bolt until preliminary adjustment marks are aligned.



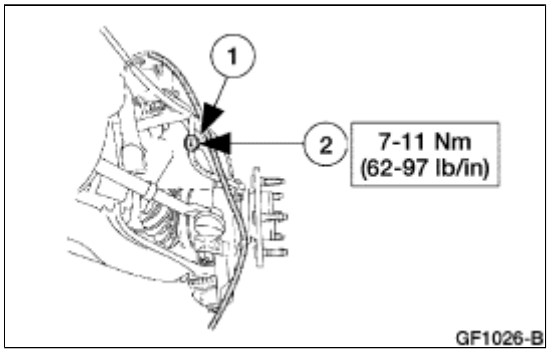
5. Remove the Torsion Bar Tool and adapters.

6. Install the torsion bar cover plate.
    1. Position the torsion bar cover plate.
    2. Install the retaining bolts.



7. Install the wheel hub. For additional information, refer to Wheel Hub in this section.

8. Install the anti-lock sensor wire bracket bolt.
   1. Position the anti-lock sensor wire.
   2. Install the bolt.



9. Adjust the ride height. For additional information, refer to Ride Height in this section.

10. Check the alignment. For additional information, refer to Section 204-00 .

Bushing —Control Arm

Removal and Installation

NOTE: The control arm bushings are not serviced separately. If the bushings require service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Lower in this section.

Removal and Installation

NOTE: The control arm bushings are not serviced separately. If the bushings require service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Upper in this section.

Bar —Stabilizer

Removal and Installation

For additional information, refer to Section 204-01A .

Ball Joint

Removal and Installation

NOTE: The ball joint is not serviced separately. If the ball joint requires service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Lower in this section.

Removal and Installation

NOTE: The ball joint is not serviced separately. If the ball joint requires service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Upper in this section.

Arm —Lower

For additional information, refer to Section 204-01A .

Arm —Upper

For additional information, refer to Section 204-01A .

Bar —Torsion

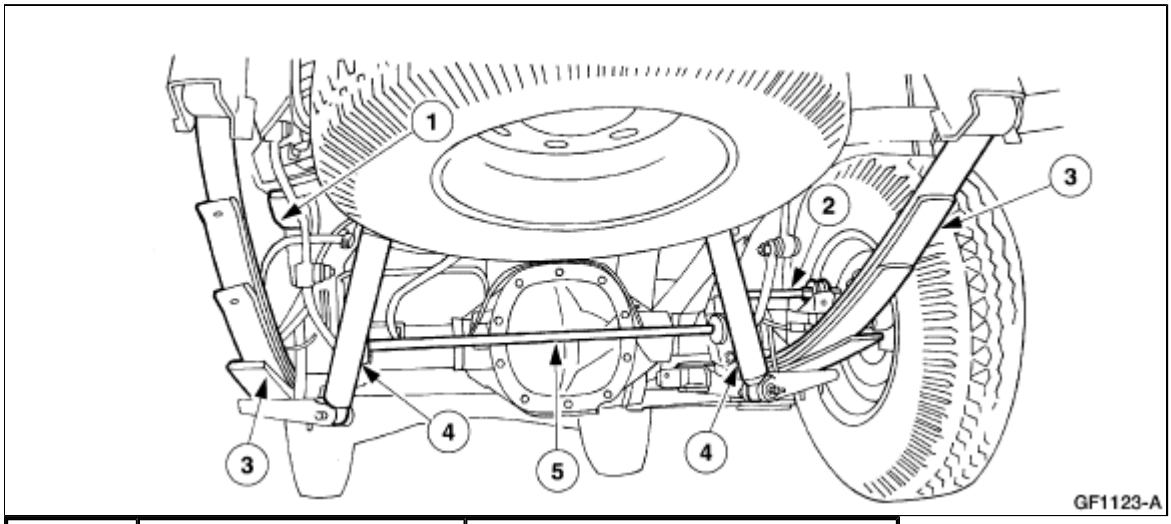
For additional information, refer to Section 204-01A .

Torque Specifications

Description	Nm	lb-ft
Anti-windup bar bolt	113-153	83-112
Rear spring shackle lower bolt and nut	115	85
Rear spring to front frame bracket bolt and nut	90	66
Rear spring U-bolt nut	103	76
Rear stabilizer bar mounting bracket nuts	40-55	30-40
Rear stabilizer bar-to-link nut	68-92	50-68
Wheel nuts	135	100
Jounce bumper nut	21-29	15-21
Shock absorber-to-frame nuts	23	17
Shock absorber lower bolt	63	46

Rear Suspension

Rear Suspension Components



Item	Part Number	Description
1	4730	Rear axle bumper
2	4A479	Anti-windup bar
3	5560	Rear spring
4	18080	Shock absorber
5	5A772	Rear stabilizer bar

Anti-Windup Bar (5.0L Only)

The anti-windup bar compensates for rotational torque placed on the rear axle (4001) during acceleration and braking by preventing the rear axle and rear spring (5560) from twisting (winding up).

The anti-windup bar minimizes noise and vibration issues caused by excessive pinion-to-driveshaft angles during acceleration and braking.

Rear Axle Bumpers

The rear axle bumpers (4730) are used to prevent metal-to-metal contact between the rear axle and the frame.

Rear Spring

Semi-elliptic, leaf-type rear springs are used for the rear suspension.

Shock Absorbers

The shock absorbers (18080) provide the necessary suspension dampening control.

Stabilizer Bar

The rear stabilizer bar (5A772) transmits forces to control vehicle roll during cornering.

Suspension Fasteners

New fasteners must be installed if the old fasteners are loosened or removed. They must be installed new with the same part number or an equivalent part if installation is necessary. Do not use a replacement part of lesser quality or substitute design. The specified torque value must be used during assembly to ensure correct part retention.

Load Leveling

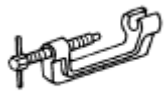
The load leveling system adjusts the suspension to accommodate quickly changing road conditions. The load leveling system is available on 4x4 vehicles. For additional information regarding the load leveling system, refer to Section 204-05 .

Rear Suspension

Refer to Section 204-00 .

Wheel Studs

Special Tool(s)

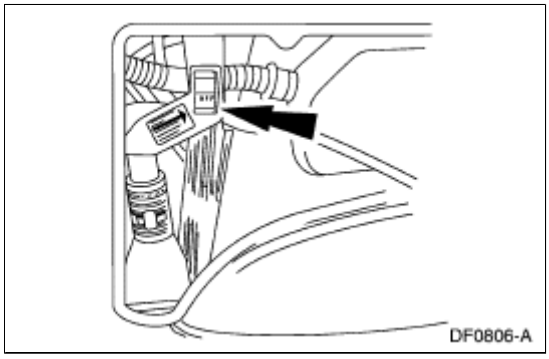
 ST1494-A	C-Frame and Clamp Assembly 211-023 (T74P-3044-A1)

Removal

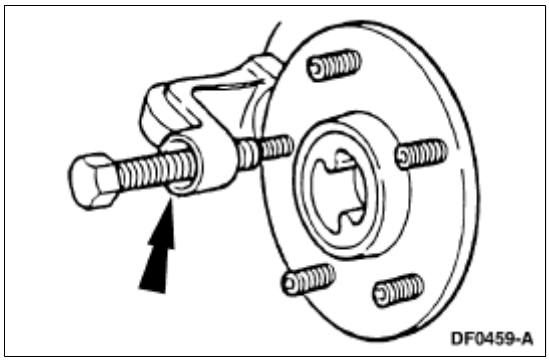
CAUTION: Never use a hammer to remove the wheel stud. Damage to the axle flange, hub flange, wheel bearing or hub bearing can result.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

   Turn the air suspension service switch off, if so equipped.

   
   DF0806-A

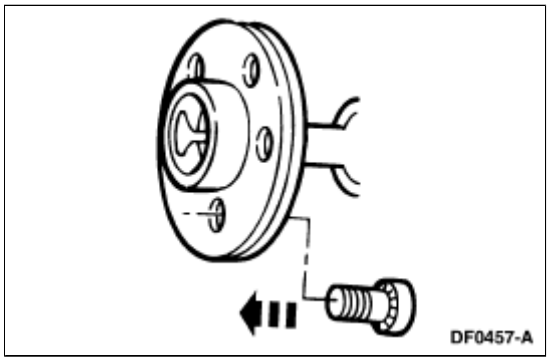
2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove the rear disc brake caliper (2552), rear disc support bracket (2B511) and brake disc (2C026) if so equipped. For additional information, refer to Section 206-04 . Support the rear disc brake caliper with safety wire.
5. Using the C-Frame and Clamp Assembly Tool, press the wheel stud from its seat and discard.



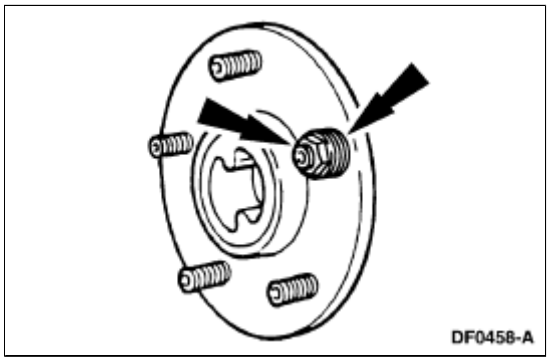
Installation

CAUTION: Never use air tools to install wheel studs. The serrations can be stripped from the stud.

1. Insert a new wheel stud in the hole in the axle flange, making sure the serrations are aligned with those made by the original wheel stud.



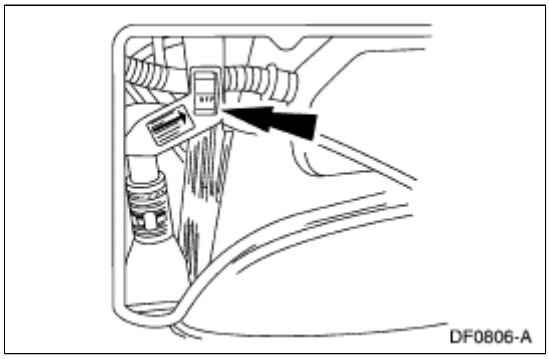
2. Seat new wheel studs in axle flange.
   - Place four flatwashers over the outside end of the wheel stud.
   - Thread a standard wheel nut with the flat side against the washers.
   - Tighten the wheel nut until the wheel stud head seats against the back side of the flange.



3. Remove the wheel nut and flatwashers.

4. Install the brake disc, rear disc support bracket and the rear disc brake caliper, if so equipped. For additional information, refer to Section 206-04 .

5. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .
6. Lower the vehicle.
7. Turn the air suspension service switch on, if so equipped.

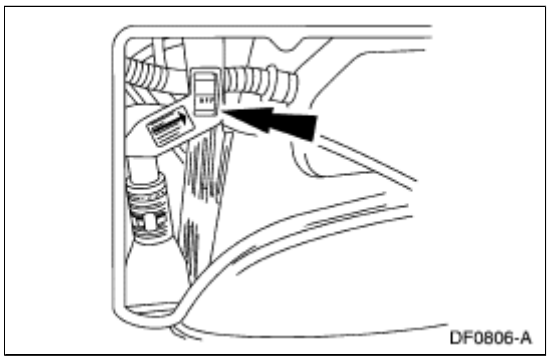


Bar and Link

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

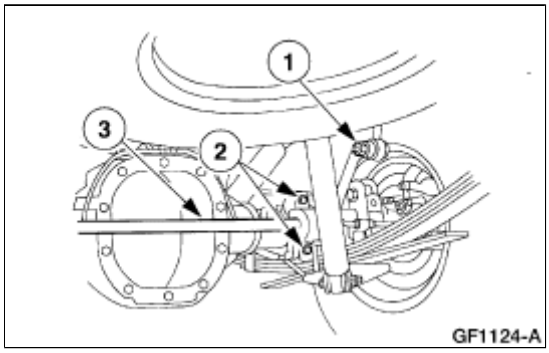
   Turn the air suspension service switch off, if so equipped.



2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .

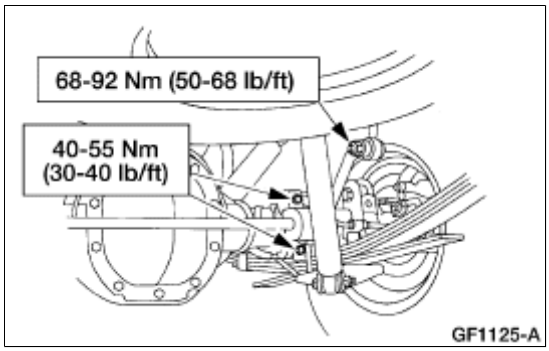
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

4. Remove the rear stabilizer bar (5A772).
   1. Remove the rear stabilizer bar link nut.
   2. Remove the two rear stabilizer bar mounting bracket nuts, and remove the bracket.
      - Repeat for the other side.
   3. Remove the rear stabilizer bar.



Installation

1. Follow the removal procedure in reverse order.


68-92 Nm (50-68 lb/ft)
40-55 Nm
(30-40 lb/ft)
GF1125-A

Spring

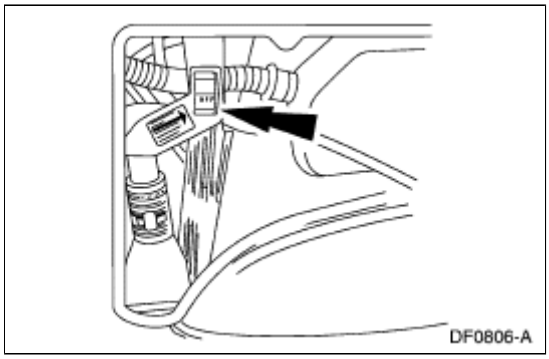
Special Tool(s)

ST1130-A	Hi-Lift Jack 014-00942 or Equivalent

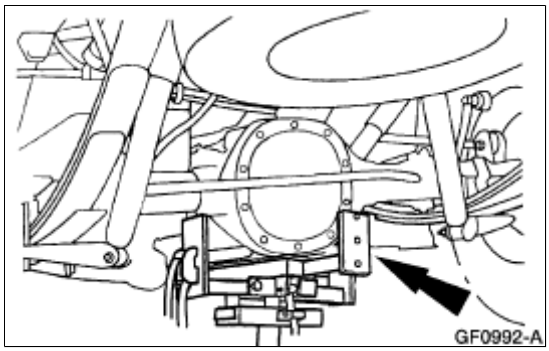
Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

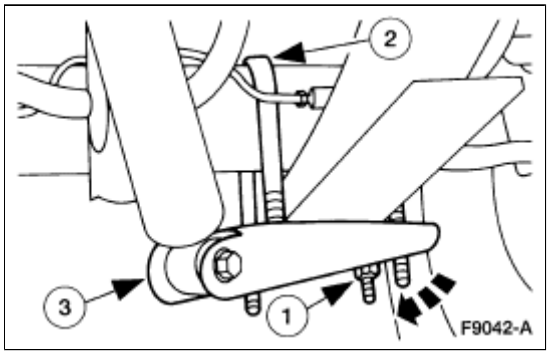
   Turn the air suspension service switch off, if so equipped.

   
   DF0806-A

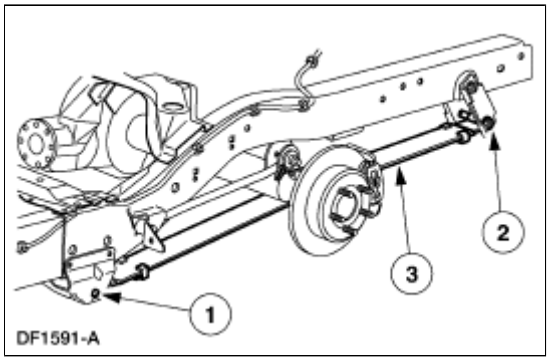
2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Use the Hi-Lift Jack to support the rear axle (4001).



5. Separate the rear spring (5560) from the rear axle.
    1. Remove the four nuts.
    2. Remove the two U-bolts.
    3. Position the rear spring plate (5796) aside.

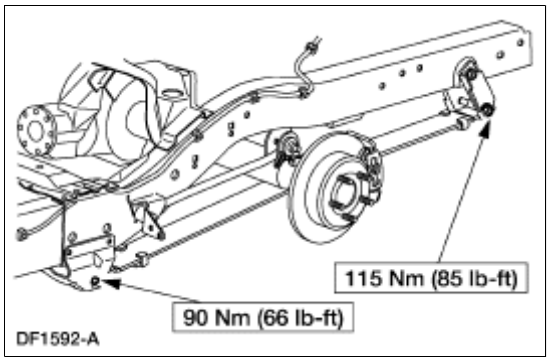


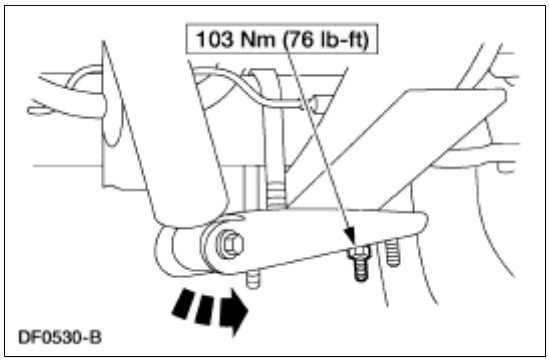
6. Remove the rear spring.
    1. Remove the bolt and nut.
    2. Remove the bolt and nut.
    3. Remove the rear spring.



Installation

1. To install, reverse the removal procedure.


115 Nm (85 lb-ft)
90 Nm (66 lb-ft)
DF1592-A


103 Nm (76 lb-ft)
DF0530-B

General Specifications

Item	Specification
Wheel stud and lug nuts (in)	1/2-20-19 mm hex
Tire Tread Depth	
P225/70R15 A/S	9.4 mm (0.37 in)
P235/75R15 A/T	10.7 mm (0.42 in)
P255/70R16 A/T	10.7 mm (0.42 in)
Wheel	
Machined aluminum	16x7
Chrome steel	15x7
Deep dish aluminum	15x7
Full face steel	15x7
Limited aluminum	16x7
Luxury aluminum	15x7
Maximum balance weight (total of inner and outer wheel flange)	170 g (6.0 oz)
Wheel offset	12 mm (0.48 in)
Wheel bolt circle runout	0.50 mm (0.02 in)
Tire Inflation	
Tires	See safety certification sticker located on driver door jamb.
Cleaners — Wheel	
Custom Bright Metal Cleaner 8A-19522-A	ESR-M5B194-B
Lubricant	Any silicon, lithium or graphite type

Wheel Rim Runout

Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.14 mm (0.045 in)	1.14 mm (0.045 in)
Steel	1.14 mm (0.045 in)	1.14 mm (0.045 in)

Tire Runout Specifications

Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.02 mm (0.040 in)	1.02 mm (0.040 in)
Steel	1.02 mm (0.040 in)	1.02 mm (0.040 in)

Torque Specifications

Description	Nm	lb-ft
Lug nuts	135	100

Wheel Leaks

1. Pinhole leaks in cast aluminum wheels compromise wheel integrity. Install a new wheel.

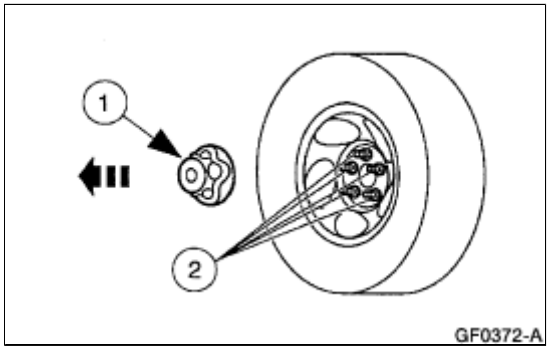
Wheel And Tire

Removal

1. **CAUTION: Do not use heat to loosen a seized wheel nut (1012). Heat can damage the wheel and wheel bearings.**

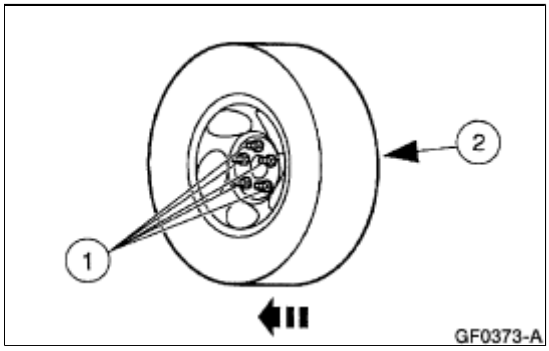
   NOTE: To avoid damage or scratching to the center cap, place facing up when removed.

   Loosen the wheel nuts.
   1. Remove the center cap.
   2. With the weight of the vehicle on the wheels, loosen the wheel nuts.



2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly.
   1. Remove the wheel nuts.
   2. Remove the wheel and tire assembly, using a side-to-side rocking motion.



Installation

1. **WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to**

come off while the vehicle is in motion, causing loss of control.

WARNING: Retighten at 800 km (500 miles) after any wheel change or any time the wheel nuts are loosened.

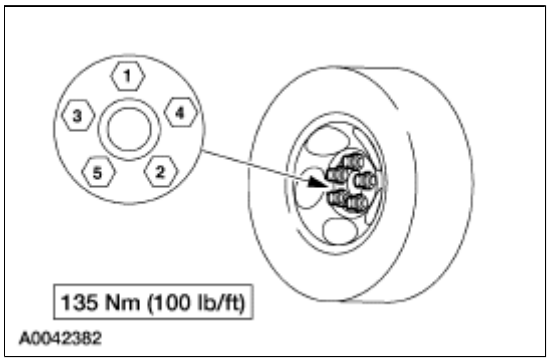
WARNING: Failure to retighten wheel nuts at the mileage specified could allow wheels to come off while the vehicle is in motion, possibly causing loss of vehicle control and collision.

Clean the wheel hub mounting surface and wheel pilot.

2. Install the tire and wheel assembly.
    1. Position the tire and wheel assembly.
    2. Install the wheel nuts hand-tight, then lower the vehicle.

3. **CAUTION: Failure to tighten the wheel nuts in a star pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

    Tighten the wheel nuts in a star pattern, using a torque wrench or torque sticks.



4. Install the center cap.

Torque Specifications

Description	Nm	lb-ft	lb-in
Air compressor assembly to frame mounting bolts	17-23	13-17	—
Air suspension switch mounting screw	10.2-13.8	—	91-123
Air suspension control module mounting screws	2-3	—	18-27
Air compressor drier screws	2-3	—	18-27
Rear height sensor upper and lower bracket nuts	7.5-10.5	—	67-93
Rear shock absorber lower mounting nut	53-72	39-53	—
Rear shock absorber upper nuts	19-26	14-19	—

Vehicle Dynamic Suspension

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking, or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

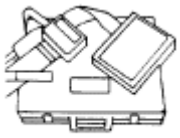
The vehicle dynamic suspension system consists of the following components:

- Air compressor (5319)
- Air suspension control module (5A919)
- Air line
- Air suspension height sensor (5359)
- Air suspension switch (5K761)
- Brake pedal position (BPP) switch (13840)
- Compressor relay (14B193)
- Drier
- Generic electronic module (GEM)(14B205)
- Message center indicator (10D898)
- Powertrain control module (PCM)(12A650)
- Rear air shock absorbers (18080)
- Solenoid valves (5311)
- Steering sensor (18B015)

Vehicle Dynamic Suspension

Refer to Wiring Diagrams Cell 41 , Rear Load Leveling for schematic and connector information.

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1391-A	EEC-V 104-Pin Breakout Box or equivalent 418-049 (014-00950)
ST1176-A	Vacuum Tester or equivalent 014-R1054
ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST1177-A	88 Digital Multimeter or equivalent 105-R0053

Principles of Operation

Rear load leveling maintains rear vehicle height. The system uses one height sensor, a steering sensor, and other vehicle sensors to measure driver and road inputs. The system maintains vehicle height on the rear axle through the use of an air compressor, two air solenoids, various air lines, and the use of an air spring integrated inside each shock.

Driver inputs include braking, throttle position, steering rate and position.

The rear load leveling system regulates the pressure in each air shock by compressing and venting the system air. Increasing air pressure (compressing) raises the vehicle. Conversely, decreasing air pressure (venting) lowers the vehicle.

The sensor sends a voltage signal to the air suspension control module. The output ranges from approximately 4.75 volts at minimum height (when the vehicle is low or in full jounce), to 0.25 volts at maximum height (when the vehicle is high or in full rebound). The sensor has useable range of 80 mm (3 inches) compared to total suspension travel of 200-250 mm (8 to 10 inches) at the wheel. Therefore, the sensor is mounted inside the wheels at a point where full suspension travel at the wheel is relative to 80 mm (3 in) of travel at the height sensor. The height sensor is not repairable.

NOTE: The compressor motor contains a thermal overload circuit breaker. The circuit breaker automatically turns the compressor off if tripped by excessive temperature. The air compressor will operate normally after it is allowed to cool.

The air compressor assembly:

- Consists of a single cylinder, electric motor driven compressor pump and vent solenoid; neither are repairable.
- Is mounted above the spare tire in the rear of the vehicle.
- Is powered by a relay, controlled by the air suspension control module.
- Passes pressurized air through the air compressor drier that contains silica gel (a drying agent). Moisture is then removed from the air compressor drier when vented air passes through the drier and out of the system during vent operation.

The vent solenoid valve:

- Is enclosed in the air pump head casting, which forms an integral valve housing that allows the valve tip to enter the pressurized side of the system.
- Opens when the air suspension control module determines lowering is required.
- Releases pressurized air when system pressures exceed safe operating levels.

The air suspension switch provides power to the control module in the ON (closed) position only. When OFF, the rear load leveling system will not function.

The steering sensor is mounted inside the passenger compartment on the steering column. It provides steering rate and position to the control module through two signals: Steering Sensor A and Steering Sensor B.

The rear fill solenoid connects the output of the compressor assembly to the two rear air shocks. When energized along with the rear gate solenoid, air pressure to the rear air shocks can be modified, affecting axle height relative to the body. The rear gate solenoid provides pneumatic isolation of the left and right sides of the vehicle, when lateral loads are detected by the air suspension control module and in response to steering and vehicle speed.

A microcontroller-based electronic air suspension control module controls the air compressor motor and all system solenoids. The module also provides power to the rear height sensor. The air suspension control module controls vehicle height adjustments by monitoring one height sensor, vehicle speed, a steering sensor, acceleration input, the door ajar signal, two transfer case signals, and the brake pedal position (BPP) switch. The module also conducts all failsafe and diagnostic strategies and contains self-test and communication software for testing of the vehicle and module.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Restricted suspension movement
• Excessive vehicle load
• Crimped, kinked, or leaking air line
	• Air suspension switch is OFF
	• Battery junction box (BJB) Fuse:
	  ▪ 8 (20A)
	  ▪ 9 (40A)
	• Central junction box (CJB) Fuse:
	  ▪ 9 (7.5A)
	  ▪ 10 (7.5A)
	• Loose connectors
	• Corroded connectors
	• Damaged solenoid valve

3. If the inspection reveals an obvious concern that is readily repaired, correct the concern before continuing with Inspection and Verification.

4. If the concern remains after the inspection, use scan tool connected to the data link connector (DLC) (located below the steering column) to retrieve continuous diagnostic trouble codes (DTCs) and to execute the air suspension control module diagnostics.
   - If the air suspension control module diagnostics passed and no DTCs are retrieved, go to Symptom Chart to continue diagnostics.
   - If DTCs are retrieved, go to Air Suspension Control Module Diagnostic Trouble Code (DTC) Index in this section.
   - If the air suspension control module cannot be accessed by scan tool, go to Pinpoint Test A.

Rear Load Leveling System Does Not Seem To Be Working

This test is used to determine if all inputs to the air suspension control module are connected and functioning. If one or any combination of inputs is not connected correctly, the vehicle may feel excessively harsh or bouncy. Also, the system may not raise or lower the vehicle correctly.

To set up the vehicle for the test, carry out the following:

5. Connect scan tool to the data link connector (DLC).

6. Monitor the following PIDS using the scan tool PID Monitor screen:
   - VSS_ARC.
   - IGN_RUN.
   - STEER_A.
   - STEER_B.
   - BOO_ARC.
   - DR_OPEN.
   - PCM_ACC.

7. Configure the air suspension control module:

- Vehicle stopped.
- Ignition switch in the ON position.
- Regular brake not applied.
- All doors closed, including rear tailgate and tailgate glass.
- No throttle.

Air Suspension Control Module Diagnostics

1. Connect Battery Charger to the vehicle. Use of the air compressor will drain the battery if it runs for extended times.

2. Prepare the vehicle.
   - Open any door.

3. Connect scan tool to the DLC.

4. Run the On-Demand Self-Test.

5. Retrieve all DTCs.

6. Clear all DTCs.

7. **CAUTION: If the air compressor runs in this test, do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.**

   Use the following active commands to raise the vehicle. Run the compressor for 30 seconds.
   - REAR FILL.
   - GATEVALVE.
   - COMPRESSR.

8. Use the following active commands to lower the vehicle. Lower the vehicle for 30 seconds.
   - REAR FILL.
   - GATEVALVE.
   - VENT.

9. Retrieve all DTCs.

10. Clear all DTCs.

Air Suspension Control Module Diagnostic Trouble Code (DTC) Index

Air Suspension Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1318	Battery Voltage Low	Air Suspension Control Module	GO to Pinpoint Test J .

B1342	ECU Is Defective	Air Suspension Control Module	GO to Pinpoint Test K.
B1485	Brake Pedal Position Switch Input Short to Battery	Air Suspension Control Module	GO to Pinpoint Test L.
B1565	Door Ajar Input Short to Power	Air Suspension Control Module	GO to Pinpoint Test M.
C1439	Acceleration Input Signal Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test B.
C1724	Height Sensor Power Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test C.
C1726	Rear Pneumatic Failure	Air Suspension Control Module	GO to Pinpoint Test D.
C1760	Rear Height Sensor Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test E.
C1770	Vent Solenoid Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test F.
C1830	Air Compressor Relay Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test G.
C1865	Rear Fill Solenoid Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test H.
C1869	Rear Gate Solenoid	Air Suspension Control Module	GO to Pinpoint Test I.

Air Suspension Control Module Parameter Identification (PID) Index

Air Suspension Control Module Parameter Identification (PID) Index

PID	Description	Expected Values
AS_COMP	Compressor Relay Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
AS_GATE	Front Gate Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
AS_VENT	Vent Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
BOO_ARC	Brake Pedal Position Switch Input	ON, OFF
CCNTARC	Number Of Continuous DTCs Counted by the air suspension control Module	one count per bit
DR_OPEN	Door Ajar Input	OPEN, CLOSED
HGTSENS	Height Sensor	ON, OFF
IGN_RUN	Detection of Ignition Switch in the RUN Position	RUN, notRUN
OFF ROAD	Vehicle Off Road Status	ON, OFF
PCM_ACC	Acceleration Signal From the Powertrain Control Module (PCM)	YES, NO
R_FILL	Rear Fill Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G

RASGATE	Rear Gate Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
RHGTSEN	Rear Height Sensor	#.## VDC
STEER_A	Steering Rotation Sensor A	LOW, HIGH
STEER_B	Steering Rotation Sensor B	LOW, HIGH
VBATARC	Battery Voltage Value	##.# VDC
VSS_ARC	Vehicle Speed Signal Input	### MPH

Air Suspension Control Module Active Command Index

Air Suspension Control Module Active Command Index

Active Command	Display	Action
AIR SUSPENSION MODULE	COMPRESSR	ON, OFF
	GATEVALVE	ON, OFF
	LR SMOTOR	ON, OFF
	LRSH FIRM	ON, OFF
	PWR CTRL	ON, OFF
	REAR FILL	ON, OFF
	RR SMOTOR	ON, OFF
	RRSH FIRM	ON, OFF
	VENT	ON, OFF

Intermittent Circuit Check

NOTE: The Intermittent Circuit Check cannot be started without erasing all stored DTCs. Record all DTCs or repair the fault(s) before starting the Intermittent Circuit Check.

1. Configure the vehicle:
   - Open any door.
   - Ignition switch is in the RUN position.
   - The vehicle is in PARK.
   - The brake pedal is fully depressed.
   - The accelerator pedal is fully depressed.

2. Connect scan tool.

3. Enter the PID monitor and select the following PIDs (make sure that the listed states are displayed before continuing):

PID	State
IGN_RUN	RUN
STEER_A	HIGH
STEER_B	HIGH
BOO_ARC	ON

DR_OPEN	AJAR
PCM_ACC	YES

4. Enter scan tool "I/O Circuit Check" in the air suspension control module menu. All inputs should indicate NO CHANGE. If not, then restart the I/O Circuit Check.

5. Wiggle the wire harness for the selected circuits, without disturbing the vehicle configuration.

6. If any PIDs indicate CHANGED, an intermittent fault exists near the location of the wiggling of the wire harness. REPAIR the circuits as necessary.

Symptom Chart

Symptom Chart

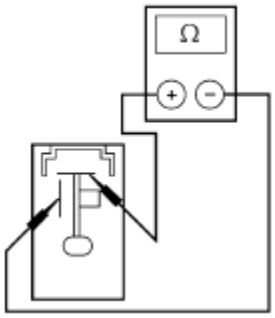
Condition	Possible Sources	Action
• No communication with the air suspension control module	• Circuitry. • Wiring connector. • Air suspension switch. • Ignition switch. • CJB Fuse 10 (7.5A) • BJB Maxi-Fuse 8 (20A)	• GO to Pinpoint Test A .
• Uneven vehicle height	• Rear pneumatic fault. • Rear height sensor(s). • Rear fill solenoids. • Rear gate solenoid. • Air compressor assembly. • Rear shock absorber.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• Vehicle rises too slowly	• Rear pneumatic fault. • Air compressor assembly.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• Vehicle drops too slowly	• Rear pneumatic fault. • Air compressor assembly.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• The air suspension system is inoperative	• Circuitry. • Ignition switch. • Steering wheel rotation sensor.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to

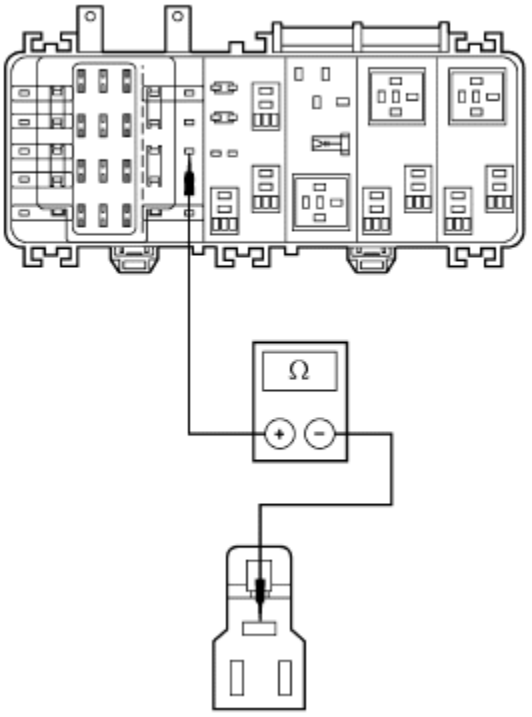
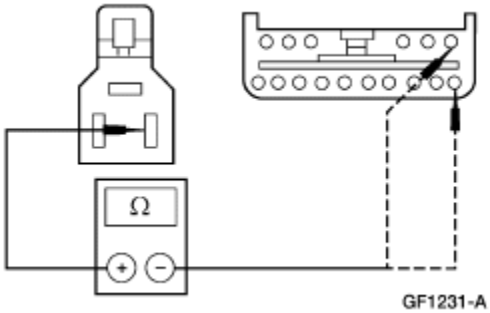
	• Brake pedal position (BPP) switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	Pinpoint Test N .
• The air suspension system is inoperative — ride height changes unexpectedly	• Circuitry. • Ignition switch. • Steering wheel rotation sensor. • BPP switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test N .
• The air suspension system is inoperative — vehicle changes height with the door open	• Circuitry. • Ignition switch. • Steering wheel rotation sensor. • BPP switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test N .
• The air suspension system operates with the air suspension switch in the OFF position	• Circuitry. • Air suspension control module. • Air Suspension Switch.	• GO to Pinpoint Test O .
• The air compressor continuously cycles with the ignition switch in the OFF position	• Circuitry. • Air compressor relay.	• GO to Pinpoint Test P .
• Excessive air compressor noise	• Compressor assembly wiring. • Air compressor mounting and bracket. • Air compressor assembly.	• GO to Pinpoint Test Q .

Pinpoint Tests

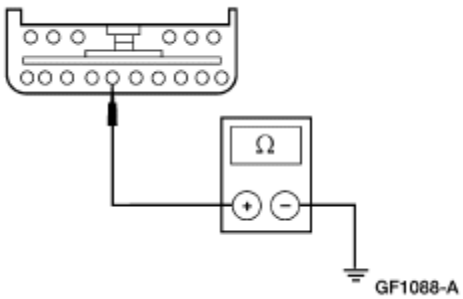
PINPOINT TEST A: NO COMMUNICATION WITH THE AIR SUSPENSION CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK WIRING HARNESS AND CONNECTORS	
1 Scan Tool	2 Check the wiring harness and connector on scan tool and data link connector (DLC) for damage. • **Is the connector and wiring okay?** → **Yes** GO to A2. → **No** REPAIR C291 or wiring to scan tool. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A2 CHECK AIR SUSPENSION SWITCH POSITION	
	1 Check the position of the air suspension switch. • **Is the air suspension switch in the ON position?** → **Yes** GO to A3. → **No** TURN the air suspension switch to the ON position. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A3 CHECK IGNITION SWITCH POSITION	
NOTE: Air suspension control module will provide communication for 40 minutes after the ignition switch is turned off.	
	1 Check the position of the ignition switch.

	• **Is the ignition switch in the RUN position?** → **Yes** GO to A4 . → **No** TURN the ignition switch to the RUN position. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A4 CHECK AIR SUSPENSION SWITCH	
1 2 Air Suspension Switch C412 3  GF1083-A	3 Measure the resistance between air suspension switch Pin 1 (component side), and air suspension switch Pin 2 (component side), with the switch in both positions. • **Is the resistance with the air suspension switch ON, less than 5 ohms; and greater than 10,000 ohms with the air suspension switch OFF?** → **Yes** GO to A5 . → **No** INSTALL a new air suspension switch; REFER to Module . REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A5 CHECK CIRCUIT 418 (DG/YE) FOR AN OPEN	
1	

 Air Suspension Control Module 2  GF1870-A 3  GF1231-A	2 Measure the resistance between BJB Maxi-Fuse 8 (20A) Pin 2, Circuit 418 (DG/YE), harness side and air suspension switch C412 Pin 1, Circuit 418 (DG/YE), harness side. 3 Measure the resistance between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and air suspension control module C2001 Pin 1, Circuit 418 (DG/YE), harness side; and between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side. • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR the circuit. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

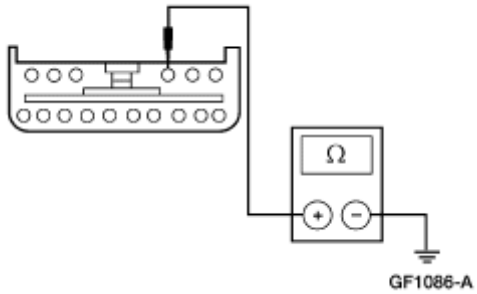
PINPOINT TEST B: DTC C1439, ACCELERATION INPUT SIGNAL CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CARRY OUT ON-DEMAND SELF-TEST	
NOTE: The accelerator pedal should not be touched during On-Demand Self-Test.	
2 On-Demand Self-Test	1 Open any door. • **Is DTC C1439 retrieved?** → **Yes** GO to B2 . → **No** REPEAT On-Demand Self-Test and REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
B2 CHECK CIRCUIT 394 (OG/BK) SHORT TO GROUND	
1 2 Air Suspension Control Module C2001 3 PCM C202 4  	4 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

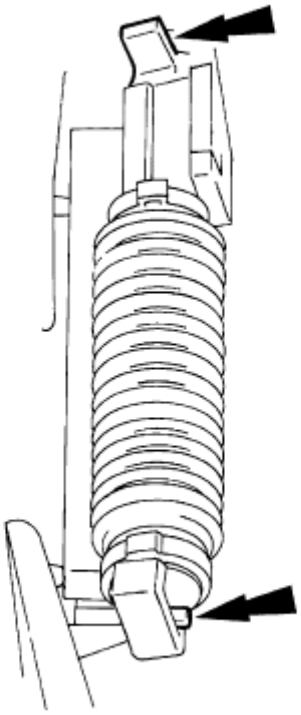
PINPOINT TEST C: DTC C1724, HEIGHT SENSOR POWER CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC C1724 retrieved?** → **Yes** GO to C2 . → **No** CHECK for intermittent short to ground in circuit 431 (PK/WH); GO to Intermittent Circuit Check. TEST the system for normal operation.
C2 CHECK CIRCUIT 431 (PK/WH) FOR SHORT TO GROUND	
1 3 Air Suspension Control Module C2000 4	2 Turn the air suspension switch to the OFF position. 4 Measure the resistance between air

	suspension control module C2000 Pin 28, Circuit 431 (PK/WH), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST D: DTC C1726, REAR PNEUMATIC FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CARRY OUT REAR COMPONENT INSPECTION	
	1 Inspect the rear suspension components for damage, obstructions, or other mechanical failures. • **Are any components damaged or obstructed?** → **Yes** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D2 .
D2 INSPECT REAR HEIGHT SENSOR	
1	1 Inspect the rear height sensor for correct installation at the upper and lower ball stud brackets.



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2 Inspect the upper and lower mounting brackets for damage.

- **Is the height sensor and mounting bracket installed correctly and undamaged?**

→ **Yes**
GO to D3 .

→ **No**
REPAIR or INSTALL a new rear height sensor and mounting bracket as needed. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

D3 CHECK REAR HEIGHT SENSOR GROUND

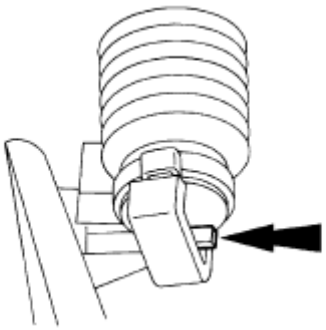
1

Scan Tool

2 Monitor the air suspension control module PID RHGTSEN.

3

3 Disconnect the rear height sensor from the lower mounting ball stud.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4 Slowly extend and compress the rear height sensor over the full range of travel.

- **Does the voltage increase as the rear height sensor is compressed, and decrease as the rear height sensor is extended?**

→ **Yes**
GO to D4 .

→ **No**
REPAIR circuit 570 (BK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

D4 VERIFY REAR PNEUMATIC CIRCUIT CAN RISE

CAUTION: Do not let the air compressor run for more than three minutes at a time.

1

2 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON.

3 Allow the rear of the vehicle to rise for 30 seconds.

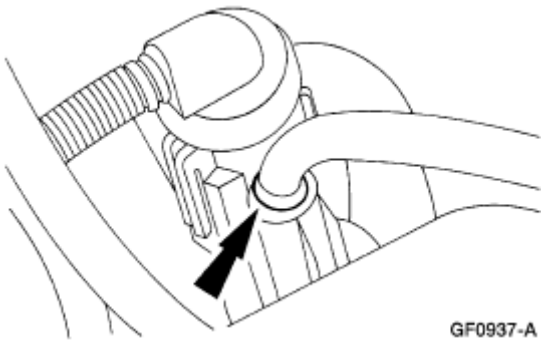
4 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF.

- **Does the rear of the vehicle rise and hold the higher position?**

→ **Yes**
GO to D5 .

→ **No**

	GO to D6 .
D5 VERIFY REAR PNEUMATIC CIRCUIT CAN LOWER	
NOTE: There must be air in the rear shocks for this test to work.	
	1 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and VENT ON. 2 Allow the rear of the vehicle to lower for 30 seconds. • **Does the rear of the vehicle lower?** → **Yes** CHECK and RESET rear mechanical ride height. CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and VENT OFF. GO to D14 .
D6 CHECK OPERATION OF AIR COMPRESSOR	
CAUTION: If the air compressor runs in this test, do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active command COMPRESSR ON. • **Does the compressor run (slight buzzing noise from the rear of the vehicle)?** → **Yes** Toggle the air suspension control module active command COMPRESSR OFF. GO to D7 . → **No** Toggle the air suspension control module active command COMPRESSR OFF. GO to Pinpoint Test R .
D7 CARRY OUT AIR COMPRESSOR LEAK TEST	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1	1 Disconnect the air line at the inlet to the rear



fill solenoid.

2 Connect an air pressure gauge with common fitting to the air line.

3 Toggle the air suspension control module active command COMPRESSR ON.

4 **NOTE:** Within 30 seconds, the pressure should reach 896 kPa (130 psi).

Monitor the air pressure gauge.

5 Toggle the air suspension control module active command COMPRESSR OFF.

6 **NOTE:** The pressure should hold steady.

Monitor the air pressure gauge for five minutes.

7 Toggle the air suspension control module active command VENT ON.

- **Did the air compressor reach and hold a minimum air pressure of 896 kPa (130 psi)?**

→ **Yes**
RECONNECT the air line. Toggle the air suspension control module active command VENT OFF. GO to D9 .

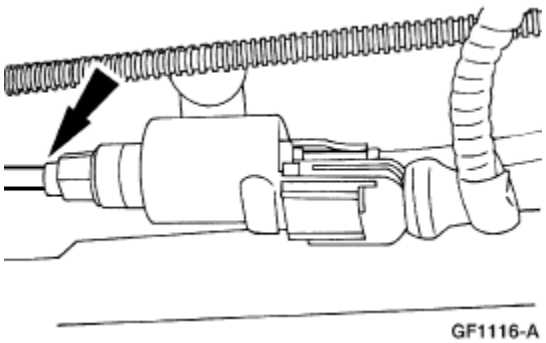
→ **No**
RECONNECT the air line. Toggle the air suspension control module active command VENT OFF. GO to D8 .

D8 CHECK AIR LINE TO FILL SOLENOIDS FOR LEAKS

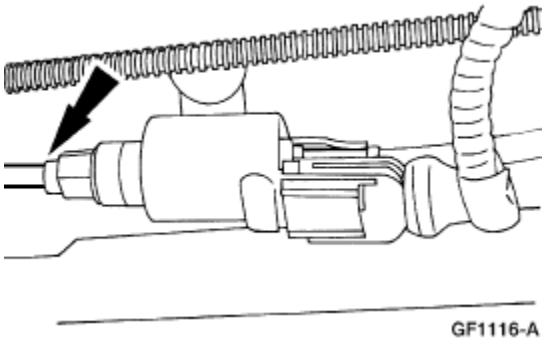
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.

1 Toggle the air suspension control module active command COMPRESSR ON.

2 Check the air line between the air compressor and the two fill solenoids for air leaks.

	3 Toggle the air suspension control module active command COMPRESSR OFF. • **Do any of the air lines leak?** → **Yes** REPAIR or INSTALL new air lines as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air compressor; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D9 CHECK REAR FILL SOLENOID OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1  GF1116-A	1 Disconnect the air line from the rear fill solenoid outlet. 2 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 3 Check for a smooth flow of air at the outlet of the rear fill solenoid. 4 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Is there a smooth flow of air without fluid flowing from the rear fill solenoid?** → **Yes** RECONNECT the air line. GO to D10 . → **No** If there is no air flow, INSTALL a new rear fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension

	Control Module Diagnostics. TEST the system for normal operation. If fluid (oil or water) is present in the air flow, PURGE the fluid from the system; REFER to Air Line Fluid Purge . If necessary, RECONNECT the air line. GO to D10 .
D10 CHECK REAR FILL SOLENOID AIR LINES	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 2 Check for air leaks, bends and kinks in the air lines. 3 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Are there any bends, kinks, or air leaks in the rear air lines?** → **Yes** REPAIR or INSTALL a new air line(s) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D11 .
D11 CHECK RIGHT REAR SHOCK ABSORBER OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 2 Observe the right rear corner of the vehicle. 3 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Does the right rear corner of the vehicle rise?** → **Yes** GO to D12 .

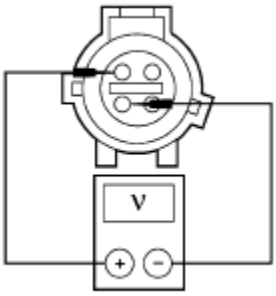
	→ **No** INSTALL a new RR air shock absorber; REFER to Air Shock Absorber—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D12 CHECK REAR GATE SOLENOID OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1  GF1116-A	1 Disconnect the air line from the rear gate solenoid outlet. 2 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON. 3 Check for a smooth flow of air at the outlet of the rear gate solenoid. 4 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF. • **Is there a smooth flow of air without fluid flowing from the rear gate solenoid?** → **Yes** RECONNECT the air line. GO to D13 . → **No** If there is no air flow, INSTALL a new rear gate solenoid. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. If fluid (oil or water) is present in the air flow, PURGE the fluid from the system; REFER to Air Line Fluid Purge . If necessary, RECONNECT the air line. GO to D13 .
D13 CHECK REAR GATE SOLENOID AIR LINE	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air	

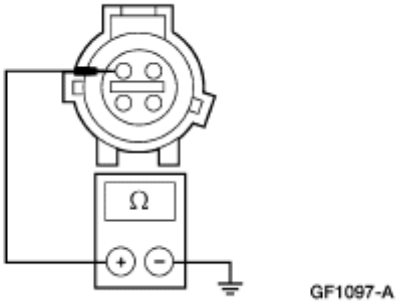
compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON. 2 Check for air leaks, bends and kinks in the air line between the rear gate solenoid and LR air shock absorber. 3 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF. • **Are there any bends, kinks, or air leaks in the rear air line?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new LR air shock absorber; REFER to Air Shock Absorber—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D14 CHECK FOR RESTRICTED AIR LINE (COMPRESSOR)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the air compressor air drier and the rear fill solenoid. 2 Connect Vacuum Tester to the air line and try to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D15 .
D15 CHECK FOR RESTRICTED AIR LINE (RR AIR SHOCK)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the rear gate solenoid and the RR air shock absorber. 2 Connect Vacuum Tester to the air line and try

	to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D16 .
D16 CHECK FOR RESTRICTED AIR LINE (REAR)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the rear gate solenoid and the rear fill solenoid. 2 Connect Vacuum Tester to the air line at the rear gate solenoid and try to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air compressor; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST E: DTC C1760, REAR HEIGHT SENSOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC C1760 retrieved?** → **Yes**

	GO to E2 . → **No** GO to E6 .
E2 CHECK HEIGHT SENSOR POWER	
1 2 Height Sensor C433 3 4  GF1093-A	4 Measure the voltage between height sensor C433 Pin 3, Circuit 431 (PK/WH), harness side and height sensor C433 Pin 1, Circuit 570 (BK/WH) harness side. • **Is the voltage approximately 5 volts?** → **Yes** GO to E4 . → **No** GO to E3 .
E3 CHECK HEIGHT SENSOR GROUND	
1	1 **NOTE:** Do not use sheet metal or frame as a ground for this test step. Measure the resistance between height sensor C433 Pin 1, Circuit 570 (BK/WH), harness side and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR Circuit 431 (PK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR Circuit 570 (BK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

E4 CHECK SUSPECT HEIGHT SENSOR OPERATION

1 Monitor the air suspension control module PID as appropriate.

2 Remove the height sensor from the lower ball stud.

3 While monitoring the RHGTSEN PID, slowly extend and compress the height sensor over the full range of travel.

- **Does the voltage increase as the sensor is compressed, and decrease as the sensor is extended?**

→ **Yes**
GO to E6 .

→ **No**
GO to E5 .

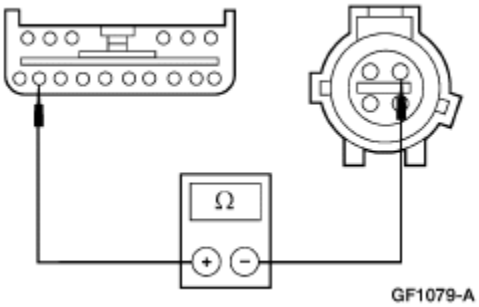
E5 CHECK CIRCUIT 422 (PK/BK) OR CIRCUIT 428 (OG/BK) FOR OPEN

1

2

Air Suspension Control Module C2001

3



3 Measure the resistance between rear height sensor C433 Pin 2, Circuit 428 (OG/BK), harness side and air suspension control module C2001 Pin 9, Circuit 428 (OG/BK), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new height sensor; REFER to Height Sensor—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR Circuit 422 (PK/BK) and Circuit 428 (OG/BK) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

E6 CHECK FOR INTERMITTENT OPEN

1 Monitor the air suspension control module PID RHGTSEN as appropriate.

2 Monitor the height sensor voltage while wiggling the harnesses between height sensor and air suspension control module.

- **Does the height sensor voltage indicate less than 0.2 volts?**

→ **Yes**
REPAIR Circuit 428 (OG/BK) and Circuit 431 (PK/WH) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
GO to E7 .

E7 CHECK FOR INTERMITTENT SHORT TO POWER	
	1 Monitor the air suspension control module PID RHGTSEN as appropriate. 2 Monitor the height sensor voltage while wiggling the harnesses between height sensor and air suspension control module. • **Does the height sensor voltage indicate more than 4.9 volts?** → **Yes** REPAIR Circuit 428 (OG/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new front height sensor; REFER to Height Sensor—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST F: DTC C1770, VENT SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC C1770 retrieved?** → **Yes** GO to F2 . → **No** GO to F10 .
F2 CHECK VENT SOLENOID CONNECTOR	
2	1 Turn the air suspension switch to the OFF position.

3

Air Compressor C430

4 Check the air compressor connector pins for damage, corrosion or pins that may be pushed out.

- **Are connector and pins OK?**

→ **Yes**
RECONNECT air compressor C430. GO to F3 .

→ **No**
REPAIR as necessary. CLEAR all DTCS. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT

1 Turn the air suspension switch to the ON position.

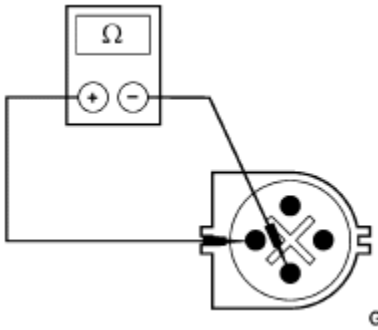
2

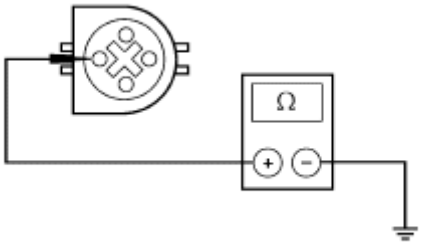
3 Select the air suspension control module active commands and activate the PID AS_VENT.

4 Use the air suspension control module active commands and activate the following commands in the given sequence:

- VENT to ON.
- REAR FILL to ON.
- VENT to OFF.
- REAR FILL to OFF.

- **Do the letters O, G, or B appear next to the ON/OFF text for the vent solenoid?**

	→ **Yes** If O appeared, GO to F4. If G appeared, GO to F7. If B appeared, GO to F9. → **No** GO to F10.
F4 CHECK VENT SOLENOID COIL FOR OPEN	
1 2 Air Compressor C430 3  	3 Measure the resistance between air compressor C430 Pin 4 (component side), and air compressor C430 Pin 2 (component side). • **Is the vent solenoid relay coil resistance less than 25 ohms?** → **Yes** GO to F5. → **No** INSTALL a new air compressor assembly; REFER to Air Compressor. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
F5 CHECK CIRCUIT 430 (GY) FOR OPEN	
1	1 Measure the resistance between air compressor C430 Pin 4, circuit 430 (GY), harness side and ground.



GF1082-A

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F6 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F6 CHECK CIRCUIT 421 (PK) FOR OPEN

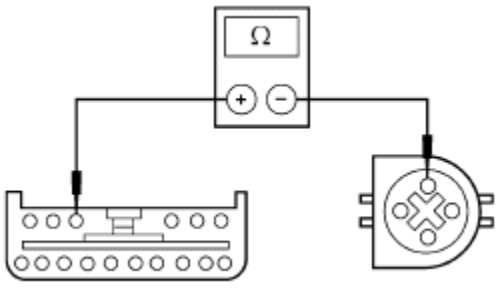
1 Turn the air suspension switch to the OFF position.

2

Air Suspension Control Module C2000

3 Measure the resistance between air suspension control module C2000 Pin 30, Circuit 421 (PK), harness side and air compressor C430 Pin 4, Circuit 421 (PK), harness side.

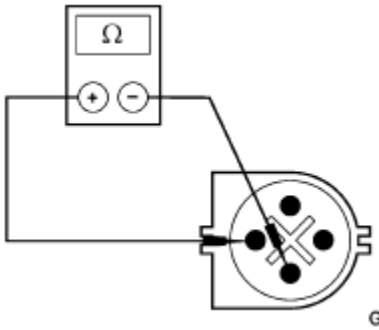
3

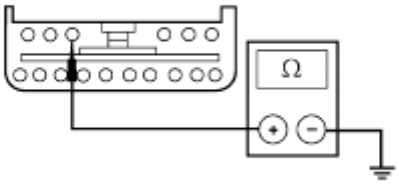


GF1588-A

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

	→ **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
F7 CHECK VENT SOLENOID FOR SHORT	
1 2 Air Compressor C430 3  GF1380-A	3 Measure the resistance between air compressor Pin 4 component side, and air compressor Pin 2 component side. • **Is the vent solenoid coil resistance greater than 25 ohms?** → **Yes** GO to F8 . → **No** INSTALL a new air compressor assembly; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
F8 CHECK CIRCUIT 421 (PK) FOR SHORT TO GROUND	
2 Air Suspension Control Module C2000 3	1 Turn the air suspension switch to the OFF position.



GF1212-A

3 Measure the resistance between air suspension control module C2000 Pin 30, Circuit 421 (PK), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F9 CHECK CIRCUIT 421 (PK) FOR SHORT TO POWER

1

2 Turn the air suspension switch to the OFF position.

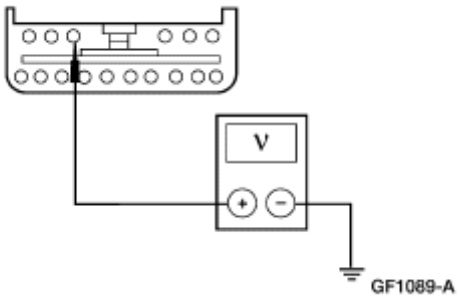
3

Air Suspension Control Module C2000

4 Turn the air suspension switch to the ON position.

5

6 Measure the voltage between air suspension control module module C2000 Pin 30, Circuit 421 (PK), harness side and ground.



- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F10 CHECK AIR COMPRESSOR ASSEMBLY CONNECTOR TERMINALS

1

2 Turn the air suspension switch to the OFF position.

3

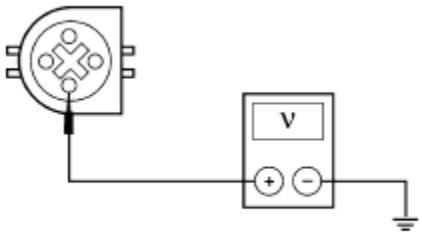
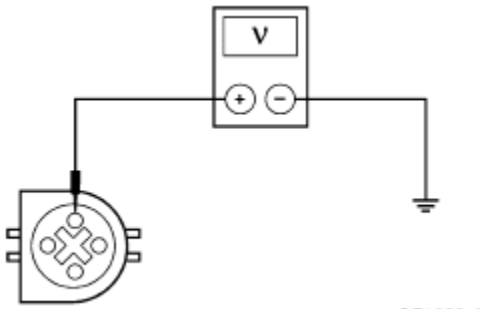
Air Compressor C430

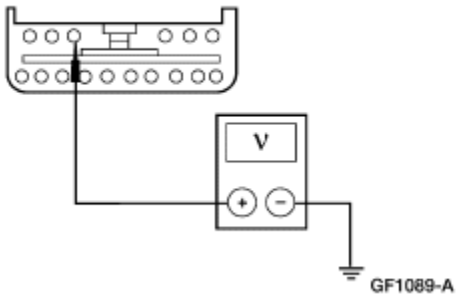
4 Inspect the pins of the air compressor connector for corrosion, bent or broken pins, moisture, or other damage.

- **Are the connectors and pins OK?**

→ **Yes**
GO to F11 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module

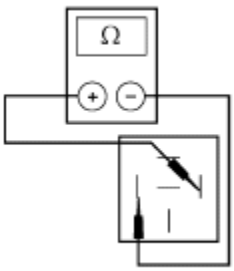
	Diagnostics. TEST the system for normal operation.
F11 CHECK CIRCUIT 421 (PK) FOR INTERMITTENT SHORT TO GROUND	
	1 Turn the air suspension switch to the ON position.
2	
	3 Toggle the air suspension control module active command VENT ON.
4  GF1092-A	4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between air compressor C430 Pin 4, Circuit 421 (PK), harness side and ground while wiggling the wiring harness between air suspension control C2000 and air compressor C430.
	• **Is the voltage recorded less than 10 volts?** → **Yes** Toggle the air suspension control module active command VENT OFF. REPAIR Circuit 421 (PK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** Toggle the air suspension control module active command VENT OFF. GO to F12 .
F12 CHECK CIRCUIT 421 (PK) FOR INTERMITTENT SHORT TO POWER	
1  GF1589-A	1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between air compressor C430 Pin 4, Circuit 421 (PK), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and air compressor C430.

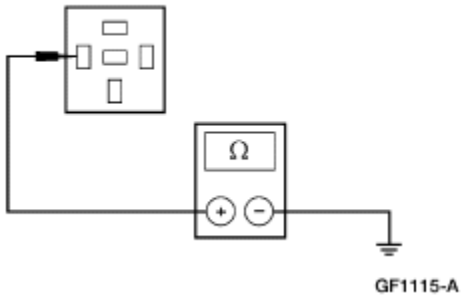
	• **Is voltage present?** → **Yes** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to F13 .
F13 CHECK INTERMITTENT MODULE FUNCTION	
1 	2 Turn the air suspension switch to the OFF position. 3 Remove Circuit 421 (PK) from air suspension control module C2000 Pin 30 (with connector connected to air suspension control module). 4 Turn the air suspension switch to the ON position.
5 	6 Toggle the air suspension control module active command VENT ON.
7 	7 Measure the voltage between air suspension control module terminal C2000 Pin 30 component side, Circuit 421 (PK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** Toggle the air suspension control module active command VENT OFF. INSERT circuit 421 (PK) back into air suspension control module connector C2000 Pin 30 cavity. GO to F14 .

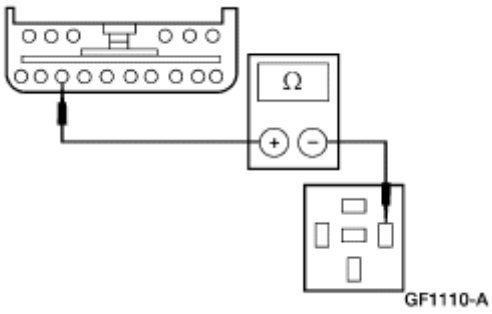
	→ **No** Toggle the air suspension control module active command VENT OFF. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
F14 CARRY OUT THE ROAD TEST	
	1 Monitor the air suspension control module PID AS_VENT. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle. • **Do the letters O, G, or B appear next to the ON/OFF text for AS_VENT?** → **Yes** If O appeared, GO to F4 . If G appeared, GO to F7 . If B appeared, GO to F9 . → **No** CLEAR all DTCs and REPEAT the road test.

PINPOINT TEST G: DTC C1830, AIR COMPRESSOR RELAY CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CARRY OUT ON-DEMAND SELF-TEST	
2 3 On-Demand Self-Test	1 Open any door. • **Is DTC C1830 retrieved?** → **Yes** GO to G2 .

	→ **No** GO to G9 .
G2 CARRY OUT AIR SUSPENSION CONTROL OUTPUT	
2 	1 Turn the air suspension switch to the ON position. 3 Select the air suspension control module active commands and activate the PID AS_COMP. 4 Use the air suspension control module active commands and toggle the COMPRESSR ON, and then OFF. • **Do the letters O, G, or B appear next to the ON/OFF text for COMPRESSR?** → **Yes** If O appeared, GO to G3 . If G appeared, GO to G6 . If B appeared, GO to G8 . → **No** GO to G9 .
G3 CHECK AIR COMPRESSOR RELAY COIL FOR OPEN	
1 2 Air Compressor Relay 3  GF1100-A	3 Measure the resistance between air compressor relay Pin 85 component side, and air compressor relay Pin 86 component side.

	• **Is the resistance less than 90 ohms?** → **Yes** GO to G4 . → **No** INSTALL a new air compressor relay. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G4 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GF1115-A	1 Measure the resistance between air compressor relay connector Pin 85, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to G5 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G5 CHECK CIRCUIT 420 (DB/YE) FOR OPEN	
2 Air Suspension Control Module C2000 3	1 Turn the air suspension switch to the OFF position. 3 Measure the resistance between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and air compressor relay connector Pin 86, Circuit 420 (DB/YE), harness side .



- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

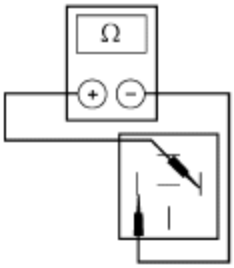
G6 CHECK AIR COMPRESSOR RELAY COIL FOR SHORT

1

2

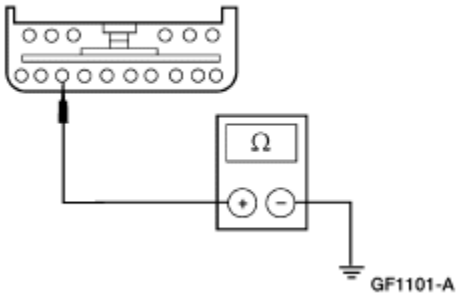
Air Compressor Relay

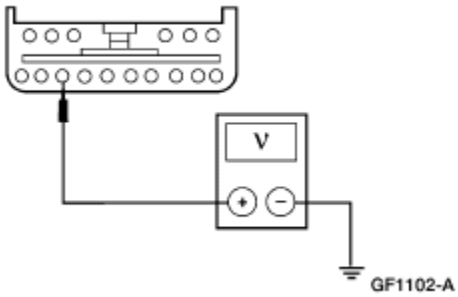
3



3 Measure the resistance between air compressor relay Pin 85 component side, and Pin 86 component side.

- **Is the resistance greater than 10 ohms?**

	→ **Yes** GO to G7 . → **No** INSTALL a new air compressor relay. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G7 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO GROUND	
2 Air Suspension Control Module C2000 3  GF1101-A	1 Turn the air suspension switch to the OFF position. 3 Measure the resistance between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G8 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO POWER	
1 	

3 Air Suspension Control Module C2000	2 Turn the air suspension switch to the OFF position. 4 Turn the air suspension switch to the ON position. 6 Measure the voltage between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground.
5 6  GF1102-A	• **Is voltage present?** → **Yes** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G9 CHECK AIR COMPRESSOR RELAY PINS	
1 3	2 Turn the air suspension switch to the OFF position.

Air Compressor Relay

4 Inspect the pins of the air compressor relay connector for corrosion, bent or broken pins, moisture, or other damage.

- **Is relay OK?**

→ **Yes**
RECONNECT air compressor relay. GO to G10 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

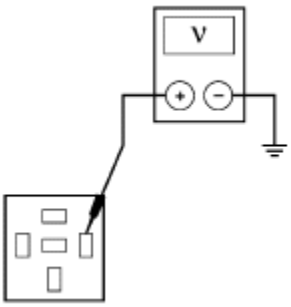
G10 CHECK CIRCUIT 420 (DB/YE) FOR INTERMITTENT SHORT TO GROUND

1 Turn the air suspension switch to the ON position.

2

3 Trigger the air suspension control module active command COMPRESSR ON.

4

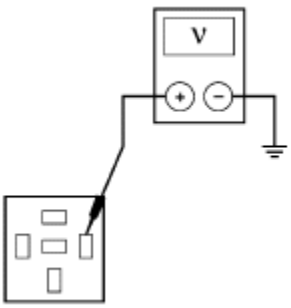


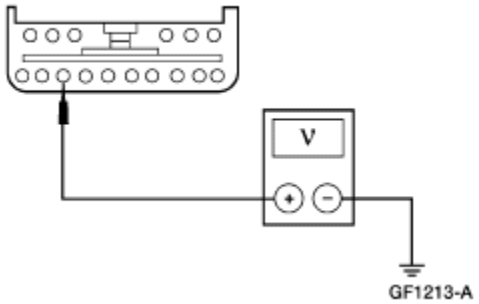
H10699-A

4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between air compressor relay C430 Pin 86, Circuit 420 (DB/YE), harness side and ground while wiggling the wiring harness between air suspension control module C2000, and air compressor C430.

- **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command COMPRESSR OFF. REPAIR circuit 420 (DB/Y). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal

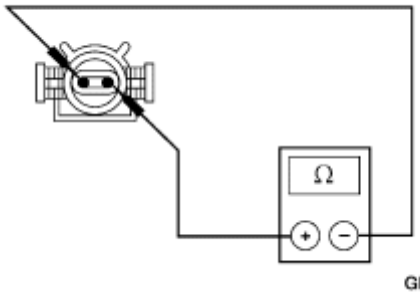
	operation. → **No** Toggle the air suspension control module active command COMPRESSR OFF. GO to G11 .
G11 CHECK CIRCUIT 420 (DB/YE) FOR INTERMITTENT SHORT TO POWER	
1  H10699-A	1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between air compressor relay connector Pin 86, Circuit 420 (DB/YE), harness side and ground while wiggling the wiring harness between air suspension control module C2000, and air compressor C430. • **Is the voltage recorded greater than 0 volts?** → **Yes** REPAIR Circuit 420 (DB/YE). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to G12 .
G12 CHECK INTERMITTENT MODULE FUNCTION	
1 	2 Turn the air suspension switch to the OFF position. 3 Remove Circuit 420 (DB/YE) from air suspension control module C2000 Pin 18 (with connector connected to air suspension control module). 4 Turn the air suspension switch to the ON position.
5 	6 Toggle the air suspension control module

7  	active command COMPRESSR ON. 7 Measure the voltage between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** Toggle the air suspension control module active command COMPRESSR OFF. RECONNECT Circuit 420 (DB/YE) back into air suspension control module connector C2000 Pin 18 cavity. GO to G13 . → **No** Toggle the air suspension control module active command COMPRESSR OFF. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G13 CARRY OUT ROAD TEST	
	1 Monitor the air suspension control module PID AS_COMP. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle. • **Do the letters O, G, or B appear next to the ON/OFF text for AS_COMP?** → **Yes** If O appeared, GO to G3 . If G appeared, GO to G6 . If B appeared, GO to G8 . → **No** CLEAR all DTCs and REPEAT the road test.

PINPOINT TEST H: DTC C1865, REAR FILL SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CARRY OUT ON-DEMAND SELF-TEST	
3 On-Demand Self-Test	1 Open any door. 2 The 4-wheel drive switch is in the 4WD LOW position and the 4WD LOW indicator is illuminated (4.0L). The ride control switch is in the OFF ROAD position (5.0L). • **Is DTC C1845 or C1865 retrieved?** → **Yes** GO to H2 . → **No** GO to H10 .
H2 CHECK FILL SOLENOID CONNECTOR	
1 3 Rear Fill Solenoid C428	2 Turn the air suspension switch to the OFF position. 4 Inspect the fill solenoid pins for damage, corrosion or pins that may be pushed out. • **Are the fill solenoid connector and pins OK?** → **Yes** RECONNECT the fill solenoid. GO to H3 . → **No** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT	

2 	1 Turn the air suspension switch to the ON position. 3 Select the air suspension control module active commands, and monitor the suspect air suspension control module R_FILL. 4 Use the active commands and activate the following commands in the given sequence: ■ GATEVALVE ON. ■ REAR FILL ON. ■ GATEVALVE OFF. ■ REAR FILL OFF. • **Do the letters O, G, or B appear next to the ON/OFF text for the vent solenoid?** → **Yes** If O appeared, GO to H4 . If G appeared, GO to H7 . If B appeared, GO to H9 . → **No** GO to H10 .
H4 CHECK FILL SOLENOID COIL OPEN CIRCUIT	
1 2 Rear Fill Solenoid C428 3	3 Measure the resistance between suspect fill solenoid pins component side.



GF1104-A

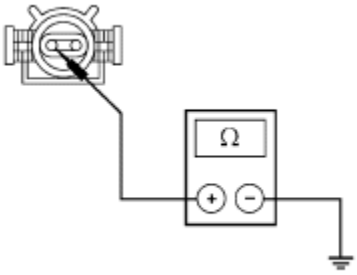
- **Is the resistance less than 20 ohms?**

→ **Yes**
GO to H5 .

→ **No**
INSTALL a new fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H5 CHECK CIRCUIT 57 (BK) FOR OPEN IN HARNESS

1



GF1105-A

1 Measure the resistance between the suspect fill solenoid C428 Pin 1, Circuit 57 (BK), harness side and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to H6 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

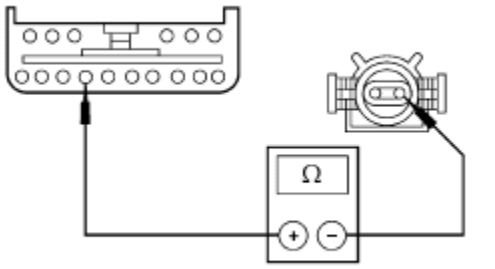
H6 CHECK CIRCUIT 416 (LB/BK) FOR OPEN

1 Turn the air suspension switch to the OFF position.

2

Air Suspension Control Module C2000

3



GF1215-A

3 Measure the resistance between air suspension control module C2000 Pin 17, Circuit 416 (LB/BK), harness side and rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H7 CHECK FILL SOLENOID COIL FOR SHORT

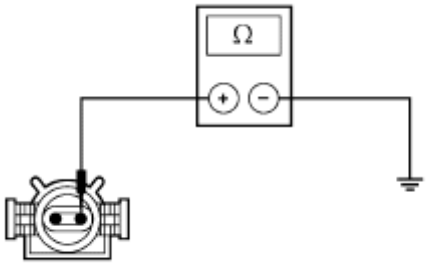
1

2

Rear Fill Solenoid C428

3

3 Measure the resistance between fill solenoid pin component side, and ground.



GF1587-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to H8 .

→ **No**
INSTALL a new fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H8 CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO GROUND

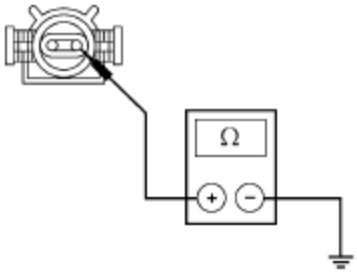
1 Turn the air suspension switch to the OFF position.

2

Air Suspension Control Module C2000

3 Measure the resistance between rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground.

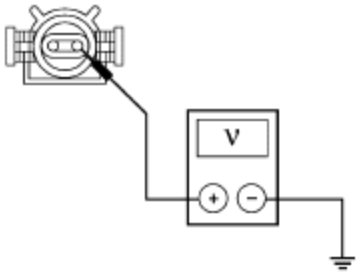
3



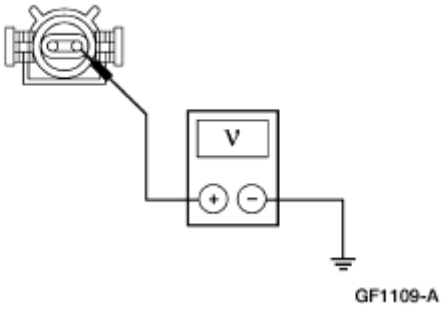
GF1108-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures.

	CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H9 CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO POWER	
	1 Turn the air suspension switch to the OFF position.
2 3 Air Suspension Control Module C2000	
	4 Turn the air suspension switch to the ON position.
5 	
6  GF1109-A	6 Measure the voltage between rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground. • **Is voltage present?** → **Yes** REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air suspension control module;

	REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H10 CHECK FILL SOLENOID CONNECTOR PINS	
1 3 Rear Fill Solenoid C428	2 Turn the air suspension switch to the OFF position. 4 Inspect the pins of the fill solenoid connector for corrosion, bent or broken pins, moisture, or other damage. • **Are the connectors and pins OK?** → **Yes** RECONNECT the fill solenoid electrical connector. GO to H11 . → **No** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H11 CHECK CIRCUIT 416 (LB/BK) FOR INTERMITTENT CONDITION	
2 4	1 Turn the air suspension switch to the ON position. 3 Toggle the air suspension control module active command REAR FILL ON. 4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground, while wiggling the wiring harness between air suspension control module C2000 and fill solenoid C428.



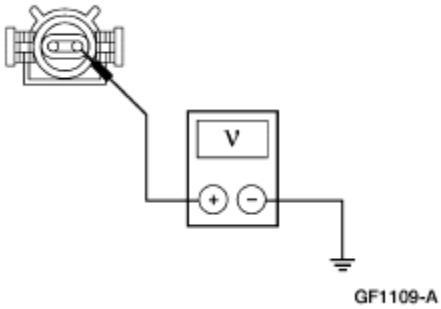
- **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command OFF. REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
Toggle the air suspension control module active command OFF. GO to H12 .

H12 CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO POWER

1



1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between the fill solenoid C428 Pin 2, Circuit 416 (LB/BK), and ground while wiggling the wiring harness between air suspension control module C2000 and fill solenoid C428.

- **Is voltage present?**

→ **Yes**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
GO to H13 .

H13 CHECK INTERMITTENT MODULE FUNCTION

1

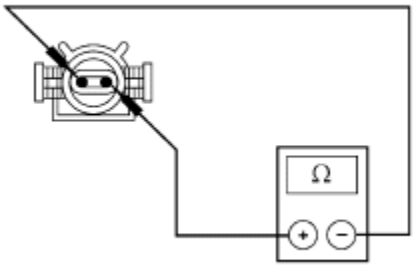
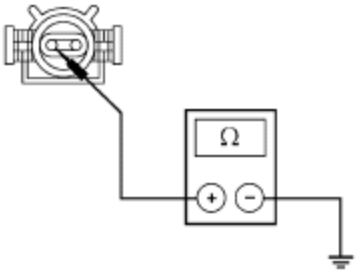
	2 Turn the air suspension switch to the OFF position. 3 Remove Circuit 416 (LB/BK) from air suspension control module C2000 Pin 17 (with connector connected to air suspension control module). 4 Turn the air suspension switch to the ON position.
5	6 Toggle the air suspension control module active command REAR FILL ON as appropriate. 7 Measure the voltage between air suspension control module C2000 Pin 17 component side, and ground. • **Is the voltage greater than 10 volts?** → **Yes** Toggle the air suspension control module active command OFF. RECONNECT Circuit 416 (LB/BK) back into the air suspension control module C2000 cavity. GO to H14 . → **No** Toggle the air suspension control module active command OFF. RECONNECT Circuit 416 (LB/BK) back into the air suspension control module C2000 cavity. INSTALL a new air suspension control module;. REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H14 CARRY OUT THE ROAD TEST	
	1 Monitor the suspect air suspension control module R_FILL. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle. • **Do the letters O, G, or B appear next to the ON/OFF text for R_FILL?**

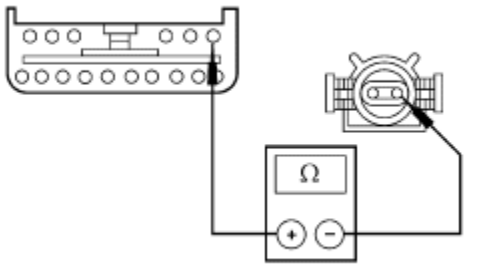
	→ **Yes** If O appeared, GO to H4 . If G appeared, GO to H7 . If B appeared, GO to H9 . → **No** CLEAR all DTCs and REPEAT the road test.

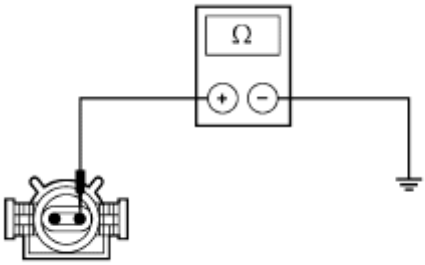
PINPOINT TEST I: DTC C1869, REAR GATE SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CARRY OUT ON-DEMAND SELF-TEST	
3 On-Demand Self-Test	1 Open any door. 2 The 4-wheel drive switch is in the 4WD LOW position and the 4WD LOW indicator is illuminated (4.0L). The ride control switch is in the OFF ROAD position (5.0L). • **Is the DTC C1869 retrieved?** → **Yes** GO to I2 . → **No** GO to I10 .
I2 CHECK REAR GATE SOLENOID CONNECTOR	
1 3 Rear Gate Solenoid C429	2 Turn the air suspension switch to the OFF position. 4 Inspect the pins of the rear gate solenoid connector for corrosion, bent or broken pins, moisture, or other damage.

	• **Is the rear gate solenoid C429 OK?** → **Yes** RECONNECT the rear gate solenoid C429. GO to I3 . → **No** REPAIR the connector as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT	
2 	1 Turn the air suspension switch to the ON position. 3 Select the air suspension control module active commands and monitor the air suspension control module PID AS_GATE. 4 Use the active commands and toggle the following commands in the given sequence: ■ GATEVALVE ON. ■ REAR FILL ON. ■ GATEVALVE OFF. ■ REAR FILL OFF. • **Do the letters O, G, or B appear next to the ON/OFF text for the rear gate solenoid?** → **Yes** If O appeared, GO to I4 . If G appeared, GO to I7 . If B appeared, GO to I9 . → **No** GO to I10 .
I4 CHECK REAR GATE SOLENOID COIL FOR OPEN	
1 	

2 Rear Gate Solenoid C429 3  GF1104-A	3 Measure the resistance between rear gate solenoid pins (component side). • **Is the resistance less than 20 ohms?** → **Yes** GO to I5 . → **No** INSTALL a new rear gate solenoid; REFER to Solenoid Valve—Rear Gate . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  GF1105-A	1 Measure the resistance between rear gate solenoid C429 Pin 1, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to I6 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal

	operation.
I6 CHECK CIRCUIT 414 (OG/RD) FOR OPEN	
2 Air Suspension Control Module C2000 3  GF1112-A	1 Turn the air suspension switch to the OFF position. 3 Measure the resistance between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR Circuit 414 (OG/RD). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I7 CHECK AIR SUSPENSION GATE SOLENOID COIL FOR SHORT	
1 2 Rear Gate Solenoid C429 3	3 Measure the resistance between rear gate solenoid pin (component side) and ground.



GF1587-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to I8 .

→ **No**
INSTALL a new rear gate solenoid; REFER to Solenoid Valve—Rear Gate . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I8 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO GROUND

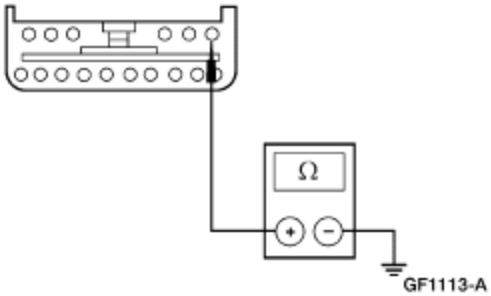
1 Turn the air suspension switch to the OFF position.

2

Air Suspension Control Module C2000

3 Measure the resistance between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and ground.

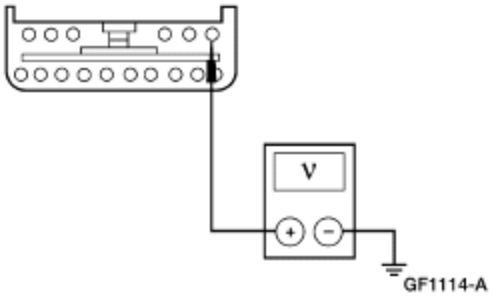
3



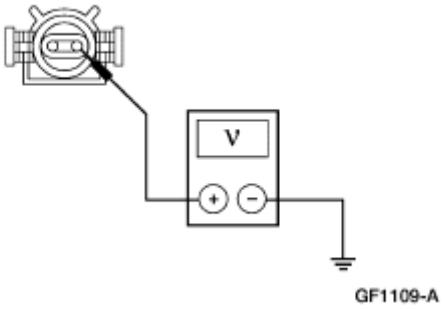
GF1113-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures.

	CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I9 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO POWER AT THE AIR SUSPENSION CONTROL MODULE	
1 3 Air Suspension Control Module C2000 5 6  GF1114-A	2 Turn the air suspension switch to the OFF position. 4 Turn the air suspension switch to the ON position. 6 Measure the voltage between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and ground. • **Is voltage present?** → **Yes** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No**

	INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I10 CHECK REAR GATE SOLENOID CONNECTOR FOR DAMAGE	
1 3 Rear Gate Solenoid C429	2 Turn the air suspension switch to the OFF position. 4 Inspect the pins of the rear gate solenoid connector for corrosion, bent or broken pins, moisture, or other damage. • **Is the rear gate solenoid C429 OK?** → **Yes** GO to I11 . → **No** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I11 CHECK REAR GATE SOLENOID FOR INTERMITTENT FAILURE	
2 4	1 Turn the air suspension switch to the ON position. 3 Toggle the air suspension control module active command GATEVALVE ON. 4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and rear gate solenoid C429.



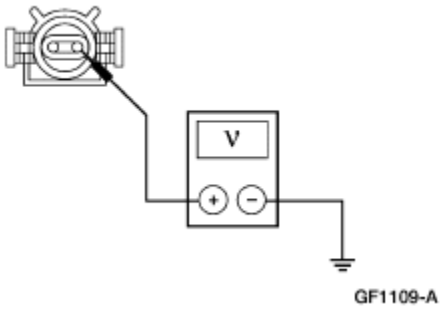
- **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command GATEVALVE OFF. REPAIR Circuit 414 (OG/RD). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
Toggle the air suspension control module active command GATEVALVE OFF. GO to I12 .

I12 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO POWER

1



1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and rear gate solenoid C429.

- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

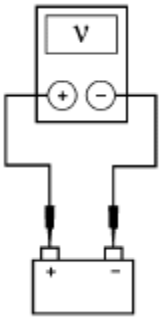
→ **No**
GO to I13 .

I13 CHECK INTERMITTENT MODULE FUNCTION

1 	2 Turn the air suspension switch to the OFF position. 3 Remove circuit 414 (OG/RD) from air suspension control module C2000 Pin 27 (with connector connected to air suspension control module). 4 Turn the air suspension switch to the ON position.
5 	6 Toggle the air suspension control module active command GATEVALVE ON. 7 Measure the voltage between air suspension control module C2000 Pin 27, (component side) and ground. • **Is the voltage greater than 10 volts?** → **Yes** Toggle the air suspension control module active command GATEVALVE OFF. RECONNECT Circuit 414 (OG/RD) back into air suspension control module connector C2000 cavity 27. GO to I14 . → **No** Toggle the air suspension control module active command GATEVALVE OFF. RECONNECT Circuit 414 (OG/RD) back into air suspension control module connector C2000 cavity 27. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
I14 CARRY OUT THE ROAD TEST	
	1 Monitor the air suspension control module PID AS_GATE. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load added to the rear of the vehicle.

	• **Do the letters O, G, or B appear next to the ON/OFF text for the AS_GATE?** → **Yes** If O appeared, GO to I4 . If G appeared, GO to I7 . If B appeared, GO to I9 . → **No** CLEAR all DTCs and REPEAT the road test. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

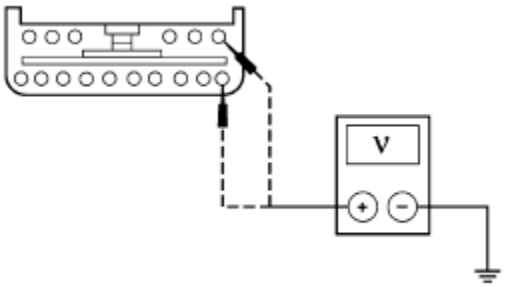
PINPOINT TEST J: DTC B1318, BATTERY VOLTAGE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK BATTERY VOLTAGE	
1  GL1223-A	1 Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running. • **Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 17 volts with the engine running?** → **Yes** GO to J2 . → **No** REFER to Section 414-00 .
J2 CHECK POWER TO AIR SUSPENSION CONTROL MODULE	
1 2	

Air Suspension Control Module

3

4



GF1872-A

4 Measure the voltage between air suspension control module C2001 Pin 1, Circuit 418 (DG/YE), harness side and ground; and between air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side and ground.

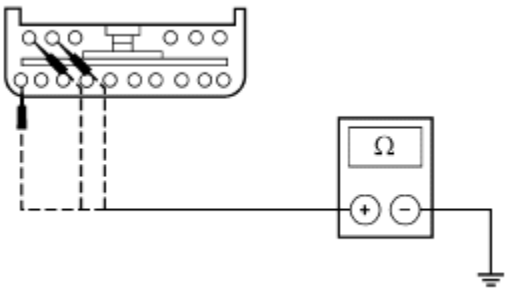
- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to J3 .

→ **No**
REPAIR the Circuit 418 (DG/YE). CLEAR the DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

J3 CHECK CIRCUIT 570 (BK) FOR AN OPEN

1



GF1873-A

1 Measure the resistance between air suspension control module C2000 Pin 20, Circuit 570 (BK), harness side and ground; and between air suspension control module C2000 Pin 32, Circuit 570 (BK), harness side and ground.

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR the DTCs. REPEAT the

	Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR Circuit 570 (BK). CLEAR the DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

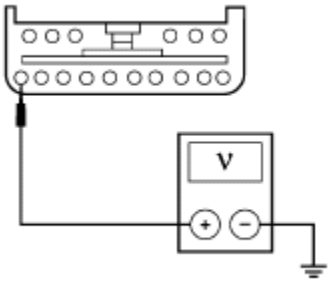
PINPOINT TEST K: DTC B1342, ECU INTERNAL FAULT

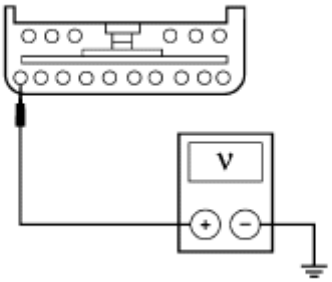
CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC B1342 retrieved?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to K2 .
K2 CHECK FOR INTERMITTENT FAILURE	
1 4 5 	2 Turn the air suspension switch to the OFF position. 3 Turn the air suspension switch to the ON position.

On-Demand Self-Test	• **Is DTC B1342 retrieved?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST L: DTC B1485, BRAKE LAMP SWITCH INPUT SHORT TO BATTERY

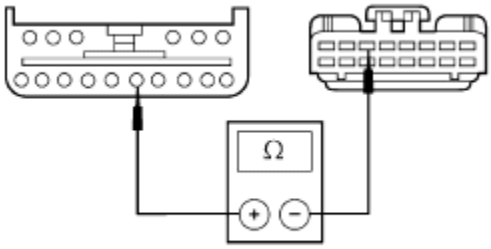
CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC B1485 retrieved?** → **Yes** GO to L2 . → **No** REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
L2 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH CIRCUITRY	
1 2 Air Suspension Control Module C2001 3	

 4  GF1614-A	4 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground. • **Is voltage present?** → **Yes** GO to L3 . → **No** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
L3 CHECK CIRCUIT 810 (RD/LG) FOR SHORT TO POWER	
1 2 BPP Switch C224 3 4	4 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground.

 GF1614-A	• **Is voltage present?** → **Yes** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new BPP switch; REFER to Section 417-01 . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST M: DTC B1565, DOOR AJAR INPUT SHORT TO POWER

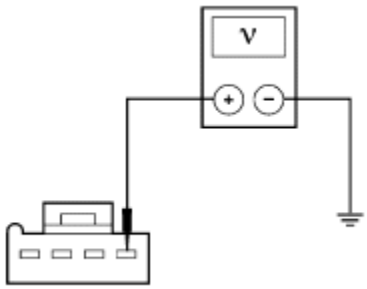
CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CARRY OUT ON-DEMAND SELF-TEST	
2 On-Demand Self-Test	1 Open any door. • **Is DTC B1565 retrieved?** → **Yes** GO to M2 . → **No** REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
M2 CHECK CIRCUIT 999 (LB/WH) FOR OPEN	
1	

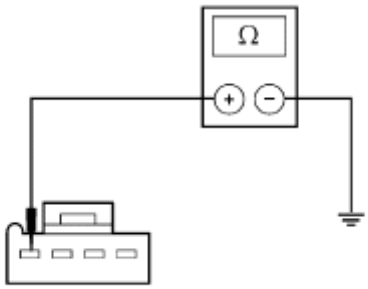
 2 Air Suspension Control Module C2001 3 GEM C281 4  GF1163-A	4 Measure the resistance between air suspension control module C2001 Pin 5, Circuit 999 (LB/WH), harness side and GEM C281 Pin 3, Circuit 999 (LB/WH), harness side. • **Is the resistance less than 5 ohms?** → **Yes** CHECK the operation of the door open warning indicator switch; REFER to Section 413-09 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST N: THE AIR SUSPENSION SYSTEM IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK IGNITION SWITCH ON INPUT	
1 Scan Tool	2 Monitor the air suspension control module PID

	IGN_RUN. • **Does the IGN_RUN PID indicate ignition switch status as RUN?** → **Yes** GO to N2 . → **No** REPAIR Circuit 1003 (GY/YE). TEST the system for normal operation.
N2 CHECK IGNITION SWITCH OFF INPUT	
1 	2 Monitor the air suspension control module PID IGN_RUN. • **Does the IGN_RUN PID indicate ignition switch status as OFF?** → **Yes** GO to N3 . → **No** REPAIR Circuit 1003 (GY/YE). TEST the system for normal operation.
N3 CHECK STEERING WHEEL ROTATION SENSORS A AND B	
1 	2 Monitor the air suspension control module PIDs STEER_A and STEER_B, while turning the steering wheel slowly 1/4 turn (90 degrees) in both directions. • **Do the STEER_A and STEER_B PIDs toggle between HIGH and LOW?** → **Yes** GO to N9 . → **No** REPEAT the test, turning the steering wheel more slowly. If STEER_A and STEER_B PIDs now toggle

	between HIGH and LOW after repeating the test, GO to N6 . If slower turning of the steering wheel does not produce HIGH/LOW toggling, GO to N4 .
N4 CHECK CIRCUIT 1003 (GY/YE) FOR OPEN	
1 2 Steering Rotation Sensor C299 3 4  GF1164-A	4 Measure the voltage between steering wheel rotation sensor C299 Pin 4, Circuit 1003 (GY/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to N5 . → **No** REPAIR the circuit. TEST the system for normal operation.
N5 CHECK CIRCUIT 57 (BK) FOR OPEN	
1 2	2 Measure the resistance between steering wheel rotation sensor C299 Pin 1, Circuit 57 (BK), harness side and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to N6 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

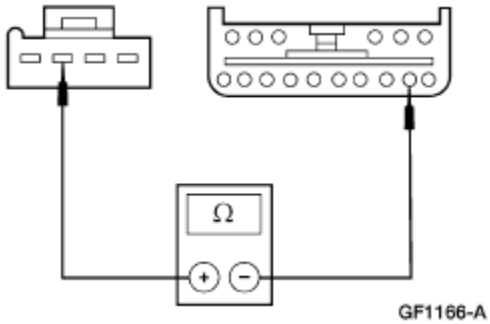
N6 CHECK CIRCUIT 634 (BN) AND CIRCUIT 633 (RD) FOR OPEN

1

2

Air Suspension Control Module C2001

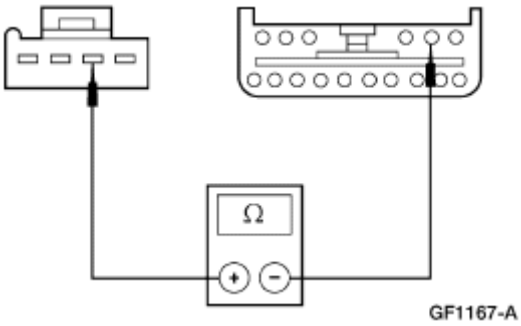
3



3 Measure the resistance between steering wheel rotation sensor C299 Pin 2, Circuit 634 (BN), harness side and air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side.

4

4 Measure the resistance between steering wheel rate sensor C299 Pin 3, Circuit 633 (RD), harness side and air suspension control module C2001 Pin 22, Circuit 633 (RD), harness side.



- **Are the resistances less than 5 ohms?**

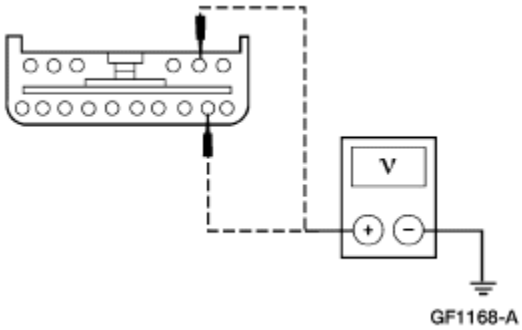
→ **Yes**
GO to N7 .

→ **No**
REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation.

N7 CHECK CIRCUIT 634 (BN) AND CIRCUIT 633 (RD) FOR SHORT TO POWER

1

2



2 Measure the voltage between air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side and ground; and between air suspension control module C2001Pin 22, Circuit 633 (RD), harness side and ground.

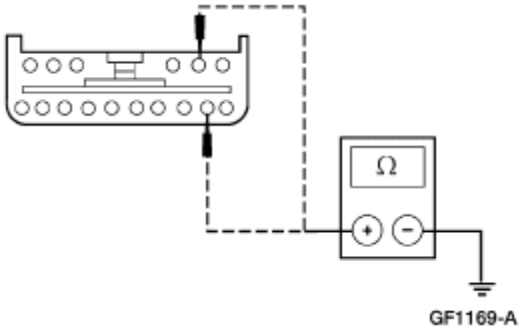
- **Is voltage present?**

→ **Yes**
REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation.

→ **No**
GO to N8 .

N8 CHECK CIRCUIT 634 (BN) AND 633 (RD) FOR SHORT TO GROUND

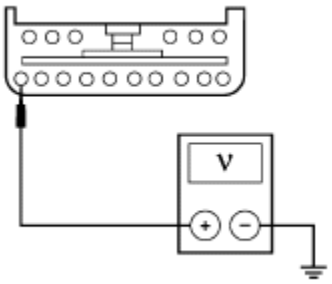
1

 2  GF1169-A	2 Measure the resistance between air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side and ground; and between air suspension control module C2001 Pin 22, Circuit 633 (RD), harness side and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** INSTALL a new steering wheel rotation sensor; REFER to Section 211-02 . TEST the system for normal operation. → **No** REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation.
N9 CHECK BRAKE PEDAL POSITION (BPP) SWITCH INPUT	
	1 Monitor the air suspension control module PID BOO_ARC. 2 **NOTE:** The brake pedal must be pressed hard enough to turn on the brake lights. Monitor the BOO_ARC PID while pressing and releasing the brake pedal. • **Did the BOO_ARC status toggle from OFF, ON, and back to OFF?** → **Yes** GO to N13 . → **No** If the BOO_ARC PID did not change to ON, GO to N10 . If the BOO_ARC PID status is ON and does not change to OFF, GO to Pinpoint Test L .
N10 CHECK THE BREAK PEDAL POSITION (BPP) SWITCH INPUT	
1	

2

Air Suspension Control Module C2001

3



GF1614-A

3 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground, while depressing the brake pedal.

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

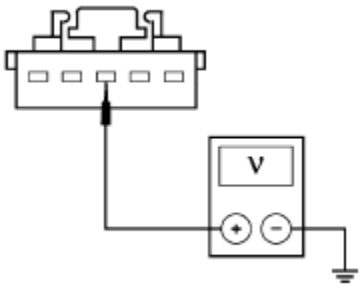
→ **No**
GO to N11 .

N11 CHECK CIRCUIT 276 (BN) FOR AN OPEN

1

BPP Switch C224

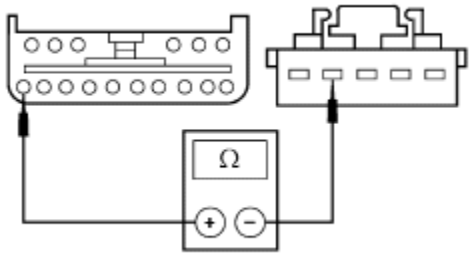
2

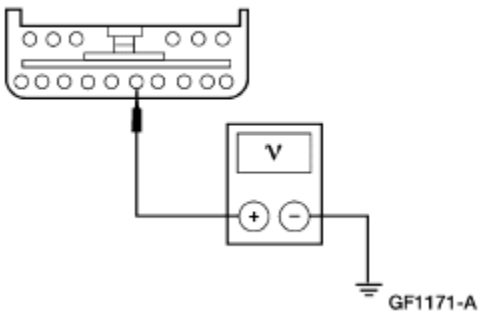


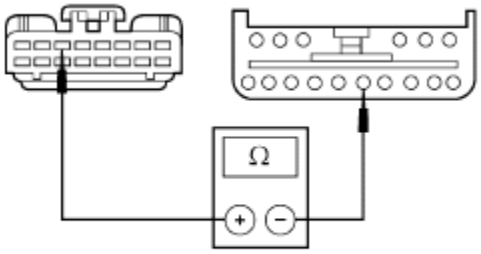
GF1615-A

2 Measure the voltage between BPP switch C224 Pin 3, Circuit 276 (BN), harness side and ground.

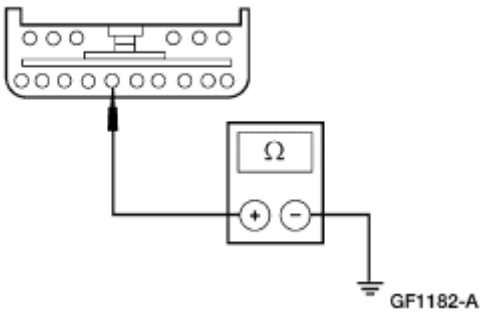
- **Is the voltage greater than 10 volts?**

	→ **Yes** GO to N12 . → **No** REPAIR the circuit. TEST the system for normal operation.
N12 CHECK CIRCUIT 810 (RD/LG) FOR AN OPEN	
1  GF1616-A	1 Measure the resistance between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and BPP switch C224 Pin 2, Circuit 810 (RD/LG), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new BPP switch; REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
N13 CHECK DOOR OPEN WARNING INDICATOR INPUTS	
	1 Close all doors, liftgate and liftgate glass so the door ajar indicator in the instrument cluster is not illuminated. 2 Monitor the air suspension control module PID DR_OPEN. 3 Open any door. • **Does the DR_OPEN PID status indicate CLOSED and then AJAR?** → **Yes** GO to N17 . → **No** GO to N14 .
N14 CHECK DOOR AJAR INPUTS TO GEM	
	1 Monitor the following GEM PIDs:

	■ D_DR_SW. ■ P_DR_SW. ■ LGATE_SW. ■ LRDR_SW. ■ RRDR_SW. 2 Check the GEM door ajar inputs by opening and closing each door individually. • **Do all five GEM inputs function correctly?** → **Yes** GO to N15 . → **No** REFER to Section 417-02 .
N15 CHECK DOOR OPEN WARNING INDICATOR SIGNAL	
1 2 Air Suspension Control Module C2001 3 5  	4 Close all the doors. 5 Measure the voltage between air suspension control module C2001 Pin 5, Circuit 999 (LB/WH), harness side and ground. 6 Open any door.

	• **Is the voltage equal to zero volts with all the doors closed and greater than 5 volts with a door open?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation. → **No** GO to N16 .
N16 CHECK CIRCUIT 999 (LB/WH) FOR OPEN	
1 2 GEM C281 3  GF1172-A	3 Measure the resistance between GEM C281 Pin 3, Circuit 999 (LB/WH), and air suspension control module C2001 Pin 5, Circuit 999 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 417-02 . → **No** REPAIR the circuit. TEST the system for normal operation.
N17 CHECK PCM ACCELERATION INPUT	
	1 **NOTE:** Make sure the accelerator pedal is fully released. Use scan tool to monitor the PCM PID PCM_ACC.

	• **With the accelerator pedal fully released, does the PCM_ACC PID status indicate NO?** → **Yes** GO to N20 . → **No** GO to N18 .
N18 CHECK PCM ACCELERATION OUTPUT	
	1 Monitor the PCM PID TP V. 2 Press and release the accelerator pedal. • **Does the PCM acceleration output voltage vary as the acceleration pedal is depressed?** → **Yes** GO to N19 . → **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
N19 CHECK CIRCUIT 394 (OG/BK) FOR SHORT TO GROUND	
1 2 Air Suspension Control Module C2001 3 PCM C202 4	4 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

→ **No**
REPAIR the circuit. TEST the system for normal operation.

N20 CHECK PCM ACCELERATION INPUT — WOT

1 **NOTE:** Make sure the accelerator pedal is in the wide-open throttle position.

Use scan tool to monitor the PCM PID PCM_ACC.

- **Does the PCM_ACC PID status indicate YES?**

→ **Yes**
GO to N23 .

→ **No**
GO to N21 .

N21 CHECK CIRCUIT 394 (OG/BK) FOR SHORT TO POWER

1

2

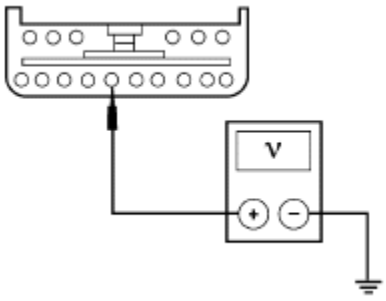
Air Suspension Control Module C2001

3

PCM C202

4

5



5 Measure the voltage between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), and ground.

- **Is voltage present?**

→ **Yes**
REPAIR the circuit. TEST the system for normal operation.

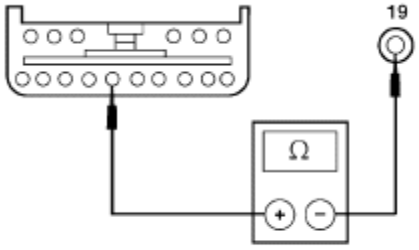
→ **No**
GO to N22 .

N22 CHECK CIRCUIT 364 (OG/BK) FOR OPEN

1

2 Connect EEC-V 104-Pin Breakout Box to PCM C202. Do not connect the PCM.

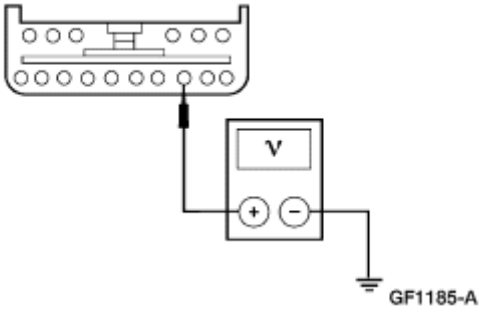
3



3 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and EEC-V 104-Pin Breakout Box Pin 19, Circuit 394 (OG/BK).

- **Is the resistance less than 5 ohms?**

	→ **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
N23 CHECK VEHICLE SPEED SIGNAL (VSS) INPUT	
	1 Monitor the VSS_ARC PID while driving the vehicle. • **Does the VSS_ARC indicate nearly the same speed as the speedometer?** → **Yes** All input signals and circuits are functional. RETURN to the Symptom Chart for further diagnostic procedures. → **No** GO to N24 .
N24 CHECK CIRCUIT 679 (GY/BK) FOR SHORT TO POWER	
1 2 Air Suspension Control Module C2001 3 Anti-Lock Brake Control Module C186 4 5	5 Measure the voltage between air suspension control module C2001 Pin 3, Circuit 679 (GY/BK), harness side and ground.



- **Is voltage present?**

→ **Yes**
REPAIR the circuit. TEST the system for normal operation.

→ **No**
GO to N25 .

N25 CHECK CIRCUIT 679 (GY/BK) FOR OPEN

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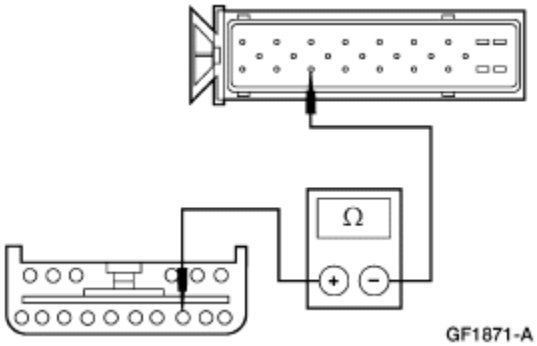
2



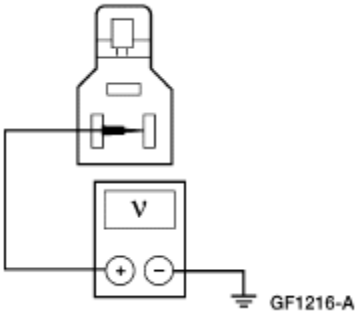
2 Measure the resistance between air suspension control module C2001 Pin 3, Circuit 679 (GY/BK), harness side and anti-lock brake control module C186 Pin 19, Circuit 679 (GY/BK), harness side.

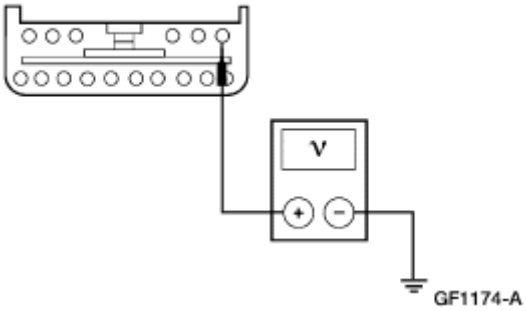
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

→ **No**
REPAIR the circuit. TEST the system for normal operation.

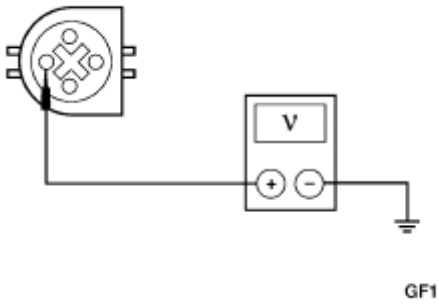
PINPOINT TEST O: THE AIR SUSPENSION SYSTEM OPERATES WITH THE AIR SUSPENSION IN THE OFF POSITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
O1 CHECK CIRCUIT 418 (DG/YE) FOR SHORT TO POWER	
1 2 Air Suspension Switch C412 3  	3 Measure the voltage between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and ground. • **Is voltage present?** → **Yes** GO to O2 . → **No** INSTALL a new air suspension switch; REFER to Switch—Air Suspension . TEST the system for normal operation.
O2 CHECK CIRCUIT 418 (DG/YE) FOR SHORT TO POWER WITH AIR SUSPENSION CONTROL MODULE DISCONNECTED	
1 Air Suspension Control Module C2001 2 3	3 Measure the voltage between air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side and ground.

	• **Is voltage present?** → **Yes** REPAIR Circuit 418 (DG/YE). TEST the system for normal operation. → **No** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

PINPOINT TEST P: THE AIR COMPRESSOR CONTINUOUSLY CYCLES WITH THE IGNITION SWITCH IN THE OFF POSITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK CIRCUIT 417 (VT/OG) FOR SHORT TO POWER	
1 2 Air Compressor Connector C430 3 Air Compressor Relay 4	4 Measure the voltage between air compressor connector C430, Circuit 417 (VT/OG), harness side and ground.

 GF1175-B	• **Is voltage present?** → **Yes** REPAIR the circuit. TEST the system for normal operation. → **No** INSTALL a new air compressor relay. TEST the system for normal operation.

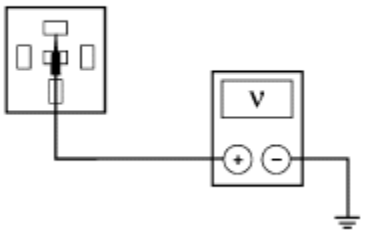
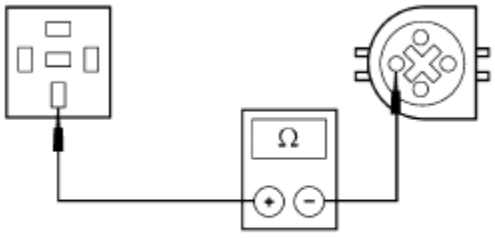
PINPOINT TEST Q: EXCESSIVE AIR COMPRESSOR NOISE

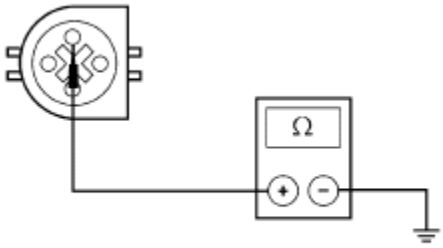
CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK COMPRESSOR WIRING FOR CONTACT WITH UNDERBODY	
	1 Check the wiring harness for any contact to the underbody. • **Is contact being made between the harness and the underbody at any point along the harness?** → **Yes** SECURE the air compressor wiring harness away from the vehicle underbody. TEST the system for normal operation. → **No** GO to Q2 .
Q2 CHECK FOR BENT AIR COMPRESSOR BRACKET	
	1 Inspect the air compressor bracket for any bends that may contact the underbody of the vehicle at any body height. • **Is contact being made or the possibility of contact being made at any point in spring compression?** → **Yes** REPAIR the bracket or INSTALL a new air compressor and bracket assembly. TEST the system for normal operation. → **No**

	GO to Q3 .
Q3 CHECK AIR COMPRESSOR MOUNTS FOR DAMAGE	
	1 Inspect the air compressor mounts for signs of cracks or insulating material that is breaking away. • **Are the air compressor mounts OK?** → **Yes** GO to Q4 . → **No** INSTALL a new air compressor and bracket assembly. TEST the system for normal operation.
Q4 CHECK AIR COMPRESSOR FOR NOISE	
	1 Remove the air compressor from the mounting position, but leave it connected to the wiring harness. 2 Run the air compressor while holding the compressor away from the body and undercarriage. • **Is the air compressor noisy?** → **Yes** INSTALL a new air compressor and bracket assembly. TEST the system for normal operation. → **No** RECHECK the mountings and bracket for damage. INSTALL a new air compressor and/or bracket assembly if any damage is found; REFER to Air Compressor . TEST the system for normal operation.

PINPOINT TEST R: AIR COMPRESSOR TEST

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK AIR COMPRESSOR RELAY	
1 Air Compressor Relay	2 Inspect the pins of the air compressor relay connector for corrosion, bent or broken pins, moisture, or other damage. • **Is the air compressor relay OK?** → **Yes**

	GO to R2 . → **No** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R2 CHECK CIRCUIT 1053 (LB/PK) FOR AN OPEN	
1  GF1176-B	1 Measure the voltage between air compressor relay Pin 87, Circuit 1053 (LB/PK), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to R3 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R3 CHECK CIRCUIT 417 (VT/OG) FOR AN OPEN	
1 Air Compressor Assembly C430 2  GF1177-A	2 Measure the resistance between air compressor relay Pin 30, Circuit 417 (VT/OG), harness side and air compressor assembly C430 Pin 4, Circuit 417 (VT/OG), harness side. • **Is the resistance less than 5 ohms?**

	→ **Yes** GO to R4 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R4 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  GF1178-A	1 Measure the resistance between air compressor assembly C430 Pin 1, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** RECONNECT the air compressor relay and air compressor assembly C430. GO to R5 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R5 CHECK AIR COMPRESSOR AFTER COOL DOWN PERIOD	
3 	1 Allow the vehicle to sit for 60 minutes to give the air compressor assembly time to cool off. 2 Turn the air suspension switch to the ON position. 4 Toggle the air suspension control module active commands VENT ON and COMPRESSR ON. • **Does the air compressor run?** → **Yes** Toggle the air suspension control module

	active commands OFF. GO to R6 . → **No** Toggle the air suspension control module active commands OFF. INSTALL a new air compressor assembly. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R6 CHECK AIR COMPRESSOR THERMAL BREAKER	
	1 Toggle the air suspension control module active command COMPRESSR ON. 2 Run the air compressor for 60 seconds. • **Did the air compressor assembly run for 60 seconds?** → **Yes** The thermal breaker was overheated. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics to VERIFY the system is OK. → **No** INSTALL a new air compressor assembly; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

Ride Height Adjustments

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

1. Check torsion bar ride height and adjust if necessary. For additional information, refer to Section 204-01A .
2. Connect scan tool to the data link connector (DLC).
3. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid).
   - VENT (vent solenoid).
4. Close all doors including the liftgate and liftgate window.
5. Reopen any door (to ensure that the height will not change until the internal electronic calibration is complete).
6. Park the vehicle on a flat surface.
7. From the function menu, quickly select RIDE HEIGHT CALIBRATION.
8. Note the warning on the scan tool screen and follow the directions.

Air Line Repair

NOTE: A soapy water solution can be applied to the air lines to verify the location of air leaks.

1. If a leak is detected in an air line, it can be repaired by carefully making a good, clean, straight cut. Trim back the outer covering of the air line 16-20 mm (0.63-0.78 in) to reveal the white inner line. Install a repair fitting and wrap securely with electrical tape.

2. If multiple leaks are detected, replace the entire air line.

Air Leaks

1. To repair the system for air leaks, inspect the line for damage from the air compressor and air compressor drier assembly to the air springs. Repair or replace damaged portions of the line as necessary. For additional information, refer to Air Line Repair .

Air Line Fluid Purge

NOTE: Perform this procedure if fluid (water or oil) is found in the rear air lines. Purge fluid from air lines and replace affected components.

1. Disconnect air line at compressor air drier that is connected to front fill solenoid inlet.
2. Disconnect air line at inlet of front fill solenoid.
3. Connect stop air line to disconnected air line and blow out any water
4. Reconnect air line.
5. Disconnect air line at compressor air drier that is connected to the rear fill solenoid inlet.
6. Disconnect air line at RR shock absorber.
7. Connect scan tool to Data Link Connector (DLC).
8. Using the RIDE CONTROL OUTPUT command, turn on the following actuators:
   - REAR_FIL (rear fill solenoid) ON.
9. Connect shop air line to disconnected air line and blow out any water.
10. Reconnect air line at RR shock absorber.
11. Disconnect air line at LR shock absorber.
12. Using the RIDE CONTROL OUTPUT command, turn on the following actuators:
    - REAR_FIL (rear fill solenoid) ON.
    - GATEVALVE (front and rear gate solenoids) ON.
13. Connect shop air line to disconnected air line and blow out any water.
14. If oil was present in air lines, replace BOTH LR and RR shock absorbers. (Do not replace s hock absorbers if only water is in the lines.)
15. Replace compressor air drier.
16. Reconnect air line.

Air Shock Absorber —Rear

Special Tool(s)

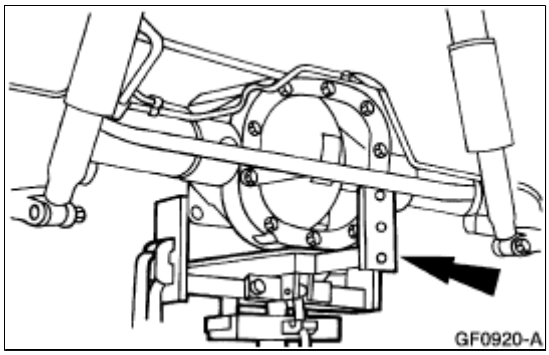
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1927-A	Highlift Transmission Jack or equivalent 164-R3508

Removal

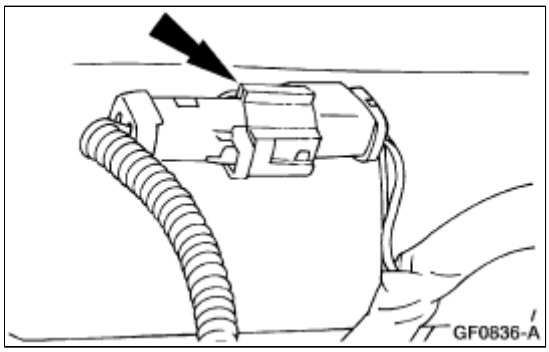
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

WARNING: The low pressure gas shock absorbers are charged with nitrogen gas 930 kpa (135 psi). Do not attempt to open, puncture, or apply heat to the shock absorbers.

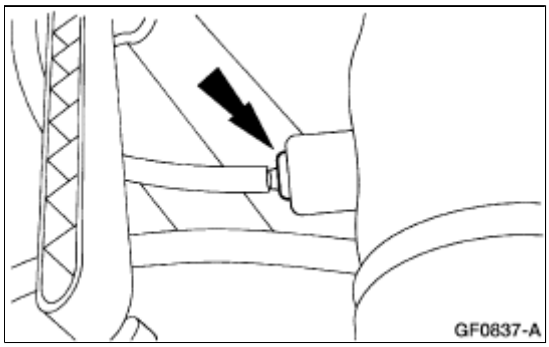
1. Connect scan tool to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATEVALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Use Hi-Lift Transmission Jack to support the rear axle.



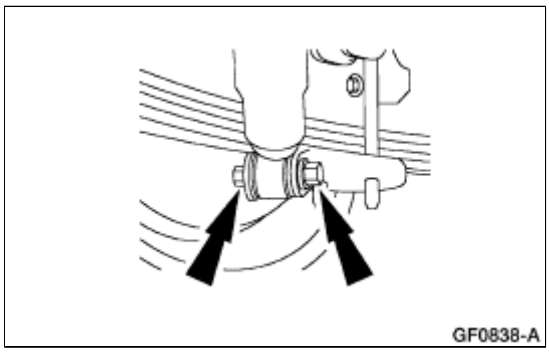
6. Remove the rear shock absorber electrical connector from the rear crossmember and disconnect the electrical connector.



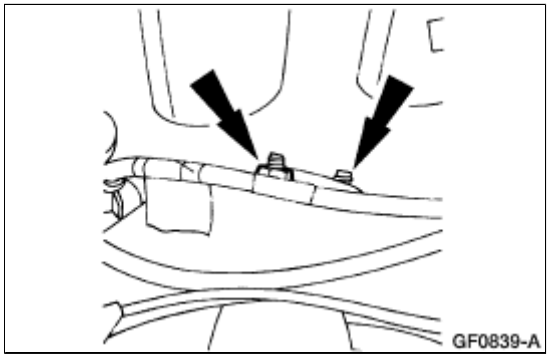
7. Disconnect the air line from the shock absorber.
    - Compress the quick connect locking ring and pull out the air line.



8. Remove the shock absorber lower retaining nut and bolt and swing the shock absorber out of the lower mounting bracket.



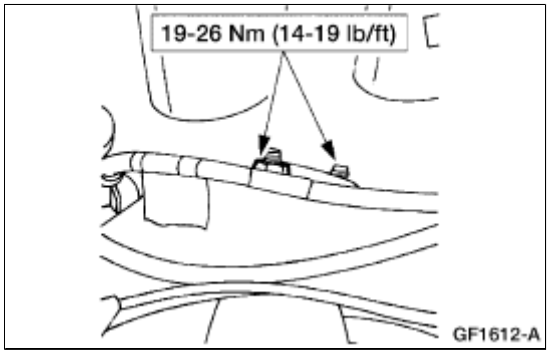
9. Remove the attaching nuts on top of the rear crossmember and remove the shock absorber.

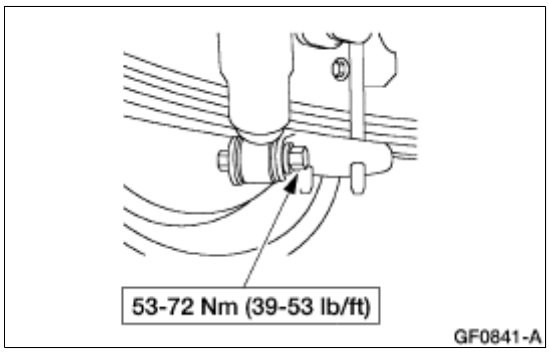


Installation

1. **NOTE:** When installing air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.



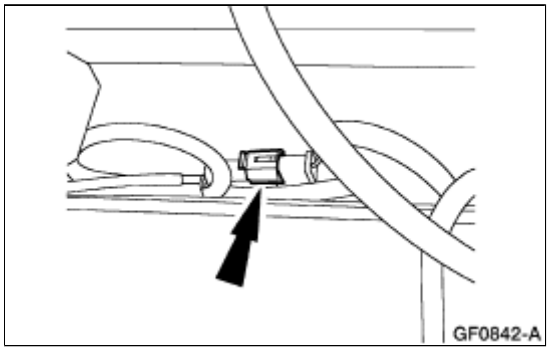


Height Sensor —Rear

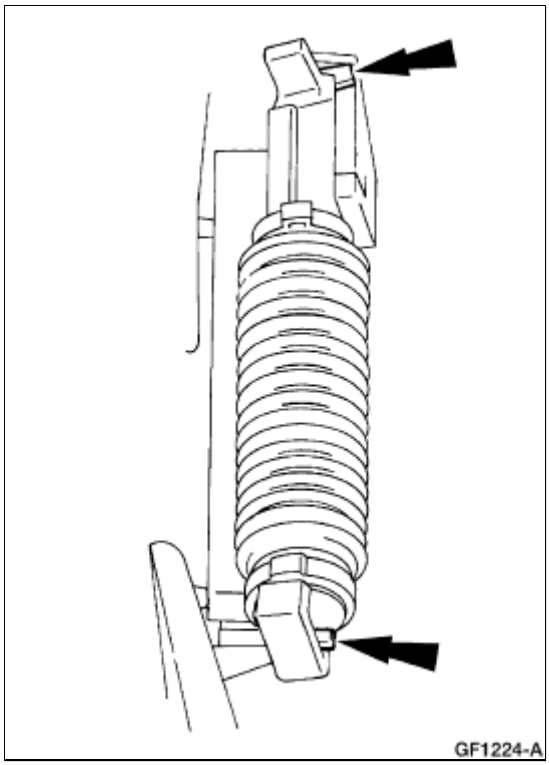
Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the spare tire.
3. Disconnect the height sensor electrical connector and remove the electrical connector harness from the frame and apron to separate the push-in fasteners.



4. Release the upper and lower spring clip and pull the sensor from the ball studs.



Installation

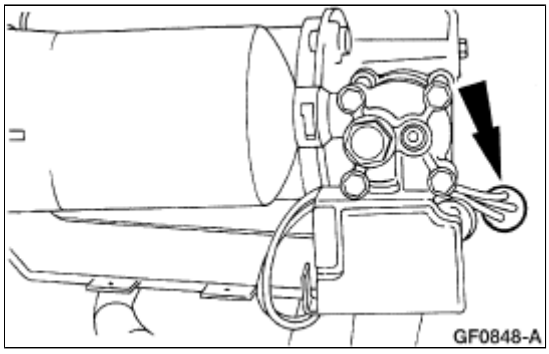
1. To install, reverse the removal procedure.

Air Compressor

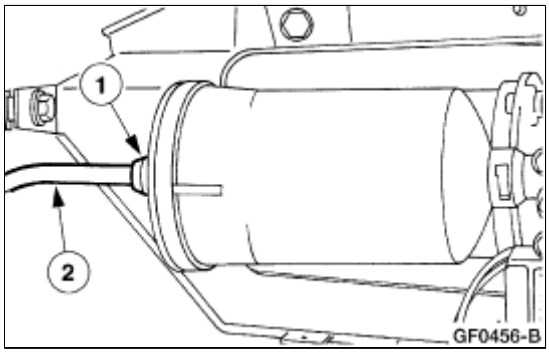
Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

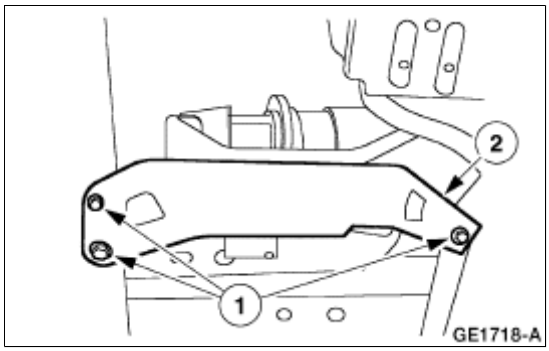
1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the spare tire.
3. Disconnect the air compressor electrical connector.



4. Disconnect the air line from the drier.
    1. Compress the quick connect locking ring and pull out the air line.
    2. Remove the air line from the drier.



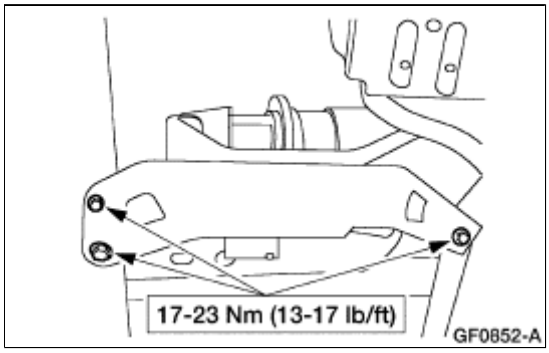
5. Remove the air compressor assembly from the vehicle.
    1. Remove the air compressor bolts.
    2. Remove the air compressor assembly.



Installation

1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.



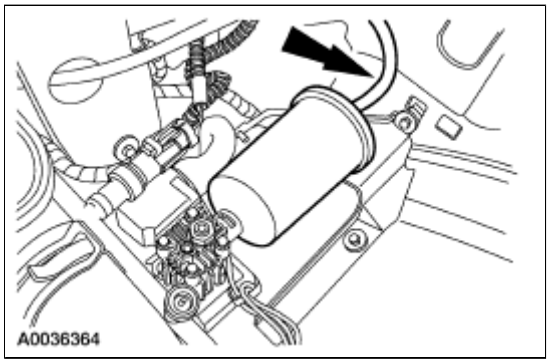
Drier

Material

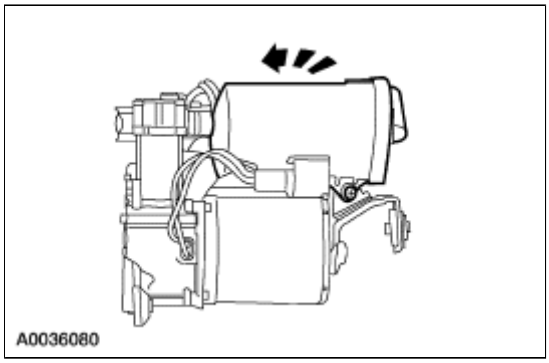
Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation

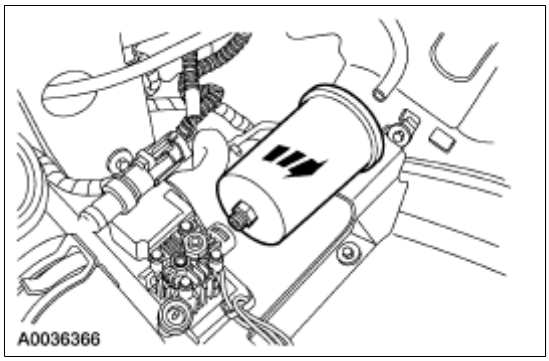
1. Disconnect the air line.



2. Remove the screw.



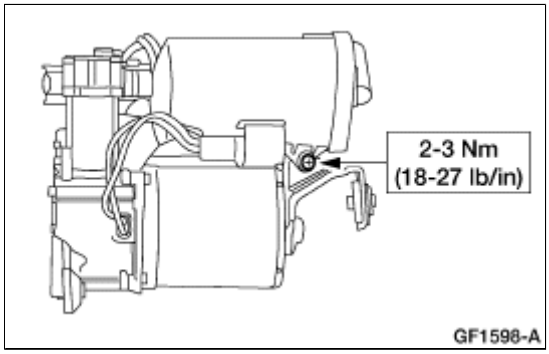
3. Rotate 90 degrees to unlock then remove the air compressor drier.



4. **NOTE:** Inspect the O-ring for damage and install a new O-ring as necessary. Lubricate the solenoid seal area with Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331A or equivalent meeting Ford specification ESE-M1C171-A.

   NOTE: When installing the air line, make sure the white air line is fully inserted into the fitting for correct installation.

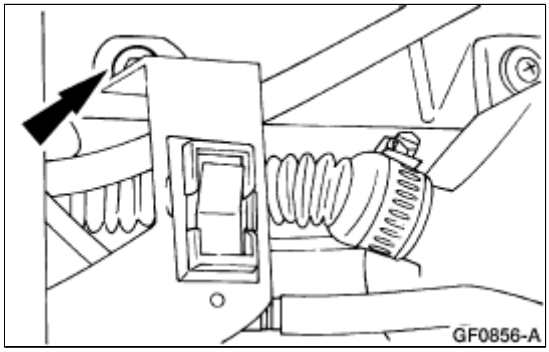
   To install, reverse the removal procedure.



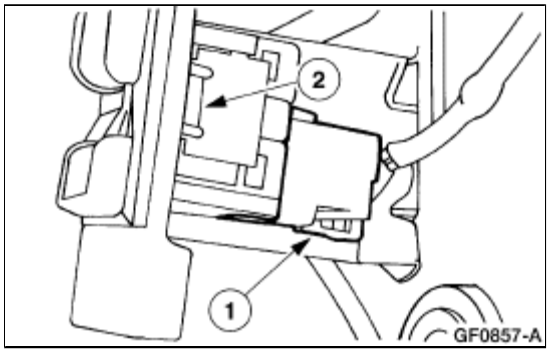
Switch —Air Suspension

Removal

1. Remove the jack storage access cover.
2. Remove the retaining screw and air suspension switch bracket.

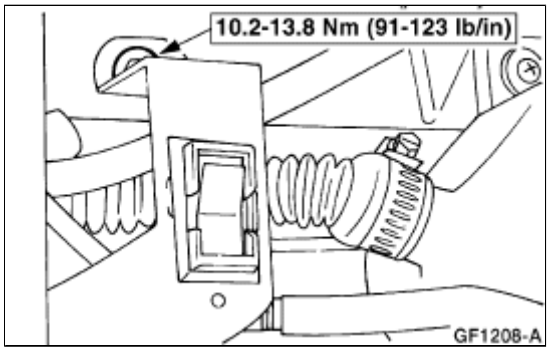


3. Remove the air suspension switch.
    1. Disconnect the electrical connector.
    2. Press the retaining clips and remove the air suspension switch from the bracket.



Installation

1. To install, reverse the removal procedure.



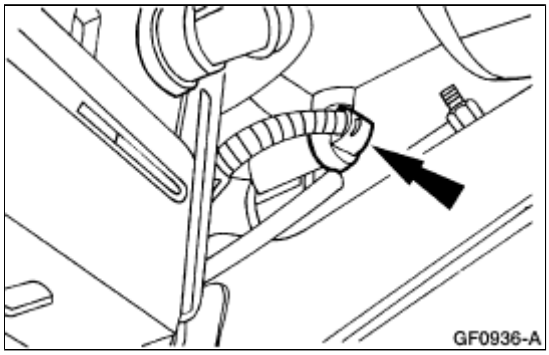
Solenoid Valve —Rear Fill

Special Tool(s)

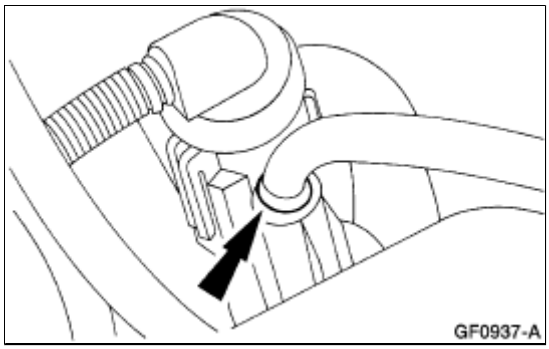
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Removal

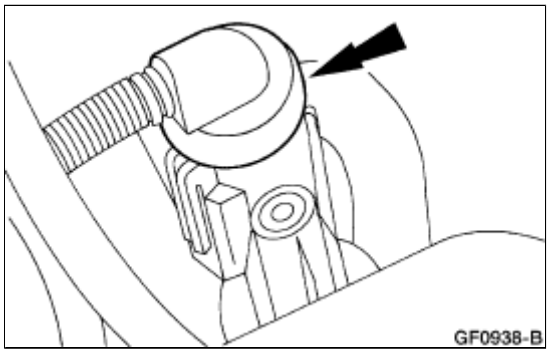
1. Connect New Generation STAR (NGS) Tester to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Remove the solenoid valve from the frame.



6. Compress the quick connect locking ring and pull out the air line.



7. Disconnect the solenoid valve electrical connector.



Installation

1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.

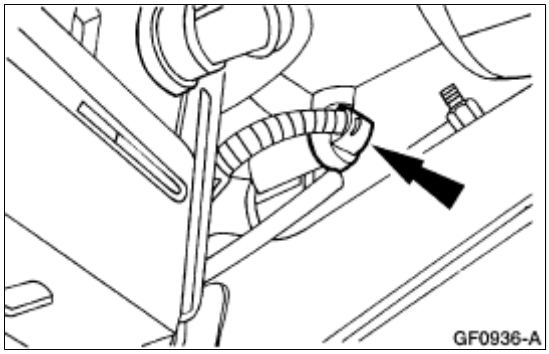
Solenoid Valve —Rear Gate

Special Tool(s)

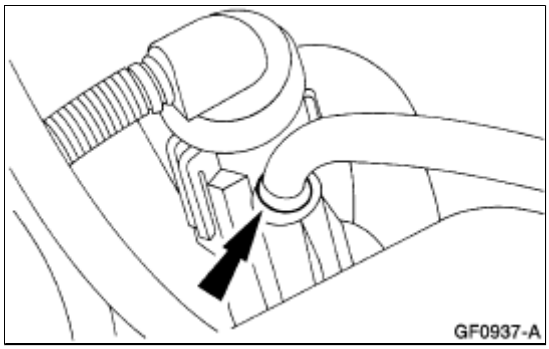
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Removal

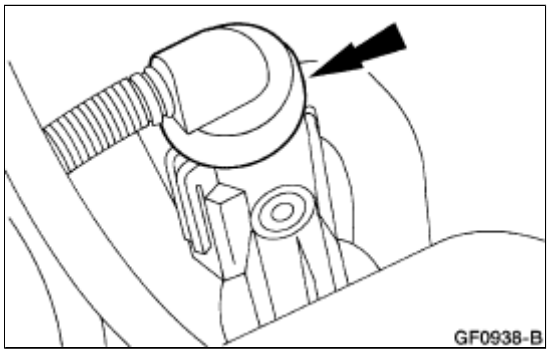
1. Connect scan tool to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Remove the evaporative canister, For more information, refer to Section 303-13 .
6. Remove the solenoid valve from the frame.


GF0936-A

7. Compress the quick connect locking ring and pull out the air line.



8. Disconnect the solenoid valve electrical connector.



Installation

1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.

Module

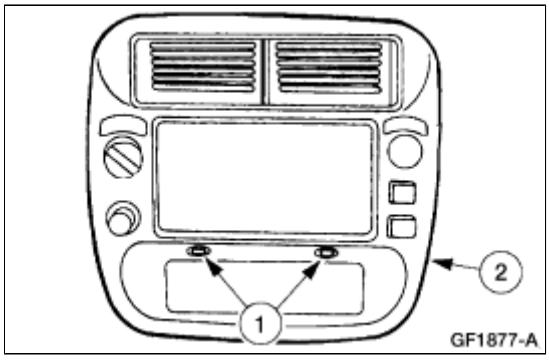
Removal

1. **CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

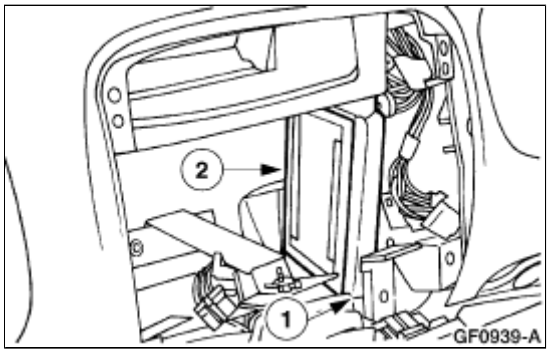
   NOTE: Ride heights must be reset for the air suspension module whenever the air suspension module is replaced.

   Disconnect the battery negative ground cable.

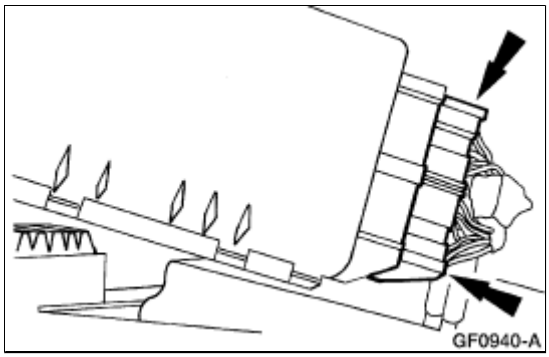
2. Remove the center instrument panel finish panel.
   1. Remove the center instrument panel finish panel screws.
   2. Disconnect the electrical connectors and remove the center panel finish panel.



3. Remove the air suspension control module.
   1. Remove the air suspension control module screws.
   2. Slide the air suspension control module down and out of the support bracket.



4. Disconnect the air suspension control module electrical connectors and remove the air suspension control module.

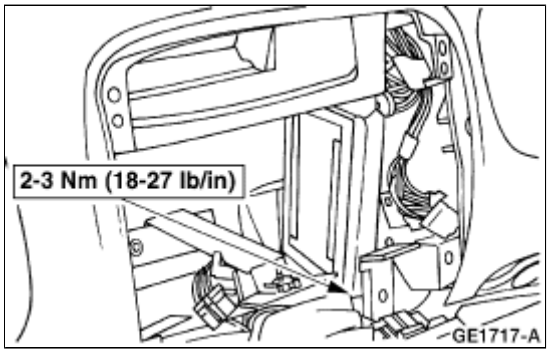


Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   NOTE: When installing a new air suspension control module, ride height adjustment must be performed. Ride Height Adjustments

   To install, reverse the removal procedure.



General Specifications

Item	Specification
Front Axle	
Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant	WSP-M2C197-A
Rear Axle	
Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Explorer and Mountaineer with 8.8-inch ring gear, 5.0L engine and Traction-Lok® differential: High Performance Synthetic 75-W140 Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Explorer with 8.8-inch ring gear and conventional 4.0L engine: Thermally Stable XY-80W90-QL	WSP-M2C197-A
Driveshaft Slip-Yoke	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacities	
Front axle	1.54 liters (2.7 pints) (9.56 mm [0.38 in] below the bottom of the filler hole)
Rear axle	2.60 liters (5.5 pints) (6-14 mm [1/4-9/16 in] below the bottom of the filler hole)
Traction-Lok® [1]	118.29 ml (4 oz)
Sealants	
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Epoxy Sealer	M-3D35A (E)
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1
Engine Angle (Degrees)	
All	4.75

[1] Friction modifier

Explorer 4x2 Rear Driveline Angles @ Curb Specifications

Model	Trans.	Engine	Ride Height mm (In.)	Rear DS Angle (deg.)	Pinion Angle (deg.)
2-door	Manual	4.0	123 (4.84)	8.0	5.35
2-door	Auto	4.0	123 (4.84)	8.3	5.35
4-door	Manual	4.0	143 (5.63)	7.7	5.1
4-door	Auto	4.0	143 (5.63)	7.9	5.1

4-door	Auto	5.0	140 (5.51)	6.6	5.0

Explorer, Mountaineer 4x4 Rear Driveline Angles @ Curb Specifications

Model	Trans.	Engine	Ride Height mm (In.)	Rear DS Angle (deg.)	Pinion Angle (deg.)
2-door	Auto/Manual	4.0	118 (4.65)	9.9	5.4
4-door without air suspension	Auto/Manual	4.0	143 (5.63)	8.4	5.1
4-door with air suspension	Auto	4.0	118 (4.65)	9.1	5.4
4-door without air suspension	Auto	5.0	140 (5.51)	6.9	5.1
4-door with air suspension	Auto	5.0	118 (4.65)	7.4	5.4

Driveline System

The source of the drivetrain's power is generated by the engine and delivered to the transmission. The driveline transfers the engine torque through the driveshaft to the axle.

- On 2-wheel drive vehicles, power is transmitted through the transmission to the driveshaft and then to the rear axle.
- On 4-wheel drive vehicles, power is transmitted through the transmission and the transfer case. The transfer case directs the power to the rear driveshaft and then to the rear axle. When engaged, it also transmits power through the front driveshaft to the front axle.
- On all wheel drive vehicles, power is transmitted through the transmission and continuously proportioned to the front and rear axles through the transfer case.

The rear driveshaft is connected to the output shaft of the transmission and to the rear axle. The front driveshaft is connected to the transfer case and to the front axle. Universal joints and CV joints are used at both ends of the driveshaft to allow for angular motions. Slip yokes are used to allow for any changes to the length of the driveshaft. The engine torque enters the axle through the drive pinion, which rotates the ring gear. The ring gear is mounted to the differential case, which contains the gears that transmit power to the rear axle shafts or front halfshafts. These shafts rotate the drive wheels.

Vehicles have the following types of driveshafts:

- One-piece rear driveshaft with two U-joints and a front slip yoke.
- One-piece front driveshaft with one front U-joint, a slip yoke and a rear CV joint.

For additional information on the front axle assembly, refer to Section 205-03 .

For additional information on the halfshaft, refer to Section 205-04 .

For additional information on the driveshaft, refer to Section 205-01 .

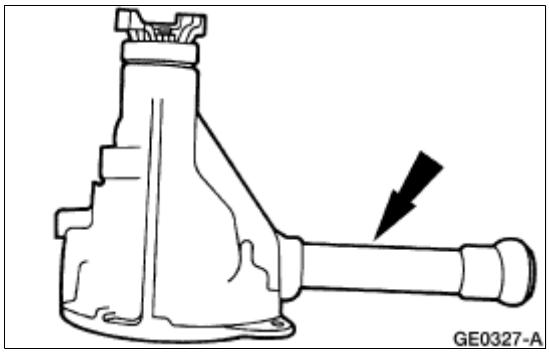
For additional information on the rear axle, refer to Section 205-02 .

The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage.

Vehicle Certification (VC) Label Example

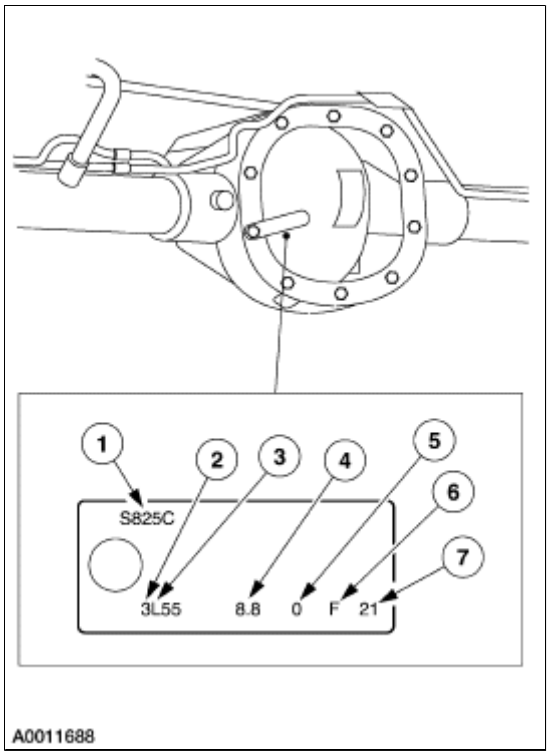
The vehicle certification (VC) label is located in the driver door jamb. The first two digits of the axle code indicate the rear axle and the third digit refers to the front axle, if so equipped. For additional information on the VC label, refer to Section 100-01 .

Front Axle Identification Tag



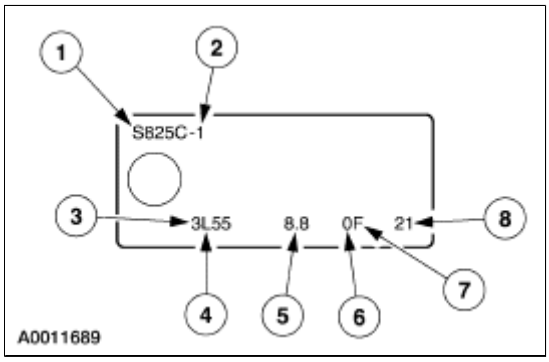
A manufacturing date code and a complete part number is stamped on the left carrier arm between the fill plug and axle end. A metal axle identification tag is attached to the differential by a housing cover bolt.

Rear Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Denotes Traction-Lok®
4	Ring gear diameter (inch)
5	Build year
6	Build month
7	Build day

Axle Identification Tag Denoting Interchangeability Affected Internally



Item	Description
1	Plant code
2	Denotes interchangeability affected internally

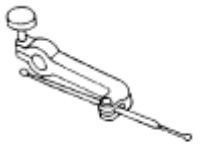
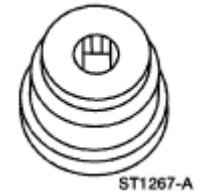
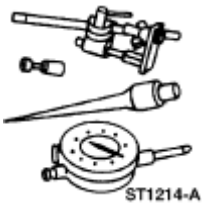
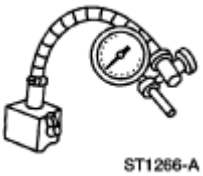
3	Axle ratio
4	Denotes Traction-Lok®
5	Ring gear diameter (inch)
6	Build year
7	Build month
8	Build day

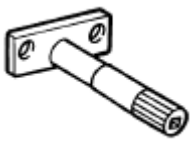
CAUTION: The axle identification tag is the official service identifier. Do not damage the tag. Always reinstall the tag after removing it for axle inspection/repair.

The axle identification tag identifies a particular axle design, a specific ratio, and if it is a conventional or limited slip (Traction-Lok®) type. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design change. If, however, an internal design change takes place during the production life of the axle and that internal change affects parts interchangeability, a dash and numerical suffix is added to the plant code. This means that as an assembly both axles are interchangeable; however, internally they are different. Therefore, each requires different internal parts at the time of repair.

Driveline System

Special Tool(s)

ST1268-A	Clamp Plate 205-320 (T92L-4851-C)
 ST1348-A	Clutch Housing Alignment Adapter 308-021 (T75L-4201-A)
ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1267-A	Companion Flange Runout Gauge 205-319 (T92L-4851-B)
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
 ST1266-A	Dial Indicator/Magnetic Base 100-D002 (D78P-4201-B) or Equivalent
ST2207-A	Vibration Analyzer 100-F027 (014-00344)

 ST2040-A	Traction-Lok® Torque Tool 205-022 (T66L-4204-A)

Inspection and Verification

Certain axle and driveline symptoms are also common to the engine (6007), transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the concern is in the axle before disassembling, adjusting or repairing the axle. Refer to Section 100-04 .

Certain driveshaft vibration symptoms are common to the front engine accessory drive (FEAD, the engine, transmission or tires. Be sure the cause of the concern is the driveshaft before repairing or installing a new driveshaft. Refer to Section 100-04

Certain symptoms may be caused by Traction-Lok® differentials (4026). Check the vehicle certification label and axle identification tag to determine the type of differential. Refer to Section 100-01 .

Noise Acceptability

NOTE: A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions such as a newly paved blacktop road. Slight noise is not detrimental to the operation of the axle and is considered normal.

With the Traction-Lok® differential axle, slight chatter noise on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the locking axle function.

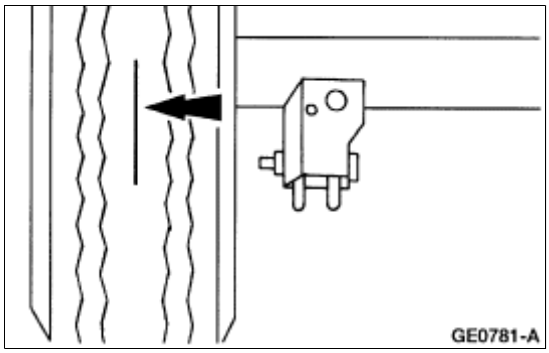
Universal Joint (U-Joint) Inspection

Place the vehicle on a frame hoist and rotate the driveshaft (4602) by hand. Check for rough operation or seized U-joints. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating. For additional information, refer to Section 205-01 .

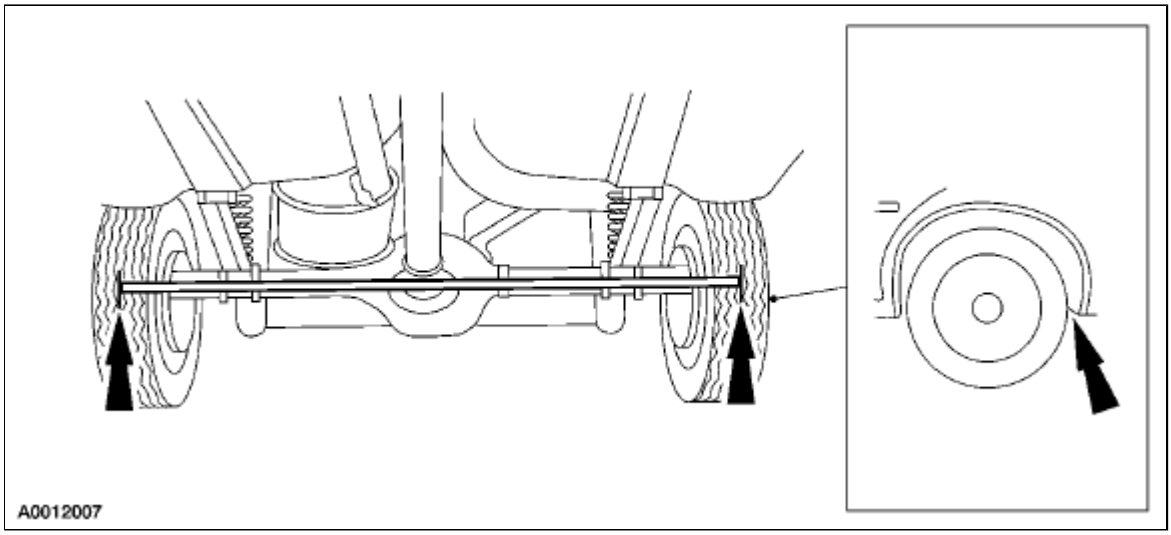
Inspection For Bent Rear Axle Housing

1. Raise and support the vehicle. For additional information, refer to Section 100-02 . Allow the rear axle (4001) to be freely suspended.

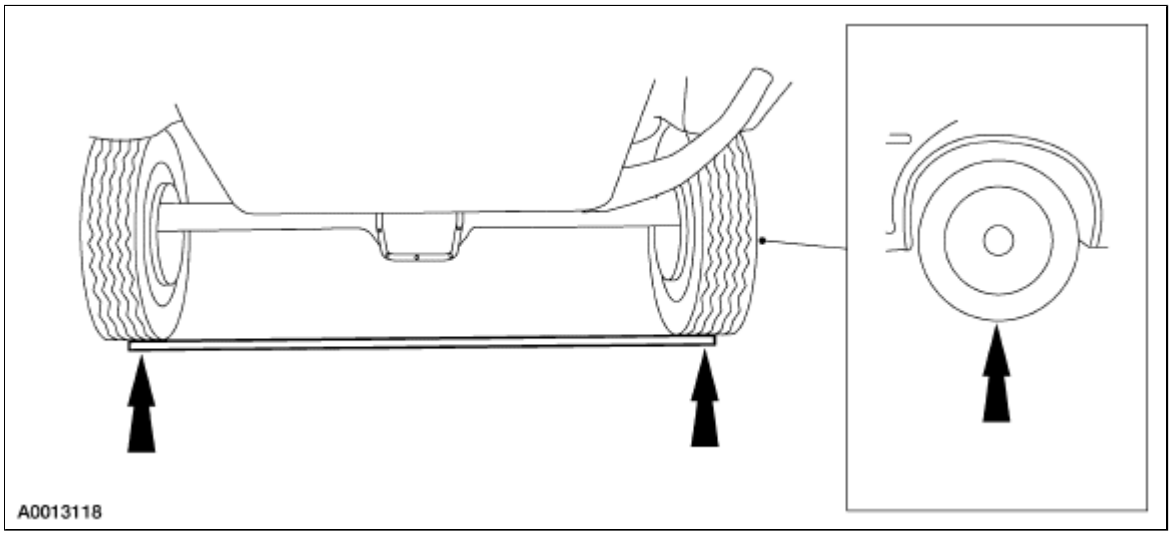
2. Use white chalk or paint to mark a vertical line on the center of each rear tire.



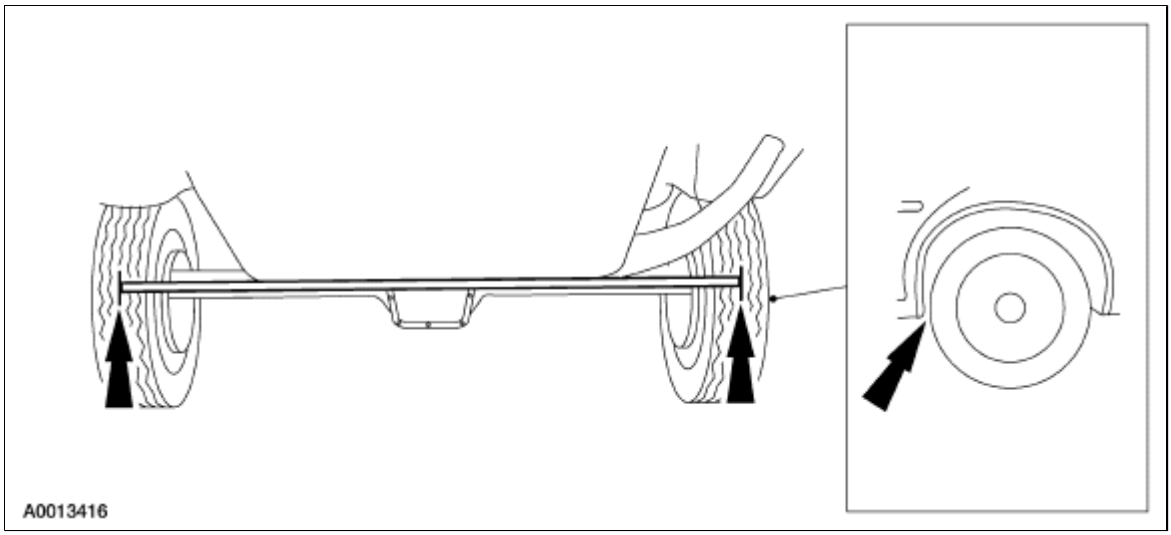
3. Adjust both wheels so that the markings face the front of the vehicle. With a tape measure, measure the distance between the marks and record this reading (front reading).



4. Rotate the rear wheels so the markings are directly underneath the vehicle. Measure the distance between the marks and record this reading (bottom reading).



5. Rotate the rear wheels so the markings face the rear of the vehicle. Measure and record the distance between the marks (rear reading).



6. Compare the front and the rear readings (Steps 3 and 5) to find the toe-in or toe-out condition.
   - Toe-in occurs when the front measurement is less than the rear measurement.
   - Toe-out occurs when the rear measurement is less than the front measurement.

7. To determine camber, find the average of the front and the rear measurements (Steps 3 and 5). Subtract the bottom reading (Step 4) from this number.
   Positive (+) camber is when the bottom reading is less than the average of the front and rear readings. Negative (-) camber is when the bottom reading is greater than the average of the front and rear readings.

8. The results of the calculations in Steps 6 and 7 must conform to the following specifications:
   Toe-in: 0 - 1/16 inch.
   Toe-out: 0 - 3/16 inch.
   Camber: 0 ± 5/32 inch.
   If the axle housing does not meet these specifications, it must be installed new. Refer to Section 205-02 .

9. After the axle housing has been installed, repeat Steps 2 through 7.

Analysis of Leakage

Clean up the leaking area enough to identify the exact source.

A plugged axle housing vent can cause excessive pinion seal lip wear due to internal pressure buildup.

Make sure the axle lubricant is at the correct level. Refer to Specifications in this section.

Axle Vent

NOTE: If a plugged vent cannot be cleared, install a new one.

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. Make sure the vent hose is not kinked. Remove the hose from the vent nipple and clear the hose of any foreign material. While the hose is removed, pass a length of mechanics wire or a small diameter Allen wrench in and out of the vent to clean it. Connect the hose when done.

Flange Yoke Seal

Leaks at the axle drive pinion seal originate for the following reasons:

- Seal was not correctly installed.
- Poor quality seal journal surface.

Any damage to the seal bore (dings, dents, gouges, or other imperfections) will distort the seal casing and allow leakage past the outer edge of the axle drive pinion seal.

The axle drive pinion seal can be torn, cut, or gouged if it is not installed carefully. The spring that holds the axle drive pinion seal against the pinion flange may be knocked out and allow leakage past the lip.

The rubber lips can occasionally become hard (like plastic) with cracks at the oil lip contact point. The contact point on the pinion flange may blacken, indicating excessive heat. Marks, nicks, gouges, or rough surface texture on the seal journal of the pinion flange will also cause leaks.

The pinion flange must be installed new if any of these conditions exist.

Metal chips or sand trapped at the sealing lip can also cause oil leaks. This can cause a wear groove on the pinion flange and heavy pinion seal wear.

When a seal leak occurs, install a new seal and check the vent and the vent hose to make sure they are clean and free of foreign material.

Axle Shaft Seals

Axle shaft oil seals are susceptible to the same kinds of damage as axle drive pinion seals if incorrectly installed. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. The axle shaft journal surface must be free of nicks, gouges, and rough surface texture.

Differential Seals

For additional information on differential seals, refer to Section 205-02 for the rear axle or Section 205-03 for the front axle.

Analysis of Vibration

WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

WARNING: An all-wheel drive (AWD) vehicle will always have all wheels on both axles driving. If only one wheel/axle is raised off the floor and the axle is driven by the engine, the wheel/axle on the floor could drive the vehicle off the stand or jack. Be sure all wheels are off the floor.

Few vibration conditions are caused by the front or rear axle. On a vibration concern, follow the diagnosis procedure in Section 100-04 unless there is a good reason to suspect the axle.

Tires

WARNING: Do not balance the wheels and tires while they are mounted on the vehicle. Possible tire disintegration/differential failure could result, causing personal injury/extensive component damage. Use an off-vehicle wheel and tire balancer only.

Most vibration is caused by tires, driveline angle or driveline imbalance.

Vibration is a concern with modern, high-mileage tires if they are not "true" both radially and laterally. They are more susceptible to vibration around the limits of radial and lateral runout of the tire and wheel assembly. They also require more accurate balancing. Wheel and tire runout checks, truing and balancing are normally done before axle inspection. For additional information, refer to Section 204-04 .

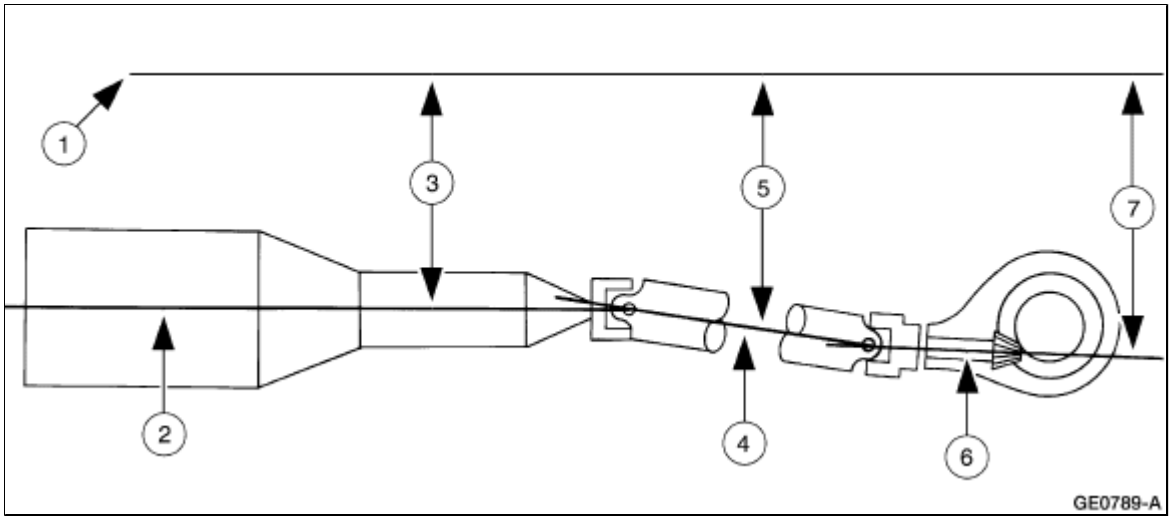
Driveline Imbalance

Driveline imbalance can be caused by excessive looseness in the driveshaft, damaged driveshaft tubing, looseness or high runout at the driveshaft attachments (axle and transfer case flanges). Excessive looseness in the driveshaft can be caused by CV joint or universal joint wear as well as loose fitting slip-yoke splines. Inspect and install new driveshaft and halfshaft components as necessary. For additional information, refer to Section 205-01 and Section 205-04 .

Driveline Angle

Driveline angularity is the angular relationship between the engine crankshaft (6303), the driveshaft, and the rear axle pinion. Some of the factors determining driveline angularity include ride height, rear spring, and engine mounts.

Driveline Angle



Item	Description
1	Bottom of the frame
2	Engine crankshaft centerline
3	Engine angle
4	Driveshaft and coupling shaft centerline
5	Driveshaft and coupling shaft angle
6	Rear axle pinion centerline

7	Axle pinion angle

An incorrect driveline (pinion) angle can often be detected by the driving condition in which the vibration occurs.

- A vibration during coastdown from 72 to 56 km/h (45 to 35 mph) is often caused by an excessive U-joint angle at the axle (pinion nose downward).
- A vibration during acceleration, from 56 to 72 km/h (35 to 45 mph) may indicate an excessive U-joint angle at the axle (pinion nose upward).

When these conditions exist, check the driveline angles as described in the General Procedures portion of this section.

If the tires and driveline angle are not the cause, carry out the NVH tests to determine whether the concern is caused by a condition in the axle. Refer to Section 100-04 .

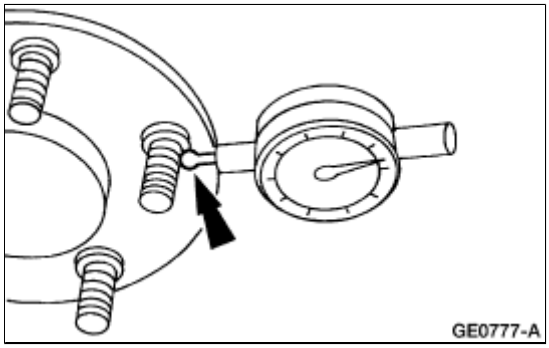
Universal Joint (U-Joint) Wear

Place the vehicle on a frame hoist and rotate the driveshaft by hand. Check for rough operation or seized U-joints. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating. For additional information, refer to Section 205-01 .

Wheel Hub or Axle Flange Bolt Circle Runout

NOTE: The brake discs must be removed to carry out all runout measurements.

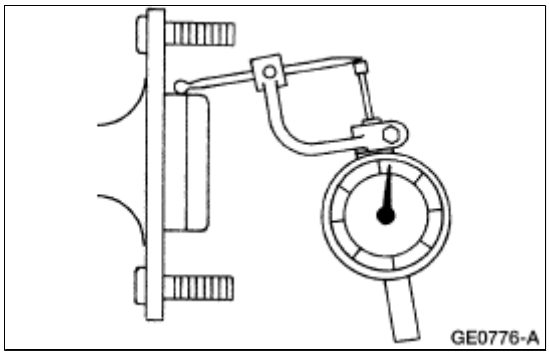
1. Position the Dial Indicator with Bracketry perpendicular to the wheel hub or axle flange bolt, as close to the hub or flange face as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange until the next bolt is contacted. Record the measurement and continue until each bolt is checked. The difference between the maximum and minimum contact readings will be the total wheel hub or axle flange bolt pattern runout. The runout must not exceed 0.38 mm (0.015 inch).

Pilot Runout

1. Position the Dial Indicator with Bracketry with the Clutch Housing Alignment Adapter to the pilot, as close to the hub or axle flange face as possible. Zero the indicator to allow the pointer to deflect either way.

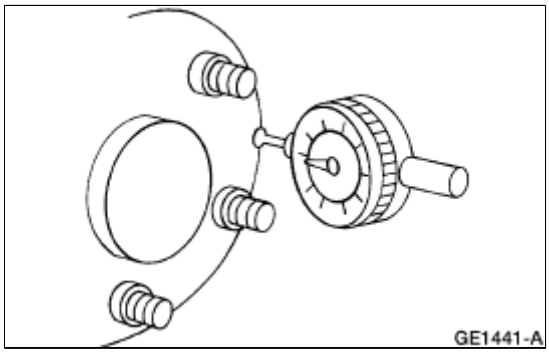


2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total pilot runout. Pilot runout must not exceed 0.15 mm (0.006 inch).

Wheel Hub or Axle Flange Face Runout

NOTE: If the axle shaft assembly is removed, check runout of the shaft itself. The forged (unmachined) part of the shaft is allowed to have as much as 3.0 mm (0.120 inch) runout. This alone will not cause a vibration condition.

1. Position the Dial Indicator with Bracketry on the wheel hub or axle flange face, as close to the outer edge as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total face runout. The runout must not exceed 0.127 mm (0.005 inch).

Drive Pinion Stem and Pinion Flange

Check the pinion flange runout when all other checks have failed to show the cause of vibration.

One cause of excessive pinion flange runout is incorrect installation of the axle drive pinion seal. Check to see if the spring on the seal lip has been dislodged before installing a new ring gear and pinion.

Halfshafts, Front Wheel

NOTE: Constant velocity (CV) joints must not be installed unless disassembly and inspection reveals unusual wear. For additional information, refer to Section 205-04 .

NOTE: While inspecting the boots, watch for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears, or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Axle Noise

NOTE: Before disassembling the axle to diagnose and correct gear noise, eliminate the tires, exhaust, trim items, roof racks, axle shafts (4234) and wheel bearings as possible causes. Follow the diagnostic procedures in Section 100-04

The noises described as follows usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are the type of noise heard during the road test.

Gear Howl and Whine

Howling or whining of the ring gear and pinion is due to an incorrect gear pattern, gear damage or incorrect bearing preload.

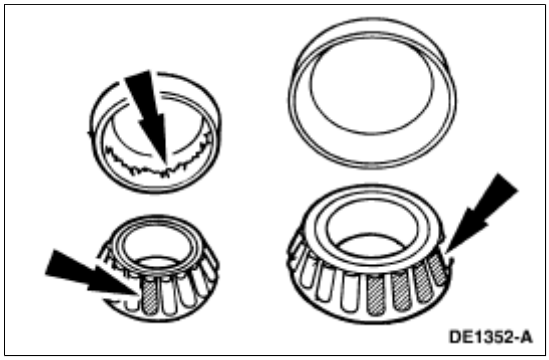
Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by worn/damaged pinion bearings, which are operating at driveshaft speed. Bearing noise occurs at all driving speeds. This distinguishes it from gear whine which usually comes and goes as speed changes.

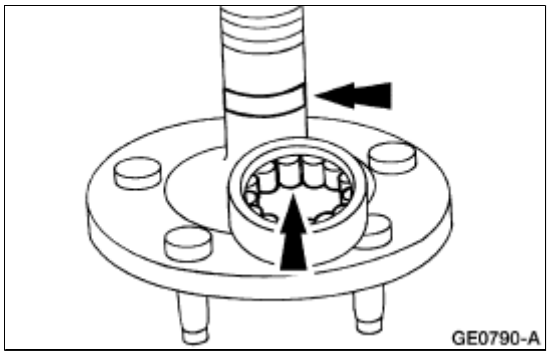
As noted, pinion bearings make a high-pitched, whistling noise, usually at all speeds. If however there is only one pinion bearing that is worn/damaged, the noise may vary in different driving phases. Pinion bearings must not be installed new unless they are scored or damaged or there is a specific pinion bearing noise. A worn/damaged bearing will normally be obvious at disassembly. Examine the large end of the rollers for wear. If the pinion bearings original blend radius has worn to a sharp edge, the pinion bearing must be installed new.

NOTE: A low-pitched rumble normally associated with a worn/damaged wheel bearing can be caused by the exterior luggage rack or tires.

A wheel bearing noise can be mistaken for a pinion bearing noise. On 4x2 vehicles, check the wheel bearing for a spalled cup, and spalled/damaged rollers. Install a new wheel bearing if any of these concerns are detected.



If the wheel bearing is damaged, the roller surface on the axle shaft may also be damaged. Install a new axle shaft if any damage is detected.



On 4x4 vehicles, check the wheel bearing for rotating smoothness and end play. Install new as required.

Chuckle

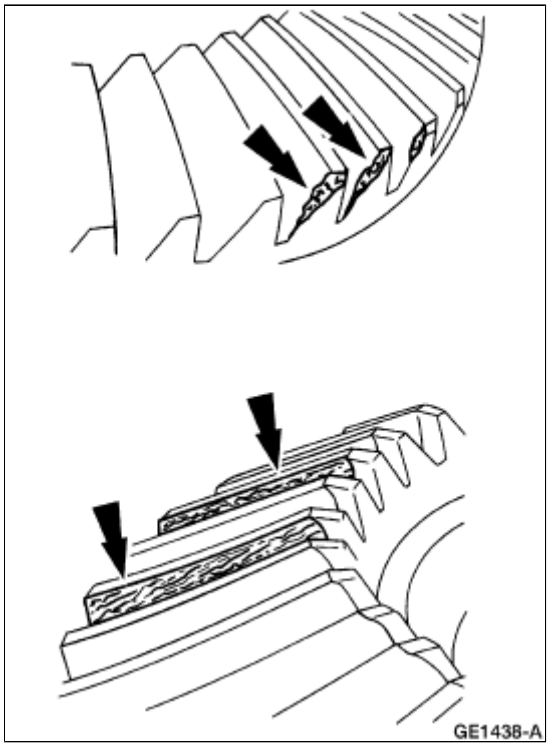
Chuckle that occurs on the coast driving phase is usually caused by excessive clearance between the differential gear hub and the differential case bore.

Damage to a gear tooth on the coast side can cause a noise identical to a chuckle. A very small tooth nick or ridge on the edge of a tooth can cause the noise.

Clean the gear tooth nick or ridge with a small grinding wheel. If the damaged area is larger than 3.2 mm (1/8 inch), install a new gearset.

To check the ring gear and pinion, remove as much lubricant as possible from the gears with clean solvent. Wipe the gears dry or blow them dry with compressed air. Look for scored or damaged teeth. Also look for cracks or other damage.

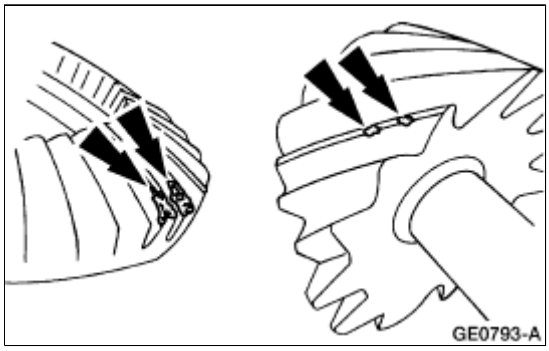
If either gear is scored or damaged badly, the ring gear and pinion must be installed new.



If metal has broken loose, the axle housing must be cleaned to remove particles that will cause damage. At this time, any other damaged parts in the axle housing must also be installed new.

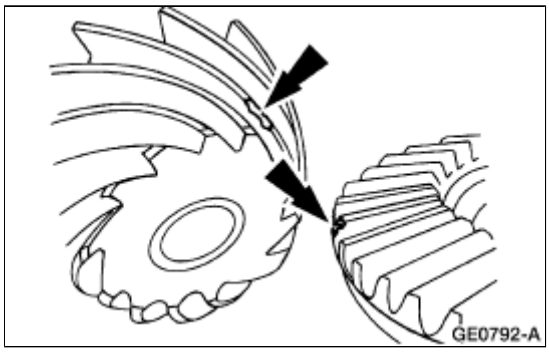
Knock

Knock, which can occur on all driving phases, has several causes including damaged teeth or gearset.



In most cases, one of the following conditions will occur:

1. A gear tooth damaged on the drive side is a common cause of the knock. This can usually be corrected by grinding the damaged area.



2. **NOTE:** Measure the end play with a Dial Indicator with Bracketry and not by feel.

   Knock is also caused by excessive end play in the axle shafts. Up to 0.762 mm (0.030 inch) is allowed in semi-float axles. The frequency of the knock will be less because the axle shaft speed is slower than the driveshaft.

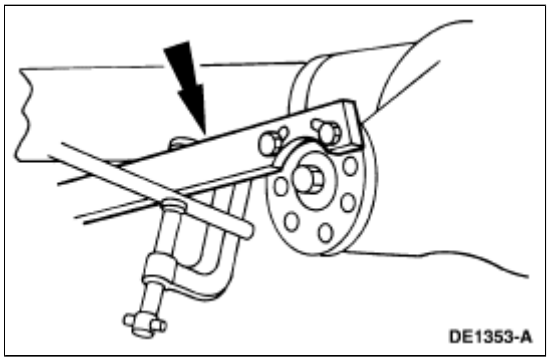
Clunk

Clunk is a metallic noise heard when the automatic transmission is engaged in REVERSE or DRIVE. The noise can also occur when throttle is applied or released. It is caused by backlash somewhere in the driveline or loose suspension components; it is felt or heard in the axle. Refer to Total Backlash Check in this section.

Additionally, clunk may be heard upon initial drive-away. This occurs as engine torque shifts vehicle weight, forcing changes in driveline angles, preventing the driveshaft slip-yoke from sliding on the output shaft. To correct for this condition, lubricate the slip-yoke splines. For additional information, refer to Section 205-01 .

Total Backlash Check

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Install the Companion Flange Holding Tool.
   - Clamp a rigid bar or pipe to the tool. Clamp the other end of the bar or pipe to the frame or a body member in order to prevent movement of the rear axle pinion flange.



4. Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will be used to measure total rear axle backlash.
5. Rotate the free wheel slowly, by hand, until the feeling of driving the rear axle is encountered. Place a mark on the side of the tire, 305 mm (12 inches) from the center of the wheel, with a crayon or chalk.
6. While holding the crayon or chalk against the tire, rotate the wheel slowly in the opposite direction until the feeling of driving the rear axle is encountered again.
7. Measure the length of the crayon or chalk mark on the tire.
   - If the length of the mark is 25.4 mm (1 inch) or less, the rear axle backlash is within allowable limits.
   - If the chalk mark is greater than 25.4 mm (1 inch), check for these conditions:
     - Elongation of the differential pinion shaft and holes in the differential case (4204).
     - Missing differential pinion thrust washer (4230) or differential side gear thrust washer (4228).
     - Galling of the differential pinion shaft (4211) and bore.
     - Excessive ring gear and pinion backlash. Follow the procedure for the type of rear axle to check backlash.

Axle Shaft Bearing Noise

Axle shaft bearing noise is similar to gear noise and differential pinion bearing whine. Axle shaft bearing noise will usually distinguish itself from gear noise by occurring in all driving modes (drive, coast, and float), and will persist with the transmission in NEUTRAL while the vehicle is moving at the speed in which the concern is occurring. If the vehicle makes this noise, remove the suspect axle shaft, install a new bearing and a new axle seal. Re-evaluate the vehicle for noise before removing any internal components.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a worn/damaged wheel bearing. The lower pitch is because the wheel bearing turns at only about one-third of the driveshaft

speed. Wheel bearing noise also may be high-pitched, similar to gear noise, but will be evident in all four driving modes.

Analysis of Inoperative Conditions

If the axle does not operate, one of the following may be the cause.

Broken Welds

If axle housing welds are completely broken, install a new axle housing.

Wheel Bearing Wear/Damage

Because of the severe loads they must handle, wheel bearings can require replacement at high mileage. If a wheel bearing fails at low mileage, it is often caused by overloading.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Traction-Lok® Does Not Work in Snow, Mud or on Ice	• Differential.	• CARRY OUT the Traction-Lok® Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-02 .
• Lubricant Leaking from the Pinion Seal, Axle Shaft Oil Seals or Support Arm to the Housing	• Vent. • Damage in the seal contact area or dust slinger on the pinion flange dust shield.	• CLEAN the axle housing vent. • INSTALL a new pinion flange and the pinion seal if damage is found.
• Front Axle Will Not Engage	• Switches. • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .
• Front Axle Will Not Disengage	• Switches. • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .

Component Tests

Driveshaft Vibration Diagnosis

1. **NOTE:** When carrying out the following procedure steps on four-wheel drive vehicles, raise and support the vehicle so that all four wheels do not touch the ground.

   Road test the vehicle to determine the critical vibration points. Note the road speed, the engine RPM, and the shift lever positions at which the vibration occurs.

2. Stop the vehicle, place the transmission lever in neutral and run the engine through the critical speed ranges determined in Step 1.

3. If no vibration is felt, balance the driveshaft. Refer to Driveline Vibration in this section.

Driveline Vibration

NOTE: An analysis of driveline vibration can also be conducted using the Vibration Analyzer; following the manufacturer's directions.

Driveline vibration exhibits a higher frequency and lower amplitude than does high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is usually noticed at various speeds. Driveline vibration can be perceived as a tremor in the floorpan or is heard as a rumble, hum, or boom. Driveline vibration can exist in all drive modes, but may exhibit different symptoms depending upon whether the vehicle is accelerating, decelerating, floating, or coasting. Check the driveline angles if the vibration is particularly noticeable during acceleration or deceleration, especially at lower speeds. Driveline vibration can be duplicated by supporting the axle upon a hoist or upon jack stands, though the brakes may need to be applied lightly in order to simulate road resistance.

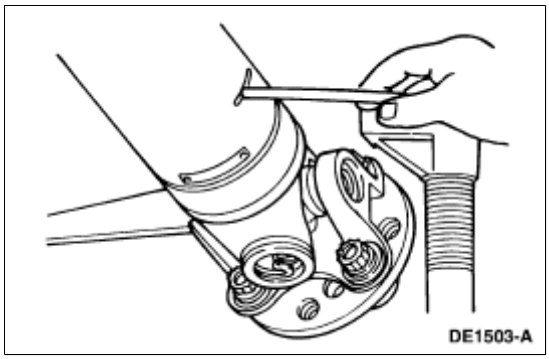
1. **NOTE:** When carrying out the following procedure steps on four-wheel drive vehicles, raise and support the vehicle so that all four wheels do not touch the ground.

   Raise the vehicle promptly after road testing. Use a twin-post hoist or jack stands to prevent tire flat-spotting. Engage the drivetrain and accelerate to the observed road test speed to verify the presence of the vibration. If the vibration is not evident, check the non-driving wheels with a wheel balancer to rule out imbalance as a possible cause. If required, balance the non-driving wheels and repeat the road test. If the vibration is still evident, proceed to Step 2.

2. Mark the relative position of the drive wheels to the wheel lugs. Remove the wheels. Install all the lug nuts in the reversed position and repeat the road speed acceleration. If the vibration is gone, refer to the tire and wheel runout procedure in Section 204-04 . If the vibration persists, proceed to Step 3.

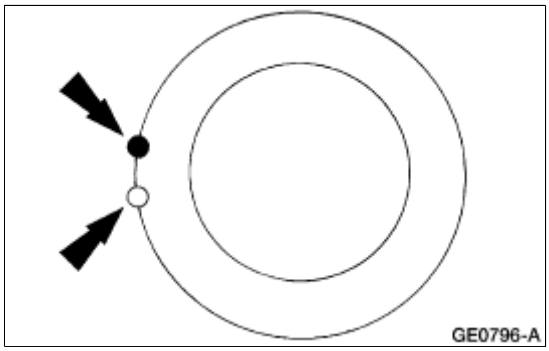
3. Inspect the driveshaft(s) for signs of physical damage, missing balance weight, undercoating, incorrect seating, wear and binding universal joints. Check the index marks (paint spots) on the rear of the driveshaft and axle pinion flange. If these marks are more than 90 degrees apart, disconnect the driveshaft and re-index to align the marks as closely as possible. After any corrections are made, recheck for vibration at the road test speed. If the vibration is gone, reinstall the wheels and road test. If the vibration persists, proceed to Step 4.

4. Raise the vehicle on a hoist and remove the wheels. Rotate the driveshafts by turning the axle and measure the runout at the front, the center, and the rear of the driveshafts with the indicator. If the runout exceeds 0.89 mm (0.035 inch) at the center, the driveshaft must be installed new. If the center is within limit, but the front or rear runout is not, mark the runout high points and proceed to Step 5. If the runout is within the limits at all points, proceed to Step 7.

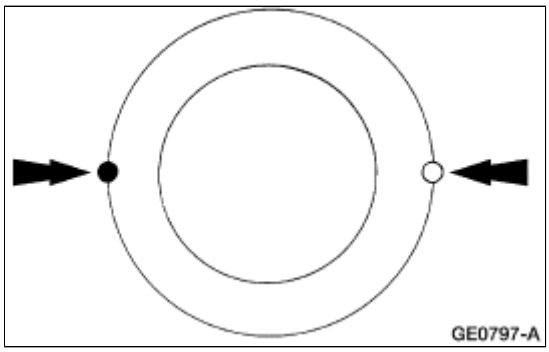


5. Scribe alignment marks on the driveshaft and the pinion flanges. Disconnect the driveshaft, rotate it one-half turn, and reconnect it. Circular axle pinion flanges can be turned in one-quarter increments to fine tune the runout condition; half-round axle pinion flanges are limited to two positions. Recheck the runout. If it is still over 0.89 mm (0.035 inch), mark the high point and proceed to Step 6. If the runout is no longer excessive, check for vibration at the road test speed. If the vibration persists, proceed to Step 7.

6. Excessive driveshaft runout may originate in the driveshaft itself or in the pinion flanges. To determine which, compare the two high points marked in Steps 4 and 5. If the marks are close together, within about 25 mm (1 inch), the shaft must be installed new and the vehicle road tested.



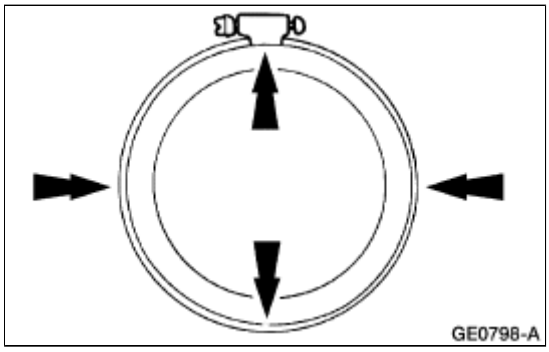
If the marks are on opposite sides of the driveshaft, the pinion flange is responsible for the vibration.



When installing or adjusting a pinion flange, the driveshaft runout must not exceed 0.064 mm (0.025 inch). When runout is within limits, recheck for vibration at road speed. If vibration persists, balance the driveshaft.

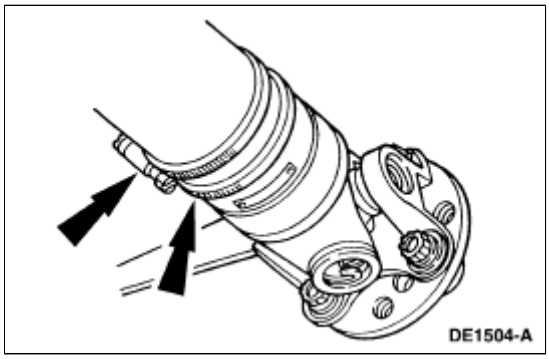
7. To balance the driveshaft, install one or two hose clamps on the driveshaft, near the ends. Position of the hose clamp head(s) can be determined by trial-and-error.

8. Mark the rear of the driveshaft into four approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1.

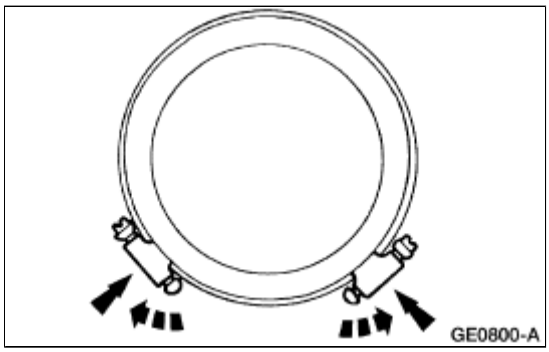


Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If two adjacent positions show equal improvement, position the clamp head between them.

9. If the vibration persists, add a second clamp at the same position and recheck for vibration.



If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 8. Separate the clamp heads about 13 mm (1/2 inch) and recheck for vibration at the road speed.



Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.

10. Install the wheels and road test (vibration noticeable on the hoist may not be evident during the road test). If the vibration is still not acceptable, install a new driveshaft. If the vibration is still not acceptable, refer to Section 205-02 for differential case and ring gear runout checks.

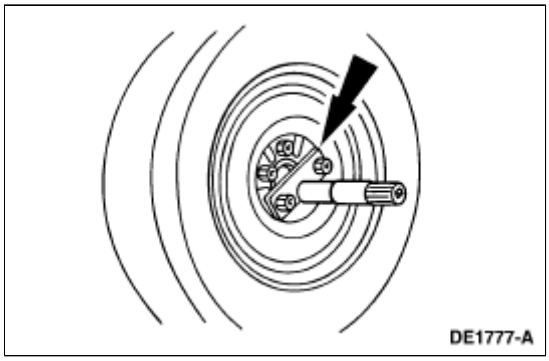
Traction-Lok® Differential Operation Check

A Traction-Lok® differential can be checked for correct operation without removing it from the rear axle housing (4010).

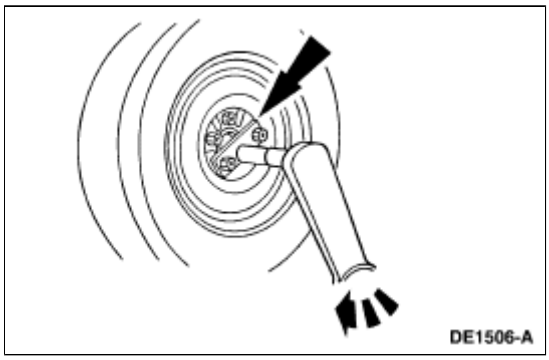
WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

WARNING: An all-wheel drive (AWD) vehicle will always have all wheels on both axles driving. If only one wheel/axle is raised off the floor and the axle is driven by the engine, the wheel/axle on the floor could drive the vehicle off the stand or jack. Be sure all wheels are off the floor.

Raise only one rear wheel. Install the Traction-Lok® Torque Tool on the wheel lugs.



Use a torque wrench with the capacity of at least 271 Nm (200 lb/ft) to rotate the axle shaft. Be sure that the transmission is in NEUTRAL, and that one rear wheel is on the floor while the other rear wheel is raised off the floor. The breakaway torque required to start rotation must be at least 27 Nm (20 lb/ft). The initial breakaway torque may be higher than the continuous turning torque.



The axle shaft must turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential case. For additional information, refer to Section 205-02 .

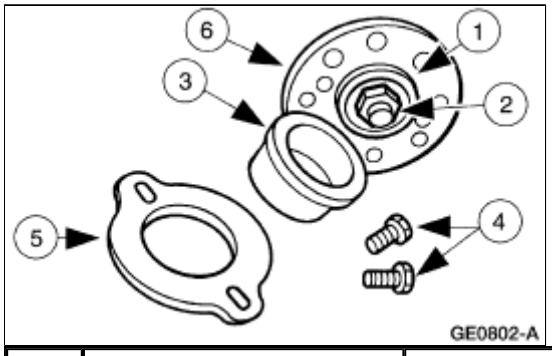
Traction-Lok® Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct operation of a Traction-Lok® rear axle assembly (4006).
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Traction-Lok® feature of the differential. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.
4. If, with unequal traction, both wheels slip, the limited slip rear axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Traction-Lok® has transferred as much torque as possible to the non-slipping wheel.

Pinion Flange Runout Check — Circular

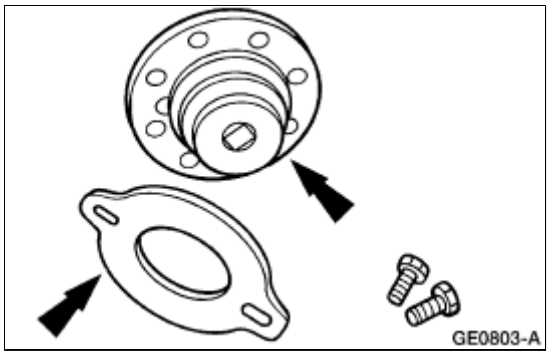
CAUTION: Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or installation.

1. Raise the vehicle on a twin-post hoist that supports the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Check the pinion flange for damage.
4. Position the Companion Flange Runout Gauge on the pinion flange.

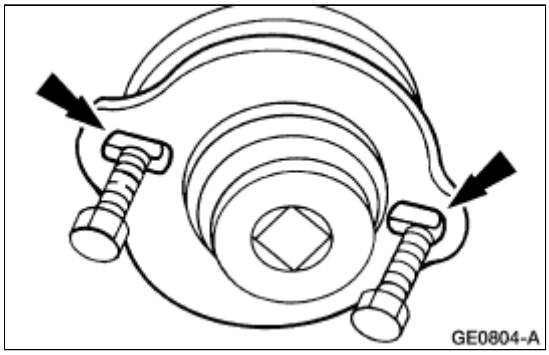


Item	Part Number	Description
1	—	Pilot (part of 205-319 (T92L-4851-B))
2	354845	Pinion nut
3	205-319 (T92L-4851-B)	Companion Flange Runout Gauge
4	—	Bolts (2 req'd) (part of 205-320 (T92L-4851-C))
5	205-320 (T92L-4851-C)	Clamp Plate
6	4851	Pinion flange

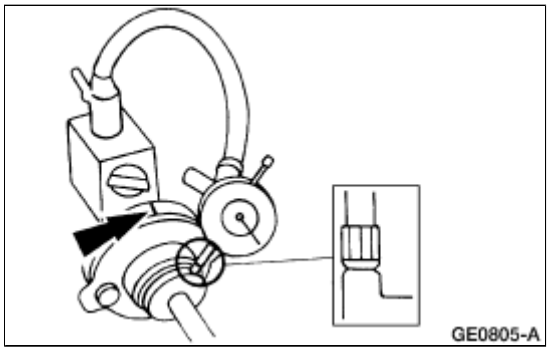
5. Position the Clamp Plate onto the Companion Flange Runout Gauge.



6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

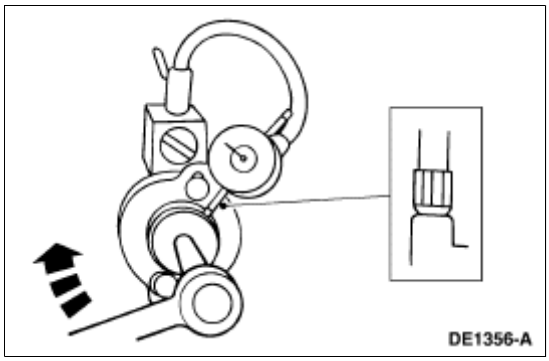


7. Position the Dial Indicator/Magnetic Base as shown. Turn the Companion Flange Runout Gauge, and locate and mark the high spot on the pinion flange with yellow paint.



If the flange runout exceeds 0.25 mm (0.010 inch), remove the pinion flange, reindex the flange one-half turn on the pinion, and reinstall it. For additional information, refer to Section 205-02 or Section 205-03 for the flange removal and installation procedures.

8. Check the runout again. If necessary, rotate the flange until an acceptable runout is obtained. If the flange runout is still more than 0.25 mm (0.010 inch), install a new pinion flange.



9. For the rear axle, if excessive runout is still evident after installation of the pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.

10. Install the driveshaft. For additional information, refer to Section 205-01 .

Tooth Contact Pattern Check — Gearset

1. To check the gear tooth contact, paint the gear teeth with the special marking compound. A mixture that is too wet will run and smear; a mixture that is too dry cannot be pressed out from between the teeth.

2. Use a box wrench on the ring gear bolts as a lever to rotate the ring gear several complete revolutions in both directions or until a clear tooth contact pattern is obtained.

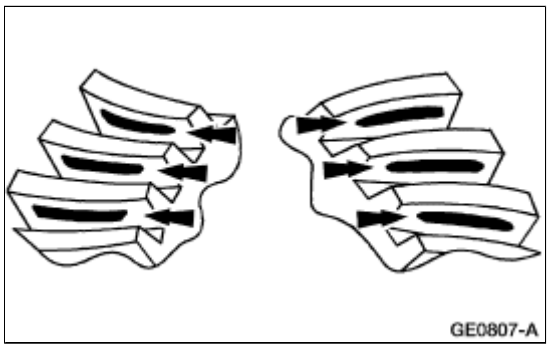
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

Contact Pattern Location

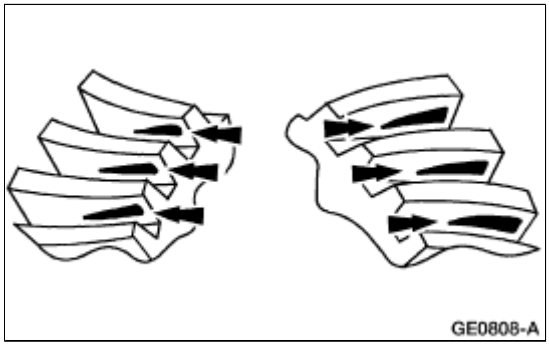
In general, desirable ring gear tooth patterns must have the following characteristics:

- Drive pattern on the drive side ring gear well centered on the tooth.
- Coast pattern on the coast side ring gear well centered on the tooth.
- Clearance between the pattern and the top of the tooth.
- No hard lines where the pressure is high.

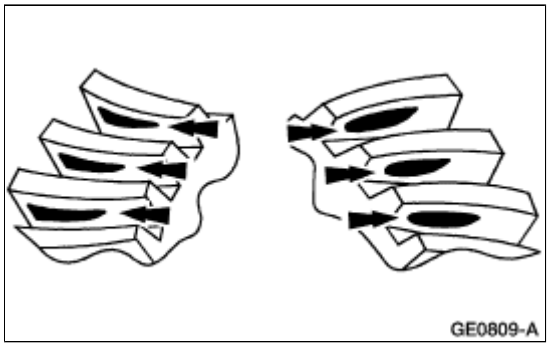
Acceptable ring gear tooth patterns for all axles.



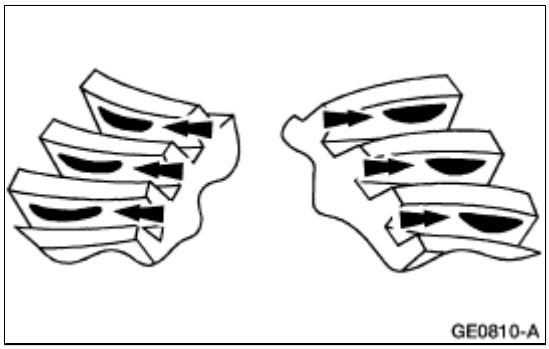
Correct backlash with a thinner pinion position shim required.



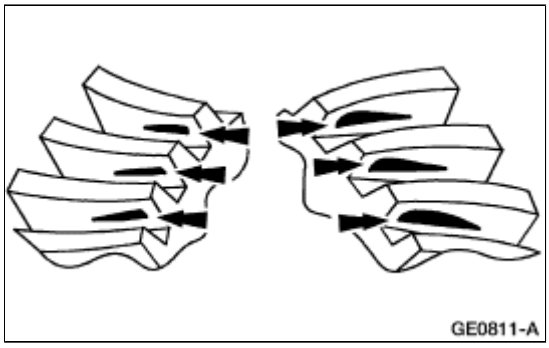
Correct backlash with a thicker pinion position shim required.



Correct pinion position shim that requires a decrease in backlash.



Correct pinion position shim that requires an increase in backlash.



Driveline Angle Inspection

Special Tool(s)

ST1622-A	Anglemaster II Driveline Inclinometer 164-R2402 or equivalent

CAUTION: Prior to checking driveline angularity, inspect the U-joints for correct operation.

NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to Section 100-04 .

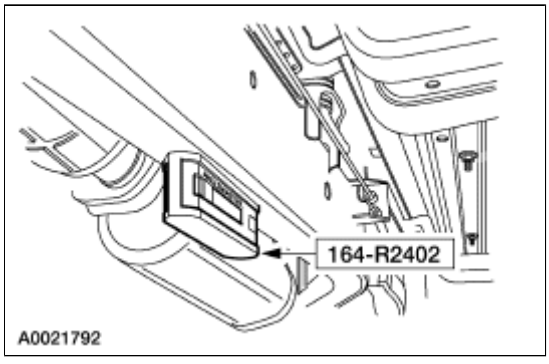
1. Check the vehicle for evidence of overload or sagging. Check for specified air pressures in all four tires.

2. Normalize the suspension.

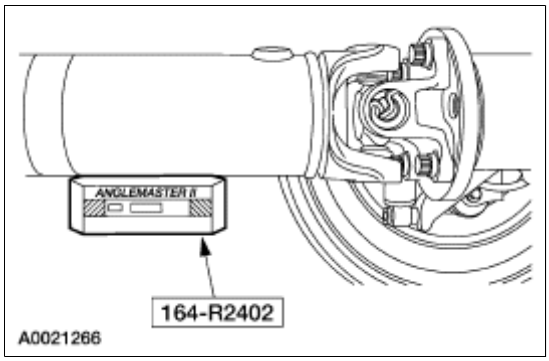
3. Drive the vehicle onto a drive-on hoist or back onto a front-end alignment rack.

4. Inspect the suspension and chassis. Verify that the vehicle curb position ride height is within specification. For additional information, refer to Section 204-00 .
   - Measure the curb position ride height with the vehicle empty and all fluid full.

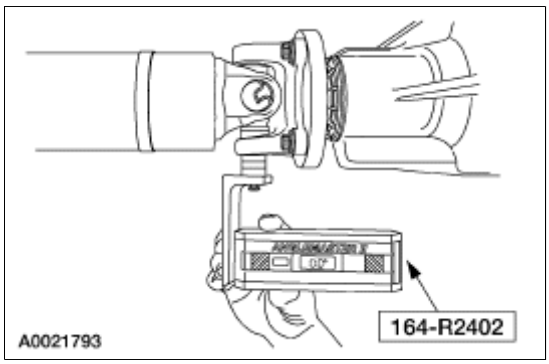
5. Place the special tool on a clean, flat level section on the bottom of the frame rail. Press the ALT ZERO button to calibrate the inclinometer to the vehicle.



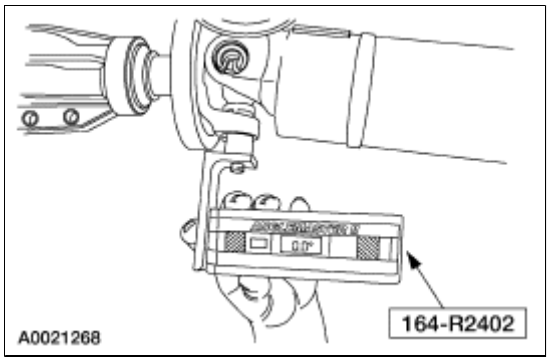
6. For the driveshaft angle reading, place the special tool flush against the bottom of the driveshaft. Check and record the reading. Compare the results with the correct angles. Refer to Specifications in this section.



7. To check the pinion angle, rotate the driveshaft so that the rear axle pinion flange yoke ear is parallel to the floor. Remove the U-joint snap ring, then install the special tool. Check and record the pinion angle reading.
    - If the angle is not within specifications, repair or adjust to obtain the correct angle . Inspect the rear suspension, rear axle, rear axle mounting or the frame for wear or damage.



8. To check the engine angle, rotate the driveshaft so that the slip yoke ear is parallel to the floor. Remove the U-joint snap ring, then install the special tool. Check and record the engine angle reading.
    - If the angle is not within specifications, repair or adjust to obtain the correct angles. Inspect the powertrain/drivetrain mounts or frame rails for wear or damage.

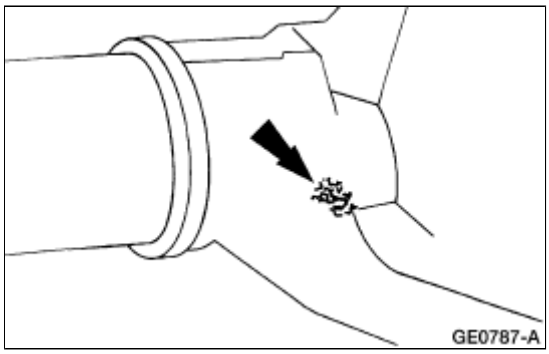


Axle Housing Casting Porosity (Holes in Casting) Repair

CAUTION: To keep the axle's sound characteristics, do not disassemble the carrier.

NOTE: Casting porosity is a condition where occasionally gas bubbles will form during the casting process leaving small pockets in the metal that will cause the axle housing to leak.

1. To fill small pockets, peen in a small amount of body lead.



2. Seal the pocket.
   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

3. To fill large pockets, drill and tap a shallow hole for a small setscrew. Install the setscrew and seal it.
   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

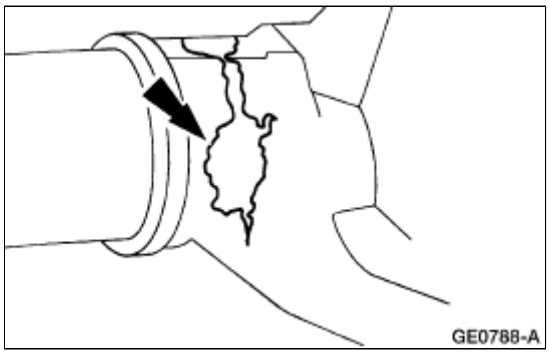
Axle Housing Weld Leaks Repair

1. **CAUTION: To keep the axle's sound characteristics, do not disassemble the carrier.**

   CAUTION: Rear axle housing straightness is too critical for field repair. Install a new axle housing if a weld is broken.

   NOTE: Most minor weld leaks are repairable. This includes the puddle and fill welds that join the axle shaft tube to the axle housing on integral axles.

   Seal the weld.
   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).



General Specifications

Item	Specification
Premium Long-Life Grease XG-1-C, -K or -T	ESA-M1C75-B
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5

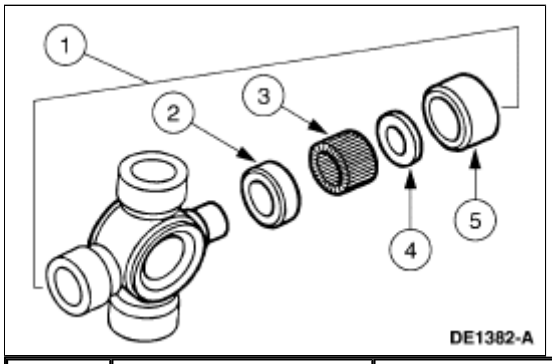
Torque Specifications

Description	Nm	lb-ft
Rear driveshaft flange yoke to transfer case bolts	112	83
Driveshaft to driveshaft rear axle pinion flange bolts	112	83
Front driveshaft to front axle bolts	15-20	11-15
Driveshaft constant velocity joint to transfer case bolts	30	22

Universal Joints

The universal joints are:

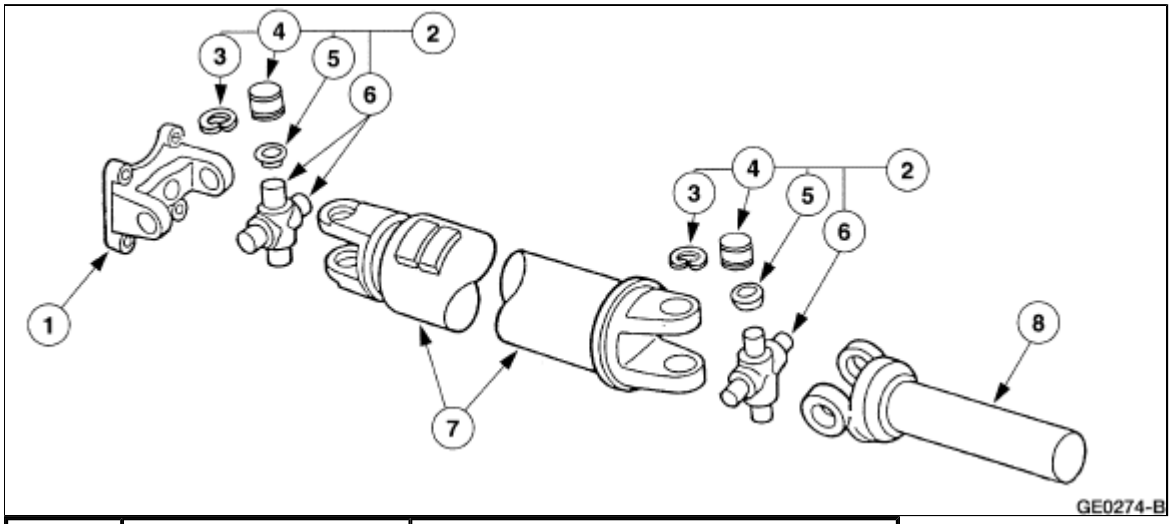
- lubed-for-life design and require no lubrication.
- equipped with nylon thrust washers, located at each base of the bearing cup, which control end play, position the needle bearing and improve grease movement.



Item	Part Number	Description
1	4635	Universal joint
2	—	Grease seal (part of 4635)
3	—	Needle rollers (part of 4635)
4	—	Thrust washer (part of 4635)
5	—	Bearing cup (part of 4635)

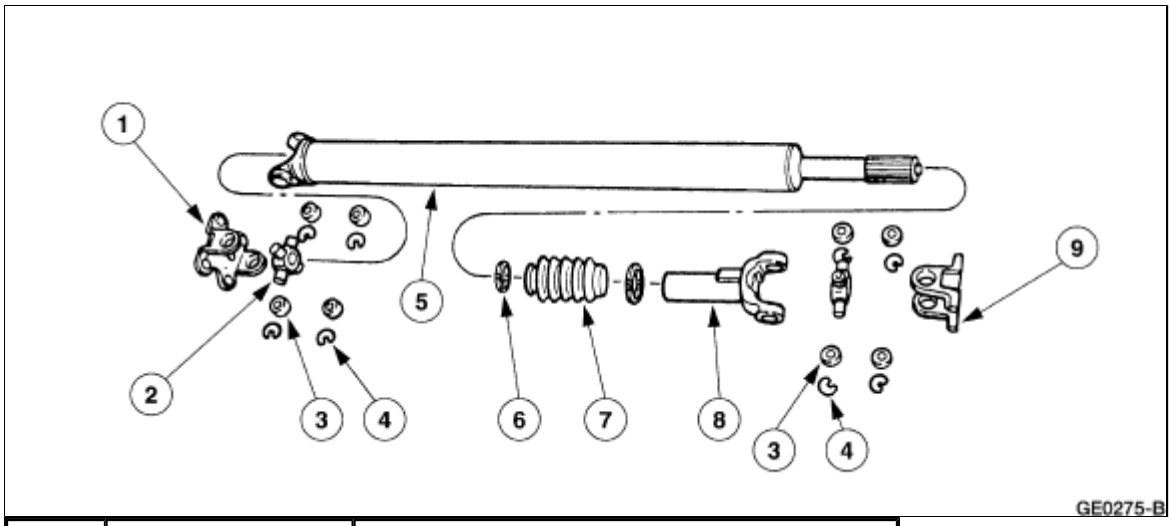
Driveshaft

Driveshaft — Rear, 4x2



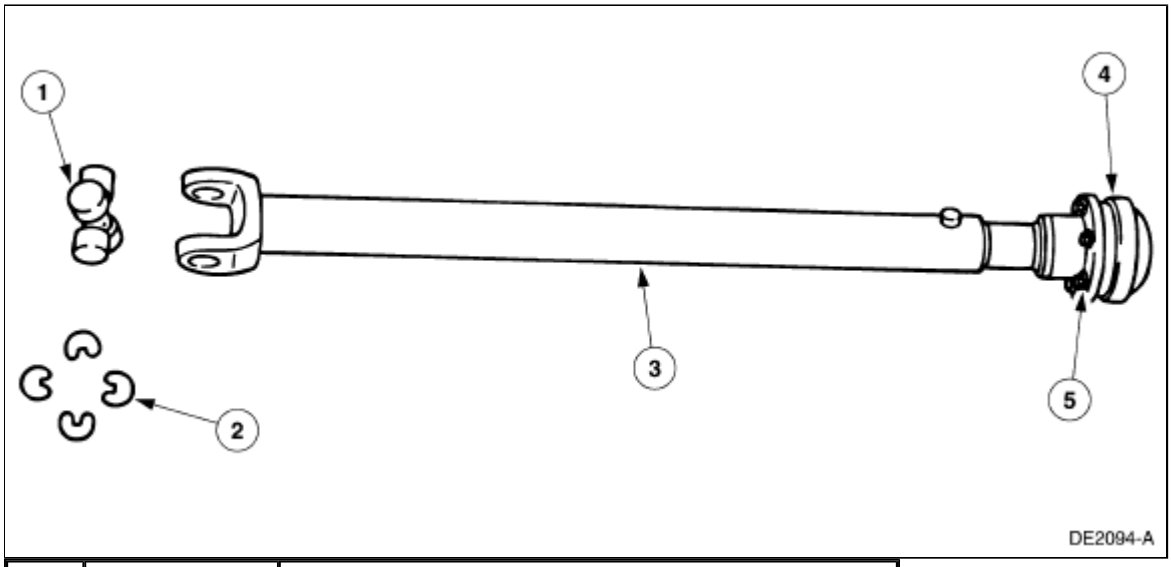
Item	Part Number	Description
1	4782	Flange
2	4635	Universal joint
3	—	Snap ring (part of 4635)
4	—	Bearing (part of 4635)
5	—	Seal (part of 4635)
6	—	Spider (part of 4635)
7	4602	Driveshaft
8	4841	Driveshaft slip yoke

Driveshaft — Rear, 4x4



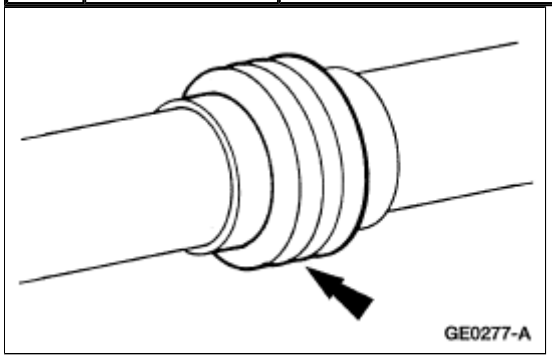
Item	Part Number	Description
1	4A378	Rear flange
2	—	Spider (part of 4635)
3	—	Bearing cup (part of 4635)
4	—	Snap ring (part of 4635)
5	4602	Driveshaft
6	3B478	Driveshaft slip-yoke boot clamp
7	4421	Universal joint slip-yoke boot
8	—	Driveshaft slip-yoke (part of 4602)
9	4A378	Front flange

Driveshaft — Front



Item	Part Number	Description
1	—	Universal joint

2	—	Snap rings
3	4A376	Front driveshaft
4	—	Constant velocity (CV) joint
5	—	Constant velocity (CV) joint bolts and washers



NOTE: Whenever the vehicle is raised on a hoist, inspect the universal joint slip yoke boot (4421) for rips or holes. Install new if required.

NOTE: All driveshafts are balanced. If undercoating the vehicle, protect the driveshaft (4602) and universal joints to prevent application of any undercoating material.

NOTE: The constant velocity (CV) joint on the front driveshaft is not serviceable.

The front driveshaft is connected to the transfer case and the front drive axle by a driveshaft flange yoke (4866).

Driveshaft

Refer to Section 205-00 .

Indexing

For additional information, refer to Section 205-00 .

Runout and Balance

For additional information, refer to Section 205-00 .

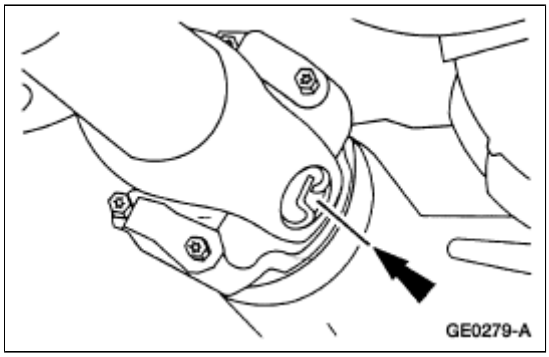
Driveshaft —Front

Material

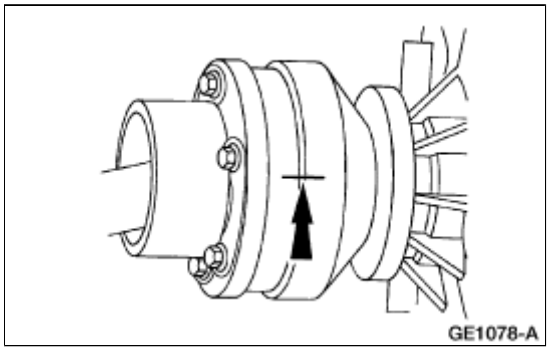
Item	Specification
Threadlock and Sealer EOAZ-19554-AA or equivalent	WSK-M2G351-A5

Removal

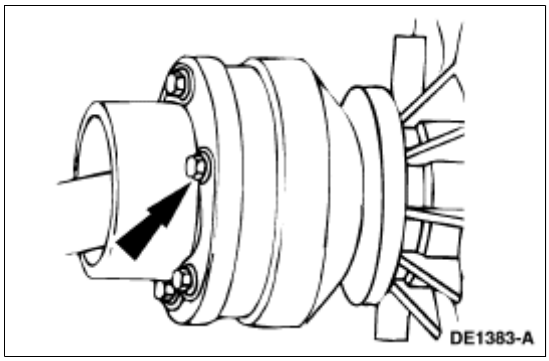
1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Index-mark the front axle pinion flange and the front driveshaft.



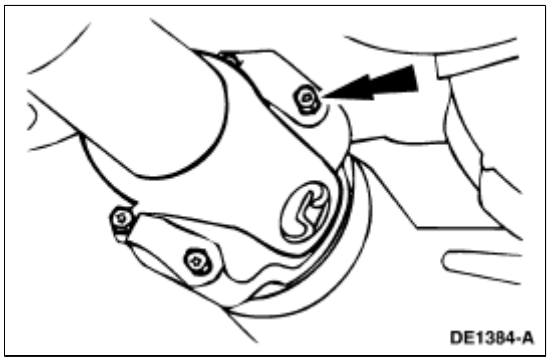
3. Index-mark the front output shaft assembly and the front driveshaft constant velocity (CV) joint.



4. Remove and discard the bolts and washers.



5. Remove and discard the bolts and universal joint retainers.

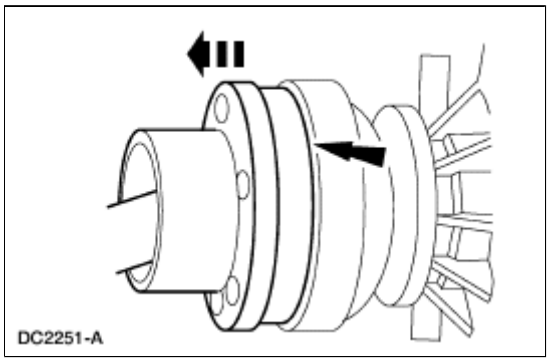


6. **CAUTION: Always disconnect the front driveshaft from the axle first. Carefully pull the driveshaft out of the CV joint housing. Otherwise the weight of the driveshaft can pinch the boot between the shaft and the boot can and cause the boot to tear.**

   CAUTION: Tape the bearing cups to the driveshaft to prevent them from falling off of the spider.

   NOTE: The front driveshaft CV joint is not repairable.

   Remove the driveshaft.

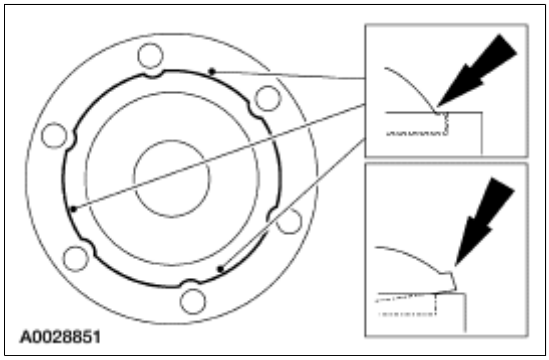


Installation

1. **CAUTION: The can (domed CV joint housing cover) is pressed into the CV joint housing**

at the factory. When housed correctly, the can will appear as shown in the cut-away illustration, top box. Do not reseat the can in the CV joint housing if the can's flange is above the CV joint housings shown in the cut-away illustration, bottom box. Install a new driveshaft.

Verify that the can flange is housed correctly in the CV joint housing as shown in the cut-away illustration, top box. Install a new driveshaft if the can flange is not housed correctly.



2. **CAUTION: Always connect the front driveshaft to the transfer case first. Otherwise the weight of the driveshaft can pinch the boot between the shaft and the boot can and cause the boot to tear.**

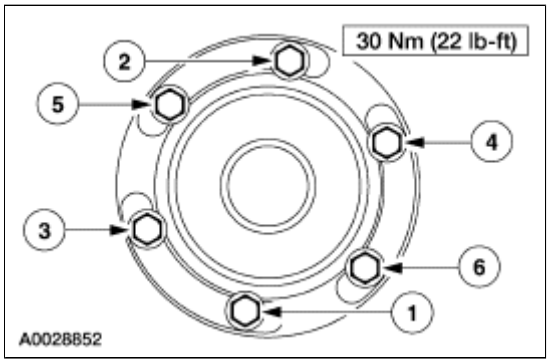
   NOTE: Align the index marks.

   Install the driveshaft.

3. **CAUTION: Tighten the bolts evenly in a cross pattern or damage will occur to the CV joint.**

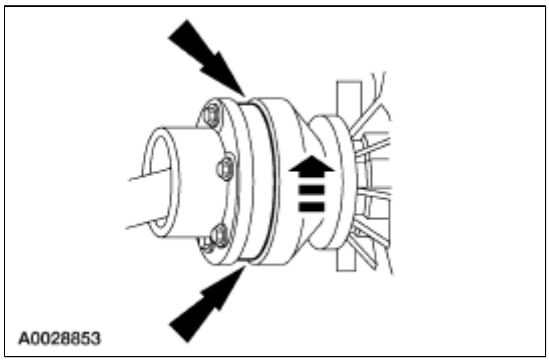
   NOTE: Install new washers and bolts. If new bolts are not available, coat the threads of the original bolts with threadlock and sealer.

   Install the new washers and bolts. Tighten the bolts evenly in a cross pattern as shown.



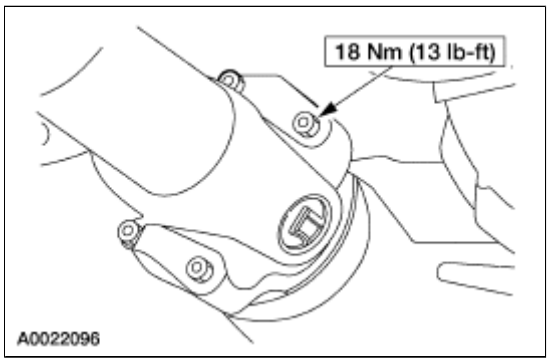
4. Verify that the CV joint has seated squarely in the transfer case flange.
   - Check that the space between the end of the CV joint cap and the end of the transfer case flange is equal from the top to the bottom of the two components.
   - Rotate the driveshaft 1/4 turn.
   - Check that the space between the end of the CV joint cap and the end of the transfer case flange is equal from the top of the bottom of the two components.

- Repeat this procedure several times.
- If the space is not equal at any point in the attachment, remove and reinstall the driveshaft as described in this procedure.



5. **NOTE:** Install new universal joint retainers and bolts. If new bolts are not available, coat the threads of the original bolts with threadlock and sealer.

   Install the new universal joint retainer and bolts.



6. Lower the vehicle.

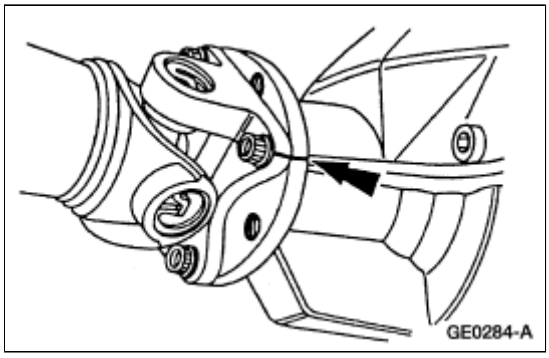
Driveshaft —Rear, 4x2

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

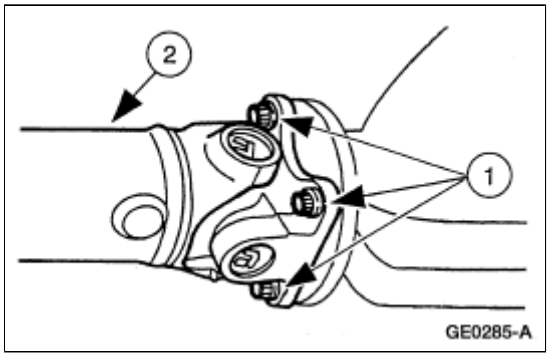
   With the vehicle in neutral, raise and support the vehicle; for additional information, refer to Section 100-02 .

2. Index-mark the driveshaft (4602) to driveshaft rear axle pinion flange.



3. **NOTE:** Index-mark the driveshaft slip yoke to the transmission output shaft.

   Remove the driveshaft.
   1. Remove and discard the four bolts, and disconnect the driveshaft.
   2. Lower the driveshaft, and slide the driveshaft rearward out of the transmission.
      - Plug the extension housing to prevent fluid loss.

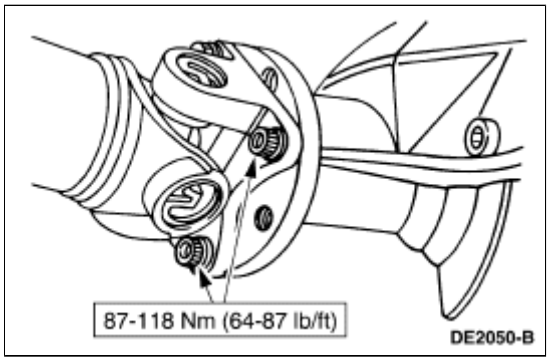


Installation

1. **NOTE:** Install new rear driveshaft-to-driveshaft rear axle pinion flange bolts. If new bolts are not available, coat the threads of the original bolts with Threadlock and Sealer EOAZ-19554-AA or

equivalent meeting Ford specification WSK-M2G351-A5.

To install, follow the removal procedure in reverse order.



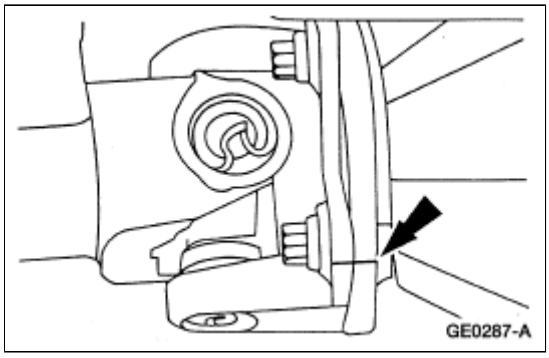
Driveshaft —Rear, 4x4

Removal

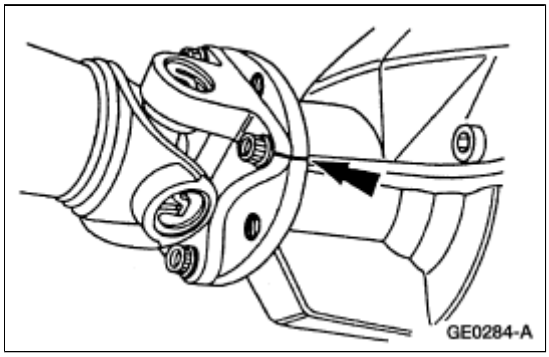
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

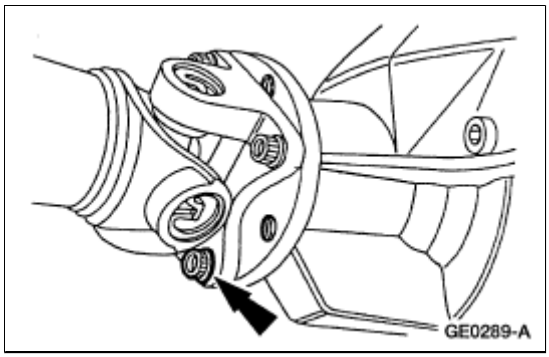
2. Index-mark the driveshaft yoke to the transfer case pinion flange.



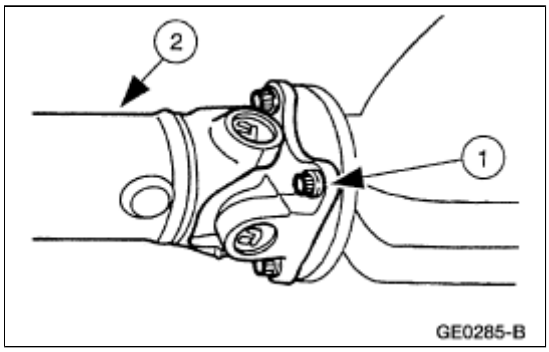
3. Index-mark the driveshaft (4602) to driveshaft rear axle pinion flange.



4. Remove the four rear bolts, and disconnect the rear driveshaft.



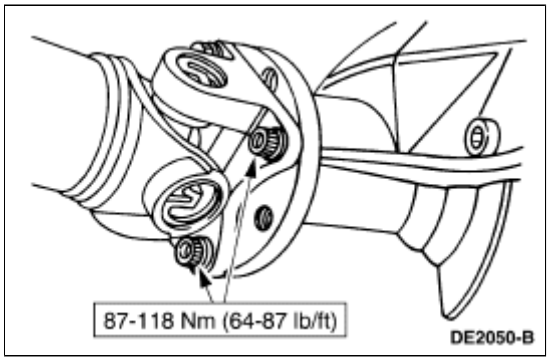
5. Separate the driveshaft from the transfer case.
    1. Remove the four bolts.
    2. Carefully remove the driveshaft.

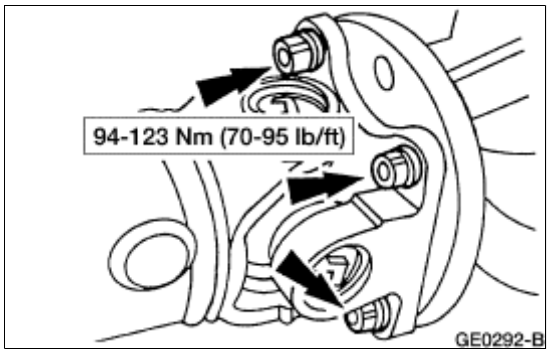


Installation

1. **NOTE:** Install new rear driveshaft-to-driveshaft rear axle pinion flange bolts and driveshaft flange yoke-to-transfer case bolts. If new bolts are not available, coat the threads of the original bolts with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5.

   To install, follow the removal procedure in reverse order.




94-123 Nm (70-95 lb/ft)
GE0292-B

Driveshaft Slip Yoke

Special Tool(s)

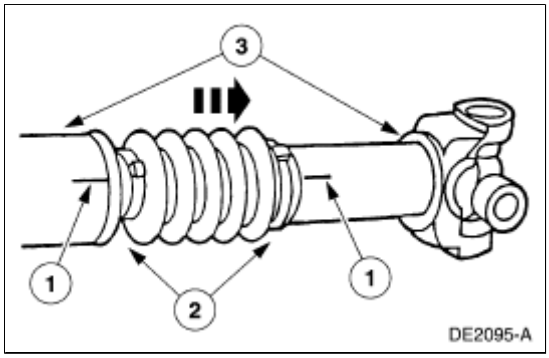
ST1173-A	Installer, Keystone Clamp 211-002 (T63P-9171-A)

Disassembly

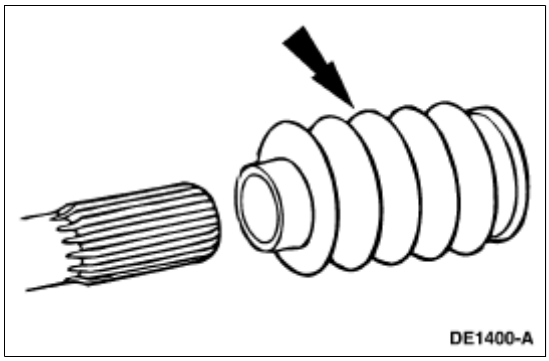
1. **CAUTION: Do not, under any circumstance, clamp the driveshaft (4602) in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.**

   Place the driveshaft on a suitable workbench. Do not damage the tube.

2. Remove the driveshaft slip-yoke from the driveshaft.
   1. Index-mark the driveshaft and driveshaft slip-yoke.
   2. Cut and discard the driveshaft slip-yoke boot clamps (4K227).
   3. Remove the driveshaft slip-yoke from the driveshaft.



3. Remove the slip-yoke boot (4421) from the driveshaft.
   - Inspect the boot for damage. Discard the boot as necessary.

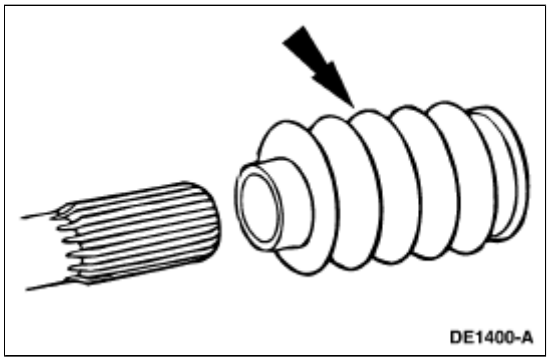


4. Inspect the lubricant on the driveshaft splines and in the driveshaft slip-yoke for contamination. If contaminated, inspect the driveshaft splines and the driveshaft slip-yoke for wear. Install new components as necessary.

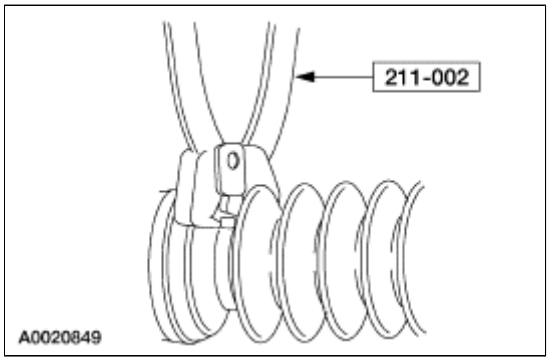
Assembly

1. Position the new small driveshaft slip-yoke boot clamp on the driveshaft stub shaft.

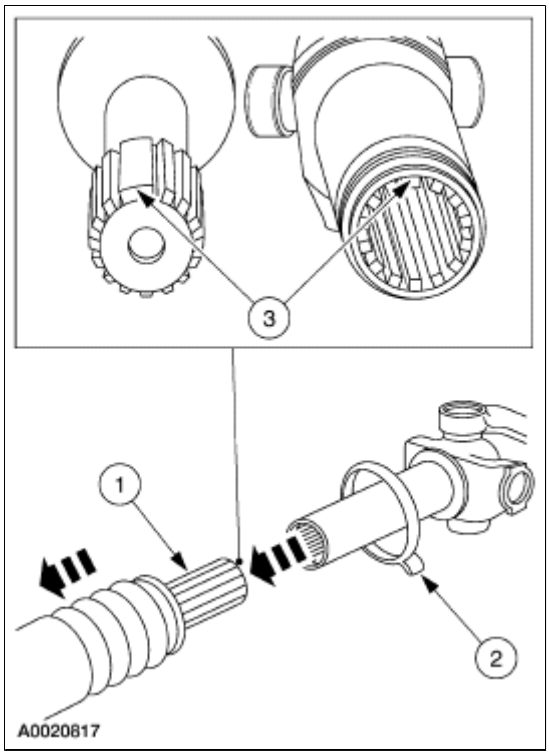
2. Slide the small opening end of the slip-yoke boot on the driveshaft stub shaft, as far as it will travel.



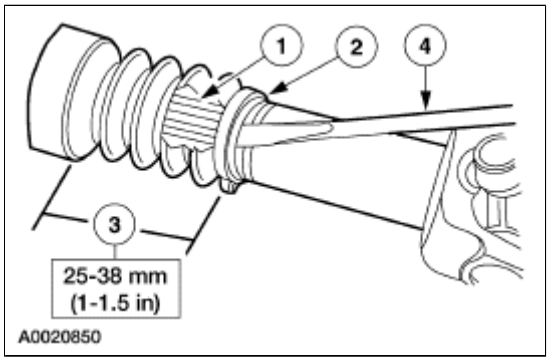
3. Using the special tool, crimp the driveshaft slip-yoke boot clamp.



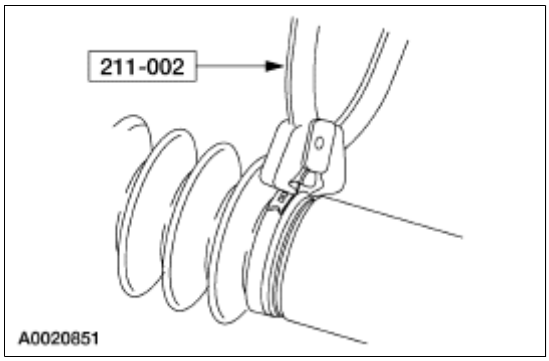
4. Install the driveshaft slip-yoke on the driveshaft.
    1. Pull the slip-yoke boot toward the driveshaft. Lubricate the driveshaft splines with approximately 10 grams (0.24 oz) of lubricant.
        - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.
    2. Position the new large slip-yoke boot clamp.
    3. Align the index-marks, and install the driveshaft slip-yoke on the driveshaft.



5. Set the driveshaft assembled length to specification.
    1. Remove any excess grease from the slip-yoke boot and driveshaft slip-yoke surfaces.
    2. Position the slip-yoke boot in the slip-yoke boot groove.
    3. Set the driveshaft assembled length to specification.
        - Measure from the stub shaft weld to the end of the driveshaft slip-yoke.
    4. Bleed the air from the slip-yoke boot.

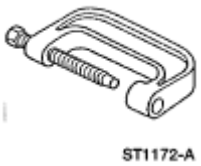


6. Using the special tool, crimp the large driveshaft slip-yoke boot clamp.


211-002
A0020851

Universal Joint —Single Cardan/Driveshaft

Special Tool(s)

 ST1172-A	C Frame & Screw 205-086 (T74P-4635-C)

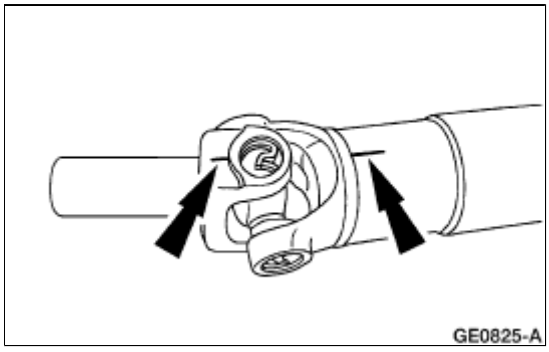
Disassembly

1. **CAUTION: Under no circumstances is the driveshaft assembly to be clamped in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.**

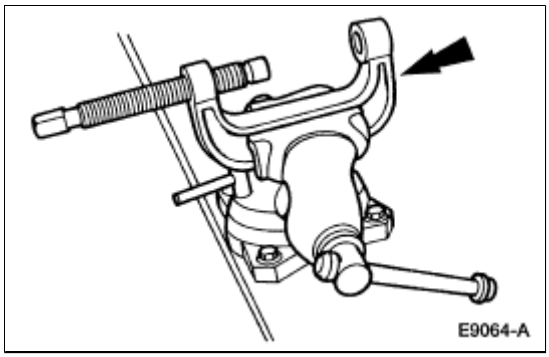
   Place the driveshaft (4602) on a suitable workbench. Be careful not to damage the tube.

2. **NOTE:** If components are not marked and therefore installed incorrectly, driveline imbalance can occur.

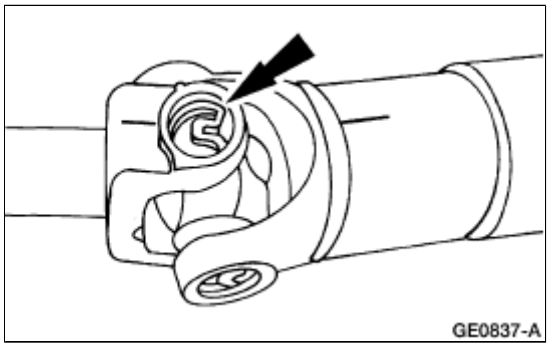
   Index-mark the driveshaft components.


GE0825-A

3. Clamp U-joint tool in a vise.

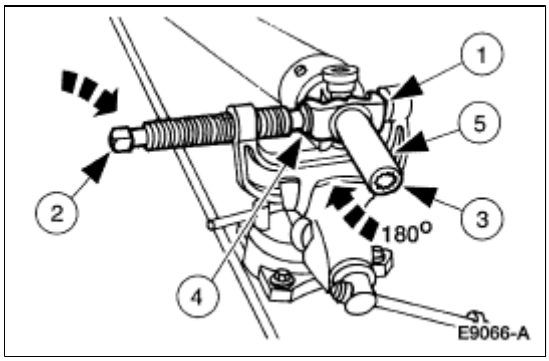


4. Remove all four of the snap rings.

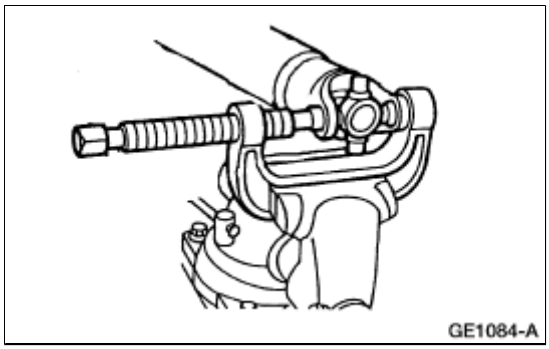


5. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup if it cannot be pressed out all the way.

   Remove the driveshaft slip-yoke (4841).
   1. Position the driveshaft slip-yoke in the U-joint tool.
   2. Press out a bearing cup.
   3. Rotate the driveshaft slip-yoke.
   4. Press on the spider to remove the remaining bearing cup.
   5. Remove the driveshaft slip-yoke.



6. Repeat Step 5 to remove the remaining bearing cups and spider from the driveshaft.

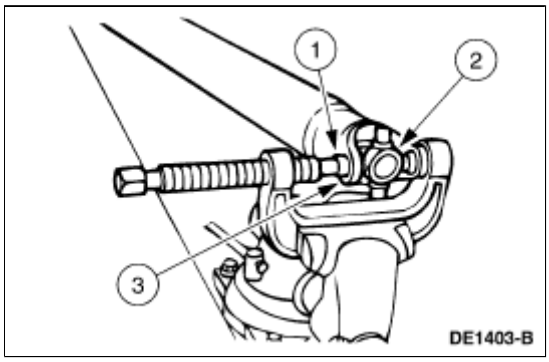


7. Clean the yoke area at each end of the driveshaft.

Assembly

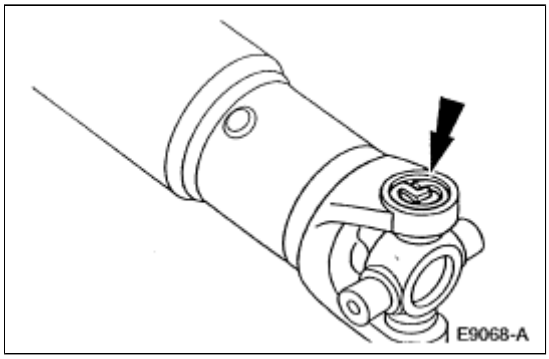
1. **NOTE:** Universal Joint Service Kits are to be installed as complete assemblies only. Do not mix components from other U-Joint Kits.

   Install the bearing cup.
   1. Start a new bearing cup into the driveshaft yoke.
      - Check the needle bearings for correct positioning.
   2. Position the new spider in the driveshaft yoke.
   3. Using the U-joint tool, press the bearing cup to just below the snap ring groove.



2. **NOTE:** Use the yellow snap rings supplied in the kit to assemble the universal joint (U-joint). If difficulty is encountered with the yellow snap rings, install the black snap rings.

   Remove the driveshaft from the U-joint tool, and install the snap ring.



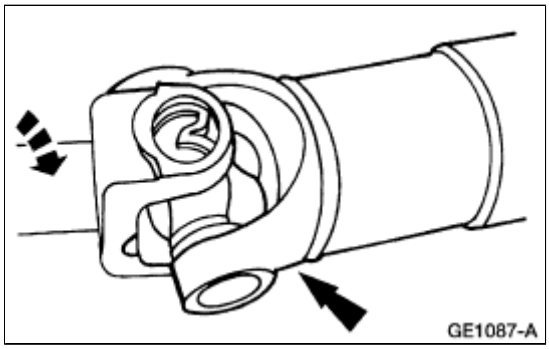
3. Repeat Steps 1 and 2 to install the opposite side of the driveshaft yoke.

4. Inspect the driveshaft slip-yoke. Install a new yoke, if necessary.

5. Repeat Steps 1 and 2 to install the remaining new bearing cups, spider, driveshaft slip-yoke, and the snap rings.

6. **NOTE:** Do not strike the bearings.

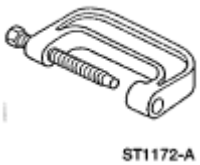
   Check the U-joints for freedom of movement.
   - If binding, strike the yoke with a brass or plastic hammer.



7. Install the driveshaft. For additional information, refer to the procedure in this section.

Universal Joint —Single Cardan/Flange Yoke

Special Tool(s)

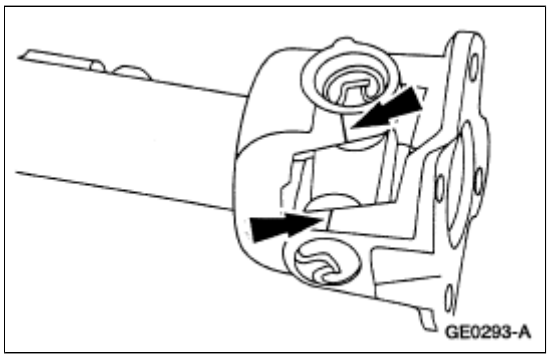
 ST1172-A	Installer/Remover, C Frame & Screw 205-086 (T74P-4635-C)

Disassembly

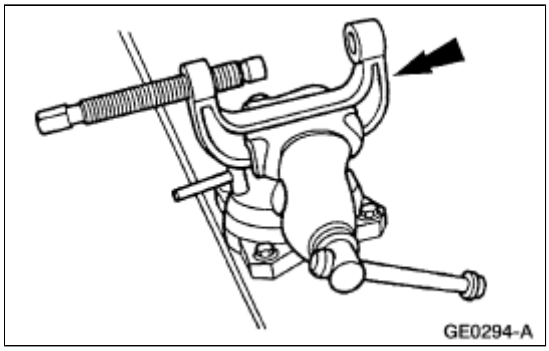
1. Remove the driveshaft. For additional information, refer to the procedure in this section.
2. **CAUTION: Do not clamp the driveshaft in a vise or similar holding fixture.**

   Place the driveshaft on a suitable workbench, being careful not to damage the tube.
3. **NOTE:** If components are not marked and installed correctly, driveline imbalance can occur.

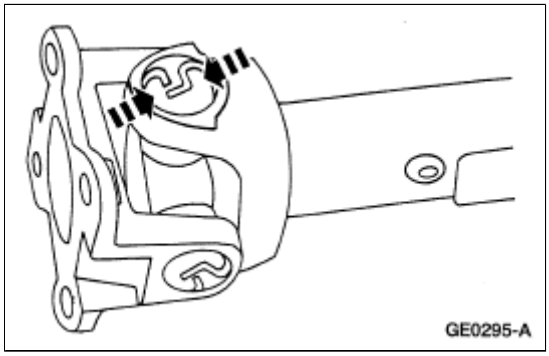
   Index-mark the positions of the driveshaft components.


GE0293-A

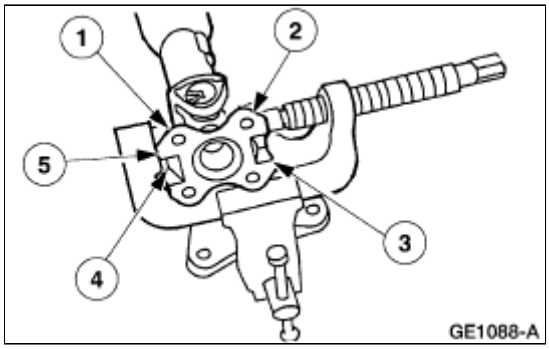
4. Clamp the U-joint tool in a vise.


GE0294-A

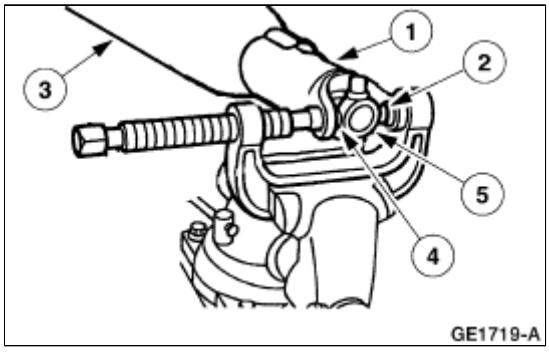
5. Remove all four of the snap rings.



6. Remove the driveshaft flange yoke.
    1. Position the driveshaft flange yoke in the U-joint tool.
    2. Press out a bearing cup.
    3. Remove the driveshaft flange yoke.
    4. Press on the spider to remove the remaining bearing cup.
    5. Remove the driveshaft flange yoke.



7. Remove the spider.
    1. Reposition the driveshaft in the U-joint tool.
    2. Press out the bearing cup.
    3. Rotate the driveshaft.
    4. Press on the spider to remove the remaining bearing cup.
    5. Remove the spider.

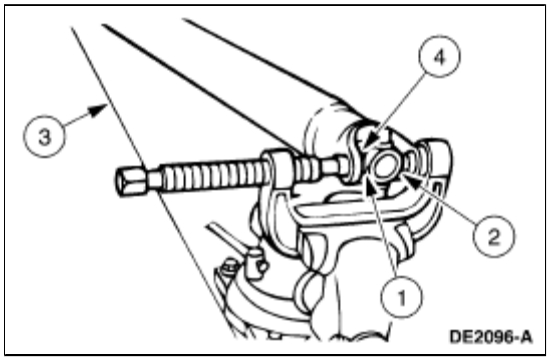


8. Clean the yoke area at the end of the driveshaft.

Assembly

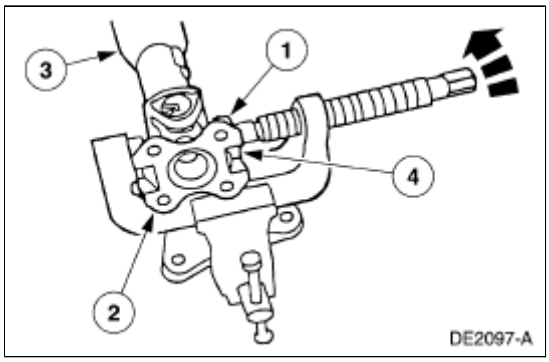
1. **NOTE:** Universal joint kits are to be installed as complete assemblies only. Do not mix components from other U-joint kits.

   Install the spider.
   1. Start a new bearing cup into the driveshaft yoke.
      - Check the needle bearings for correct positioning.
   2. Position the new spider in the driveshaft yoke.
   3. Position the driveshaft in the U-joint tool.
   4. Press the bearing cup to just below the snap ring groove.
      - Repeat for the other bearing cup.



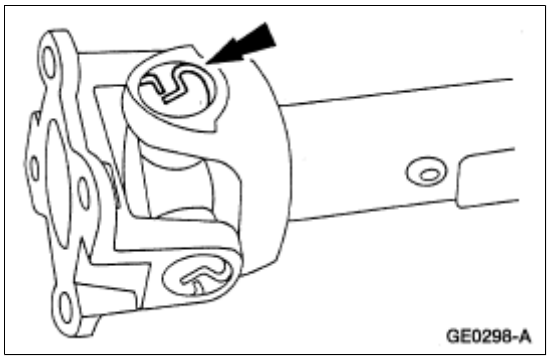
2. Inspect the driveshaft flange yoke. Install new if necessary.

3. Install the driveshaft flange yoke.
   1. Start a new bearing cup into the driveshaft flange yoke.
      - Check the needle bearings for correct positioning.
   2. Position the driveshaft flange yoke.
   3. Position the driveshaft in the U-joint tool.
   4. Press the bearing cup to just below the snap ring groove.
      - Repeat for the other bearing cup.



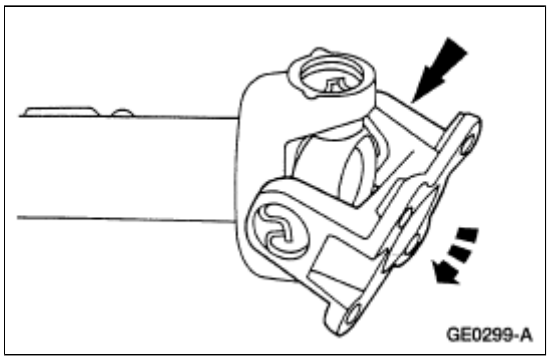
4. **NOTE:** Use the yellow snap rings supplied in the kit to assemble the universal joint (U-joint). If difficulty is encountered with the yellow snap rings, install the black snap rings.

   Remove the driveshaft from the U-joint tool, and install the four snap rings.



5. **NOTE:** Do not strike the bearings.

   Check the U-joints for freedom of movement.
   - If binding, strike the yoke with a brass or plastic hammer.



6. Install the driveshaft. For additional information, refer to Driveshaft in this section.

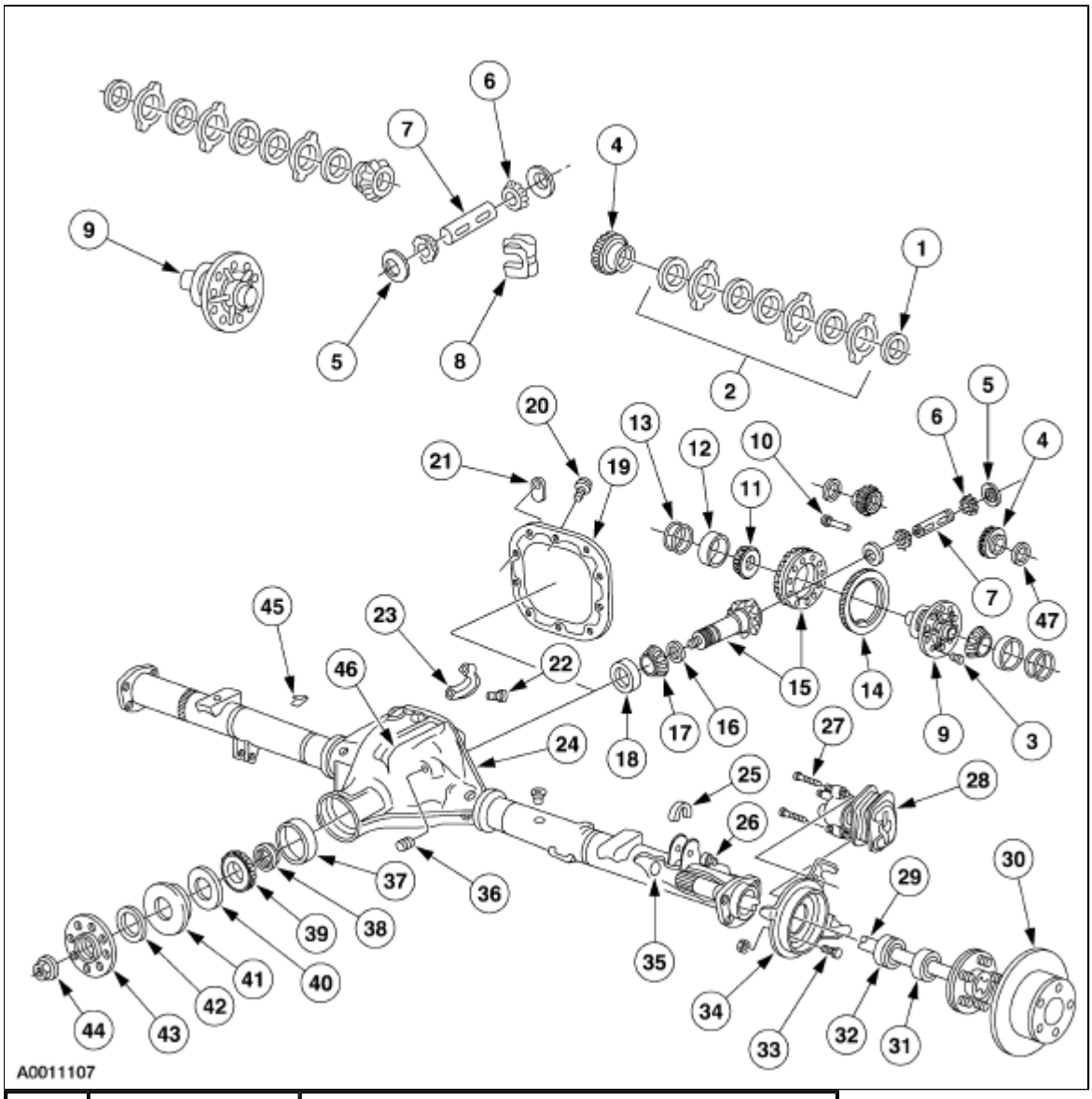
General Specifications

Item	Specification
Lubricants	
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B (All with limited slip differential, and 5.0L)	WSL-M2C192-A
SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (4.0L SOHC and EI with conventional differential)	WSP-M2C197-A
Ford Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacity	
Approximate axle fill capacity	2.4L (5.5 pints) 6.4 mm (0.25 in)- 14.2 mm (0.56 in) below the fill hole
Sealants	
Clear Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Adhesive	
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1
Clearance, Tolerance and Adjustments	
Maximum ring gear backface runout	0.102 mm (0.004 in)
Maximum differential case runout	0.076 mm (0.003 in)
Maximum axle shaft end play	0.762 mm (0.03 in)
Backlash between ring gear and pinion teeth	0.203 mm (0.008 in)- 0.381 mm (0.015 in) [0.305 mm (0.012 in)- 0.381 mm (0.015 in) preferred]
Maximum ring gear backlash variation between teeth	0.102 mm (0.004 in)
Maximum pinion runout	0.25 (0.010 T.I.R.)
RABS sensor air gap	0.127 mm (0.005 in)- 1.143 mm (0.045 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Differential bearing cap bolt	105	77	—
Differential pinion shaft lock bolt	30	22	—
Filler plug	30	22	—
Rear axle housing vent	11-24	8-18	—
Differential housing cover bolts	45	33	—
Rear spring plate nuts	115	85	—
Ring gear bolts	95-115	70-85	—
Differential clutch gauge nut	6.7	—	60
Pinion bearing preload (used pinion bearings)	0.9-1.5	—	8-14
Pinion bearing preload (new pinion bearings)	1.8-3.3	—	16-29
Brake hose junction block retaining bolt	7	—	62
Handle (pinion bearing preload simulation)	2.2	—	20
Initial minimum breakaway torque, Traction-Lok®	27	20	—

Rear Drive Axle and Differential



Item	Part Number	Description
1	4A324	Rear axle differential clutch shim
2	4947	Differential clutch pack
3	4216	Rear axle differential gear case bolt
4	4236	Differential side gear
5	4230	Differential pinion thrust washer
6	4215	Differential pinion gear
7	4211	Differential pinion shaft

8	4214	Differential clutch spring
9	4204	Differential case
10	4241	Differential pinion shaft lock bolt
11	4221	Differential bearing
12	4222	Differential bearing cup
13	4067	Differential bearing shim
14	4B409	Anti-lock speed sensor ring
15	4209	Ring gear and pinion
16	4663	Drive pinion bearing adjustment shim
17	4630	Pinion bearing (inner)
18	4628	Rear axle pinion bearing cup
19	4033	Differential housing cover
20	4346	Differential housing cover bolt
21	—	Rear axle identification tag
22	—	Bearing cap bolt (part of 4010)
23	—	Bearing cap (part of 4010)
24	4141	Rear axle differential carrier
25	4N237	U-washer
26	390317-S190	Bolt
27	N606046-S60	Bolt
28	2552	Rear disc brake caliper
29	4234	Axle shaft
30	2C026	Rear brake disc
31	1177	Wheel bearing oil seal
32	1225	Rear wheel bearing
33	—	Bolt (part of 2C220)
34	2C220	Rear disc brake adapter
35	4A332	Rear axle shaft O-ring
36	390943-S100	Filler plug
37	4616	Pinion bearing cup (outer)
38	4662	Collapsible spacer
39	4621	Pinion bearing (outer)
40	4670	Rear axle drive pinion shaft oil slinger
41	4676	Rear axle drive pinion seal
42	4859	Drive pinion oil seal deflector
43	4851	Pinion flange
44	389546-S100	Pinion nut
45	2251	Rear axle brake line clip

46	9E731	Vehicle speed sensor
47	4228	Differential side gear thrust washer

The rear axle assembly has the following features:

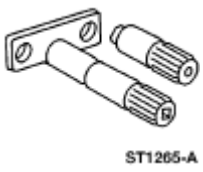
- An integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear).
- The hypoid differential ring gear and pinion consists of a ring gear and an overhung drive pinion which is supported by two opposed tapered roller bearings.
- Pinion bearing preload is maintained by a collapsible spacer on the differential pinion shaft (4211) and adjusted by the pinion nut.
- The rear axle housing (4010) consists of a cast center section with two steel tube assemblies and a stamped differential housing cover (4033).
- The differential housing cover uses silicone sealant as a gasket.
- The differential pinion shaft is retained by a threaded differential pinion shaft lock bolt assembled to the differential case (4204)
- The differential case is mounted in the rear axle housing between two opposing differential bearings (4221) that are retained in the rear axle housing by removable bearing caps
- Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A for 4.0L SOHC and 4.0L EI with a conventional differential.
- Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A for 4.0L SOHC and 4.0L EI with a limited slip differential and 5.0L.
- Differential bearing preload and ring gear backlash are adjusted by differential bearing shims located between the differential bearing cups and the rear axle housing.
- Rear axle identification is on an embossed metal tag bolted to the axle housing cover. For additional information, refer to Section 205-00 .

Rear Drive Axle and Differential

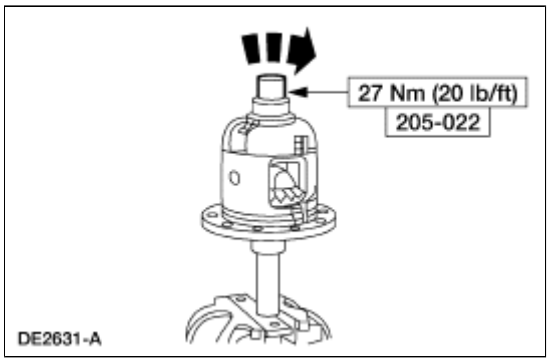
Refer to Section 205-00 .

Differential Bench Torque Test

Special Tool(s)

 ST1265-A	Traction-Lok® Torque Tool 205-022 (T66L-4204-A)

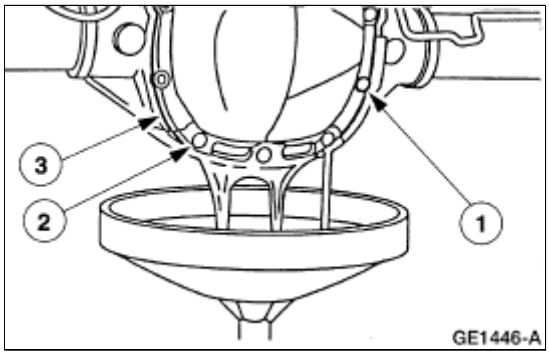
1. Check the torque required to rotate one differential side gear.
   - Mount the differential case and Traction-Lok® Torque Tool in a vise.
   - The initial minimum break-away torque, if original clutch plates are used, must be no less than the specification. The minimum rotating torque required to keep the differential side gear turning with new clutch plates may vary.
   - Refer to Section 205-00 .



Axle Shaft

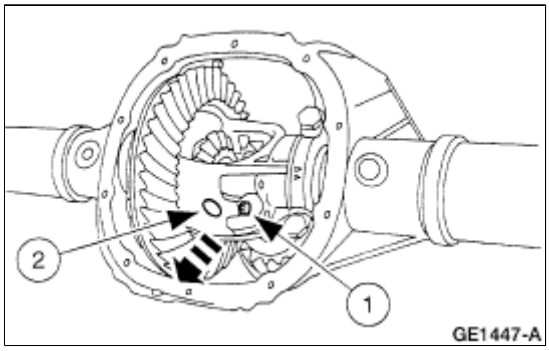
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. Remove the differential housing cover (4033).
   1. Loosen the bolts and drain the lubricant from the rear axle housing (4010).
   2. Remove the bolts.
   3. Remove the differential housing cover.



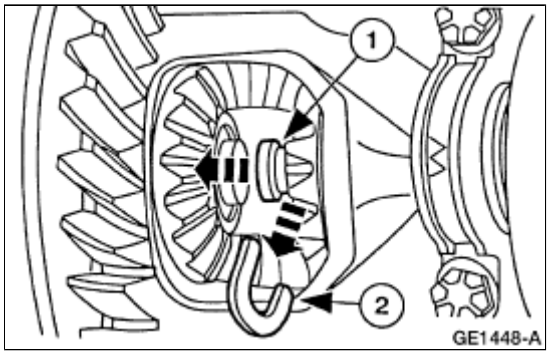
4. Remove the rear brake disc (2C026). For additional information, refer to Section 206-04 .
5. **CAUTION: Turning the differential case (4204) or an axle shaft (4234) with the differential pinion shaft (4211) removed will cause the differential pinion gears (4215) to fall out of the assembly and damage the components.**

   Remove the differential pinion shaft.
   1. Remove the differential pinion shaft lock bolt.
   2. Remove the differential pinion shaft.

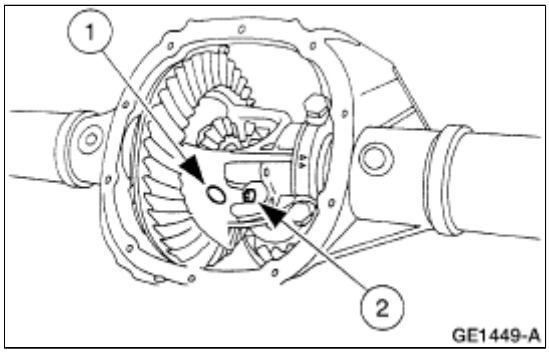


6. **CAUTION: Do not damage the rubber O-ring in the U-washer groove.**

Remove the U-washer (4N237).
1. Push the axle shaft inboard.
2. Remove the U-washer.

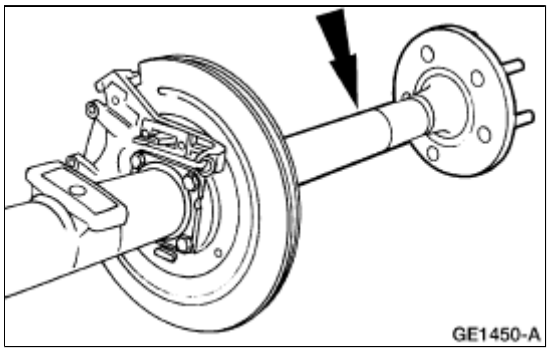


7. Reinstall the differential pinion shaft.
   1. Install the differential pinion shaft.
   2. Install the differential pinion shaft lock bolt finger-tight.



8. **CAUTION: Do not damage the wheel bearing oil seal (1177).**

   Remove the axle shaft.

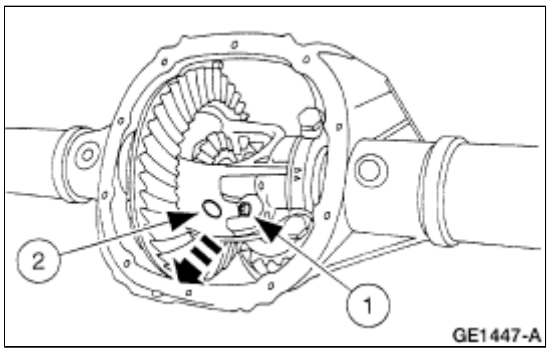


Installation

1. Lubricate the lip of the wheel bearing oil seal (1177).
   - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

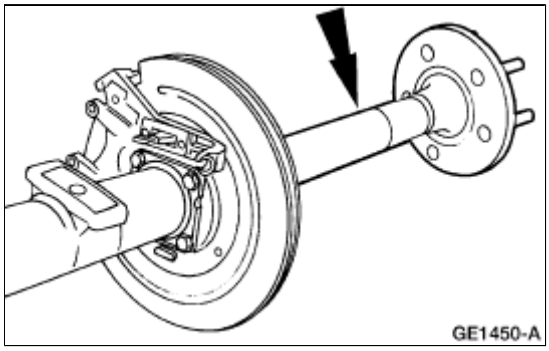
2. **CAUTION: Turning the differential case or an axle shaft with the differential pinion shaft removed will cause the differential pinion gears to fall out of the assembly and damage the components.**

   Remove the differential pinion shaft.
   1. Remove the differential pinion shaft lock bolt.
   2. Remove the differential pinion shaft.



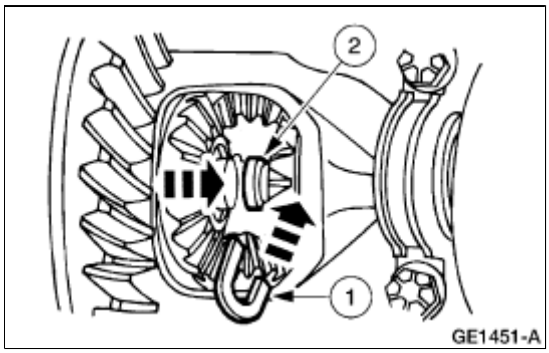
3. **CAUTION: Do not damage the wheel bearing oil seal.**

   Install the axle shaft.



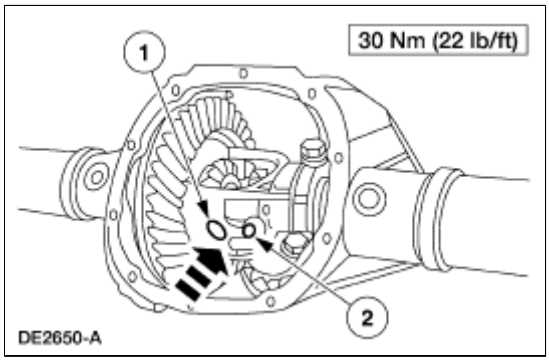
4. **CAUTION: Do not damage the rubber O-ring in the U-washer groove.**

   Install the U-washer.
   1. Position the U-washer on the button end of the axle shaft.
   2. Pull the axle shaft outward.



5. **CAUTION: If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5.**

   Install the differential pinion shaft.
   1. Align the hole in the differential pinion shaft with the differential pinion shaft lock bolt hole.
   2. Install a new differential pinion shaft lock bolt.



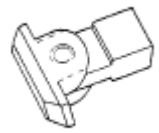
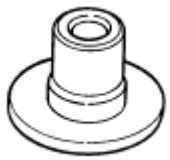
6. Install the rear brake disc. For additional information, refer to Section 206-04 .

7. Install the differential housing cover, and fill the rear axle housing (4010) with the specified lubricant type and quantity. For additional information, refer to Differential Housing Cover in this section.

8. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

Rear Wheel Bearing and Axle Shaft Oil Seal

Special Tool(s)

 ST1283-A	Axle Bearing Remover 205-193 (T83T-1225-A)
 ST2027-A	Axle Seal Replacer 205-190 (T83T-1175-A)
ST1326-A	Handle 205-153 (T80T-4000-W)
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
ST1322-A	Rear Axle Bearing Replacer 205-194 (T83T-1225-B)

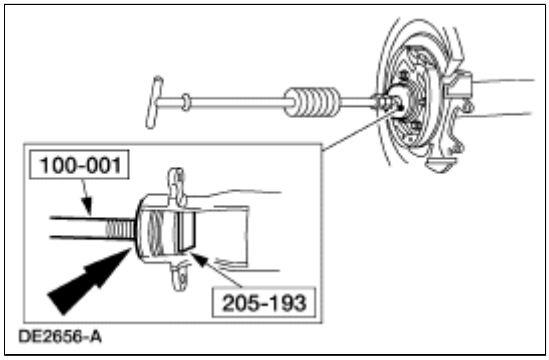
Removal

1. Remove the axle shaft (4334). For additional information, refer to Axle Shaft in this section.

2. **CAUTION: Never remove the wheel bearing oil seal (1177) by itself. Always remove the rear wheel bearing (1225) and the inner wheel bearing oil seal at the same time.**

   NOTE: If the wheel bearing oil seal is leaking, the axle housing vent may be plugged with foreign material.

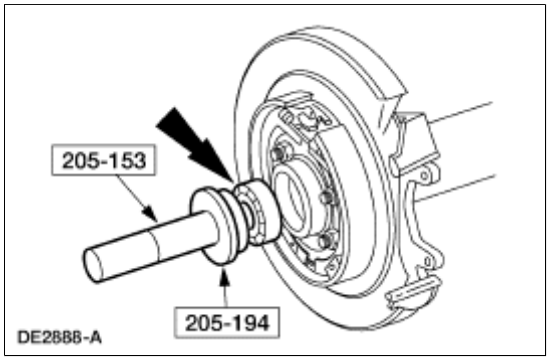
Using the special tools, remove the rear wheel bearing and wheel bearing oil seal together.



Installation

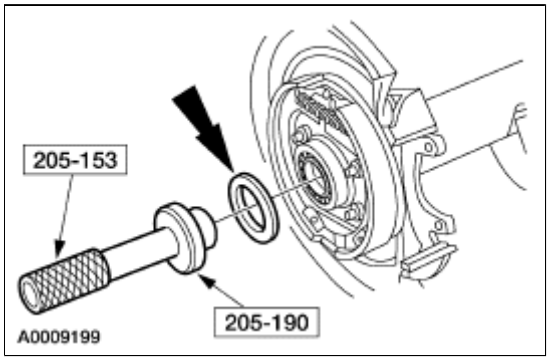
1. Lubricate the new rear wheel bearing.
   - For 4.0L SOHC and 4.0L EI with limited slip rear axles and 5.0L vehicles, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
   - For 4.0L SOHC and 4.0L EI with conventional rear axles, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

2. Using the special tools, install the rear wheel bearing.



3. Lubricate the lip of the new wheel bearing oil seal.
   - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

4. Using the special tools, install the wheel bearing oil seal.



5. Install the axle shaft. For additional information, refer to Axle Shaft in this section.

Drive Pinion Flange

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
ST1862-A	Companion Flange Replacer 205-002 (TOOL-4858-E) or Equivalent

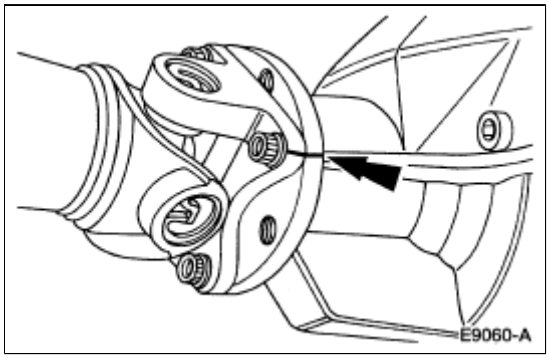
Removal

1. **CAUTION: Do not allow the calipers to hang from the brake hoses.**

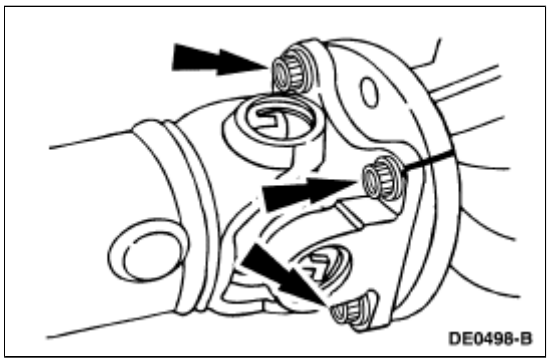
   NOTE: Remove the rear wheels and the rear disc brake calipers (2552) to prevent brake drag during the drive pinion bearing preload adjustment.

   Remove the rear disc brake calipers. For additional information, refer to Section 206-04 .

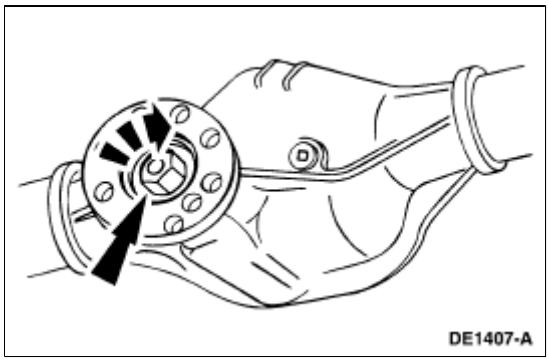
2. Index-mark the driveshaft flange and pinion flange (4851) to maintain initial balance during installation.



3. Remove the four bolts and disconnect the driveshaft.
   - Position the driveshaft aside.

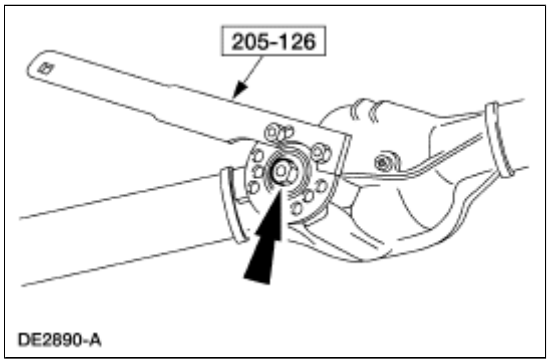


4. Install a Nm (inch-pound) torque wrench on the pinion nut, and record the torque necessary to maintain rotation of the pinion through several revolutions.

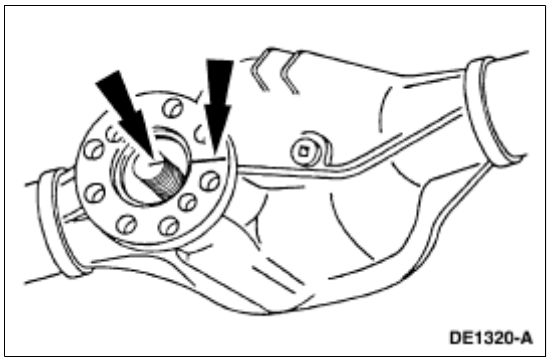


5. **CAUTION: After removing the pinion nut, discard it. Use a new nut for installation.**

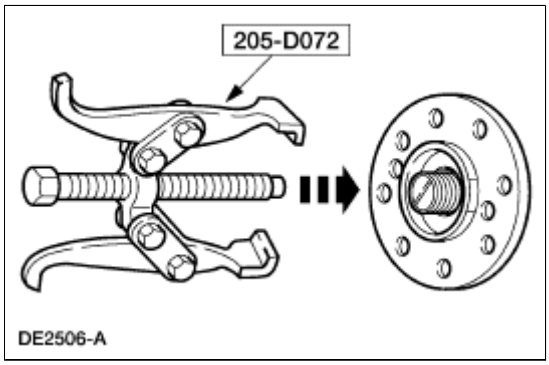
   Use the special tool to hold the pinion flange while removing the pinion nut.



6. Index-mark the pinion flange and the drive pinion stem to maintain initial balance during installation.



7. Using the special tool, remove the pinion flange.

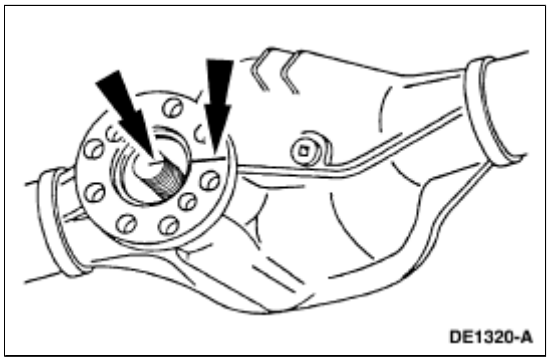


Installation

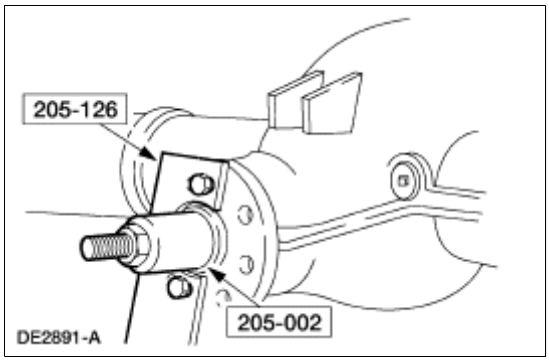
1. Lubricate the pinion flange splines.
   - For vehicles with 4.0L SOHC and 4.0L EI with Traction-Lok ® differentials and 5.0L, use Motorcraft Synthetic 75W140 Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L SOHC and 4.0L EI with conventional differentials, use Thermally Stable Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

2. **NOTE:** Disregard the scribe marks if installing a new pinion flange.

   Align the pinion flange with the drive pinion shaft.



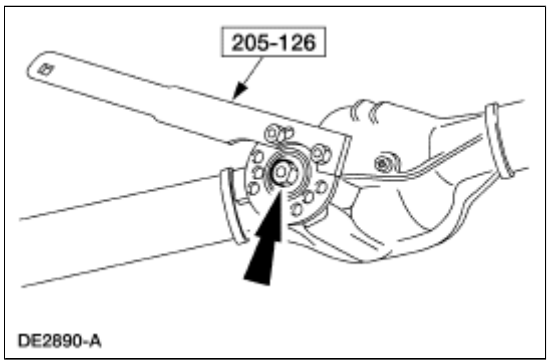
3. Using the special tools, install the pinion flange.



4. **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer (4662) and pinion nut.**

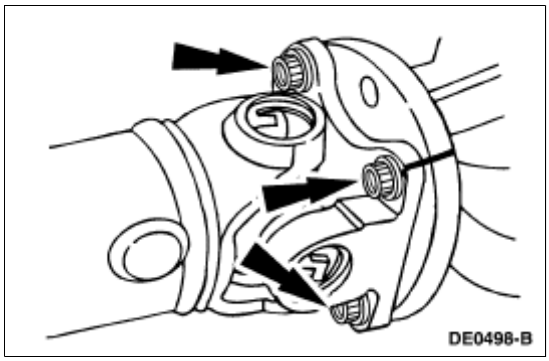
   CAUTION: Remove the special tool when taking preload readings with the Nm (inch-pound) torque wrench.

   Use the special tool to hold the pinion flange while tightening the pinion nut.
   - Rotate the pinion occasionally to make sure the pinion bearings (4630) (4621) seat correctly. Take frequent pinion bearing torque preload readings by rotating the pinion with a Nm (inch-pound) torque wrench.
   - If the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the pinion nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the pinion nut to the original reading as recorded.
   - Refer to the torque specification for used pinion bearings in the Specifications portion of this section.



5. **CAUTION: Be sure to align the index-marks.**

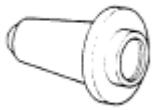
   Connect the driveshaft. For additional information, refer to Section 205-01 .



6. Install the rear disc brake calipers. For additional information, refer to Section 206-04 .
7. Install the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
8. Refer to Differential Housing Cover in this section for the specified axle lubricant type and fill capacity.

Drive Pinion Seal

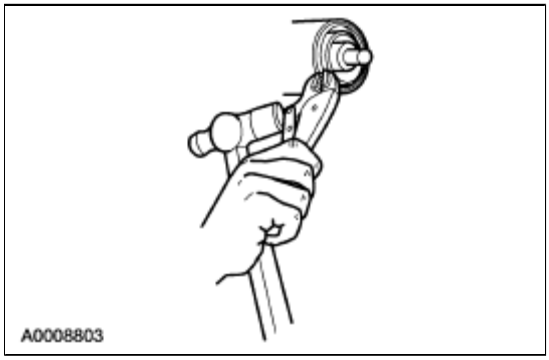
Special Tool(s)

 ST1325-A	Pinion Seal Replacer 205-208 (T83T-4676-A)

Removal

1. Remove the pinion flange (4851). For additional information, refer to Pinion Flange in this section.

2. Force up on the metal flange of the rear axle drive pinion seal (4676). Install gripping pliers and strike with a hammer until the rear axle drive pinion seal is removed.

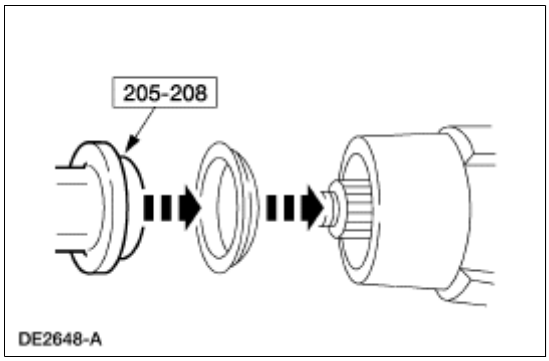


Installation

1. Lubricate the new rear drive pinion seal.
   - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2. **CAUTION: If the rear axle drive pinion seal becomes misaligned during installation, remove the rear axle drive pinion seal and install a new seal.**

   Using the special tool, install the rear axle drive pinion seal.

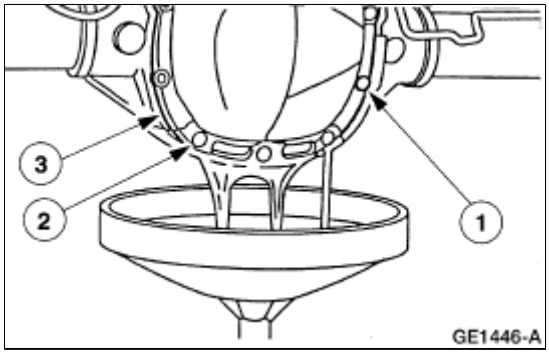


3. Install the pinion flange. For additional information, refer to Pinion Flange in this section.

Differential Housing Cover

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the differential housing cover (4033).
    1. Loosen the bolts and drain the lubricant from the rear axle housing (4010).
    2. Remove the bolts.
    3. Remove the differential housing cover.



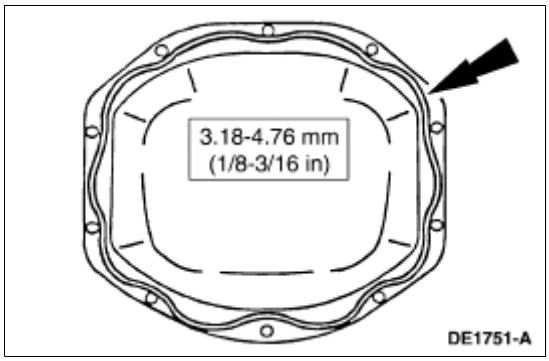
Installation

1. **CAUTION: Make sure the machined surface on the rear axle housing and the differential housing cover are clean and free of oil before applying the new silicone sealant. To prevent contamination, cover the inside of the rear axle (4001) prior to cleaning the machined surface.**

   Clean the rear axle housing and the differential housing cover gasket mating surfaces.

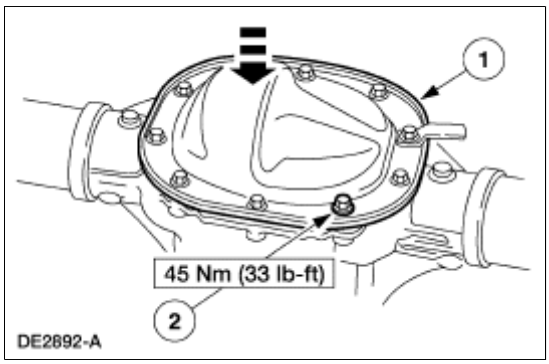
2. **CAUTION: Install the differential housing cover within 15 minutes of applying the silicone, or it will be necessary to remove and reapply new sealant.**

   Apply a new continuous bead of sealant to the differential housing cover.
    - Use Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specifications ESB-M4G92-A.



3. **NOTE:** If possible, allow one hour before filling the axle with lubricant to make sure the silicone sealant has cured.

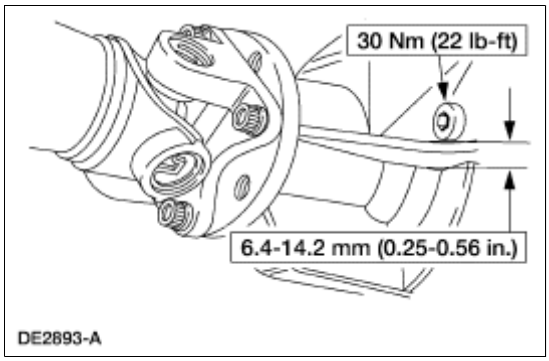
   Install the differential housing cover.
   1. Install the differential housing cover.
   2. Install the bolts.



4. **CAUTION: For Traction-Lok® axles, first fill the rear axle with 118 ml (4 oz) of Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A.**

   NOTE: In-vehicle repair refill capacities are determined by filling the rear axle to the level shown.

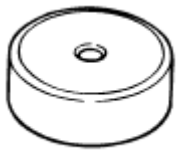
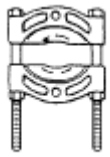
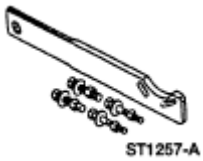
   Fill the rear axle.
   - For vehicles with 4.0L SOHC and 4.0L EI with Traction-Lok® rear axles and 5.0L, use 2.4 liters (5.5 pints) of SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A, and install the filler plug.
   - For vehicles with 4.0L SOHC and 4.0L EI with conventional rear axles, use 2.4 liters (5.5 pints) of SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

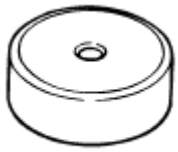
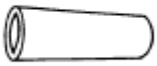
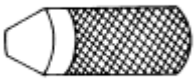
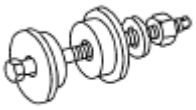
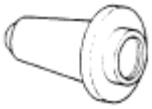


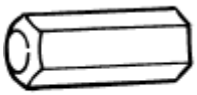
5. Lower the vehicle.

Drive Pinion

Special Tool(s)

 ST1743-A	Aligning Adapter 205-105 (T76P-4020-A3)
 ST1368-A	Bearing Puller 205-D064 (D84L-1123-A) or Equivalent
ST1254-A	Bearing/Seal Service Plate 205-090 (T75L-1165-B)
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
ST1862-A	Companion Flange Replacer 205-002 (TOOL-4858-E) or Equivalent
ST1431-A	Gauge Block 205-110 (T76P-4020-A10)
	Gauge Disc 205-129 (T79P-4020-A18)

 ST1743-A	
 ST1434-A	Gauge Tube 205-130 (T79P-4020-A19)
 ST1432-A	Handle 205-111 (T76P-4020-A11)
ST1326-A	Handle 205-153 (T80T-4000-W)
ST1653-A	Handle 205-D055 (D81L-4000-A) or Equivalent
ST1367-A	Pinion Bearing Cone Replacer 205-005 (T53T-4621-C)
 ST1678-A	Pinion Bearing Cup Replacer 205-024 (T67P-4616-A)
 ST1325-A	Pinion Seal Replacer 205-208 (T83T-4676-A)
	Pinion Thread Protector 205-460

 ST1882-A	
ST1429-A	Screw 205-109 (T76P-4020-A9)

Removal

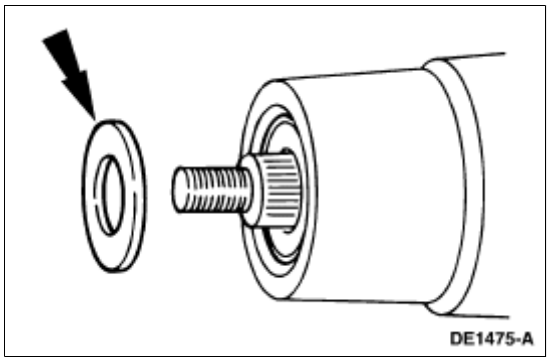
1. Remove the differential case (4204). For additional information, refer to Differential Case in this section.

2. **CAUTION: Record the torque necessary to maintain rotation of the pinion through several revolutions prior to removing the pinion flange (4851).**

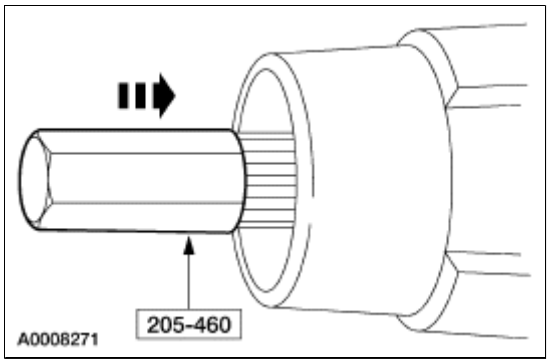
   Remove the pinion flange. For additional information, refer to Drive Pinion Flange in this section.

3. Remove the rear axle drive pinion seal (4676). For additional information, refer to Drive Pinion Seal in this section.

4. Remove the rear axle drive pinion shaft oil slinger (4670).

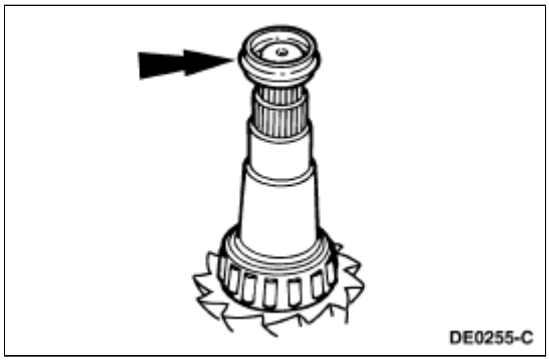


5. Using the special tool and a soft-faced hammer, drive the pinion assembly out of the outer pinion bearing (4621), and remove the pinion through the rear of the housing.

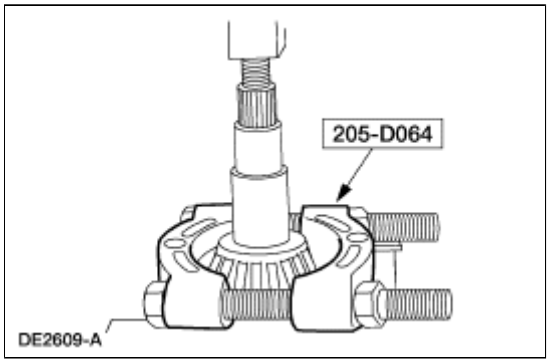


6. Remove the outer pinion bearing.

7. Remove and discard the collapsible spacer (4662).

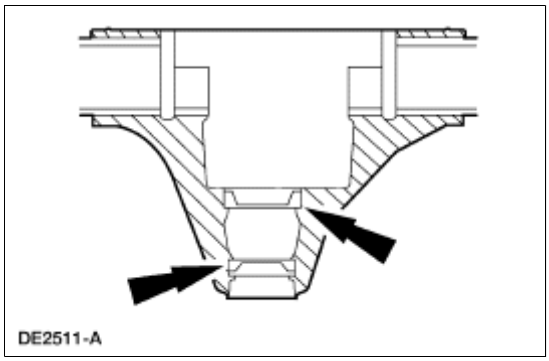


8. Using the special tool and a suitable press, remove the inner pinion bearing (4630).



9. **NOTE:** Do not remove the pinion bearing cups from the axle housing (4010) unless the cups are damaged.

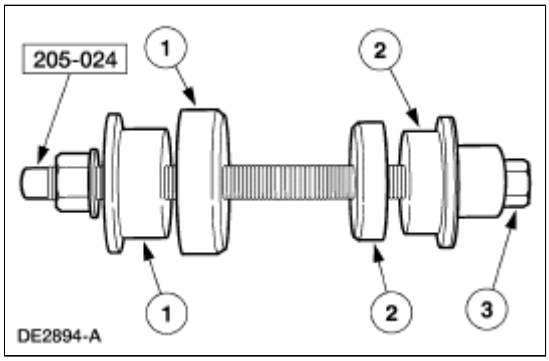
   To remove the bearing cups, tap alternately (with a brass drift of suitable length) on opposite sides of the cup to prevent the cup from cocking in the casting.



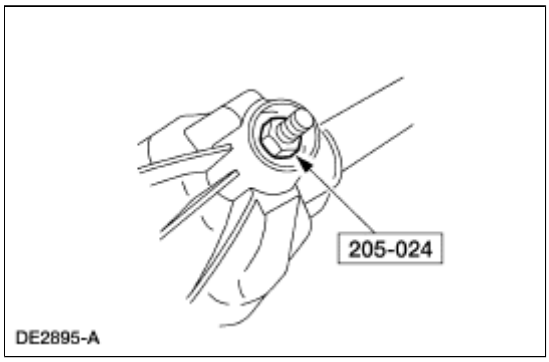
Installation

Using 205-024

1. Position the special tools and the inner and outer bearing cups in their respective axle housing bores.
    1. After placing the inner and outer bearing cups in their bores, place the special tool (inner) on the inner pinion bearing cup.
    2. Place the special tool (outer) on the outer pinion bearing cup.
    3. Install the special tool.

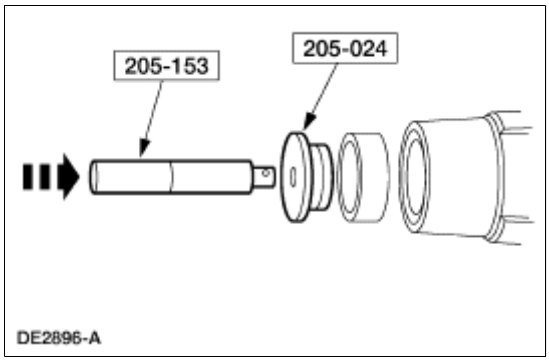


2. Tighten the special tool to seat the pinion bearing cups in their bores.

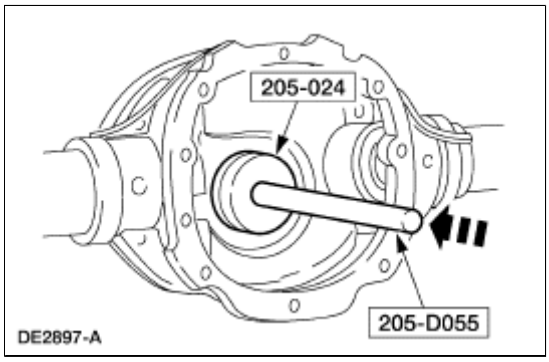


Using 205-153 and 205-D055

3. Using the special tools, drive the outer pinion bearing cup into the axle housing.



4. Using the special tools, drive the inner pinion bearing cup into the axle housing.

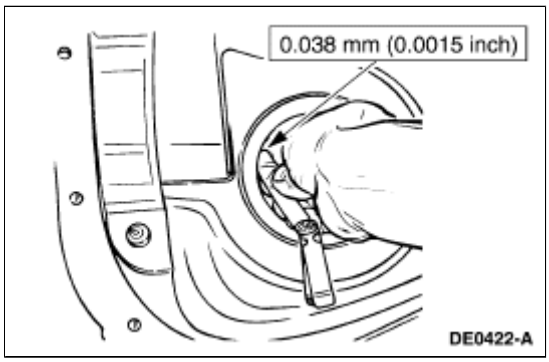


Setting pinion depth

5. **CAUTION: Always install new pinion bearings when installing new bearing cups.**

   NOTE: If the feeler gauge can fit between a cup and the bottom of its bore at any point around the cup, remove and reseat the cup.

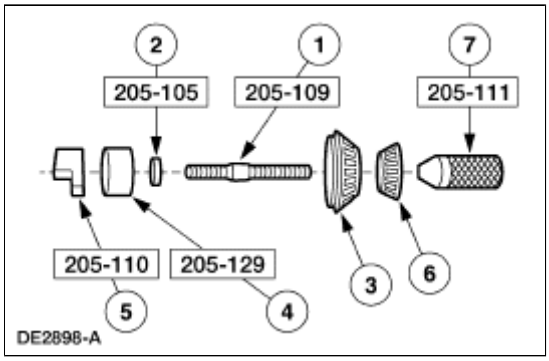
   Check that the cups have seated correctly in their bores.



6. **NOTE:** Apply only a light oil film on the pinion bearings before assembling the tools.

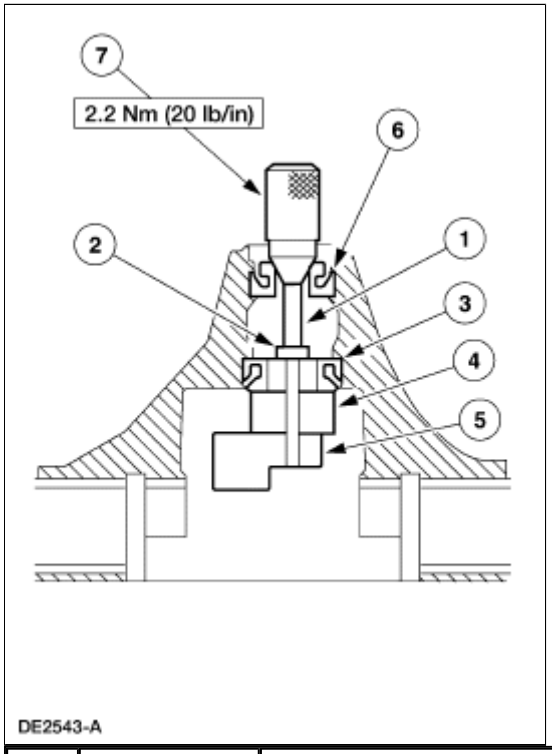
   Assemble and position the special tools and pinion bearings in the axle housing.
   1. Position the Screw.
   2. Position the Aligning Adapter.
   3. Position the inner pinion bearing.
   4. Position the Gauge Disc.

5. Position the Gauge Block.
6. Position the outer pinion bearing.
7. Thread on the Handle.



7. **NOTE:** This step simulates pinion bearing preload.

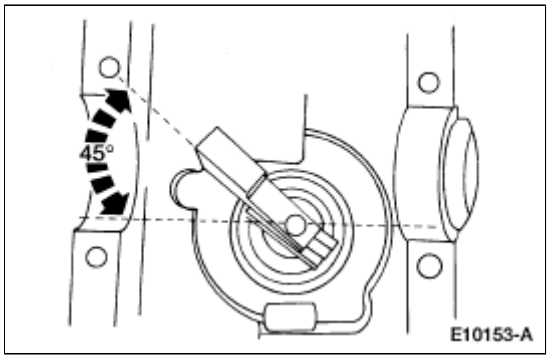
   Using a Nm (inch-pound) torque wrench, tighten the Handle to the specification.



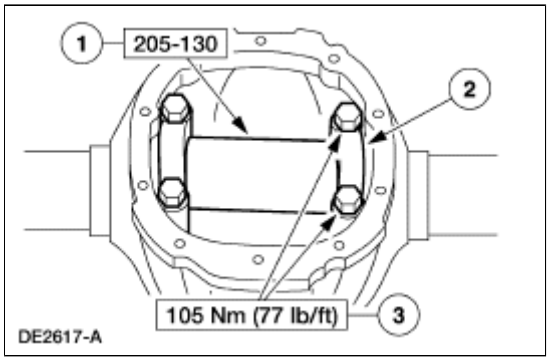
Item	Part Number	Description
1	205-109	Screw (T76P-4020-A9)
2	205-105	Aligning Adapter (1.612 inch O.D.) (T76P-4020-A3)
3	4630	Rear (inner) pinion bearing
4	205-129	Gauge Disc (1.1884 inch thick) (T79P-4020-A18)
5	205-110	Gauge Block (1.7 inch thick) (T76P-4020-A10)
6	4621	Front (outer) pinion bearing
7	205-111	Handle (T76P-4020-A11)

8. **NOTE:** Offset the Gauge Block to obtain an accurate reading.

   Rotate the Gauge Block several half-turns to make sure of correct seating of the pinion bearings and position the Gauge Block.



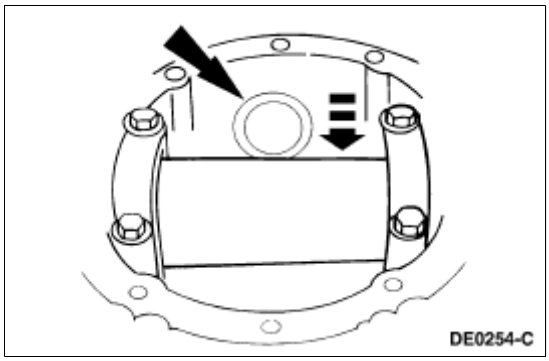
9. Install the special tool.
   1. Position the special tool.
   2. Install the bearing caps (4010).
   3. Install the four bolts.



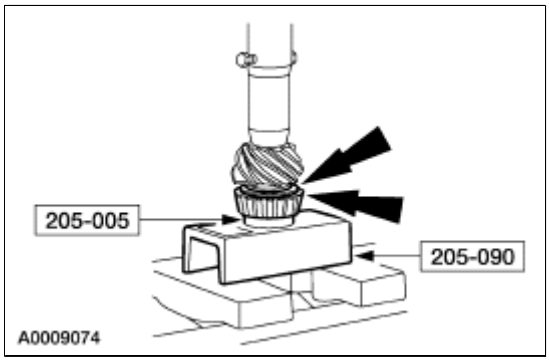
10. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims.

    NOTE: Selection of too thick a pinion shim results in a deep tooth contact at final assembly of integral rear axle assemblies. Do not attempt to force the pinion shim between the Gauge Block and the Gauge Tube. A slight drag indicates correct shim selection.

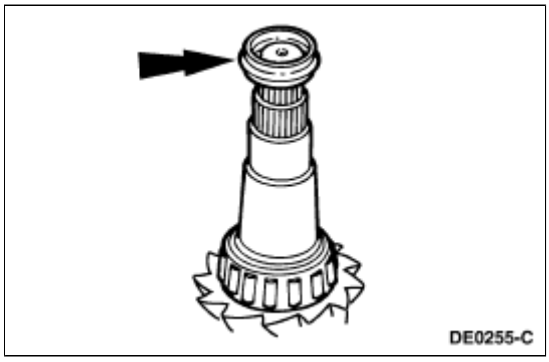
    Use a drive pinion bearing adjustment shim as a gauge for shim selection.
    - Check the pinion bearing adjustment shim thickness between the Gauge Block and the Gauge Tube.
    - After determining the correct shim thickness, remove the special tools.



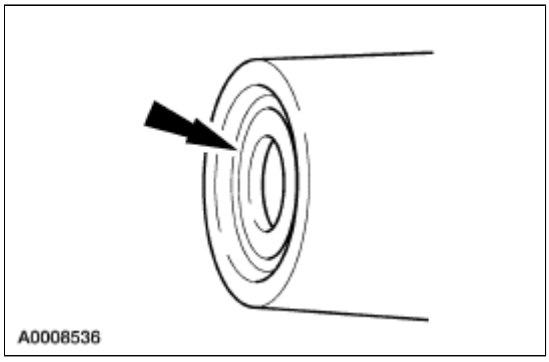
11. Using the special tool and a suitable press, seat the pinion bearing firmly against the pinion gear.



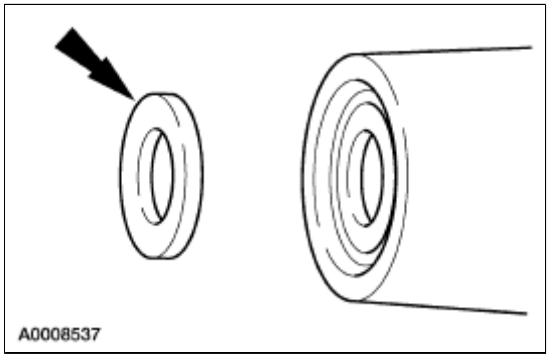
12. Place a new collapsible spacer on the pinion shaft against the pinion stem shoulder.



13. Install the outer pinion bearing.



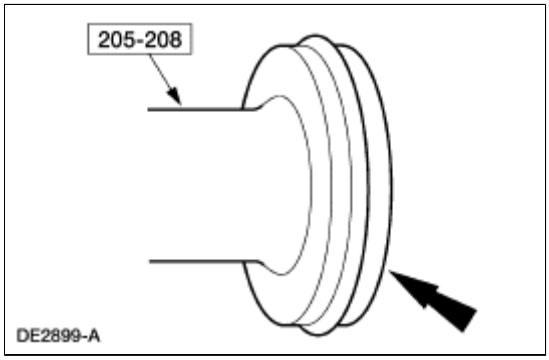
14. Install the rear axle drive pinion shaft oil slinger.



15. **CAUTION: Installation without the correct tool can result in early seal failure.**

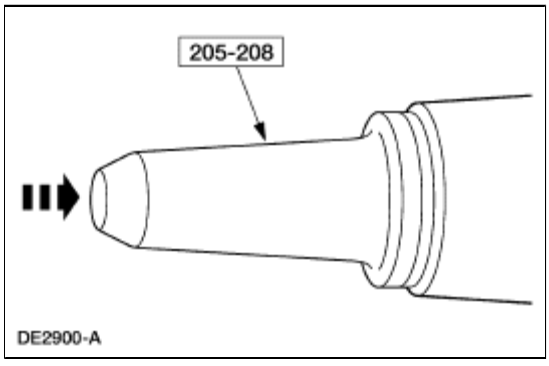
NOTE: Coat the lips of the rear axle drive pinion seal with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

Place the rear axle drive pinion seal on the special tool.

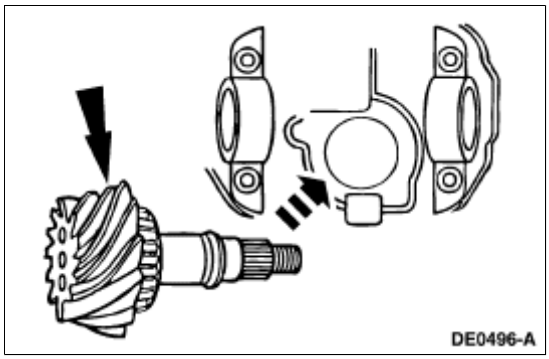


16. **CAUTION: If the rear axle drive pinion seal becomes cocked during installation, remove it and install a new one.**

Place the special tool and seal in the pinion seal bore and drive the rear axle drive pinion seal into place.



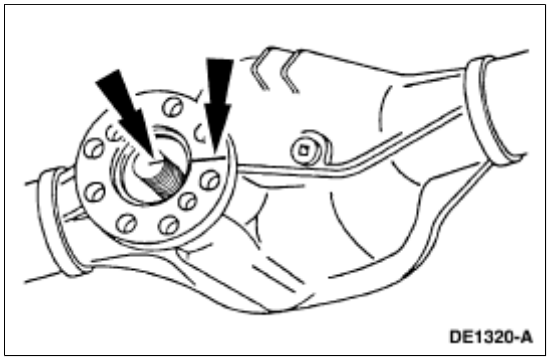
17. Install the pinion assembly (pinion, shims, inner pinion bearing, and collapsible spacer) into the rear axle housing bore.



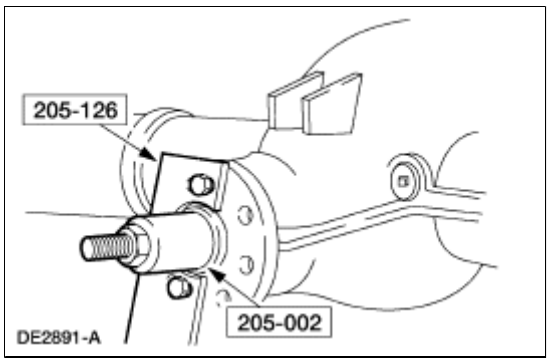
18. Lubricate the pinion flange splines.
    - Vehicles with 4.0L SOHC and 4.0L EI with a conventional differential, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.
    - Vehicles with 4.0L SOHC and 4.0L EI with Limited Slip differential and 5.0L, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

19. **NOTE:** Disregard the alignment marks if installing a new pinion flange.

    Align the pinion flange with the drive pinion shaft.



20. Using the special tools, install the pinion flange.

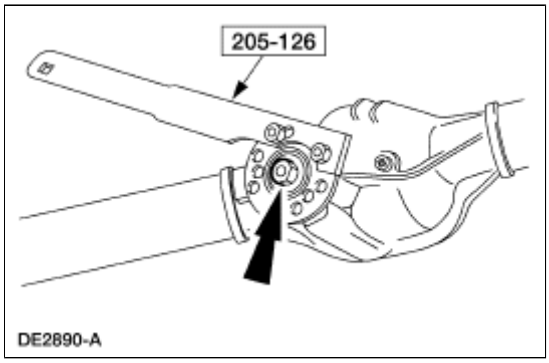


21. **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer and pinion nut.**

CAUTION: Remove the special tool when taking preload readings with the Nm (inch-pound) torque wrench.

Use the special tool to hold the pinion flange while tightening the pinion nut.

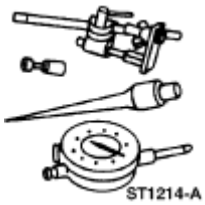
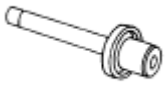
- Rotate the pinion occasionally to make sure the cone and roller bearings are seating correctly.
- Install a Nm (inch-pound) torque wrench on the pinion nut.
- Rotating the the pinion through several revolutions, take frequent cone and roller bearing torque preload readings until the original recorded preload reading is obtained.
- If the original recorded preload is lower than specifications, tighten to the appropriate specifications for used bearings. If the preload is higher than specification, tighten the nut to the original reading as recorded. Refer to the torque specification for new pinion bearings in the Specifications portion of this section.



22. Install differential case and the remaining components. For additional information, refer to Differential Case in this section.

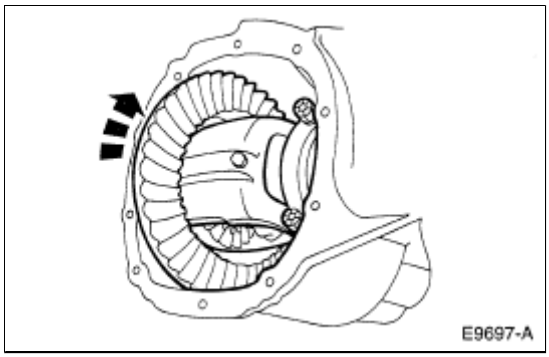
Differential Case

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
ST1485-A	Shim Driver 205-220 (T85L-4067-AH)
ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

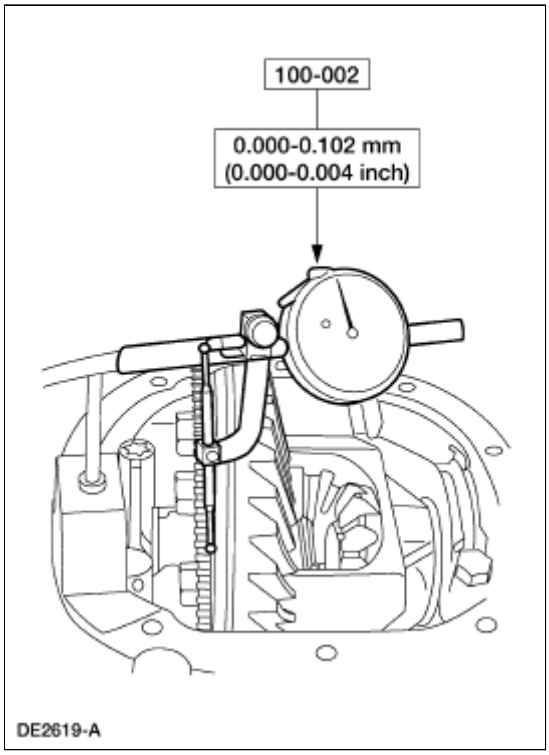
Removal

1. Remove the axle shafts (4234). For additional information, refer to Axle Shaft in this section.
2. Wipe the lubricant from the internal working parts and visually inspect the parts for wear and damage.
3. Rotate the differential case (4204) to see if there is any roughness which would indicate damaged bearings or gears.



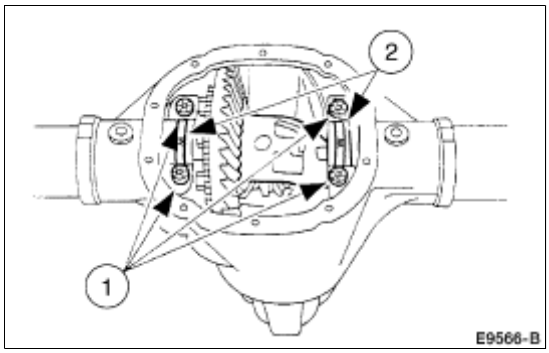
4. **NOTE:** There is a space between the anti-lock speed sensor ring and the ring gear for measuring ring gear backface runout.

   Position the special tool and check the ring gear backlash and ring gear backface runout.



5. **CAUTION: Mark the position of the bearing caps, as the arrows may not be visible. The bearing caps must be installed in their identical locations and positions.**

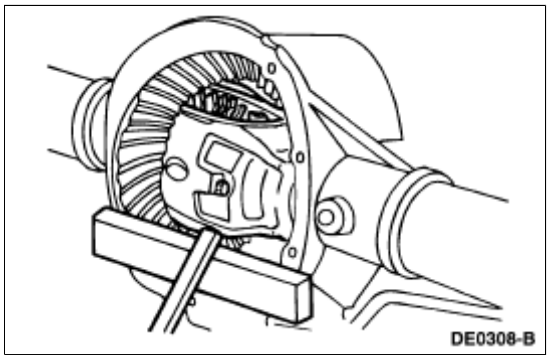
   Loosen the differential case.
   1. Remove the four bearing cap bolts.
   2. Remove the two bearing caps.



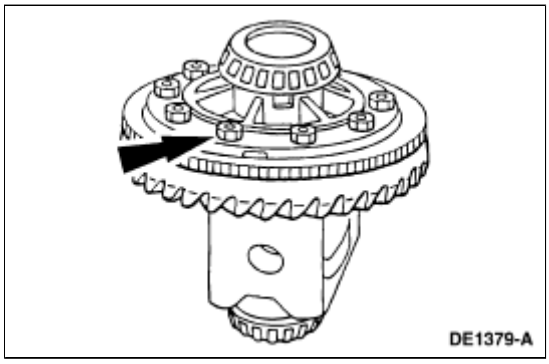
6. **WARNING: Be careful not to allow the differential case to fall.**

   CAUTION: Place a wood block between the pry bar and the rear axle housing (4010) to protect the machined surface from damage.

   Use the pry bar and the wood block to remove the differential case from the rear axle housing.



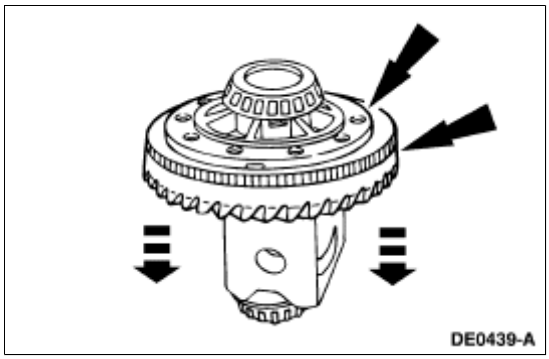
7. Remove the 10 ring gear bolts.



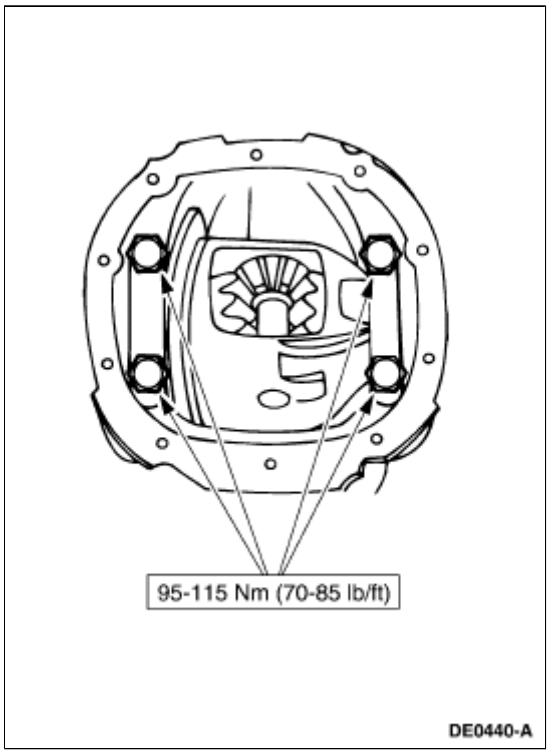
8. **CAUTION: Care should be taken not to damage the ring bolt hole threads.**

   CAUTION: The anti-lock speed sensor ring cannot be reused once removed.

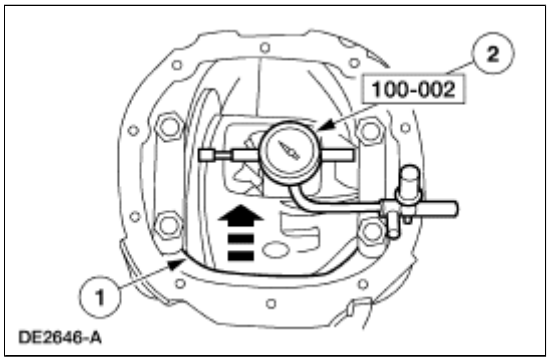
   Insert a punch in the bolt holes and drive off the ring gear and, if necessary, the anti-lock speed sensor ring.



9. Install the differential case.
   - Position the differential case assembly, including the bearing cups and shims, in the rear axle housing. Install the differential bearing caps and the differential bearing cap bolts.

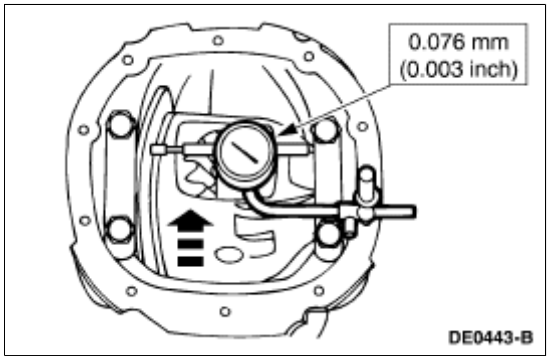


10. Position the special tool.
    1. Rotate the differential case to make sure the differential bearings (4221) are correctly seated.
    2. Position the special tool.

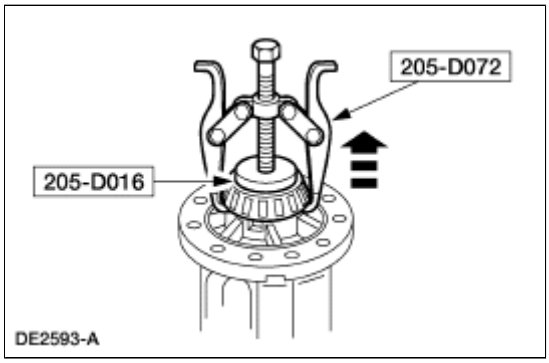


11. **NOTE:** If runout is less than the specification, install a new ring gear and pinion. If runout exceeds the specification, the ring gear is true and the concern is due to either a damaged differential case or differential bearings. Inspect the differential bearings. If the differential bearings are not damaged, install a new differential case and differential bearings.

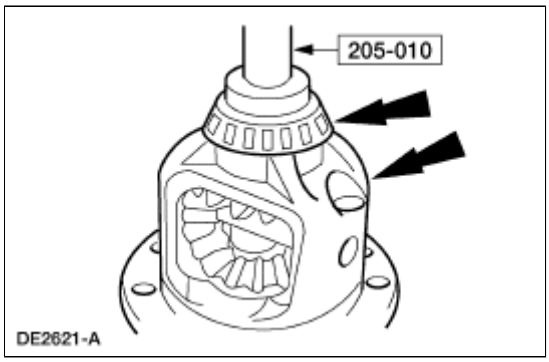
    Measure the differential case runout without the ring gear.



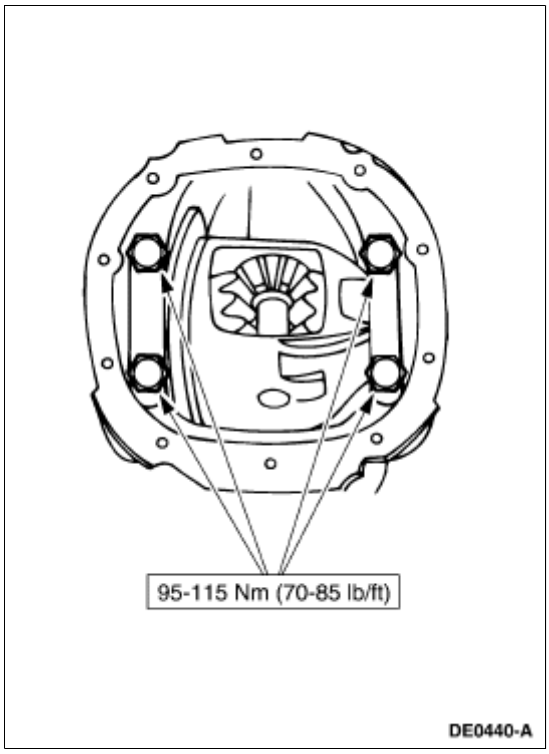
12. Remove the differential case from the rear axle housing and remove the differential bearings using the special tools.



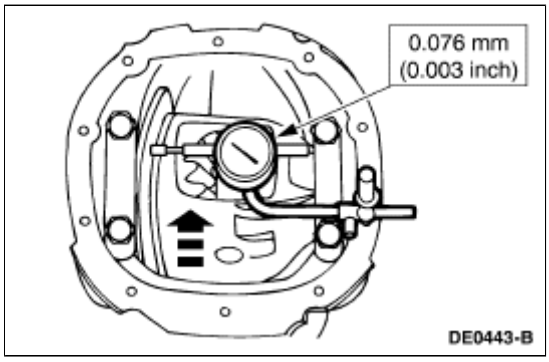
13. Use the special tool to install the new differential bearings on the differential case.



14. Install the differential case. Position the differential case assembly, including the bearing cups and shims in the rear axle housing. Tighten bearing caps to specifications.



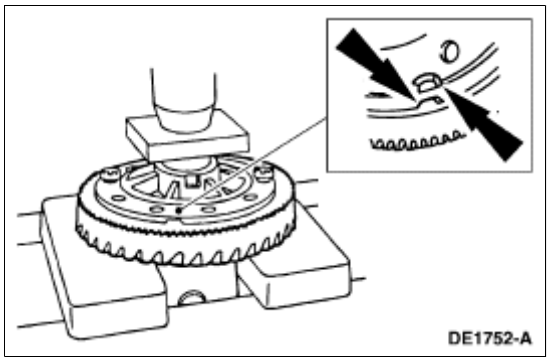
15. Measure the differential case runout without the ring gear, and check the case runout again with the new differential bearings.
    - If the runout is now less than the specification shown, use the new differential bearings for assembly.
    - If the runout is still excessive, the differential case is damaged and a new differential case must be installed.



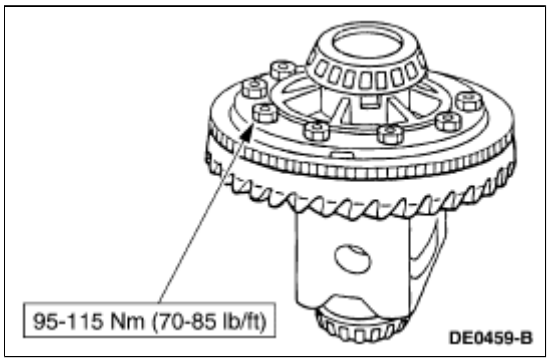
Installation

All vehicles

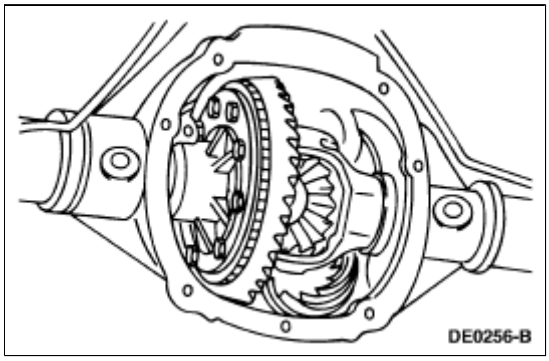
1. Press a new anti-lock speed sensor ring, if removed, and the ring gear on the differential case.
    - Align the notch on the differential case flange with the notch on the anti-lock speed sensor ring.



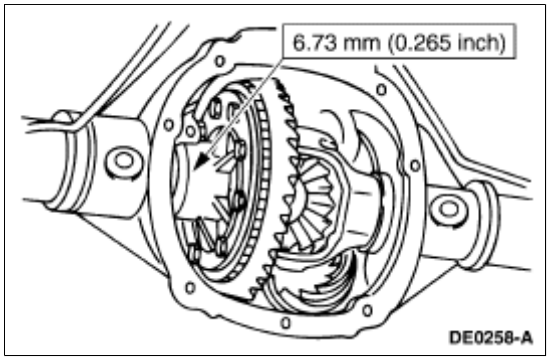
2. Install the ring gear bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to ring gear bolts.



3. With pinion depth set and pinion installed, place the differential case in the rear axle housing.



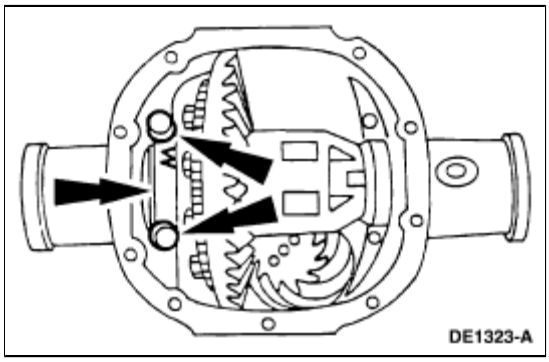
4. Install a shim on the left side.



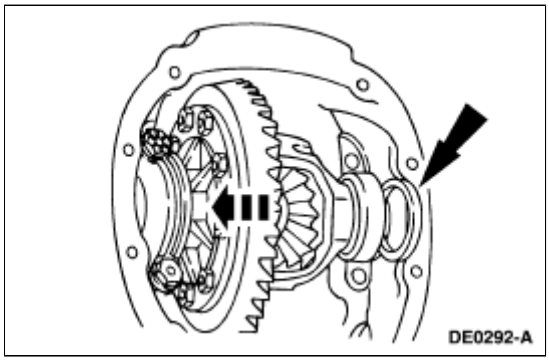
5. **CAUTION: Mark the position of the bearing caps as the arrows may not be visible. The bearing caps must be installed in their identical locations and positions.**

   NOTE: Apply pressure toward the left side to make sure the left bearing cap is seated.

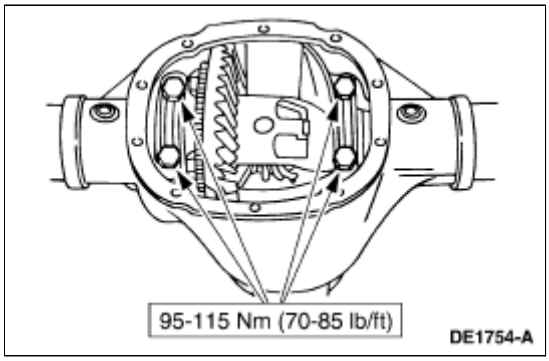
   Install the left bearing cap and loosely install the bearing cap bolts.



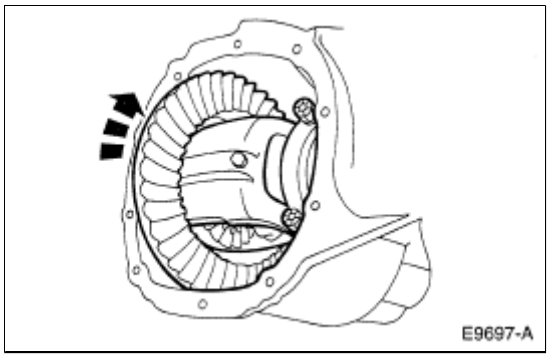
6. Install progressively larger shims on the right side until the largest shim selected can be assembled by hand.



7. Install the right side bearing cap and tighten the left side and right side bolts to specification.



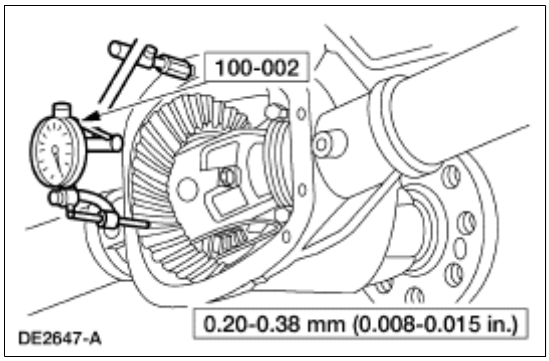
8. Rotate the differential case to make sure it rotates freely.



Measuring backlash

9. Use the special tool to measure the ring gear backlash.
    - If the backlash is within specification, go to Backlash within specification in this procedure.
    - If a zero backlash condition occurs, go to Zero backlash in this procedure.
    - If the backlash is not within specification, go to Backlash not within specification in this procedure.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

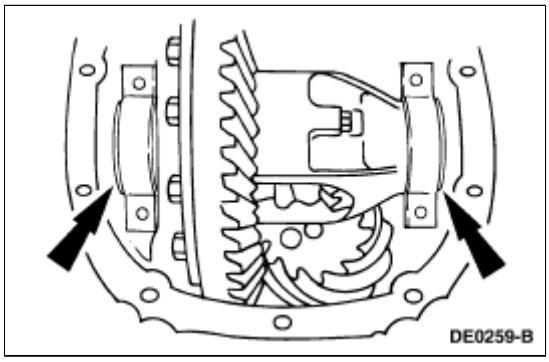


Zero backlash

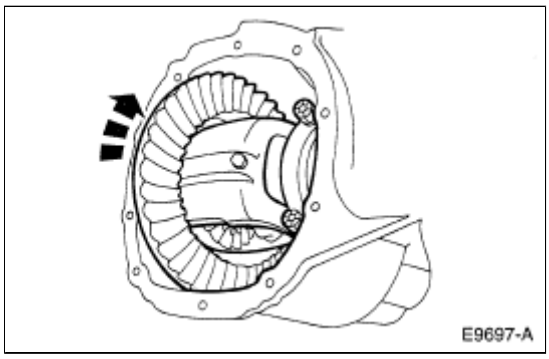
10. If a zero backlash condition occurs, add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication. Check the backlash. Repeat Measuring backlash in this procedure.

Backlash not within specification

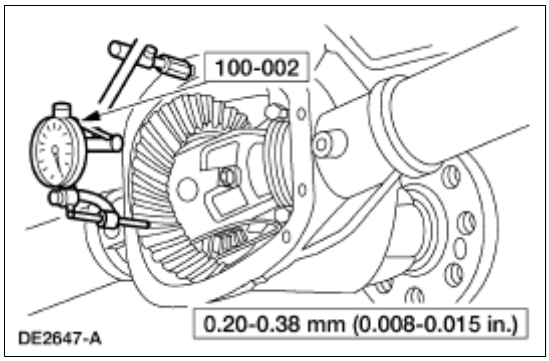
11. To increase or decrease the backlash, remove the bearing caps and install a thicker shim or a thinner shim as shown.
    - If the backlash is not within specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount.



12. Rotate the differential several times to make sure the differential bearings are correctly seated.

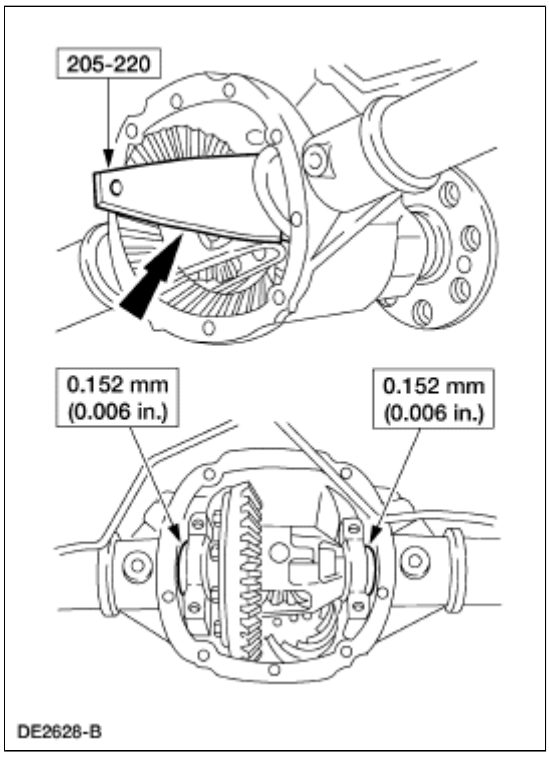


13. Using the special tool, recheck the backlash.
    - If the backlash is within specification, go to Backlash within specification in this procedure. If the backlash is not within specification, repeat Measuring backlash in this procedure.

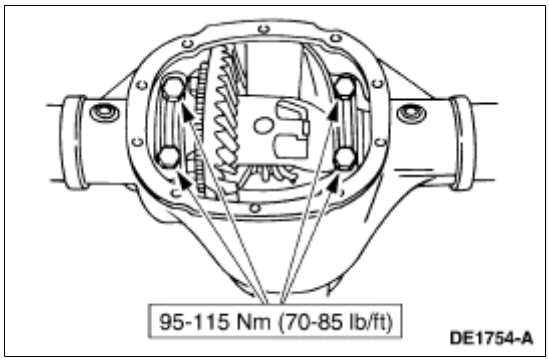


Backlash within specification

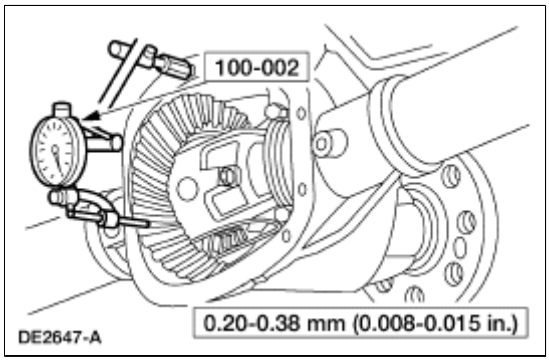
14. Remove the bearing caps and bolts.
    - To establish differential bearing preload, increase both left and right shim sizes by the specification shown in the illustration.
    - Using the special tool, make sure that the differential bearing shims are fully seated and the assembly turns freely.



15. Install the bearing caps and bearing cap bolts.



16. Using the special tool, recheck the backlash.



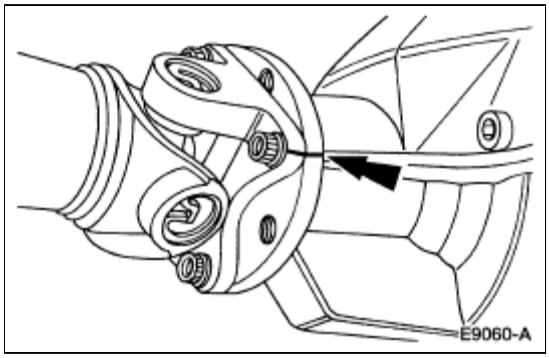
17. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

18. Install the differential housing cover and refill the rear axle with specified lubricant. For additional information, refer to Differential Housing Cover in this section.

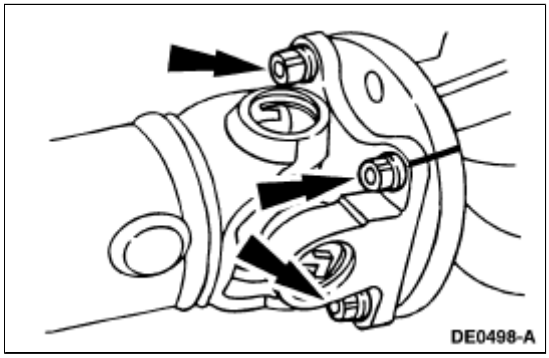
Axle Assembly

Removal

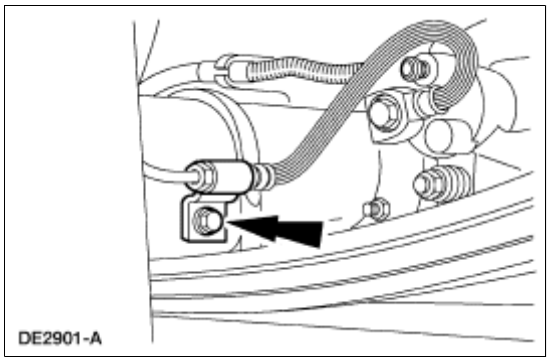
1. Release the tension on the parking brake cable. For additional information, refer to Section 206-05 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
4. Index-mark the driveshaft flange and the pinion flange (4851) to maintain initial balance during installation.



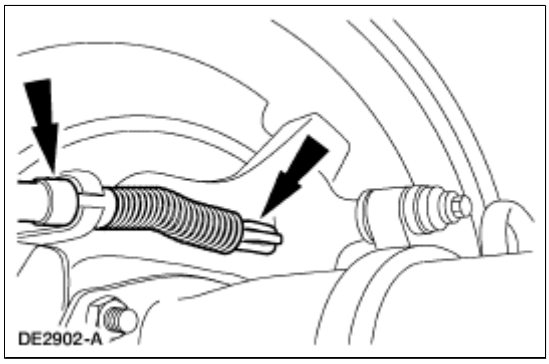
5. Remove the four bolts and position the driveshaft (4602) aside.



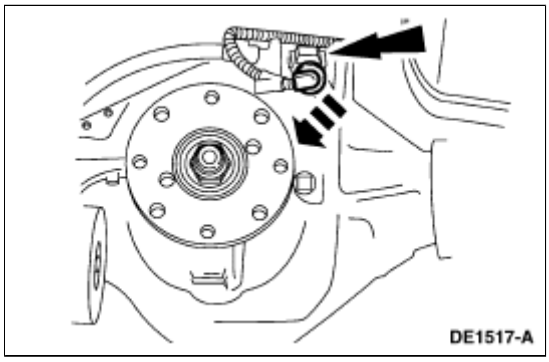
6. Remove the bolt, and position the brake hose junction block aside.



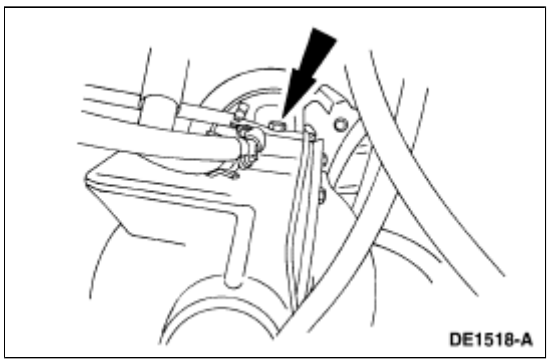
7. Disconnect the parking cable and conduit at the parking brake lever.



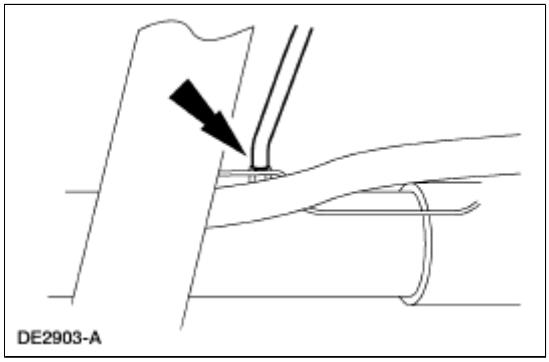
8. Disconnect the vehicle speed sensor.



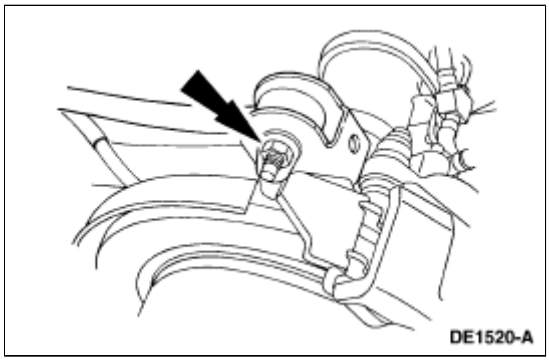
9. Remove the bolt, and reroute the parking brake cables and the vehicle speed sensor wiring.



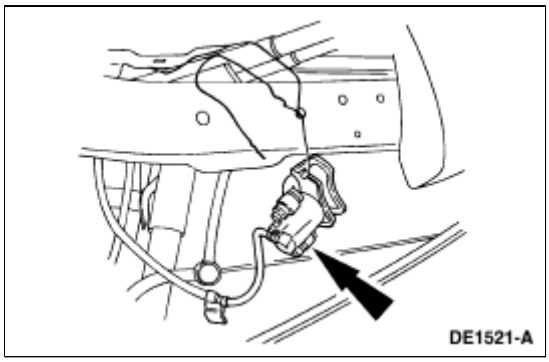
10. Disconnect the vent hose.



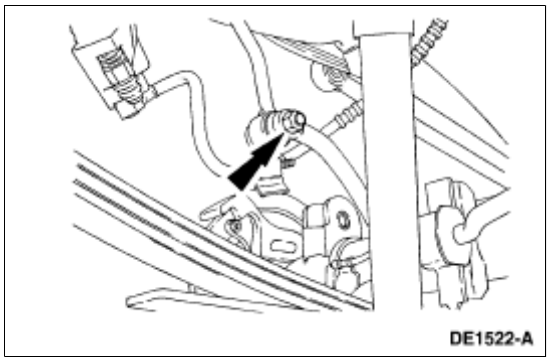
11. Disconnect the anti-windup bar, if so equipped.



12. Remove, and wire the rear disc brake calipers (2552) aside. For additional information, refer to Section 206-04 .

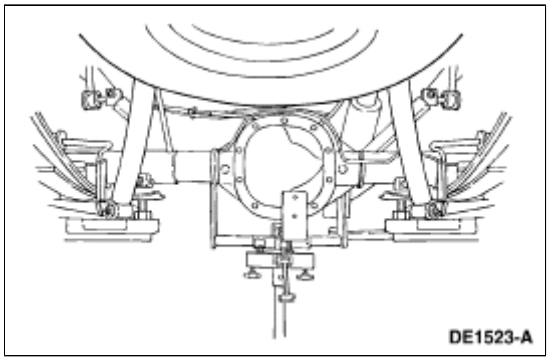


13. Disconnect the rear stabilizer bar (5A772) at the links.

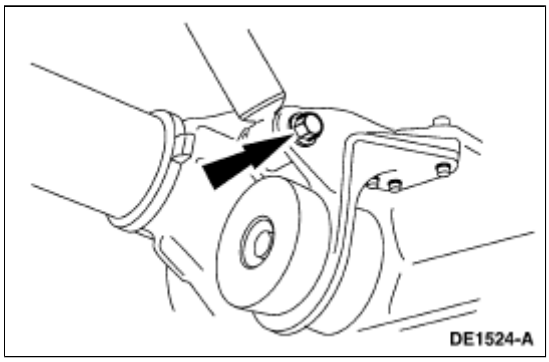


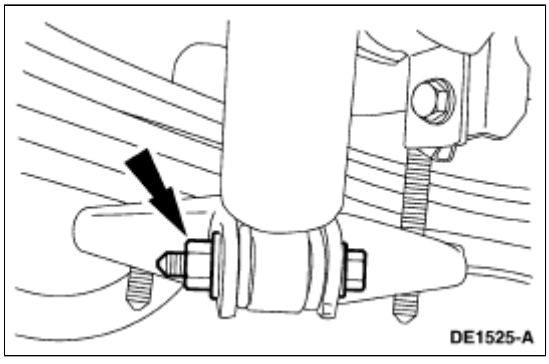
14. **WARNING: Use an extra support strap to secure the rear axle to the jack.**

    Use a suitable jack to support the rear axle assembly.

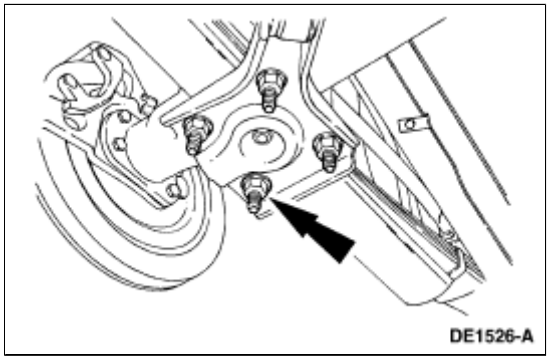


15. Remove the lower nuts and bolts from all three shock absorbers.





16. Remove the nuts and the U-bolt.



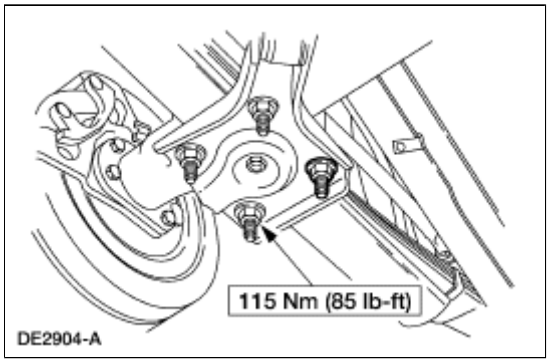
17. **CAUTION: Be careful of obstructions and of causing damage to vehicle components when performing this step.**

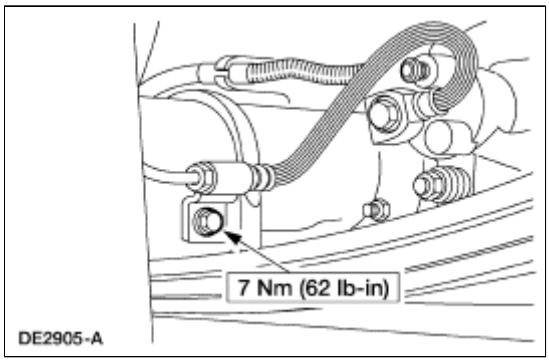
    Raise the rear axle off the rear springs and manipulate the rear axle from the vehicle.

Installation

1. To install, reverse the removal procedure.
   - Refer to Section 204-02 for the shock absorber, stabilizer bar and anti-windup bar fastener tightening specifications.
   - **CAUTION: Be sure to align the driveshaft flange and the pinion flange index-marks.**

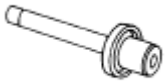
     Refer to Section 205-01 for driveshaft fastener tightening specifications.
   - For wheel and tire torques, refer to Section 204-04 .





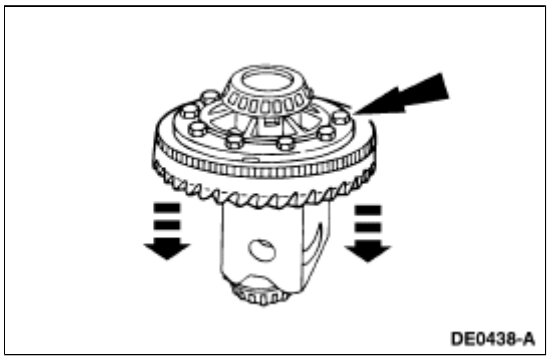
Differential Case and Ring Gear —Conventional

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

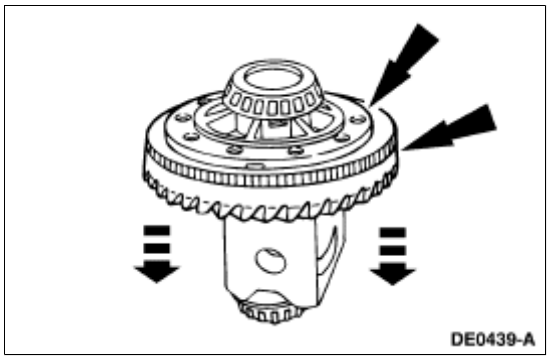
Disassembly

1. Remove the differential case. For additional information, refer to Differential Case in this section.
2. Remove the 10 ring gear bolts.


DE0438-A

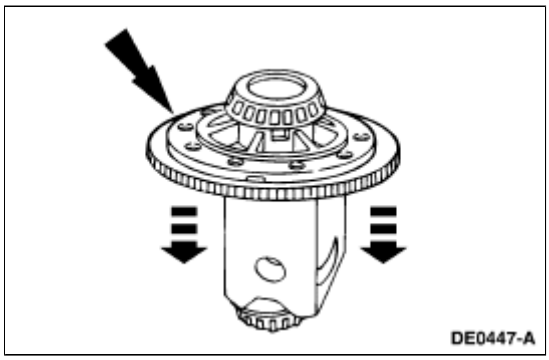
3. **CAUTION: Care should be taken not to damage the bolt hole threads.**

   Insert a punch in the bolt holes and drive the ring gear off.

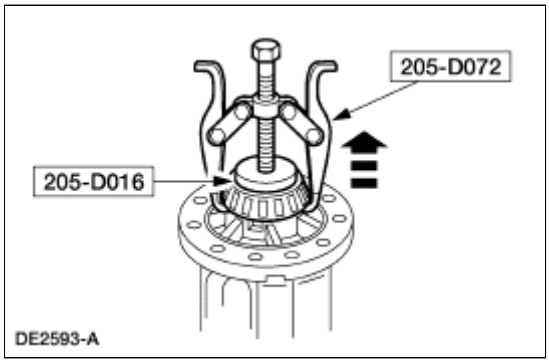


4. **NOTE:** The speed sensor ring cannot be reused once removed.

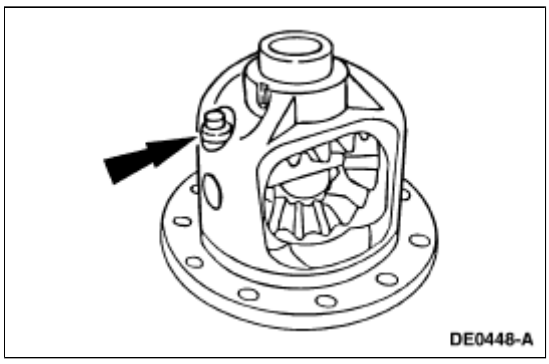
   Remove the speed sensor ring if required.



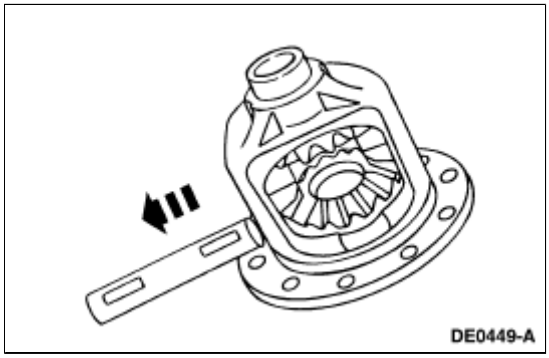
5. If required, use the special tools to remove the differential bearings.



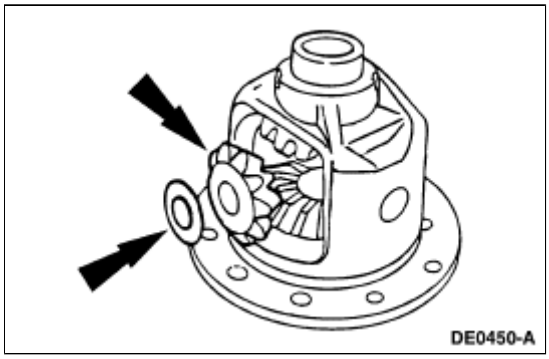
6. Remove the differential pinion shaft lock bolt.



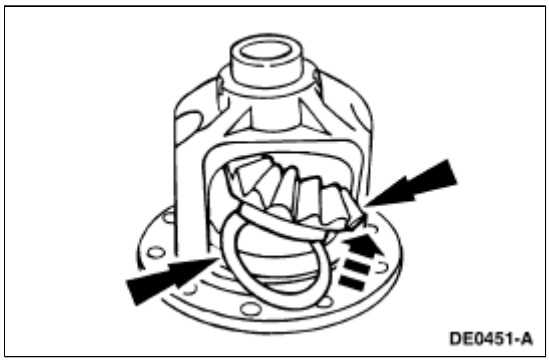
7. Remove the differential pinion shaft (4211).



8. Rotate and remove the differential pinion gears (4215) and the differential pinion thrust washers (4230).

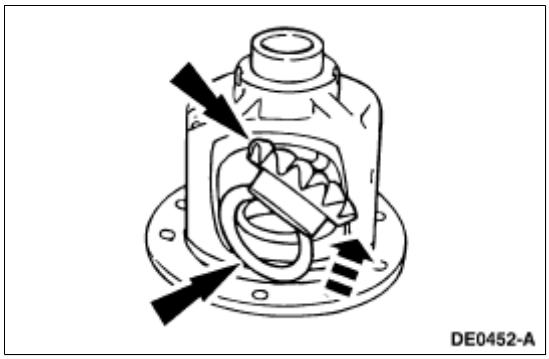


9. Remove the differential side gears (4236) and the differential side gear thrust washers.

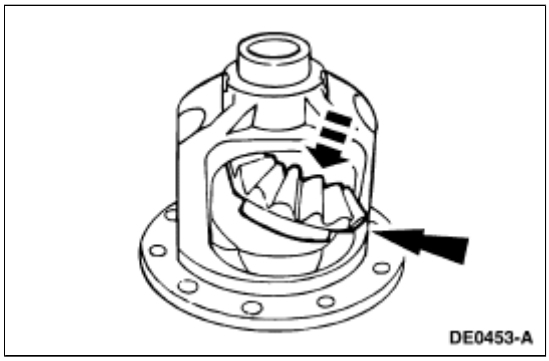


Assembly

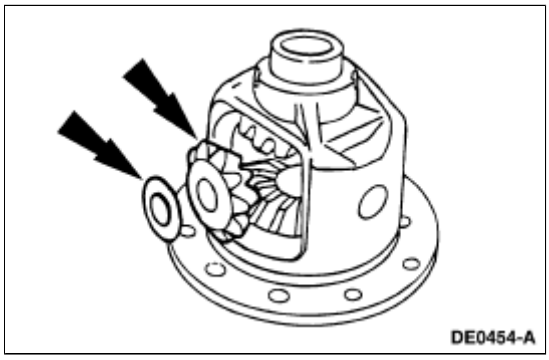
1. Lubricate the differential side gear thrust washers (4228) and the differential side gear journals.
   - For vehicles with 5.0L engines, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L engines, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL meeting Ford specification WSP-M2C197-A.
   - Position the differential side gear thrust washers on the differential side gears.



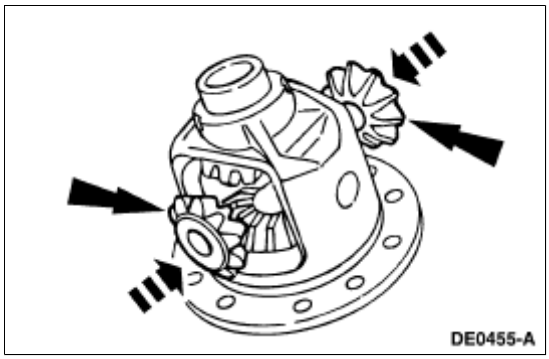
2. Position the differential side gears.



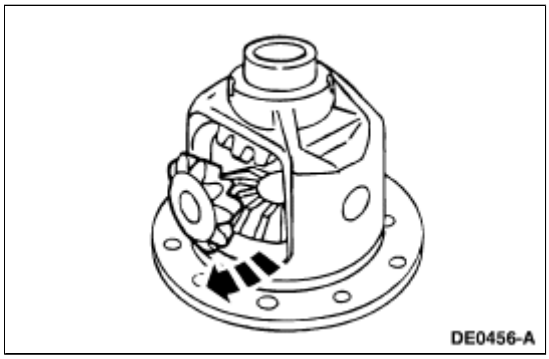
3. Lubricate the differential pinion thrust washers and the differential pinion gears and assemble.
   - For vehicles with 5.0L engines, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L engines, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL meeting Ford specification WSP-M2C197-A.



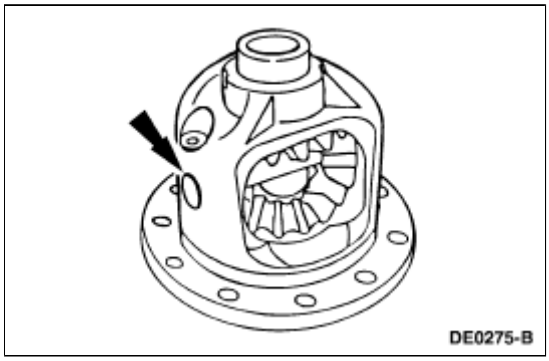
4. Engage the differential pinion gears opposite the differential side gears.



5. Rotate the differential pinion gears to align with the differential pinion shaft bore.

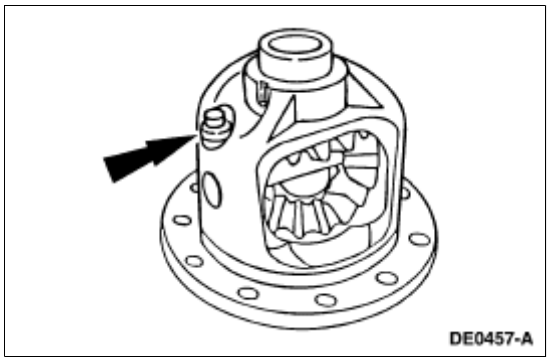


6. Insert the differential pinion shaft.
   - Align the hole in the differential pinion shaft with the hole in the differential case (4204).

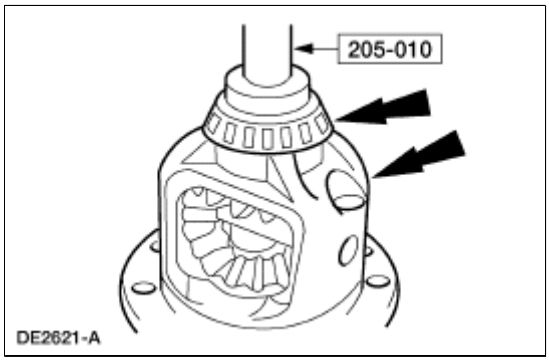


7. **CAUTION: If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specifications WSK-M2G351-A5 prior to installation.**

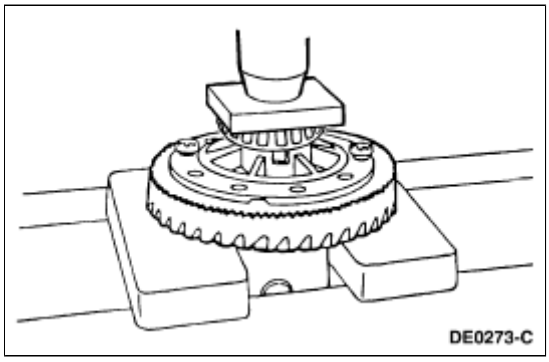
   Install a new differential pinion shaft lock bolt and tighten finger-tight.



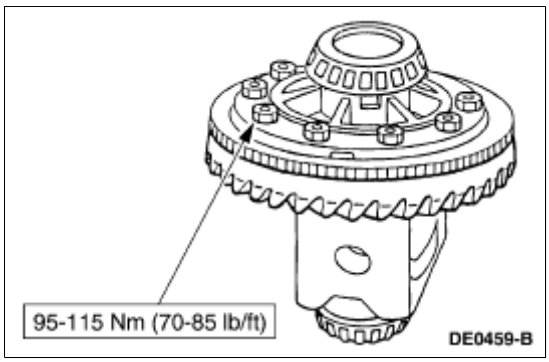
8. Using the special tool, install the new differential bearings (4221) on the differential case.



9. Press the new anti-lock speed sensor ring and the ring gear on the differential case.



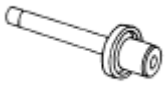
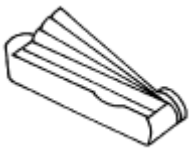
10. Install the ring gear bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to ring gear bolts.



11. Install the differential case. For additional information, refer to Differential Case in this section.

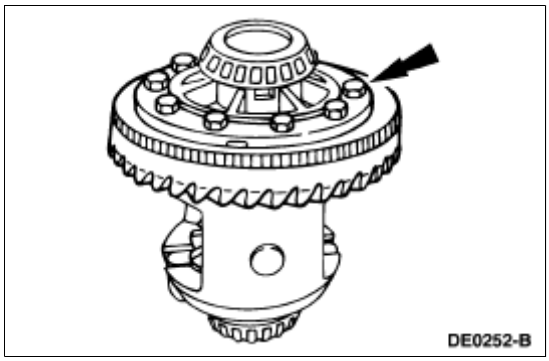
Differential Case and Ring Gear —Traction-Lok®

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
ST1374-A	Differential Clutch Gauge 205-135 (T80P-4946-A)
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or Equivalent
ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

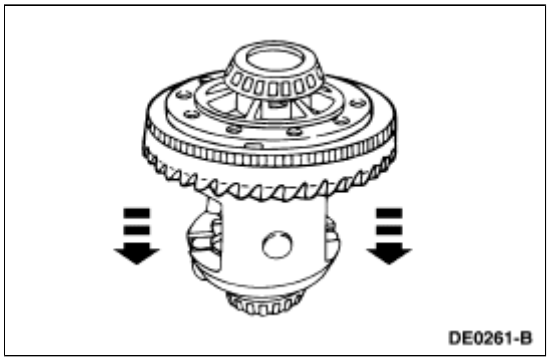
Disassembly

1. Remove the differential case (4204). For additional information, refer to Differential Case in this section.
2. Remove the 10 bolts.



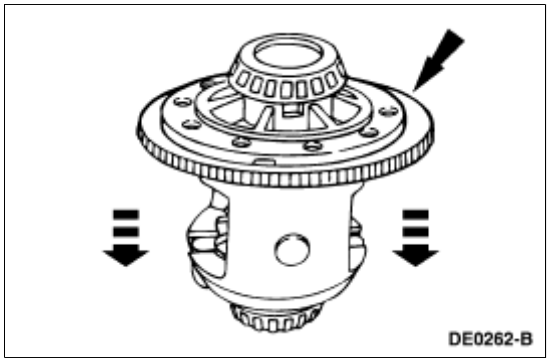
3. **CAUTION: Do not damage the bolt hole threads.**

   Insert a punch in the bolt holes, and drive the ring gear off.

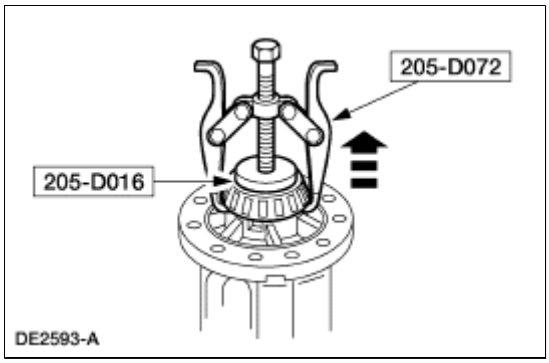


4. **CAUTION: Do not reuse the anti-lock speed sensor ring (4B409) after removing it.**

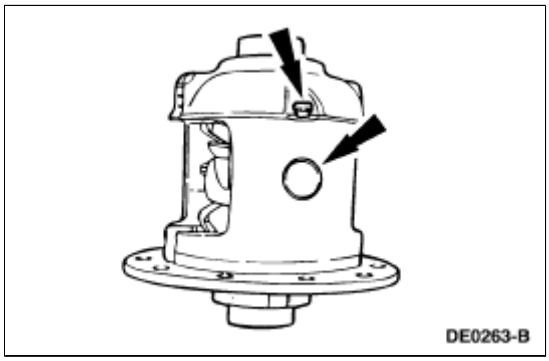
   If necessary, remove the anti-lock speed sensor ring and discard it.



5. Using the special tools, remove the differential bearings (4221).

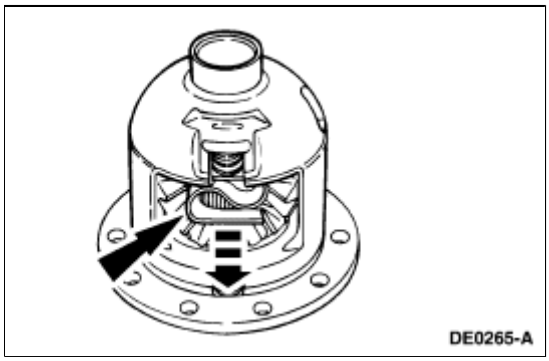


6. Remove the differential pinion shaft lock bolt, and remove the differential pinion shaft (4211).

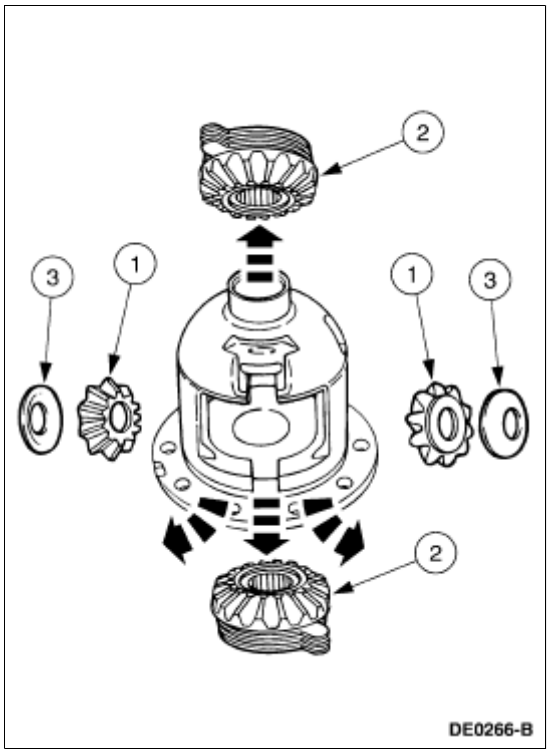


7. **WARNING: Due to the spring tension, take care when removing the differential clutch spring (4214).**

   Remove the differential clutch spring.

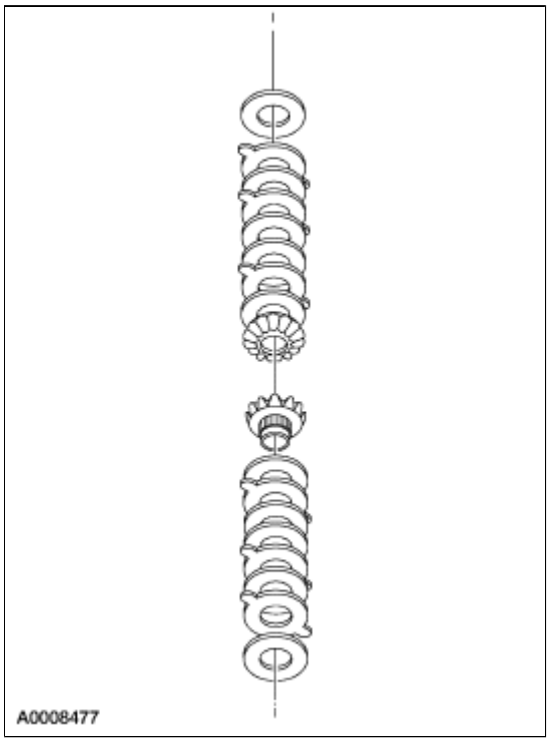


8. Remove the differential gears and washers.
   1. Remove the differential pinion gears (4215).
   2. Remove the differential side gears (4236).
   3. Remove the differential pinion thrust washers (4230).



9. **CAUTION: Keep the differential clutch packs (4947) in order. Do not mix them. Be sure to reassemble them in the same sequence.**

   Remove and tag the differential clutch packs, shims and differential side gears "right" and "left".



10. **CAUTION: Do not use acids or solvents to clean the differential clutch packs. Wipe the components with a clean, lint-free cloth only.**

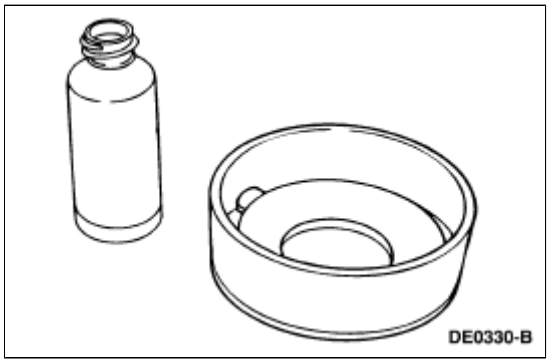
    Clean and inspect the differential clutch packs for wear and damage. Install new parts as necessary.

11. Clean and inspect the remaining differential case components for wear and damage. Install new components as necessary.

Assembly

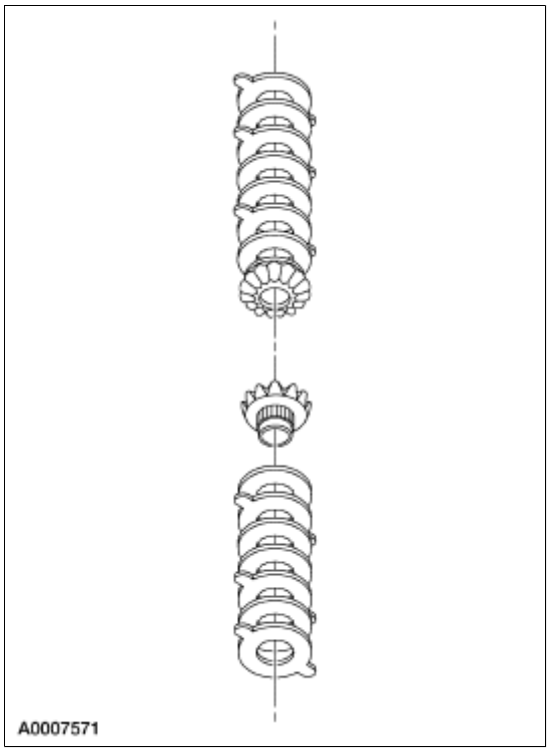
1. **CAUTION: Use 118 ml (4 oz) of Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A in the axle.**

   Prelubricate each steel clutch plate and soak all of the friction plates in Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A for at least 15 minutes.



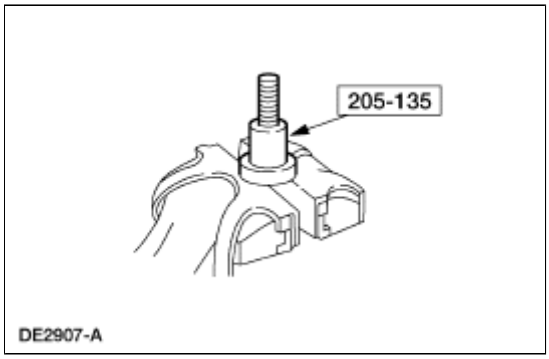
2. **CAUTION: Do not mix the left and right side differential clutch packs and shims.**

   Assemble the left and right differential clutch packs (without the shims) and differential side gears.

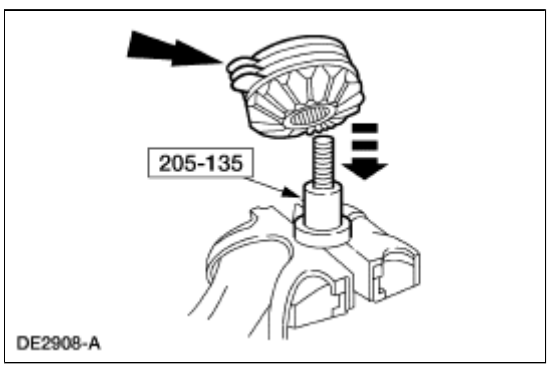


3. **CAUTION: Use the correct mandrel with the Differential Clutch Gauge.**

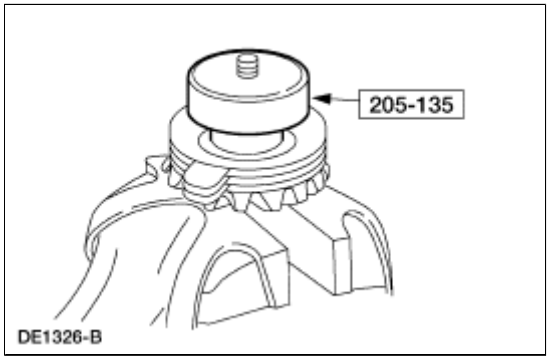
   Place the special tool in a vise.



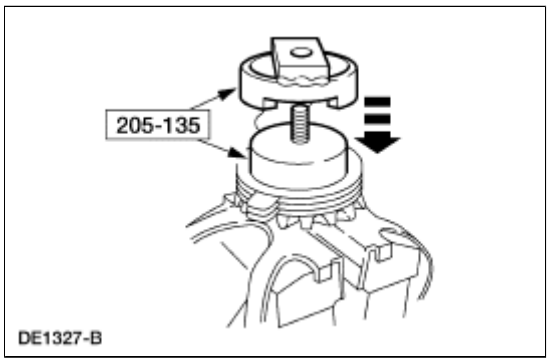
4. Install the differential clutch pack and differential side gear (without the shim) on the special tool.



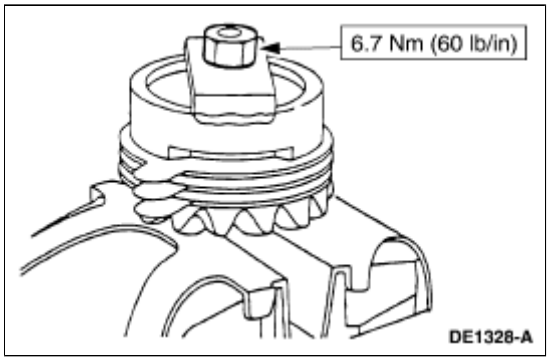
5. Position the special tool hand-tight on top of the differential clutch pack.



6. Install the special tool over the disc and differential clutch pack.



7. Install the nut.



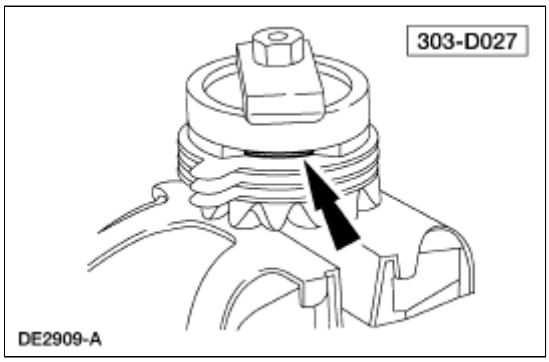
8. **NOTE:** Clutch Pack Kit F5AZ-4947-BA is available to rebuild the 8.8-inch ring gear Traction-Lok® differential.

   Using the special tool, determine the thickness of the new clutch shim.
   - Insert the thickest blade that will enter between the tool and the differential clutch pack.

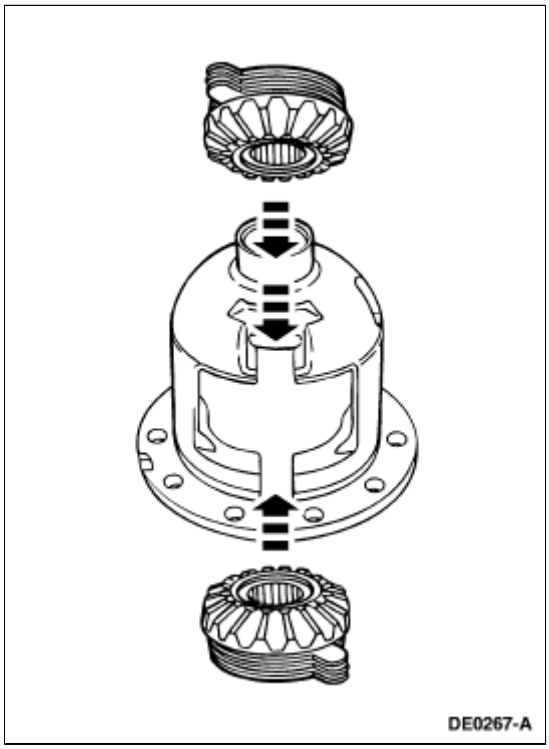
Selective Shims

Part Number	Description
EOAZ-4A324-G	0.025 Inch
EOAZ-4A324-H	0.030 Inch

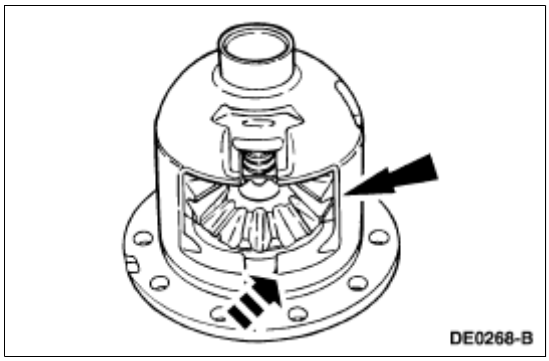
EOAZ-4A324-C	0.035 Inch
EOAZ-4A324-D	0.040 Inch
EOAZ-4A324-F	0.045 Inch



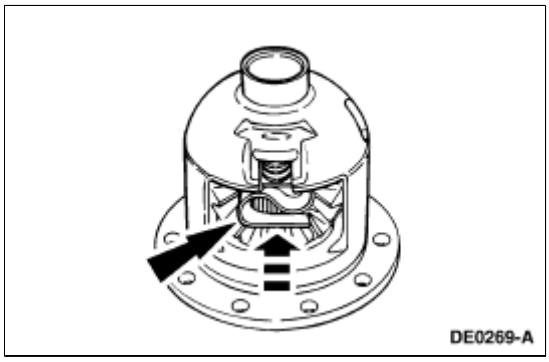
9. Remove the special tool from the clutch pack and side gear assembly.
10. Install the shims on the clutch pack and side gear assembly.
11. Install the differential side gear assemblies in the differential case.



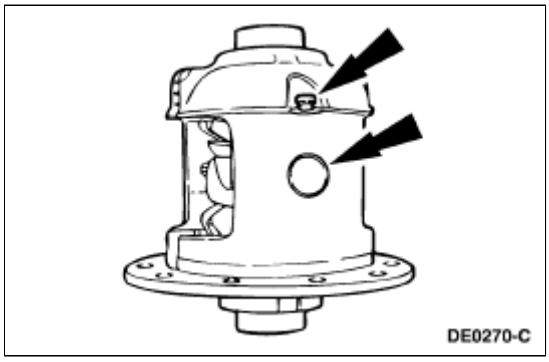
12. Install the differential pinion gears with the differential pinion thrust washers in the differential case.



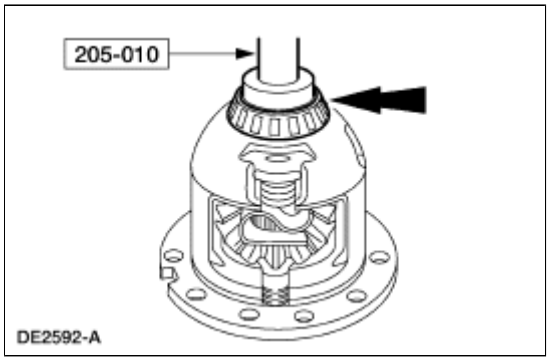
13. Using a soft-faced hammer, install the differential clutch spring.



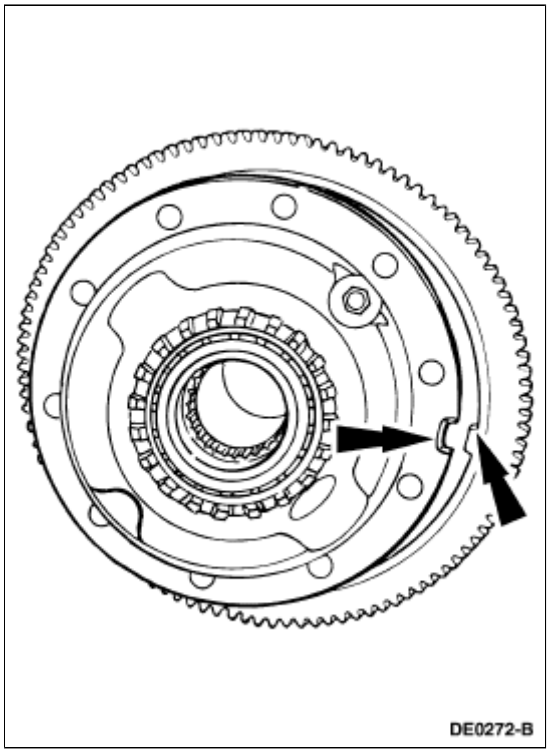
14. Install the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.



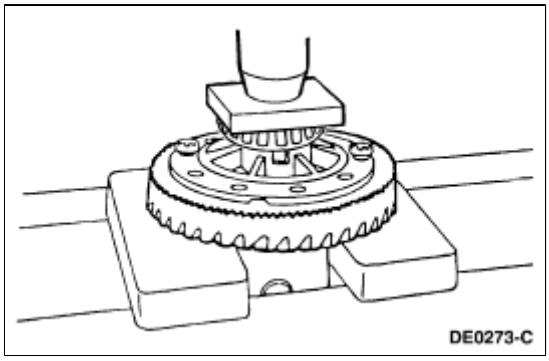
15. Using the special tool, install the differential bearings.



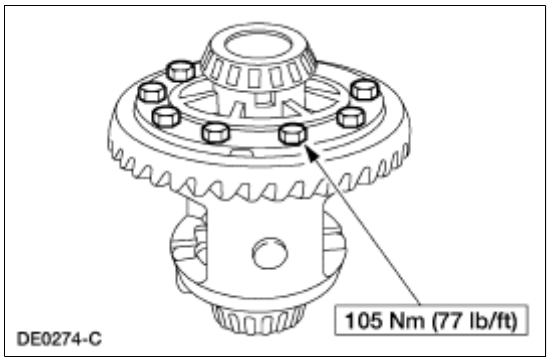
16. Install the anti-lock speed sensor ring by aligning the tab with the slot.
    - Start two bolts through the differential case and into the ring gear to make sure the ring gear bolt holes align with the differential case bolt holes.



17. Press the new anti-lock speed sensor ring and the ring gear on the differential case.



18. Install the bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



19. Install the differential case. For additional information, refer to Differential Case in this section.

General Specifications

Item	Specification
Housing Spreader Adapter bolt thread engagement mm (inch)	12.7 (0.500)
Maximum spread of differential housing mm (inch)	0.381 (0.015)
Ring gear backlash mm (inch)	0.13-0.20 (0.005-0.008)
Maximum backlash variation between points checked mm (inch)	0.05 (0.002)
Sealant	
Ford Black Silicone Rubber F4AZ-19562-B	WSE-M4G323-A1
Lubricant	
Motorcraft SAE 80W90 XL-80W90-QL Thermally Stable 4x4 Axle Lubricant	WSP-M2C197-A
Capacity	
Front axle L (Pint)	1.54 (3.25)
Lubricant level mm (in)	9.56 (0.38) below bottom of axle cover filler hole

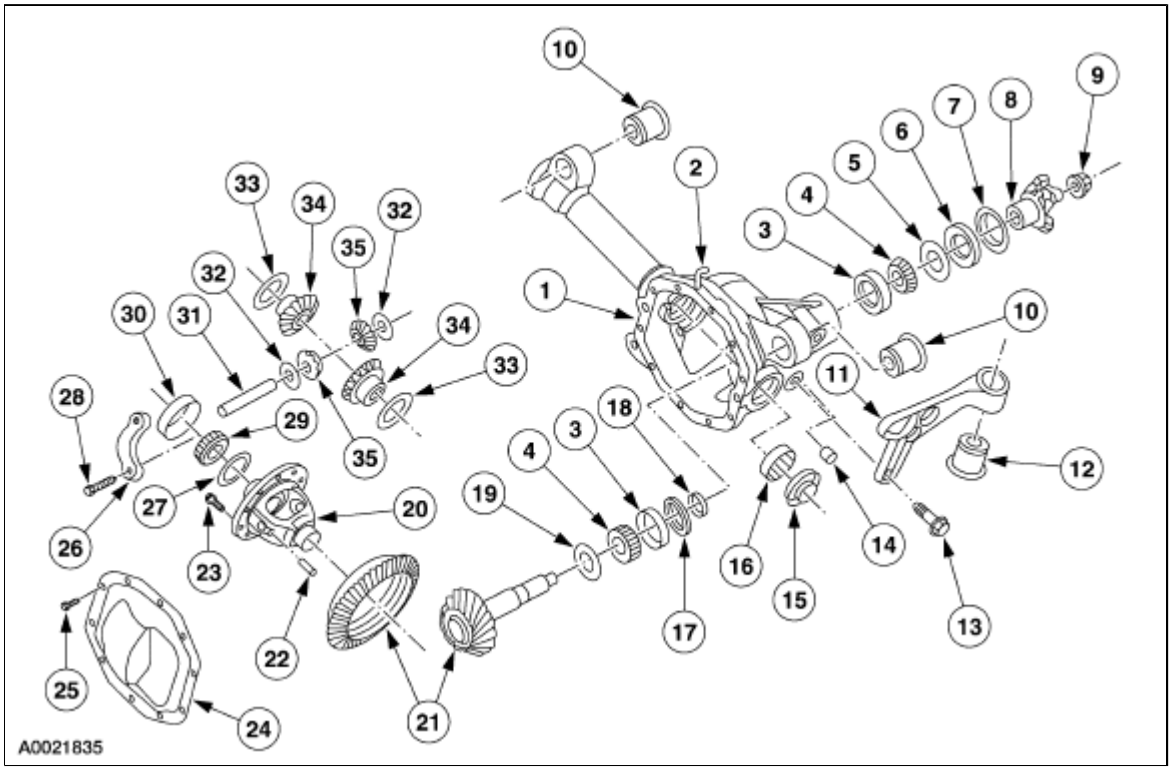
Torque Specifications

Description	Nm	lb-ft	lb-in
Front axle retainer bracket bolt	106	78	—
Ring gear bolt	109	80	—
Differential bearing cap bolt	61	45	—
Differential housing cover bolt	22	16	—
Axle to frame bolt	66	49	—
Pinion bearing preload (new pinion bearings)	1.7-3.4	—	15-30
Pinion bearing preload (original pinion bearings)	[a]	—	[a]
Universal joint spider retainer bolt	19	14	—
Brake caliper guide pin bolt	33	24	—
Tie-rod nut	91	67	—
Upper ball joint pinch bolt	48	35	—

[a] The reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during disassembly.

Front Drive Axle and Differential

AWD Dana 35 Exploded View



Item	Description
1	Differential Housing
2	Vent tube
3	Differential drive pinion bearing cup (2 req'd)
4	Differential pinion bearing (2 req'd)
5	Front axle drive pinion shaft oil slinger
6	Pinion seal
7	Drive pinion oil seal deflector
8	Pinion flange
9	Pinion nut
10	Bushing (2 req'd)
11	Axle to frame bracket
12	Bushing
13	Axle bracket to housing bolt (3 req'd)

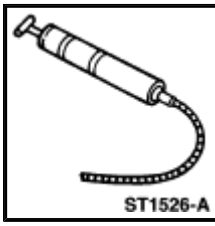
14	Fill plug
15	Axle shaft oil seal (LH)
16	Axle shaft bearing
17	Oil restrictor plate (baffle)
18	Collapsible spacer
19	Pinion position shim
20	Differential case
21	Differential ring gear and pinion
22	Differential pinion shaft roll pin
23	Differential ring gear bolt (8 req'd)
24	Differential housing cover
25	Differential cover bolts (10 req'd)
26	Differential bearing cap (part of 3010)
27	Differential preload/backlash shim
28	Differential bearing cap bolt (4 req'd)
29	Differential bearing
30	Differential bearing race
31	Differential pinion shaft
32	Differential pinion thrust washer (2 req'd)
33	Differential side gear thrust washer (2 req'd)
34	Differential side gear (2 req'd)
35	Differential pinion gear (2 req'd)

Front Drive Axle

Refer to Section 205-00 .

Axle and Differential Drain and Refill

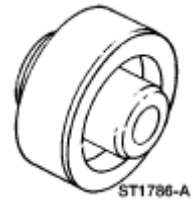
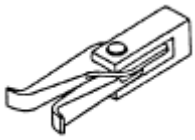
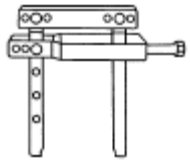
Special Tool(s)

 ST1526-A	Oil Suction Gun 303-D104 (D94T-9000-A)

1. Raise the vehicle on a hoist.
2. Remove the differential fill plug.
3. Use the oil suction gun and remove the axle lubricant through the fill opening.
4. If necessary, a cleaning solvent can be injected to remove any contaminants.
5. Repeat Step 3 to remove the cleaning solvent.
6. Refill the differential with Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.
7. Install the fill plug and tighten.

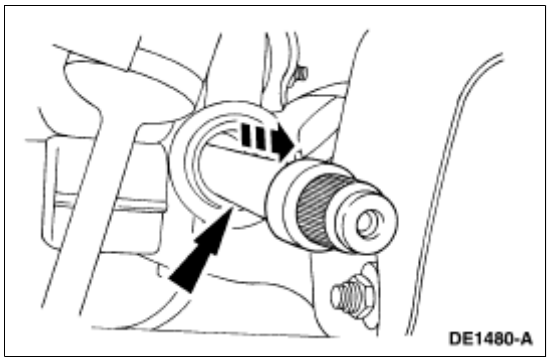
Axle Tube Bearing

Special Tool(s)

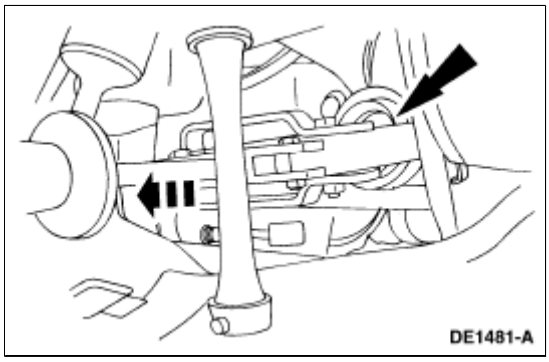
ST2472-A	Axle Bearing Replacer 205-345 (T95T-1175-B)
 ST1786-A	Axle Seal Replacer 205-350 (T95T-3010-A)
 ST1362-A	Bearing Remover 307-318 (T94P-77001-KH)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
ST1255-A	Handle 205-153 (T80T-4000-W)

Removal

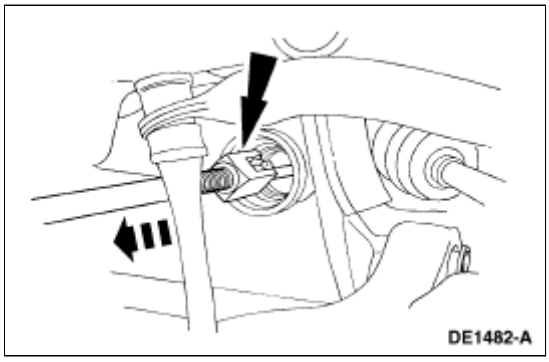
1. Remove the right-hand halfshaft. For additional information, refer to Section 205-04 .
2. Remove the right-hand axle shaft.



3. Use a converter oil seal remover and a slide hammer to remove the axle seal.



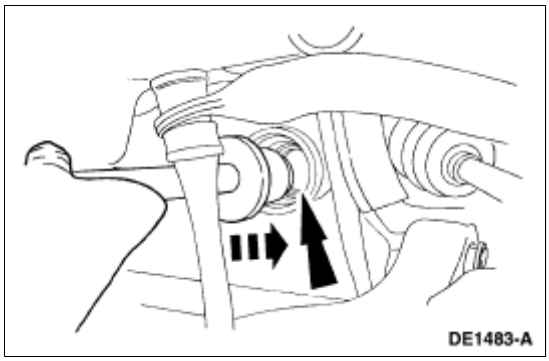
4. Use an axle bearing remover and a slide hammer to remove the axle tube bearing.



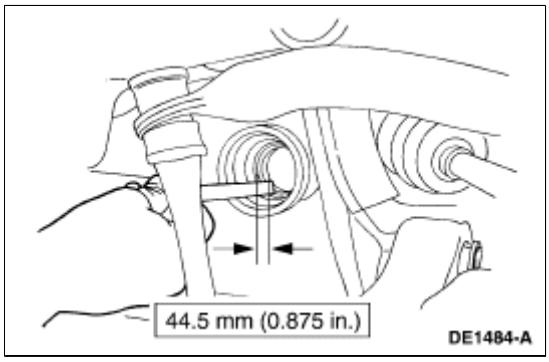
5. Clean the bearing and seal surfaces of any foreign debris.

Installation

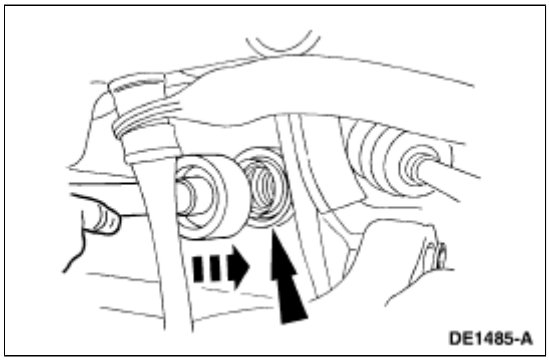
1. Use the Axle Bearing Replacer and the Handle to replace the RH axle tube bearing.



2. Check the bearing depth as shown.

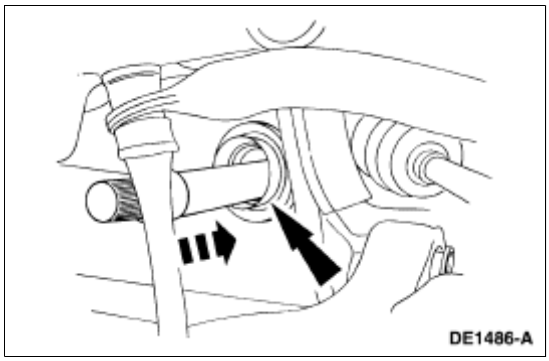


3. Use the Axle Seal Replacer and the Handle to replace the axle tube seal.



4. **CAUTION: Care should be taken not to damage the axle seal surface.**

   Install the axle shaft.

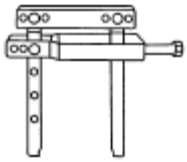
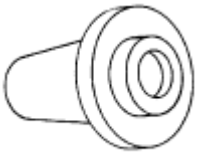


5. Refill the front drive axle to proper level using Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

6. Install the RH halfshaft. For additional information, refer to Section 205-04 .

Drive Pinion Seal

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
 ST1358-A	Pinion Seal Replacer 205-133 (T79P-4676-A)

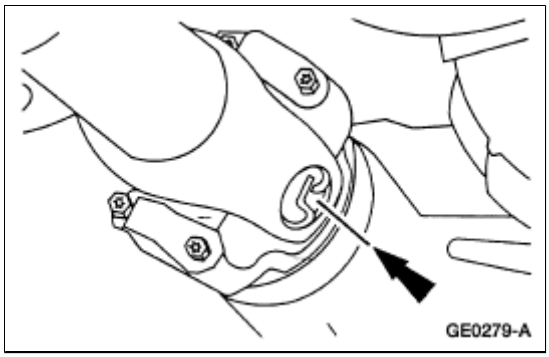
Removal

CAUTION: This operation disturbs the differential pinion bearing preload. Carefully reset the preload during assembly.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

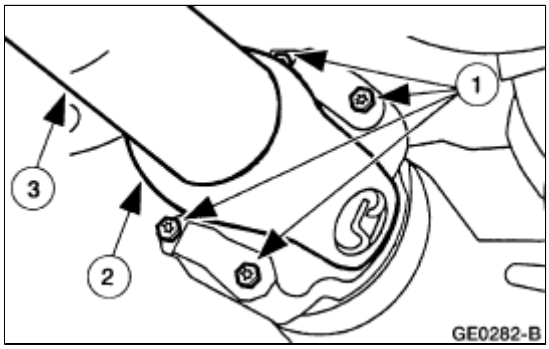
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Index-mark the front driveshaft and pinion flange.

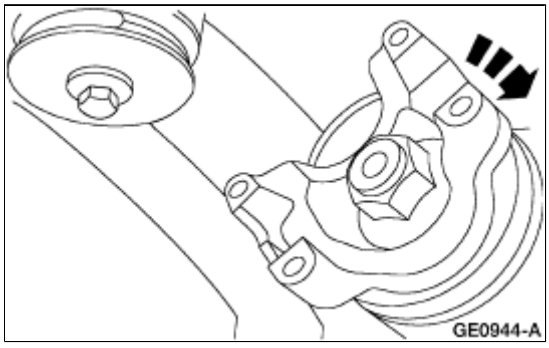


3. **CAUTION: Do not allow the driveshaft to hang unsupported.**

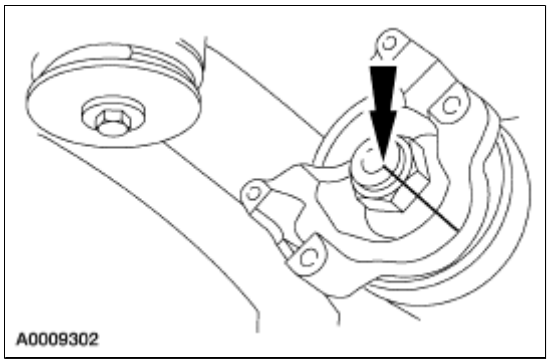
   Disconnect the front driveshaft from the pinion flange, and position it aside.
   1. Remove the bolts and the universal joint spider retainers.
   2. Disconnect the front driveshaft from the pinion flange.
   3. Position the front driveshaft aside.



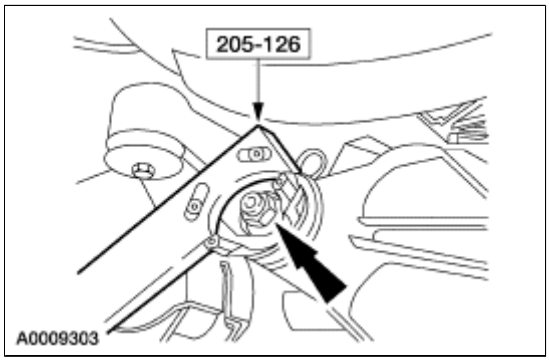
4. Measure the pinion bearing preload.
   - Using a Nm (inch-pound) torque wrench, measure the torque required to maintain pinion rotation. Record the measurement.



5. Index-mark the pinion flange and the pinion stem.

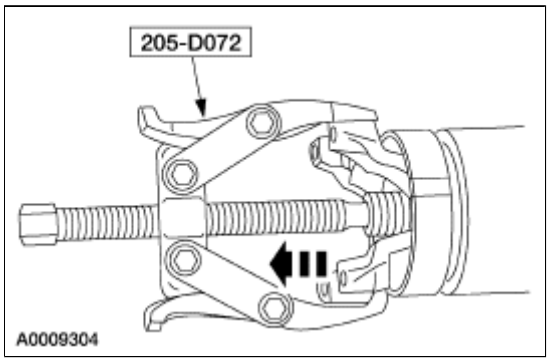


6. Use the special tool to hold the pinion flange while removing the nut.



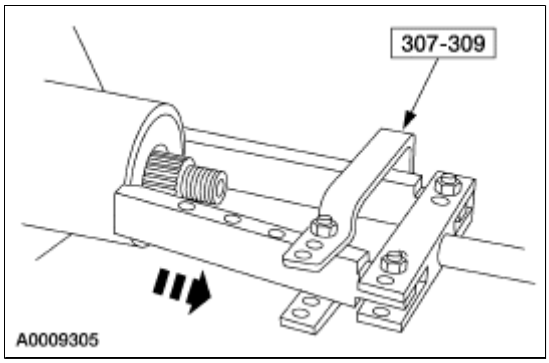
7. **CAUTION: Place a drain pan under the differential housing.**

   Using the special tool, remove the pinion flange.

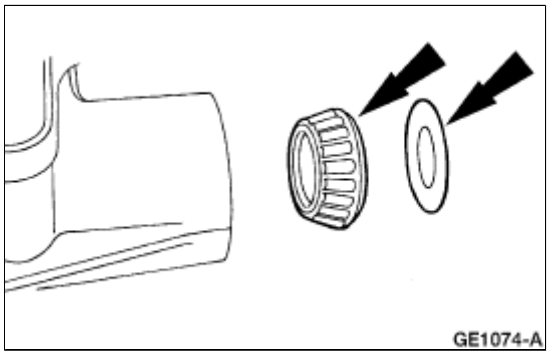


8. Inspect the pinion flange for burrs and damage. Inspect the end of the pinion flange that contacts the bearing cone, the nut counterbore, and the seal surface for nicks. Discard the pinion flange as necessary.

9. Using the special tool and a suitable impact slide hammer, remove the pinion seal.



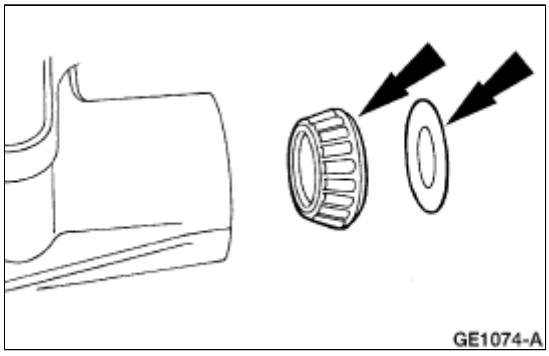
10. Remove the front axle drive pinion shaft oil slinger and the differential pinion bearing.



11. Remove and discard the collapsible spacer.

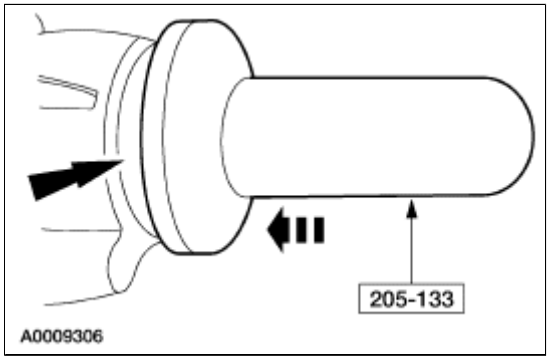
Installation

1. Verify that the splines on the pinion stem are free of burrs. If burrs are evident, remove them with a fine crocus cloth. Work in a rotating motion to wipe the pinion clean.
2. Clean the pinion seal bore.
3. Install a new collapsible spacer.
4. Install the original differential pinion bearing and the front axle drive pinion shaft oil slinger.



5. Lubricate the pinion seal.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

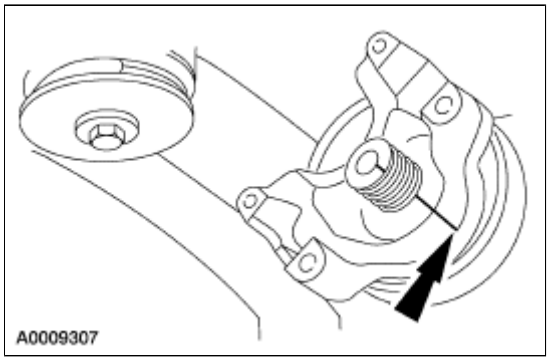
6. Using the special tool, install the pinion seal.



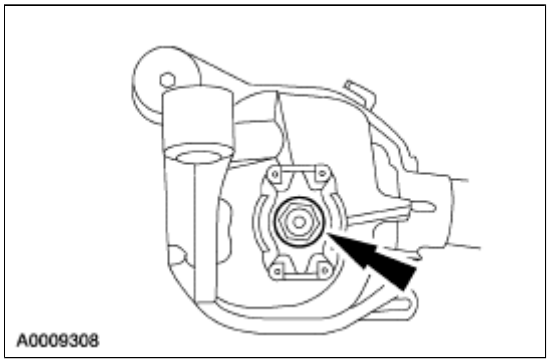
7. Lubricate the pinion flange splines.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

8. **CAUTION: Never use a metal hammer on the pinion flange or install the flange with power tools. If necessary, use a plastic hammer to tap on a tight fitting flange.**

   Align the index marks and install the pinion flange.



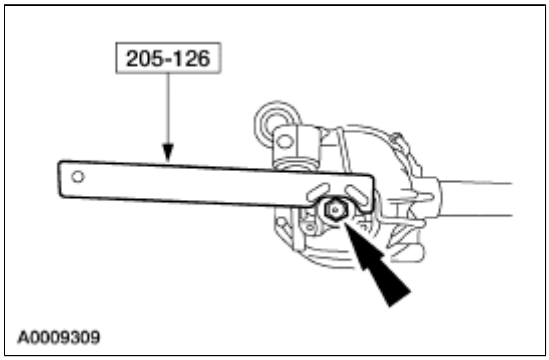
9. Install the new nut hand-tight.



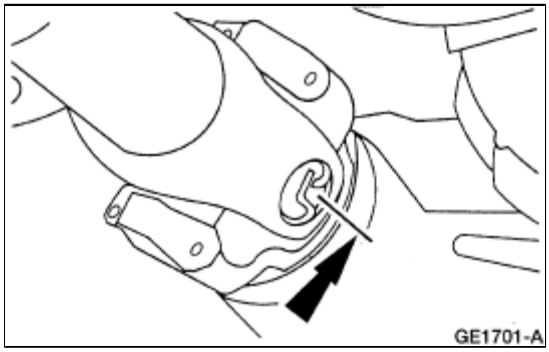
10. **CAUTION: Do not loosen the nut to reduce preload. Install a new collapsible spacer and nut if preload reduction is necessary.**

    Use the special tool to hold the pinion flange while tightening the nut to set the preload.

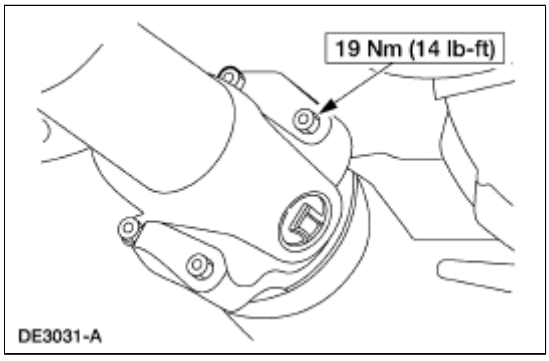
- Tighten the nut, rotating the pinion occasionally to ensure the differential pinion bearings are seating correctly. Take frequent differential pinion bearing preload readings by rotating the pinion with a Nm (inch-pound) torque wrench. The final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during removal.



11. Align the index marks and position the front driveshaft.



12. Install the universal joint spider retainers and bolts.



13. Check the fluid level and, if necessary, fill the axle to specification.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

14. Lower the vehicle.

15. If so equipped, reactivate the air suspension.

Axle Assembly —Front

Special Tool(s)

ST2453-A	Axle Service Plugs Set 205-S358 (T95T-4850-A)
ST1106-A	Tie Rod End Remover 211-001 (TOOL-3290-D) or equivalent

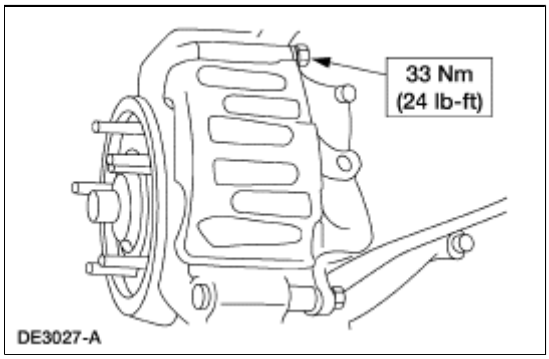
Removal

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. **WARNING: Remove or tape the brake pads, to prevent them from falling out of the caliper guides.**

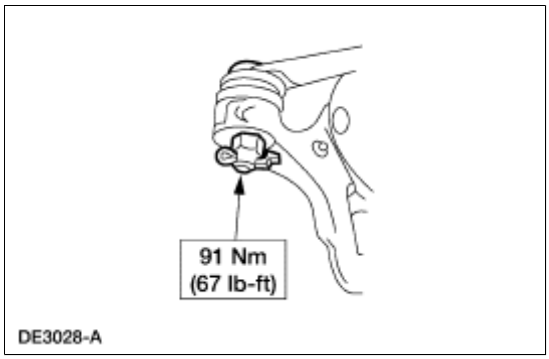
   CAUTION: Do not allow the calipers to hang by the hoses.

   NOTE: Install a wheel nut to secure each brake disc in place.

   Remove the bolts and position both calipers aside.

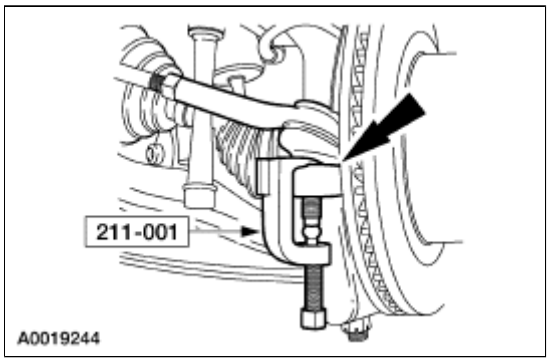


4. Remove the cotter pins and nuts from both outer tie-rods.



5. **NOTE:** Do not damage the tie-rod dust boots when installing the special tool. Apply a small amount of grease to the tie-rod stud.

   Using the special tool, separate the tie-rod ends from the knuckles.

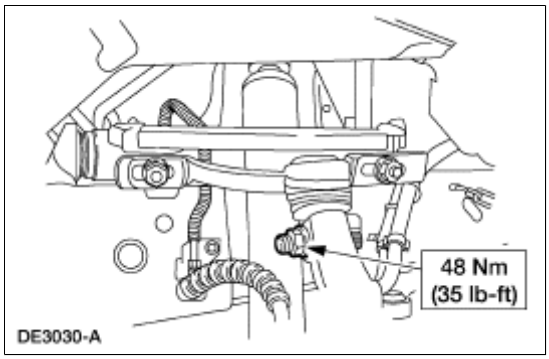


6. Unclip the left and right wheel anti-lock sensor wiring harnesses from the locators on the vehicle chassis, located above the stabilizer bar brackets.

7. **WARNING: Do not allow the wheel knuckle to hang freely. It is possible to overextend and internally separate the inner CV joint. Separate both axle halfshafts from the front axle.**

   CAUTION: Take necessary precautions to protect the machined sealing surfaces on each axle.

   Remove both pinch bolts and disconnect the upper ball joints.
   - Pull the RH axle halfshaft, with the wheel knuckle, away from the axle until the axle halfshaft is out of the axle.
   - Pull the LH axle halfshaft, with the wheel knuckle, away from the axle. The LH axle cannot be removed from the axle at this time.



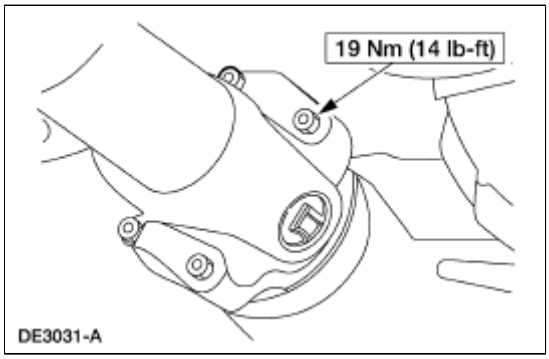
8. Raise the vehicle.

9. Remove the lower engine splash shield, if equipped.

10. **WARNING: Tape the U-joint bearing caps to prevent them from falling off the U-joint.**

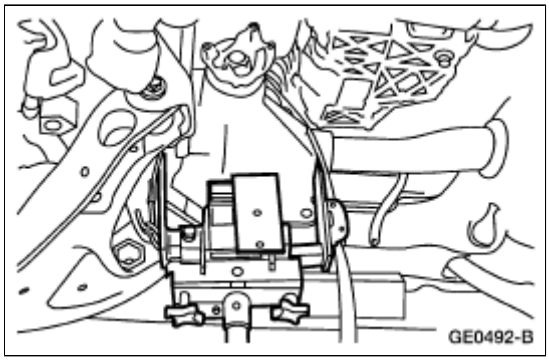
    WARNING: Index-mark the front axle pinion flange to the front driveshaft.

    Remove and discard the bolts and straps. Secure the driveshaft out of the way.

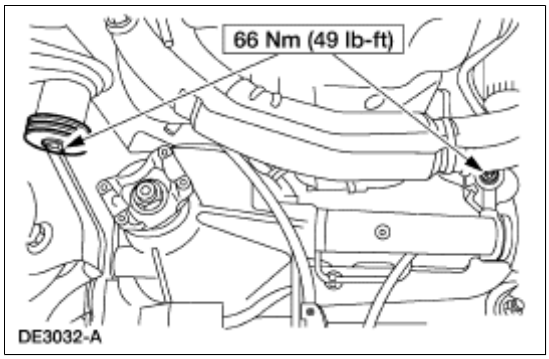


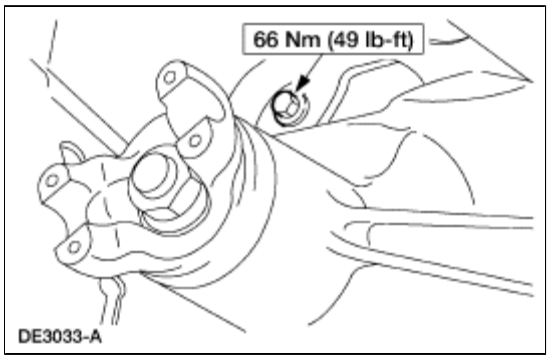
11. **NOTE:** Use the Axle Service Plugs Set T95T-4850-A to plug the axle openings.

    Secure the axle housing to a suitable lift.



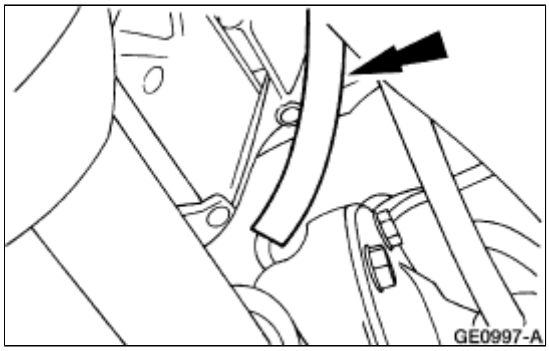
12. Remove and discard the bolts.





13. Lower the axle 25 mm (1 inch) and move to the right 19 mm (0.75 inch), guiding the LH axle halfshaft out of the axle.

14. Disconnect the vent hose from the front axle housing.



15. Lower the axle from the vehicle.

Installation

1. **CAUTION: Install a new retainer circlip on the left inboard CV joint housing. If reinstalling the original axle housing, install a new retainer circlip on the right side.**

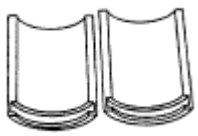
   CAUTION: Make sure the halfshaft circlips fully seat.

   To install, reverse the removal procedure.
   - Fill the front axle with the correct type and quantity of lubricant.
   - Install new driveshaft bolts and straps.

- Install new axle mounting bolts.

Bushing

Special Tool(s)

 ST1160-A	Bushing Collet Replacer 205-372 (T96T-5638-F)
ST1159-A	Bushing Cup Remover/Replacer 205-371 (T96T-5638-E)
ST1155-A	Bushing Remover 205-376 (T96T-5638-K)
ST1156-A	Bushing Replacer 205-370 (T96T-5638-B)
ST1162-A	Drawbolt 205-374 (T96T-5638-H)
ST1158-A	Ring Gauge (0.225) 204-206 (T96T-5638-D)

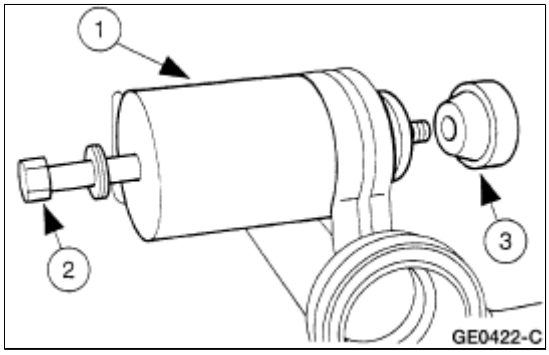
Removal

1. **NOTE:** Axle tube bushing removal shown, axle housing bushing is a similar procedure.

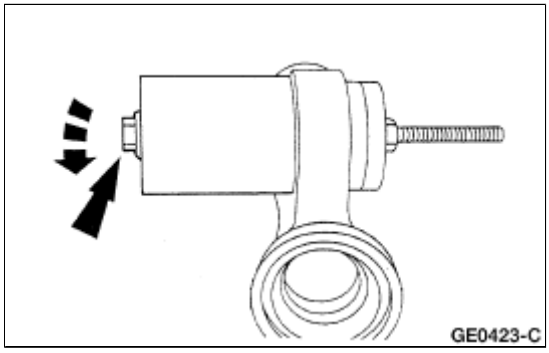
   Remove the front axle assembly. For additional information, refer to Axle Assembly—Front in this

section.

2. Position the tube bushing removal tools.
    1. Position the Bushing Cup Remover/Replacer.
    2. Position the Drawbolt.
    3. Thread the Bushing Remover on the Drawbolt.



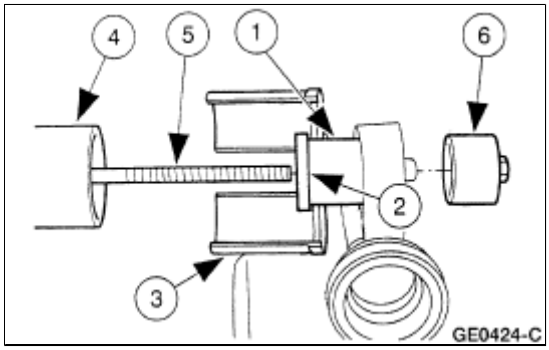
3. Tighten the Drawbolt to remove the tube bushing.



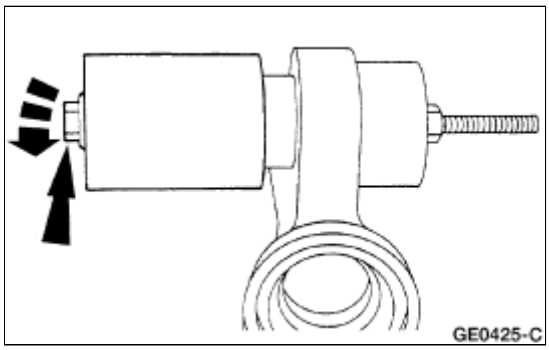
Installation

1. **NOTE:** Axle tube bushing installation shown, axle housing bushing is a similar procedure.

    Position the tube bushing and the tube bushing installation tools.
    1. Position the tube bushing.
    2. Position the Ring Gauge.
    3. Position the Bushing Collet Replacer.
    4. Position the Bushing Cup Remover/Replacer.
    5. Position the Drawbolt.
    6. Thread the Bushing Replacer on the Drawbolt.



2. Tighten the Drawbolt to install the tube bushing.
    - Remove the tools.



3. Install the front axle assembly. For additional information, refer to Axle Assembly—Front in this section.

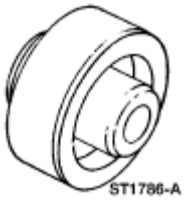
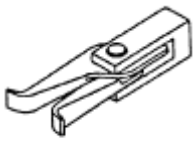
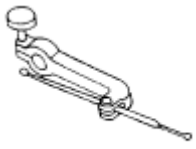
4. Check the fluid level and fill the axle to specification.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

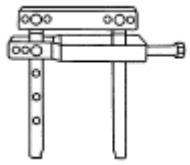
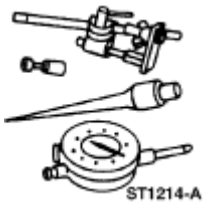
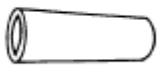
5. Lower the vehicle.

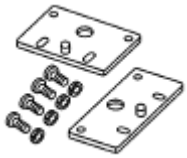
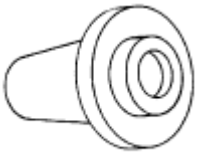
6. If equipped with air suspension , reactivate the system by turning on the air suspension switch.

Axle

Special Tool(s)

ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
ST2472-A	Axle Bearing Replacer 205-345 (T95T-1175-B)
ST1768-A	Axle Bearing Replacer 205-347 (T95T-1175-D)
 ST1786-A	Axle Seal Replacer 205-350 (T95T-3010-A)
ST1200-A	Bearing Cup Remover 308-047 (T77F-1102-A)
 ST1362-A	Bearing Remover 307-318 (T94P-77001-KH)
 ST1348-A	Clutch Housing Alignment Adapter 308-021 (T75L-4201-A)

ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
ST1361-A	Cup Replacer (Outer) (use with 205-098) 205-054 (T71P-4616-A)
ST1544-A	Dana Pinion Depth Gauge 205-S156 (T80T-4020-A)
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
ST1259-A	Differential Carrier Spreader 205-001 (TOOL-4000-E) or Equivalent
ST1548-A	Dummy Bearing, Differential Bearing 205-247 (T86T-4222-AH)
 ST1434-A	Gauge Tube 205-D034 (D80T-4020-F49) or equivalent
	Handle 205-153 (T80T-4000-W)

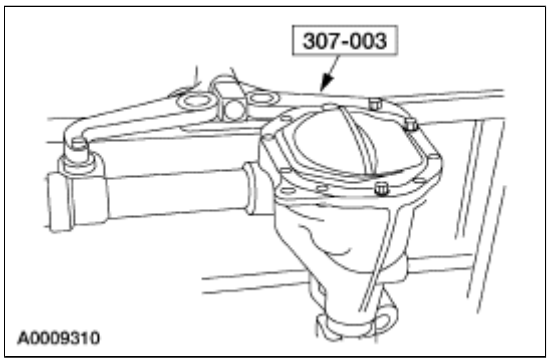
ST1255-A	
ST1186-A	Holding Fixture 307-003 (T57L-500-B)
 ST1610-A	Housing Spreader Adapter Set 205-356 (T95T-4000-A)
ST1484-A	Pinion Bearing Cone Replacer 205-005 (T53T-4621-C)
ST1361-A	Pinion Bearing Cup Replacer (Inner) (use with 205-098) 205-014 (T60K-4616-A)
 ST1358-A	Pinion Seal Replacer 205-133 (T79P-4676-A)
ST1869-A	Rear Axle Draw Bar 205-098 (T75T-1176-A)
ST1310-A	Universal Bearing Puller 205-055 (T71P-4621-B)

Disassembly

CAUTION: Many components and surfaces in the axle are precision machined. Careful handling during disassembly, cleaning, inspection, and assembly will prevent unnecessary damage to machined surfaces.

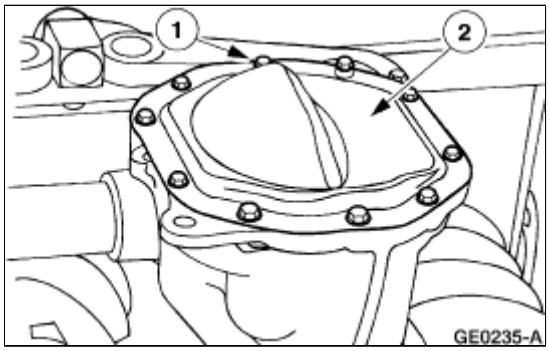
1. Remove the front drive axle assembly from the vehicle. For additional information, refer to Axle Assembly—Front in this section.

2. Attach the axle assembly to the special tool.



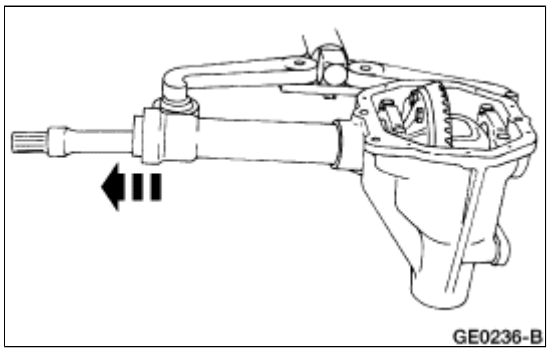
3. **NOTE:** Place a suitable drain pan under the axle.

   Remove the differential housing cover.
   1. Remove the bolts.
   2. Remove the differential housing cover.

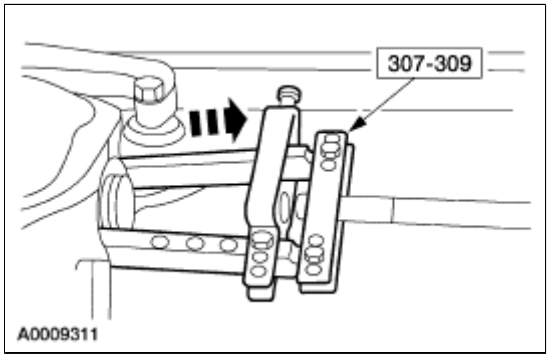


4. Drain the axle lubricant from the differential housing.

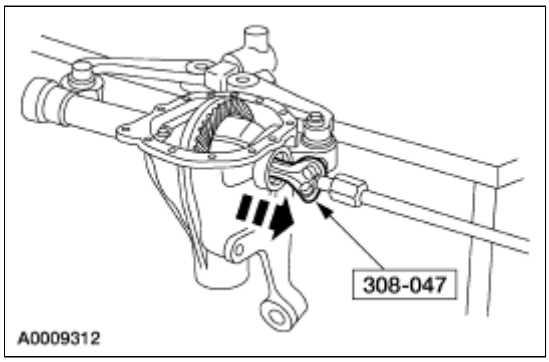
5. Remove the axle shaft using a jerking motion.



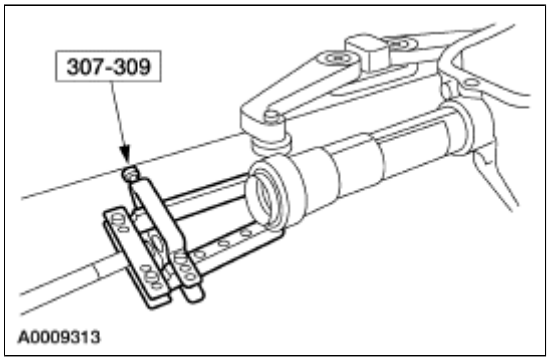
6. Using the special tool and a suitable impact slide hammer, remove the axle shaft oil seal.



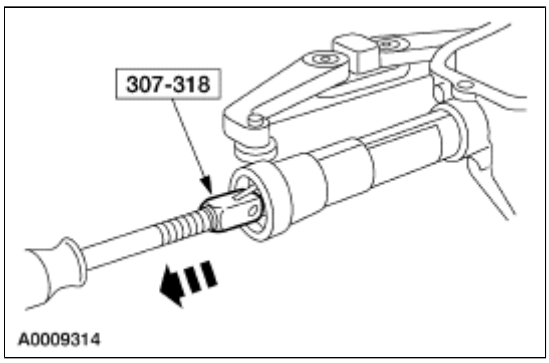
7. Using the special tool and a suitable impact slide hammer, remove the axle shaft bearing.



8. Using the special tool and a suitable impact slide hammer, remove the axle shaft oil seal.

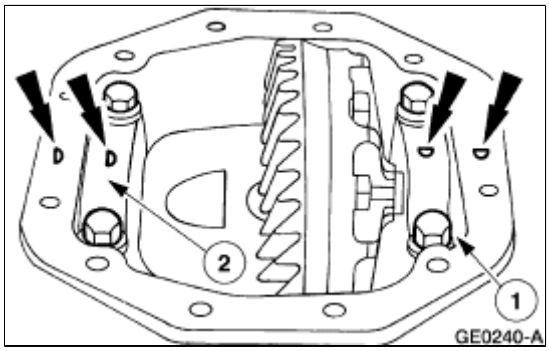


9. Using the special tool and a suitable impact slide hammer, remove the axle tube bearing.



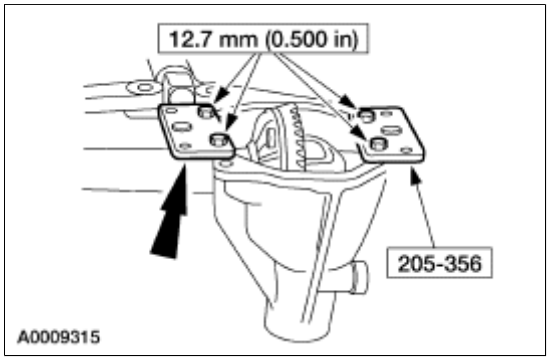
10. **CAUTION: The matched numbers or letters stamped on both of the differential bearing caps and the differential housing must correspond during assembly.**

    Remove the differential bearing caps.
    1. Remove the bolts.
    2. Remove the differential bearing caps.

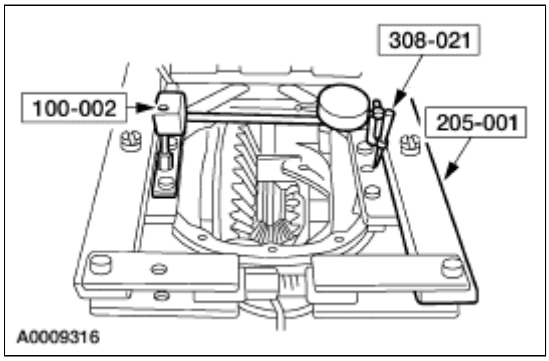


11. **CAUTION: The Housing Spreader Adapter bolts have a minimum thread engagement as specified.**

    Install the special tool.



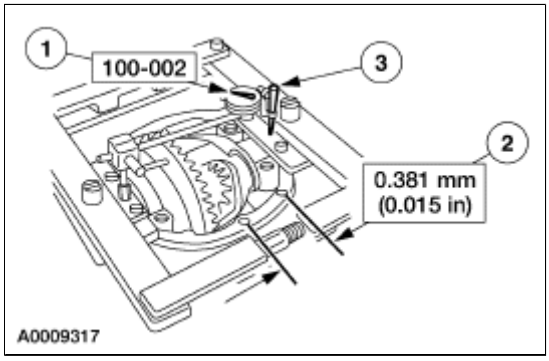
12. Install the special tools.
    - Position the Clutch Housing Alignment Adapter needle in the Housing Spreader Adapter hole.



13. **CAUTION: Over spreading can damage the differential housing.**

Spread the differential housing to the specification.

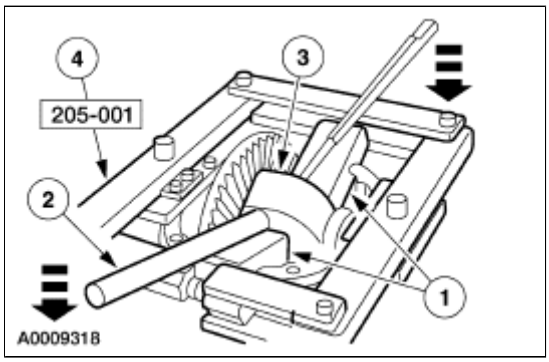
1. Adjust the special tool to zero.
2. Tighten the Differential Carrier Spreader screw to spread the differential housing to the specification.
3. Remove the Dial Indicator with Bracketry and the Clutch Housing Alignment Adapter.



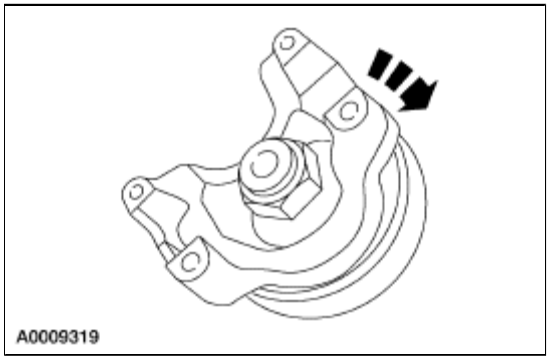
14. **CAUTION: Use wood blocks to avoid damaging the differential housing.**

Remove the differential assembly from the differential housing.

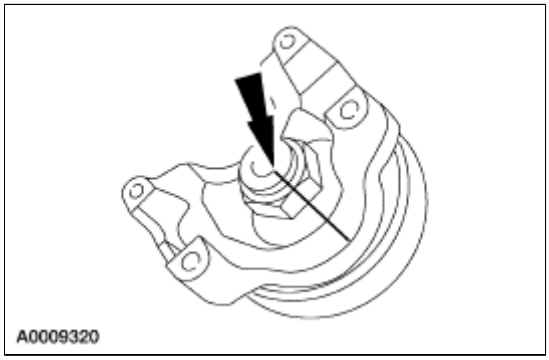
1. Position the wood blocks.
2. Push downward on the pry bars.
3. Remove the differential assembly.
4. Remove the special tool.



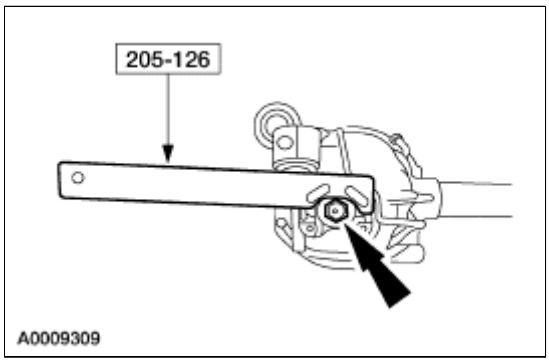
15. Measure the pinion bearing preload.
    - Using a Nm (pound-inch) torque wrench, measure the torque required to maintain pinion rotation. Record the measurement.



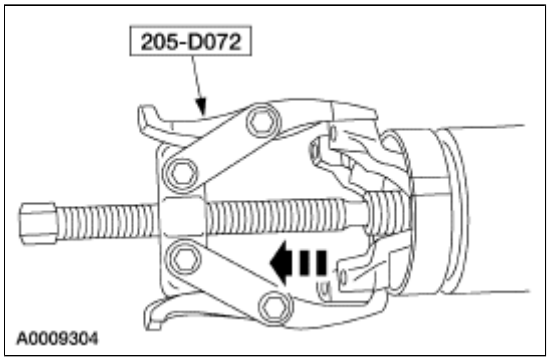
16. Index-mark the pinion flange and the pinion stem.



17. Use the special tool to hold the flange while removing the nut.



18. Using the special tool, remove the pinion flange.

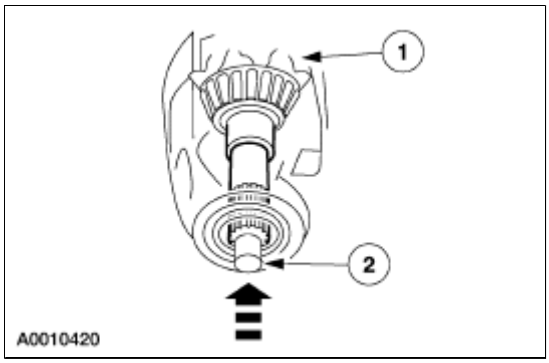


19. **WARNING: The gear teeth have sharp edges. Handle the gear with care to avoid personal injury.**

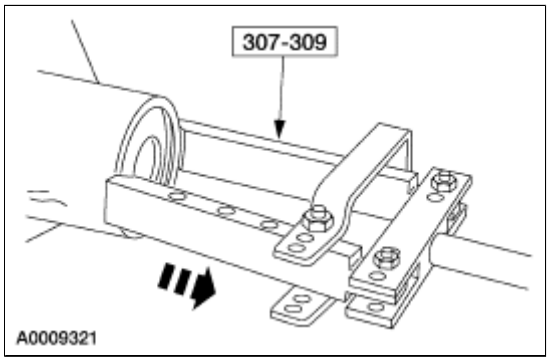
CAUTION: Never use a metal hammer on the pinion. Use a soft mallet to drive the pinion out of the differential housing.

Using a soft-face hammer, remove the pinion from the differential housing.

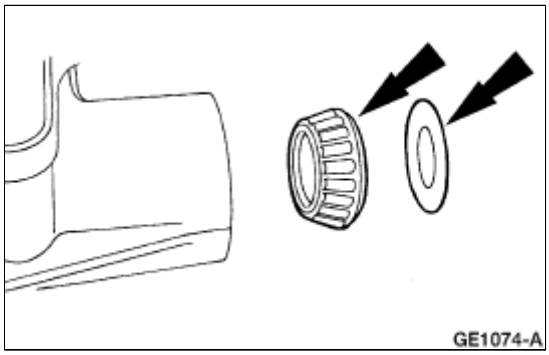
1. Hold the pinion inside the differential housing.
2. Use a soft-face hammer to remove the pinion from the differential housing.



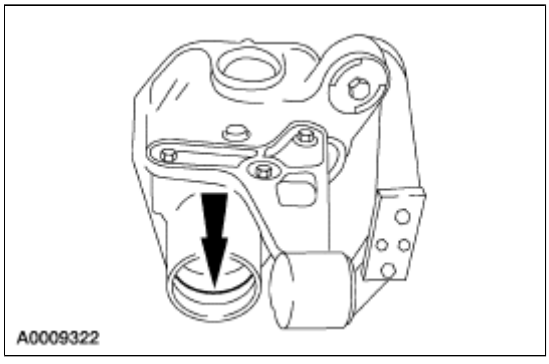
20. Using the special tool and a suitable impact slide hammer, remove the pinion seal.



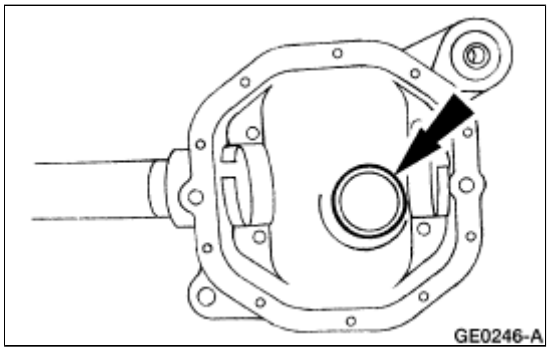
21. Remove the front axle drive pinion shaft oil slinger and the differential pinion bearing.



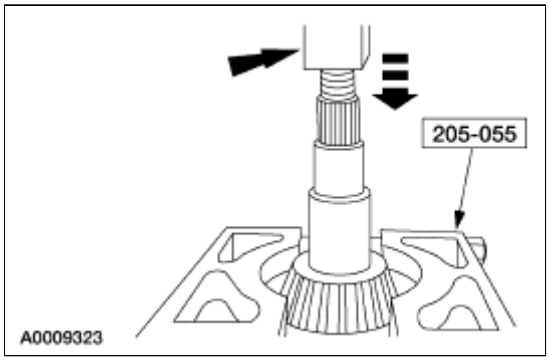
22. Remove the outer differential drive pinion bearing cup by tapping alternately on each side of the cup to prevent it from cocking in the bore.



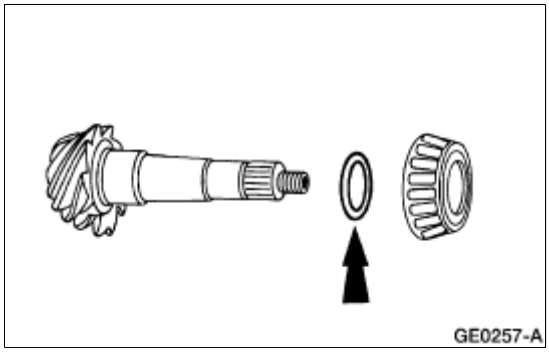
23. Remove the inner differential drive pinion bearing cup by tapping alternately on each side of the cup to prevent it from cocking in the bore.



24. Using the special tool and a suitable press, remove the differential pinion bearing.



25. Remove the pinion position shim from the differential pinion gear. Measure the pinion position shim thickness with a micrometer. Record the measurement.



26. Remove the differential ring gear, the differential bearings, and if necessary, disassemble the differential case. For additional information, refer to Differential Case in this section.

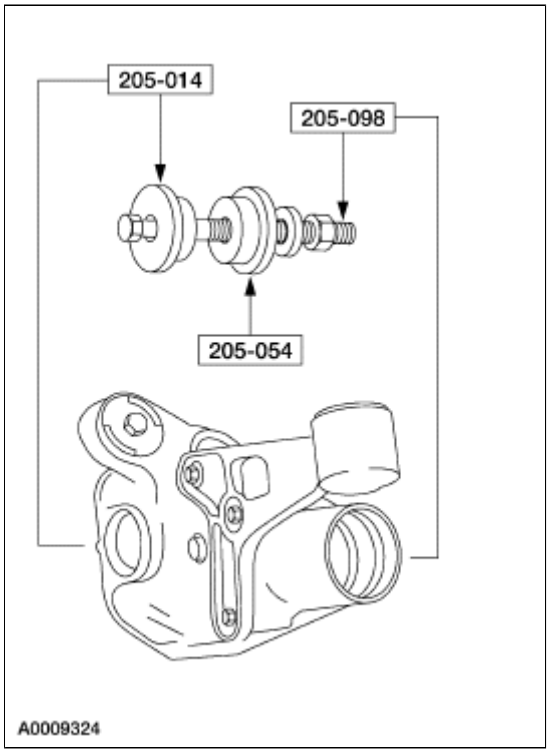
Assembly

CAUTION: Always install new gaskets and seals when assembling the axle. When building the subassembly, lubricate each component with clean Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A. Also, lubricate the subassembly when installing it into the differential housing. Tighten all fasteners to specification.

1. **CAUTION: Always install new differential pinion bearings when installing new differential drive pinion bearing cups.**

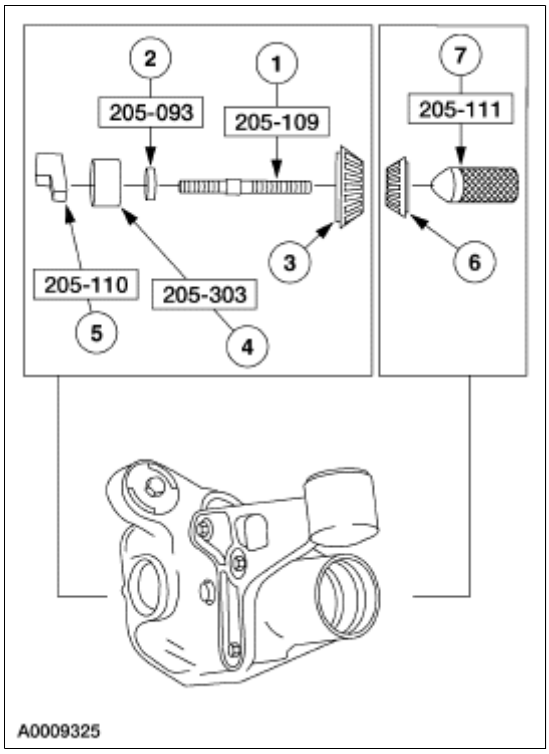
   Lubricate the new differential drive pinion bearing cups.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

2. Using the special tools, install the differential drive pinion bearing cups.

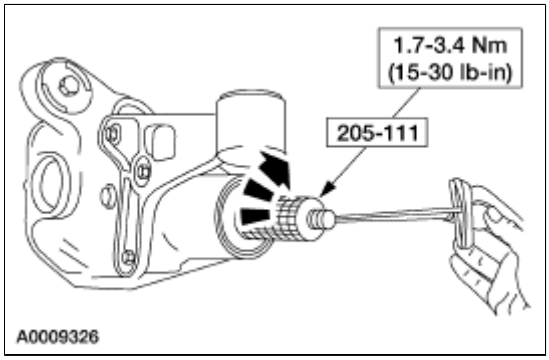


3. **NOTE:** Apply a light film of oil to the differential pinion bearings before installing them.

   Assemble and position the following in the differential housing.
   1. Position the Screw.
   2. Position the Aligning Adapter.
   3. Position the inner differential pinion bearing.
   4. Position the Gauge Disc.
   5. Position the Gauge Block.
   6. Position the outer differential pinion bearing.
   7. Thread on the Handle.

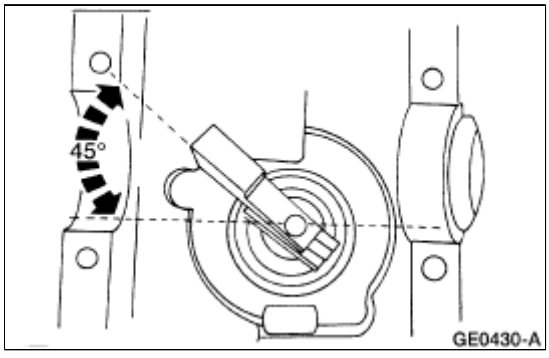


4. Using a Nm (pound-inch) torque wrench, tighten the Handle.

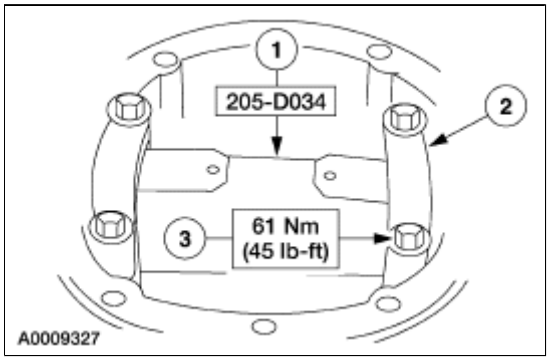


5. **NOTE:** Offset the Gauge Block to obtain an accurate reading.

   Rotate the Gauge Block several half turns to ensure the differential pinion bearings seat correctly, and position the Gauge Block as shown.



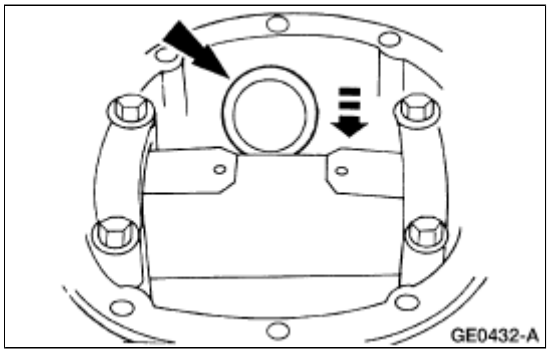
6. Install the special tool and the paper shipping tags.
    1. Position the special tool and the paper shipping tags.
    2. Install the differential bearing caps.
    3. Install the bolts.



7. **NOTE:** Use a feeler gauge, or flat, clean drive pinion position shims as a measuring device.

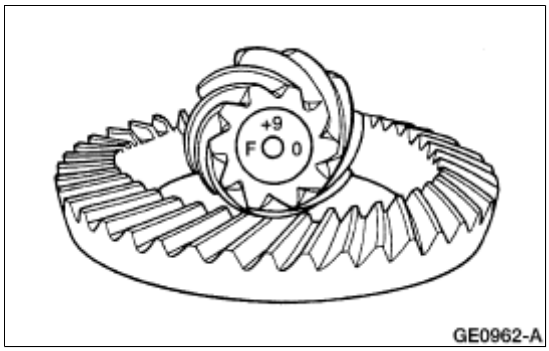
    NOTE: Selection of a shim that is too thick results in deep tooth contact at final assembly. Do not attempt to force the gauge or shim between the Gauge Block and the Gauge Tube. A slight drag indicates a correct selection.

    Using a feeler gauge, or a flat, clean drive pinion position shim, measure between the Gauge Block and the Gauge Tube. Record the measurement.
    - Remove the special tools after determining the correct shim thickness.

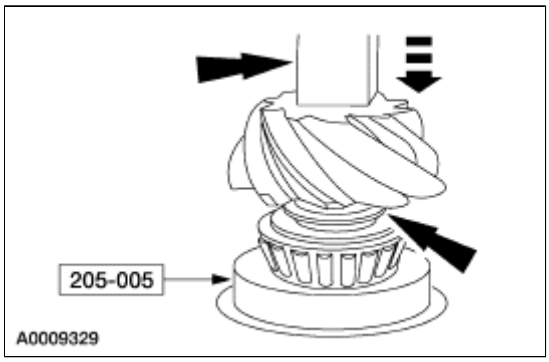


8. Select the correct thickness drive pinion position shim.
    - New drive pinion position shims are available in 0.762 mm (0.030 in), 0.8128 mm (0.032 in), 0.8636 mm (0.034 in), 0.9144 mm (0.036 in), 0.9652 mm (0.038 in), 1.016 mm (0.040 in), 1.0668 mm (0.042 in), 1.1176 mm (0.044 in), 1.1684 mm (0.046 in), 1.2192 mm (0.048 in), 1.27 mm (0.050 in), and 1.3208 mm (0.052 in) thickness.

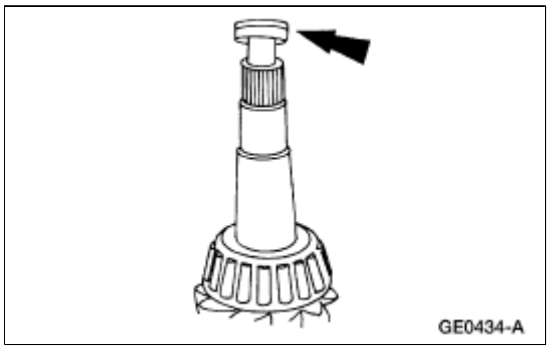
9. The shim selection tool steps identify the correct shim for a ring and pinion with an "O" etching. Optimum depth for each gearset is determined at the factory and the number is etched, + or -, on the pinion button. If the etched number is positive, subtract that number from the shim thickness identified by the selection tool steps. If the number is negative, add that number to the selected shim thickness.



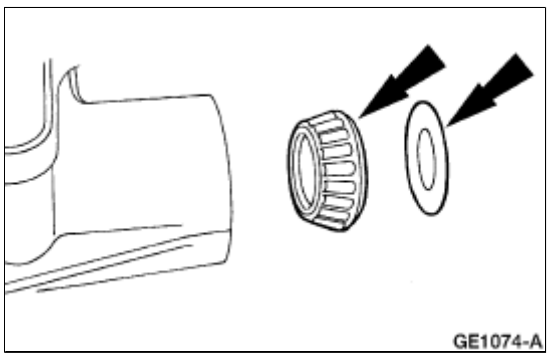
10. Install the pinion position shim and the differential pinion bearing.
    - Using the special tool and a suitable press, seat the differential pinion bearing firmly against the pinion position shim.



11. Install a new collapsible spacer.



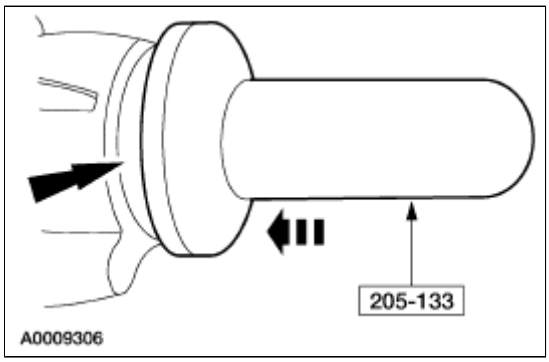
12. Install the differential pinion bearing and the front axle drive pinion shaft oil slinger.



13. **CAUTION: Installing the pinion seal without the correct tool can result in early seal failure.**

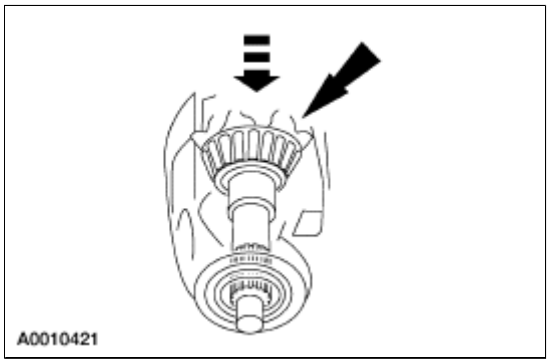
    CAUTION: If the pinion seal becomes cocked during installation, remove it and install a new one.

    Using the special tool, install the pinion seal.



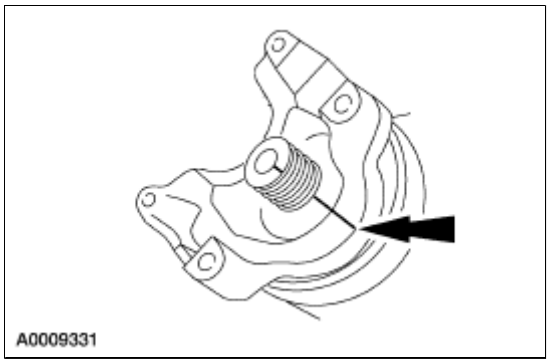
14. Lightly lubricate the pinion gear splines.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

15. Position the pinion gear in the differential housing.

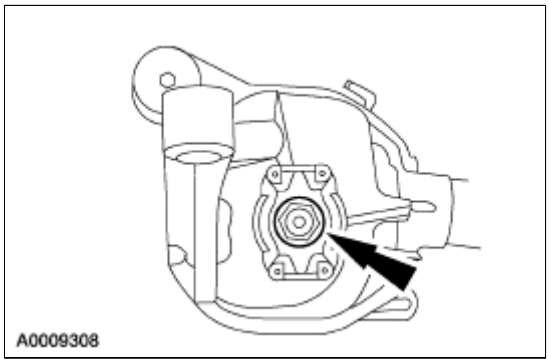


16. **CAUTION: Never use a metal hammer on the pinion flange or install the flange with power tools. If necessary, use a plastic hammer to tap on a tight fitting flange.**

    Align the index marks and install the pinion flange.



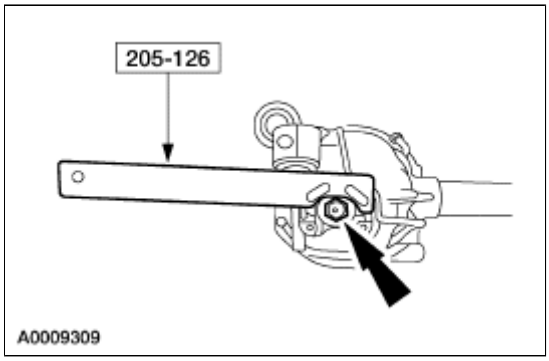
17. Install the new nut hand-tight.



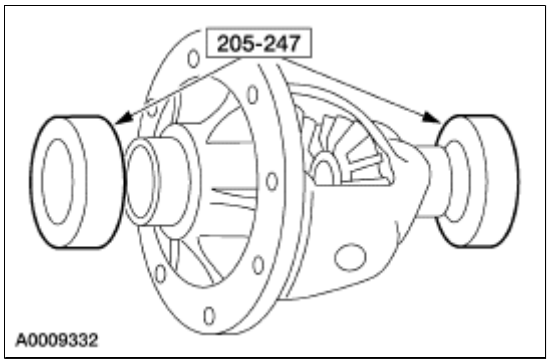
18. **CAUTION: Do not loosen the nut to reduce preload. Install a new collapsible spacer and nut if preload reduction is necessary.**

Use the special tool to hold the pinion flange while tightening the nut to set the preload.

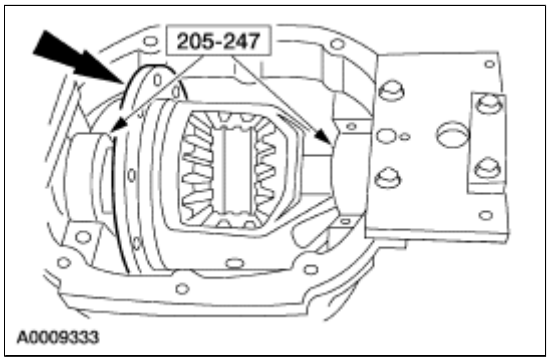
- Rotate the pinion occasionally to ensure the differential pinion bearings are seating correctly. Take frequent differential pinion bearing preload readings by rotating the pinion with a Nm (inch-pound) torque wrench.
  - If installing new differential pinion bearings, tighten the nut to specification. Refer to Specifications in this section.
  - If installing the original differential pinion bearings, the final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during disassembly.



19. Install the special tool.

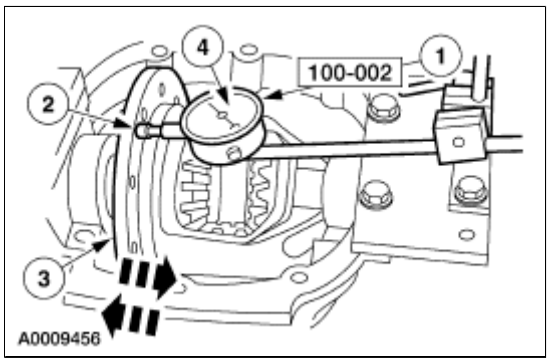


20. Install the differential case in the differential housing.

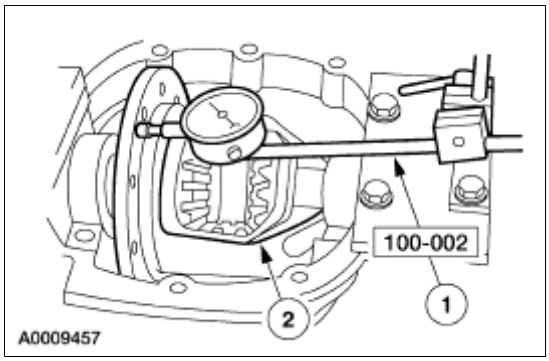


21. **NOTE:** Repeat this step until obtaining a consistent reading.

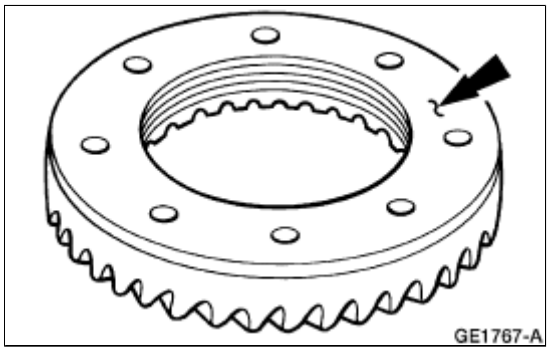
    Measure the total end play.
    1. Install the special tool.
    2. Force the differential case as far as possible away from the indicator. Position the indicator tip on the machined surface and adjust it to measure full travel. With force still applied, set the indicator to zero.
    3. Force the differential case as far as possible in the opposite direction.
    4. Record the total end play reading on the Differential Bearing Shim Selection Procedure Worksheet, Line A in this procedure.



22. Remove the special tool, and remove the differential case.
    1. Remove the special tool.
    2. Remove the differential case.



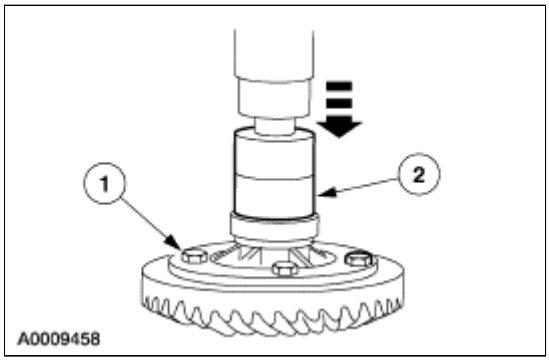
23. Use a fine flat file to remove any burrs and nicks found on the differential ring gear mounting surface.



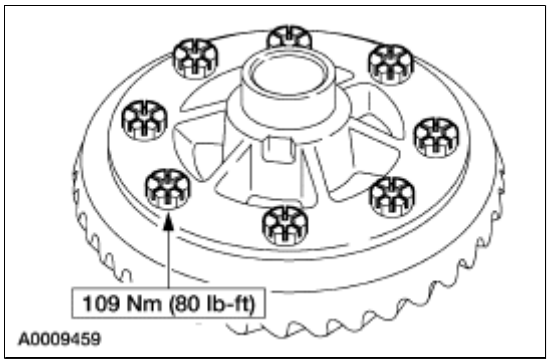
24. **CAUTION: Do not reuse the original bolts.**

Using a suitable press, install the differential ring gear.

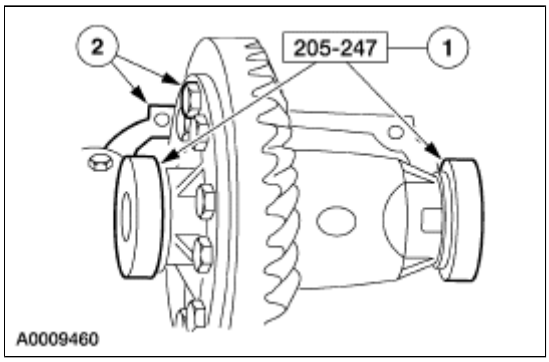
1. Position the differential ring gear and the differential case. Start two or three new bolts to align the holes in the ring gear and the differential case.
2. Using a suitable press, install the differential ring gear.



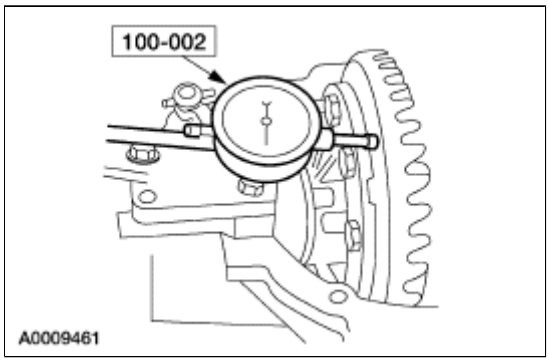
25. Install the remaining new bolts. Tighten all of the bolts to specification.



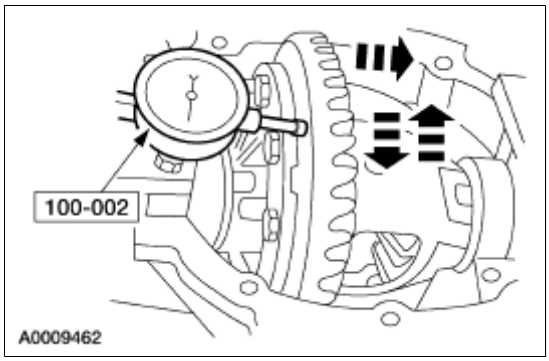
26. Install the special tool, and position the assembly in the differential housing.
    1. Install the special tool.
    2. Position the assembly in the differential housing.



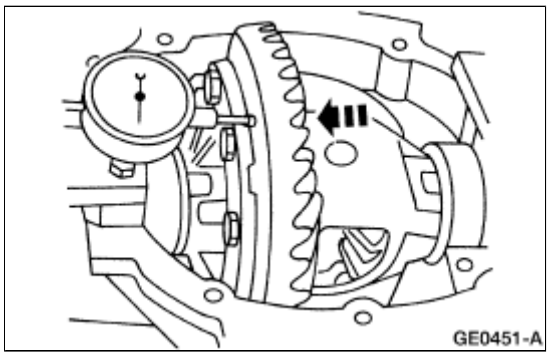
27. Position the special tool.



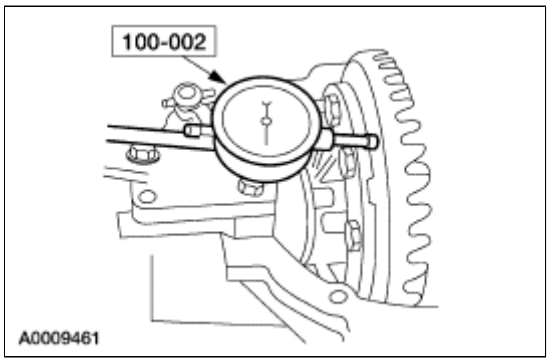
28. Force the differential ring gear into mesh with the pinion gear (zero backlash). With force still applied, set the special tool to zero.



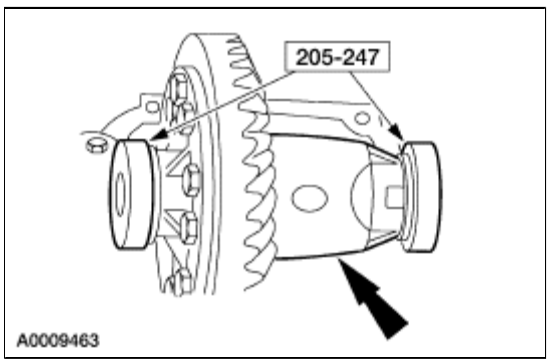
29. Force the differential ring gear away from the pinion gear as far as possible. Record the reading on the Differential Bearing Shim Selection Procedure Worksheet, Line D in this procedure.



30. Remove the special tool.



31. Remove the differential case from the differential housing. Remove the special tool from the differential case hubs.

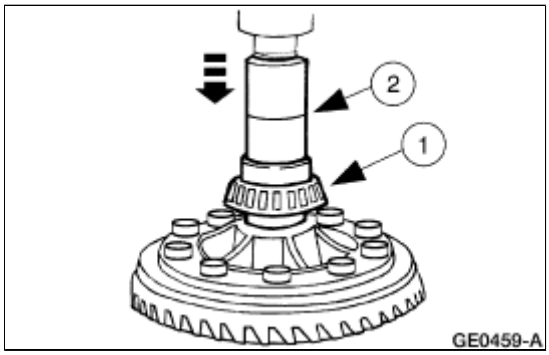


32. Complete the worksheet, and select the appropriate thickness differential shims. New differential shims are available in 0.0762 mm (0.003 in), 0.127 mm (0.005 in), 0.254 mm (0.010 in), and 0.762 mm (0.030 in) thickness.

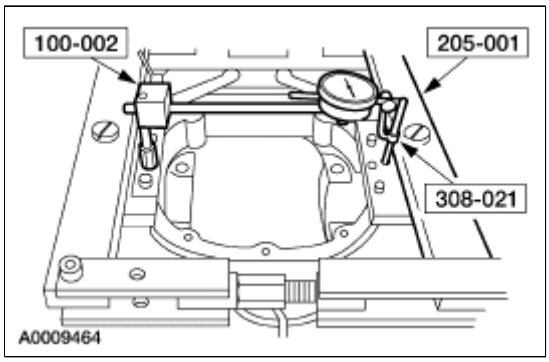
Differential Bearing Shim Selection Procedure Worksheet

Line	Item	Result (actual) mm (in)	Result (example) mm (in)
A	Total end play reading (without gears)		2.032 (0.080)
B	Add preload	+0.2032 (+0.008)	+0.2032 (+0.008)
C	Total (add A and B)		2.2352 (0.088)
D	End play measurement (with gears)		1.0414 (0.041)
E	Subtract the shim thickness on the ring gear side	-0.0762 (-0.003)	-0.0762 (-0.003)
F	Total (subtract E from D) (thickness of shims to place on the ring gear side)		0.9652 (0.038)
G	Total (subtract F from C) (thickness of shims to place on the drive pinion side)		1.27 (0.050)

33. Install the differential shims and the differential bearing.
    1. Position the differential shims and the differential bearing.
    2. Using a suitable press, install the differential bearing.
    - Repeat this step for opposite side of the differential case.

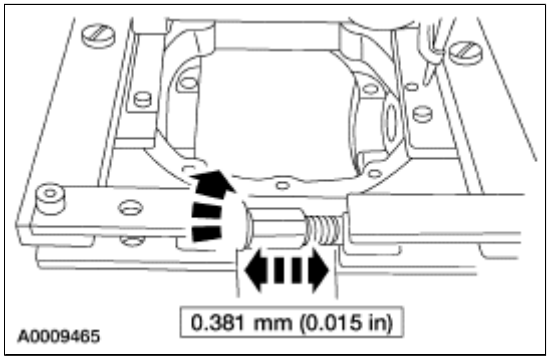


34. Install the special tools.
    - Position the Clutch Housing Alignment Adapter needle in the Housing Spreader Adapter hole.

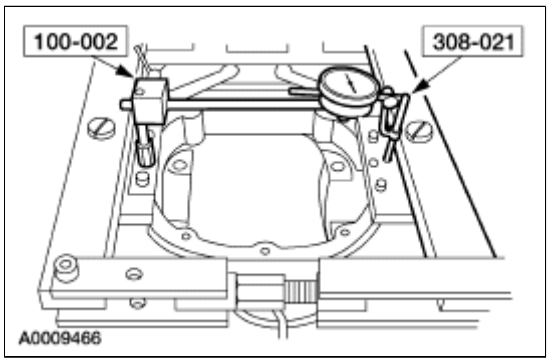


35. **CAUTION: Over spreading can damage the differential housing.**

Spread the differential housing to the specification.

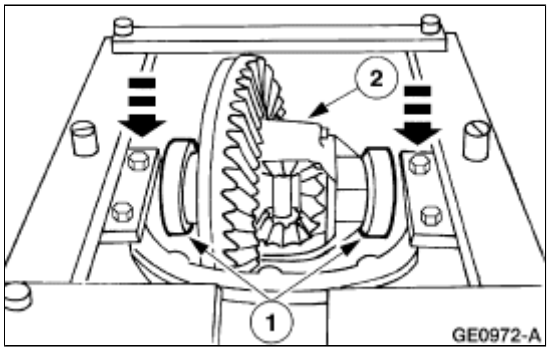


36. Remove the special tools.



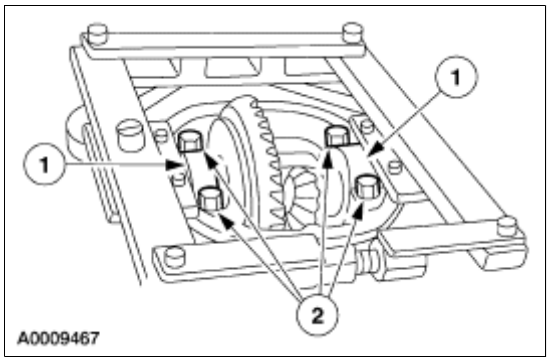
37. **NOTE:** Push the differential case downward to fully seat the differential bearing cups in the differential housing.

Install the differential bearing cups and the differential case in the differential housing.
1. Position the differential bearing cups on the differential bearings.
2. Lower the differential case in place.

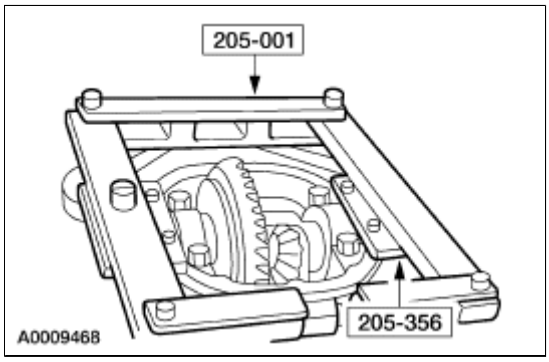


38. **CAUTION: Do not tighten the bolts to specification at this time.**

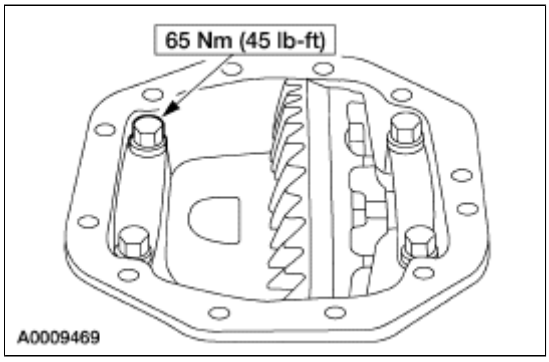
Install the differential bearing caps in their original positions.
1. Position the differential bearing caps.
2. Install the bolts hand-tight.



39. Remove the special tools.

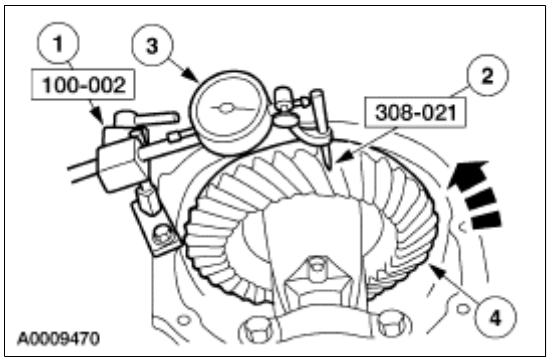


40. Tighten the bolts.

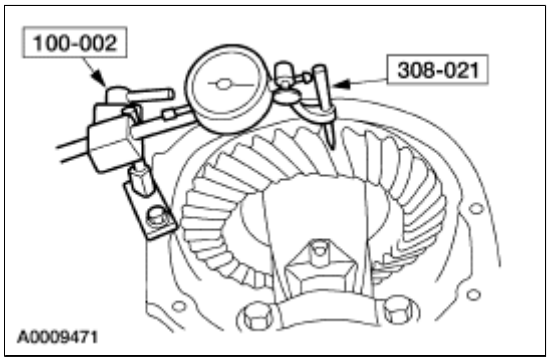


41. Verify that the differential case rotates freely.

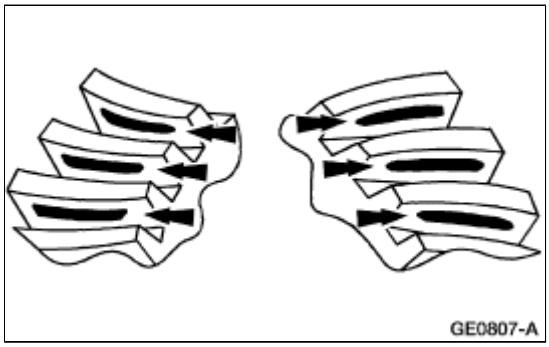
42. Using the special tools, measure the backlash at three equally spaced points on the differential ring gear.
    1. Mount the special tool.
    2. Position the special tool.
    3. Zero the indicator.
    4. Turn the differential ring gear without turning the pinion gear. Record the measurement.
    - The backlash tolerance is 0.13 mm (0.005 in) to 0.20 mm (0.008 in) and cannot vary more than 0.05 mm (0.002 in) between points checked. A backlash variation of more than 0.005 mm (0.002 in) indicates gear/case runout.
    - If the backlash is not within specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount.



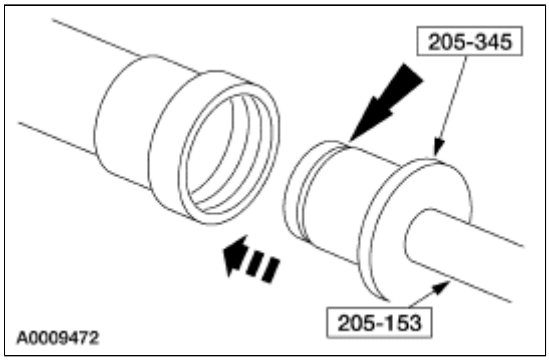
43. Remove the special tools.



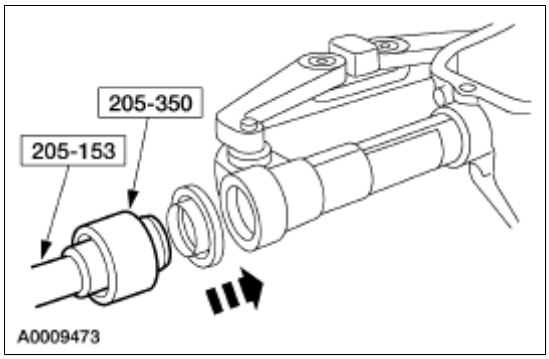
44. Check the gear tooth contact pattern. For additional information, refer to Section 205-00 .



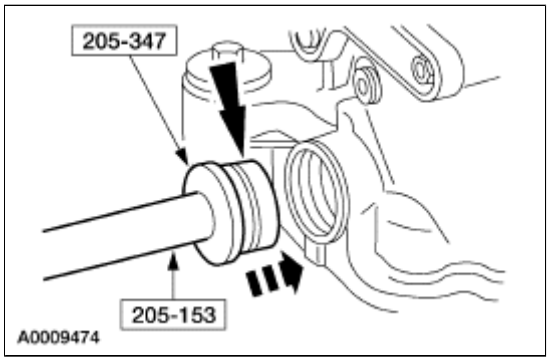
45. Using the special tools, install the axle tube bearing.



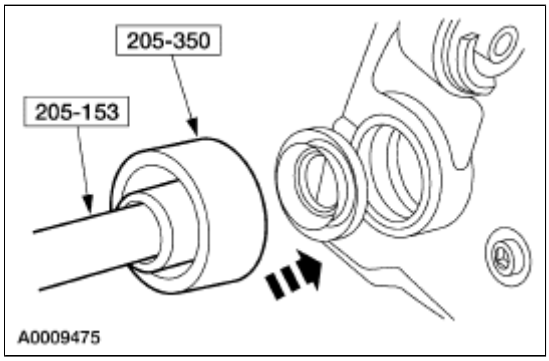
46. Using the special tools, install the axle shaft oil seal.



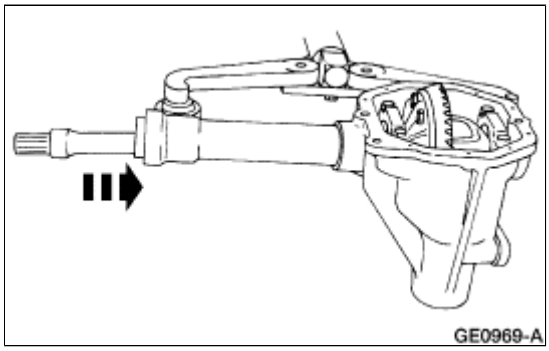
47. Using the special tools, install the axle shaft bearing.



48. Using the special tools, install the axle shaft oil seal.



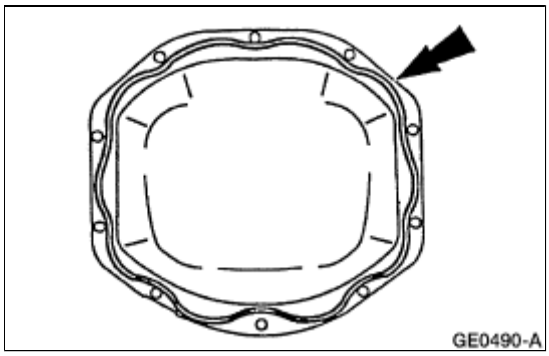
49. Install the axle shaft.



50. **CAUTION: The machined mating surfaces on the differential housing and the differential housing cover must be clean and free of lubricant before applying the new silicone sealant. Cover the inside of the differential housing before cleaning the machined surface to prevent contamination.**

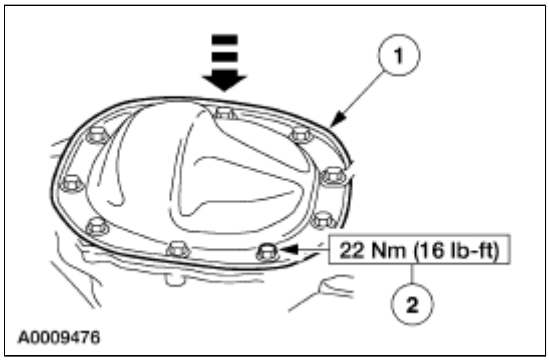
    Clean the differential housing and the differential housing cover mating surfaces.

51. Apply a continuous bead of sealant to the differential housing cover.
    - Use Ford Black Silicone Rubber F4AZ-19562-B or equivalent meeting Ford specification WSE-M4G323-A1.



52. **CAUTION: Install the differential housing cover within 15 minutes of applying the silicone or it will be necessary to apply new sealant. If possible, allow one hour before filling the axle with lubricant to make sure the silicone sealant has cured.**

    Install the differential housing cover.
    1. Position the differential housing cover.
    2. Install the bolts.



53. Install the front axle assembly. For additional information, refer to Axle Assembly—Front in this section.

54. Fill the axle with 1.54 Liter (2.25 pints) of lubricant.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

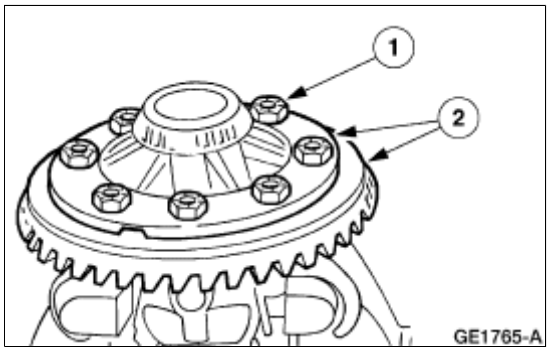
Differential Case

Special Tool(s)

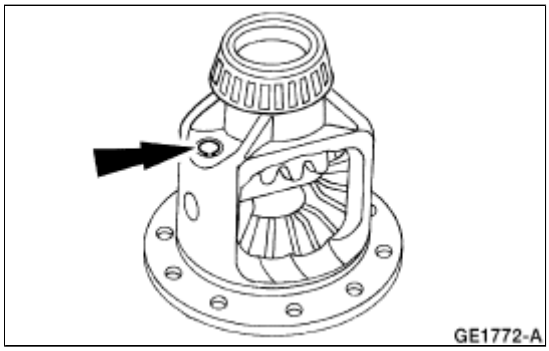
ST1347-A	Pinion and Carrier Puller 205-D036 (D81L-4220-A) or Equivalent

Disassembly

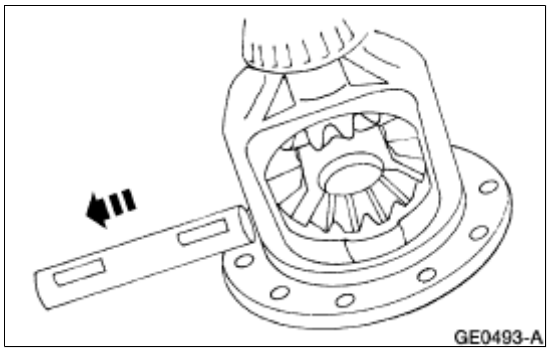
1. Remove the differential ring gear.
    1. Remove and discard the bolts.
    2. Using a drift that will bottom out in the bolt holes, separate the differential ring gear from the differential case.



2. Drive out the differential pinion shaft roll pin.

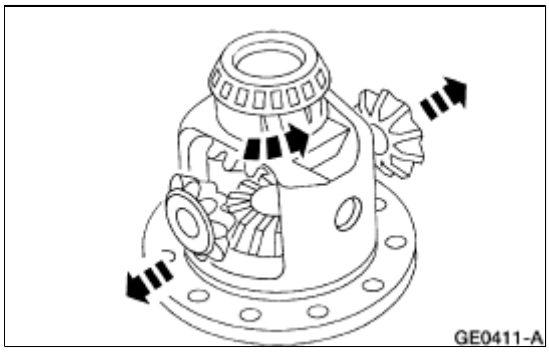


3. Remove the differential pinion shaft.

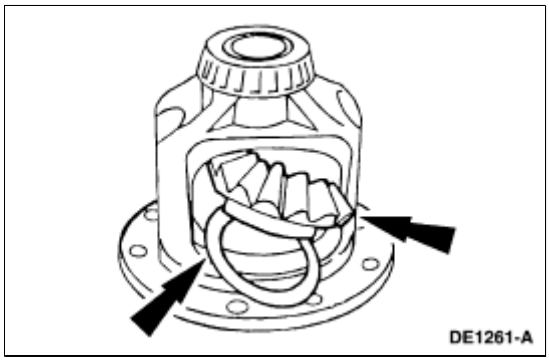


4. **CAUTION: The upper differential side gear may fall out of the case bore after removing the differential pinion gears.**

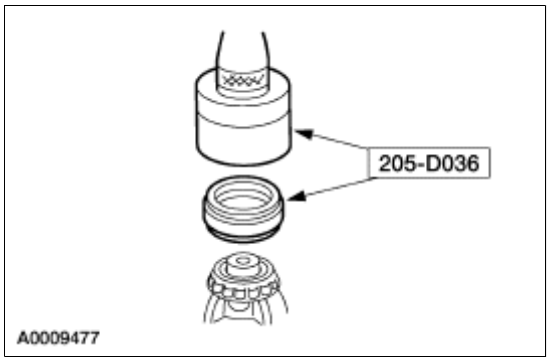
   Rotate the differential pinion gears to the differential case window and remove them and the differential pinion thrust washers.



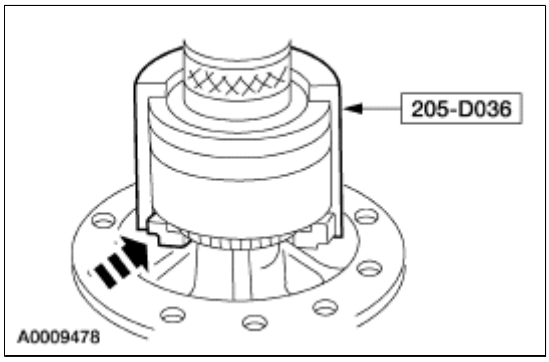
5. Remove the differential side gears and the differential side gear thrust washers.



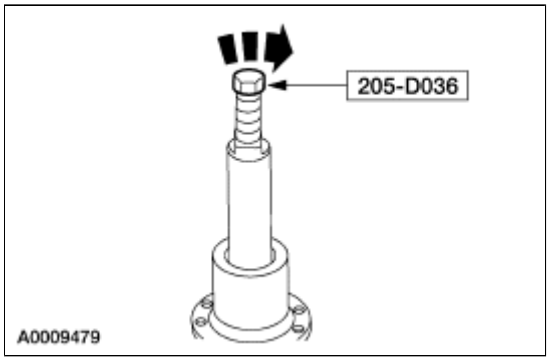
6. Assemble the special tool.



7. Position the special tool on the differential bearing.

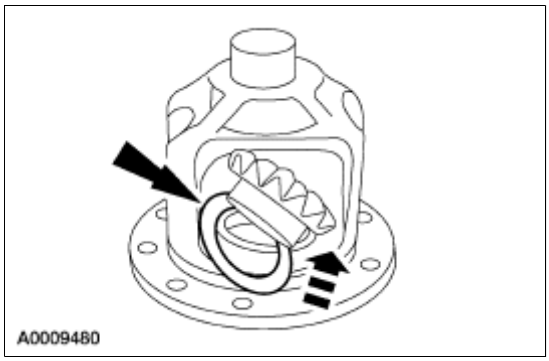


8. Using the special tool, remove the differential bearing.
    - Repeat the procedure for the other bearing.

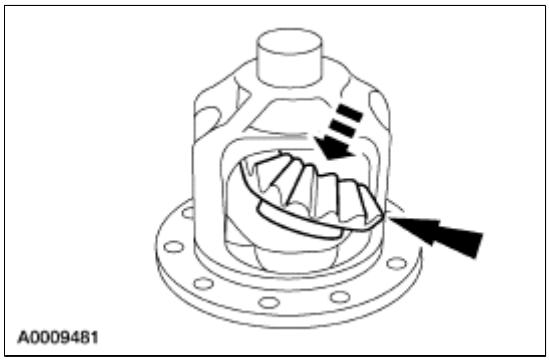


Assembly

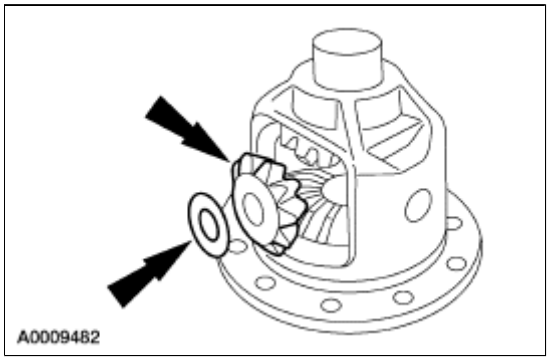
1. Lubricate the differential side gear thrust washers and the differential side gears, and assemble them.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.



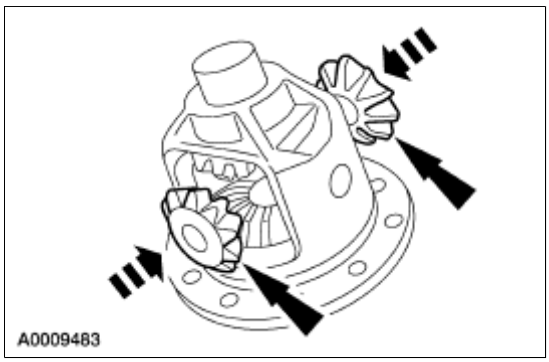
2. Position the differential side gear and thrust washer assemblies in the differential case.



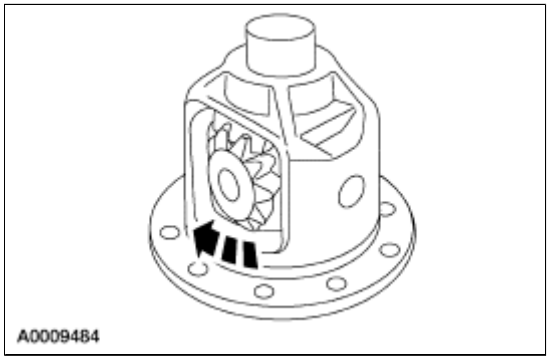
3. Lubricate the differential pinion thrust washers and the differential pinion gears, and assemble them.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.



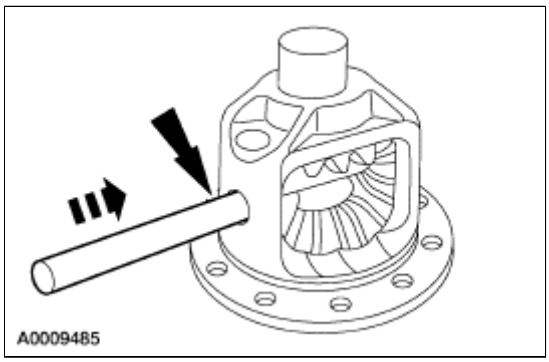
4. Engage the differential pinion gears between the differential side gears.



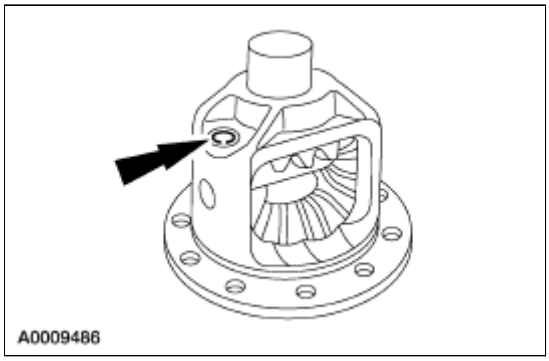
5. Rotate the differential pinion gears and align them with the differential pinion shaft bore.



6. Insert the differential pinion shaft.



7. Install the differential pinion shaft roll pin.



8. Install the differential bearing shims, the differential bearings, and the differential ring gear. For additional information, refer to Axle in this section.

General Specifications

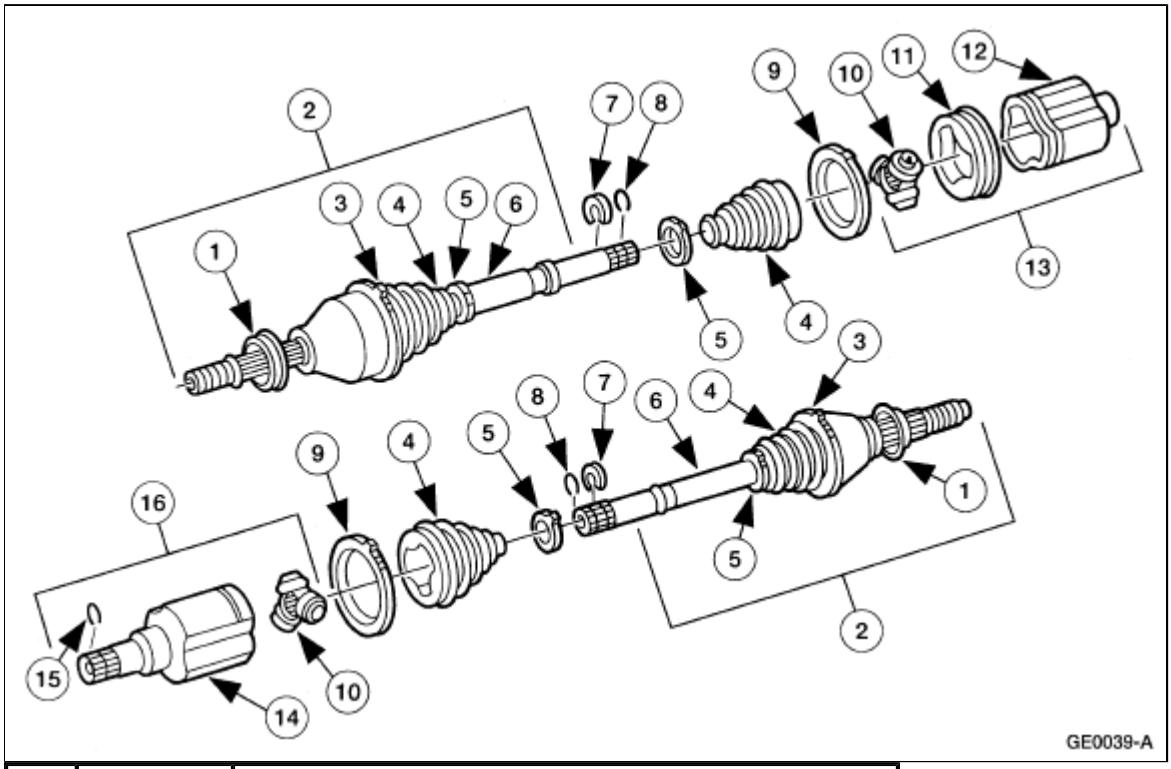
Item	Specification
Ford High Temp Constant Velocity Joint Grease Motorcraft XG-2 or equivalent	ESP-M1C207-A

Torque Specifications

Description	Nm	lb-ft
Disc brake caliper bolts	33	24
Upper ball joint nut	69	51
Front axle wheel hub retainer	250	184
Tie-rod end nut	70	52
Stabilizer bar link nut	25	18

Front Drive Halfshafts

Front Drive Halfshaft and Joint Assembly



Item	Part Number	Description
1	3K070	Front Wheel Excluder Seal
2	3B436	Side Shaft Assembly
3	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436)
4	3A331	Front Wheel Halfshaft Joint Boot
5	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436)
6	—	Interconnecting Shaft (Part of 3B436)
7	—	Stop Ring (Part of 3A331, 3B436 and 3B414)
8	3Z498	Retainer Circlip (Part of 3A331, 3B436 and 3B414)
9	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436 and 3B414)
10	—	Inboard CV Joint (Part of 3B414)
11	—	Tri-Lobe Insert (Part of 3B414)

12	—	Housing (Part of RH 3B414)
13	3B414	Front Wheel Halfshaft Joint (Plunge Type, RH) (Inboard)
14	—	Housing (Part of LH 3B414)
15	—	Retainer Circlip (Part of 3A331 and 3B414)
16	3B414	Front Wheel Halfshaft Joint (Plunge Type, LH) (Inboard)

The front wheel driveshaft joints:

- transmit equal engine torque from the axle to both front wheels.
- use a constant velocity (CV) joint, at both the inboard and outboard ends, for operating smoothness.
- rotate at approximately one-third the speed of a driveshaft and do not normally contribute to any rotational vibration that may occur.

The only replaceable components of the front wheel driveshaft and joints are:

- Wheel driveshaft and joint boots (inboard and outboard). The replacement kit includes wheel driveshaft and joint boots and clamps, snap rings, retainer ring and grease.
- Inboard CV joint (plunge type).
- Side shaft. Replacement includes the outboard front wheel halfshaft joint (fixed type), outboard boot and clamps, front wheel excluder seal (assembled on the interconnecting shaft).

Front Drive Halfshafts

Halfshafts, Front Wheel

NOTE: Constant velocity (CV) joints must not be replaced unless disassembly and inspection reveals unusual wear.

NOTE: While inspecting the boots, watch for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears, or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Symptom Chart

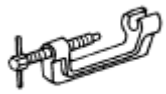
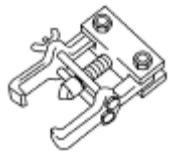
Symptom Chart

Condition	Possible Sources	Action
• Clicking, Popping, or Grinding Noises While Turning	• Inadequate or contaminated lubrication in the constant velocity (CV) joint.	• INSPECT, CLEAN and LUBRICATE as necessary.
	• Another component contacting the halfshaft.	• INSPECT and REPAIR as necessary.
	• Wheel bearings.	• REFER to Section 204-00 .
	• Brake components.	• REFER to Section 206-00 .
	• Suspension components.	• REFER to Section 204-00 .
	• Steering components.	• REFER to Section 211-04 .
• Shudder, Vibration During Acceleration	• High constant velocity (CV) joint operating angles caused by improper ride height.	• CHECK the ride height and VERIFY the proper spring rate. REPAIR as necessary.
	• Constant velocity (CV) joint.	• INSPECT and REPLACE as necessary.
	• Front suspension components.	• CHECK for worn suspension bushings and damaged components. REPAIR as necessary.
• Vibration at Speeds Greater Than 35 mph	• Out-of-balance wheels or tires.	• BALANCE wheels or tires, REPLACE as necessary.

	• Improperly seated constant velocity (CV) joint in the front wheel hub.	• REFER to Halfshaft in this section.
	• Lateral and radial tire and wheel runout.	• REFER to Section 204-04 .
	• CV joint worn.	• REPLACE the halfshaft.

Halfshaft

Special Tool(s)

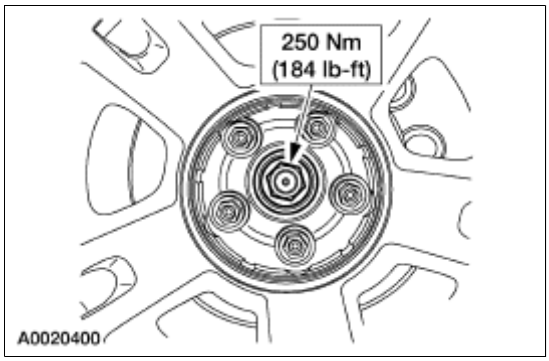
 ST1494-A	Installer/Remover, C-Frame and Screw 211-023 (T74P-3044-A1)
ST2272-A	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent
ST2517-A	Remover, Halfshaft 205-291 (T89P-3514-A)
 ST2273-A	Remover, Steering Arm 211-003 (T64P-3590-F)

Removal and Installation

NOTE: Except where noted, this procedure applies to both front halfshaft assemblies. Use only the procedure steps necessary for the halfshaft requiring removal/installation.

LH/RH halfshaft

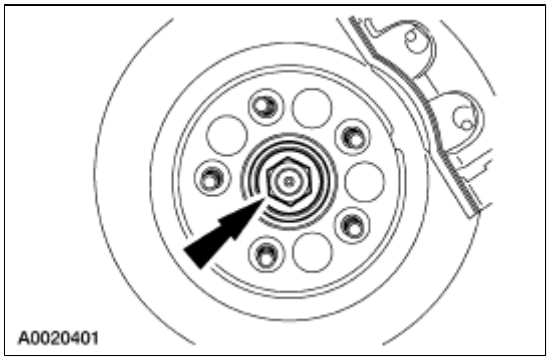
1. Remove the center cap from the front wheel.
2. Loosen the front axle wheel hub retainer.



3. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Remove the front wheel and tire assembly. For additional information, refer to Section 204-04 .

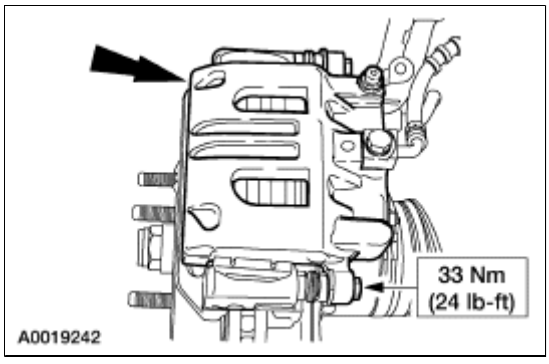
5. Remove the front axle wheel hub retainer and the washer. Discard the front axle wheel hub retainer.



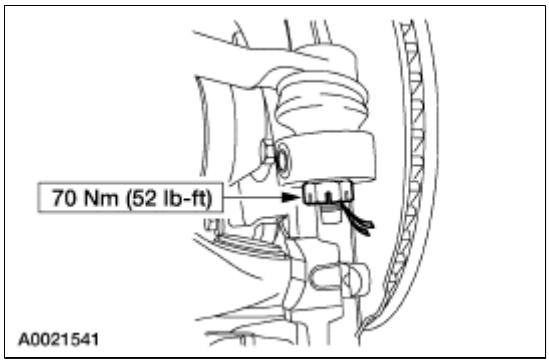
6. **WARNING: Remove or tape the brake pads to prevent them from falling out of the anchor plate. Failure to follow these instructions may result in personal injury or component damage.**

   CAUTION: To prevent damage to the brake hose, do not allow the disc brake caliper to hang suspended from the hose.

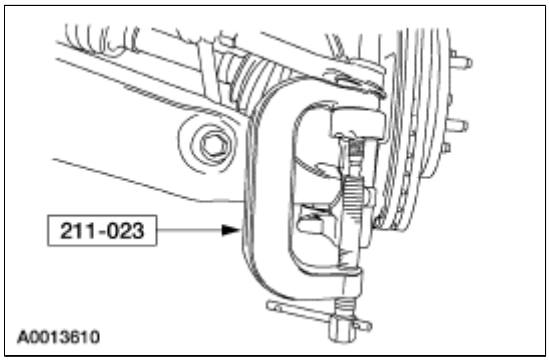
   Remove the two bolts and position the disc brake caliper aside.



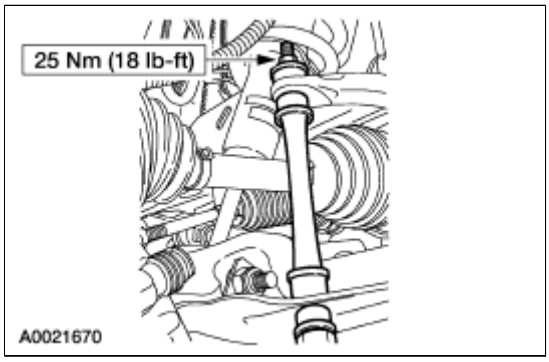
7. Remove and discard the cotter pin and the nut.



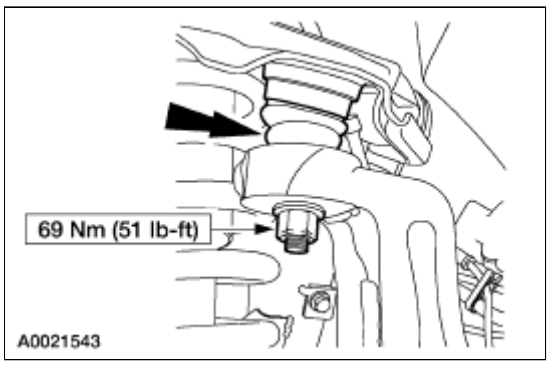
8. Using the special tool, separate the tie-rod end from the knuckle.



9. Remove the stabilizer bar link.

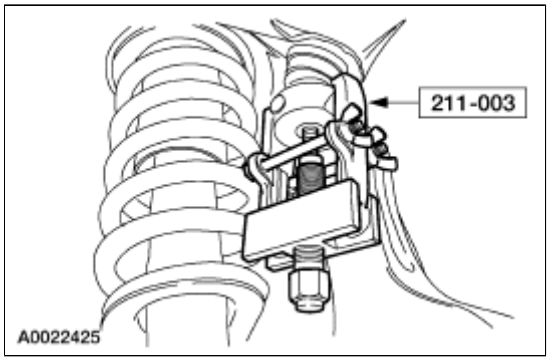


10. Remove and discard the nut.



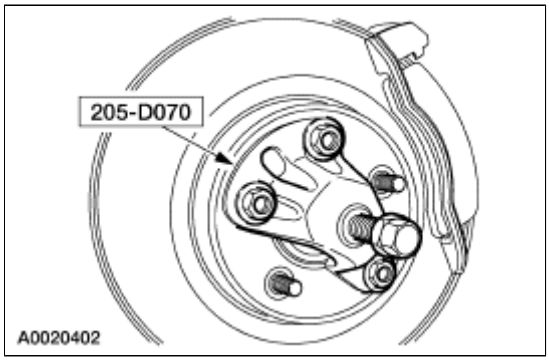
11. **CAUTION: Do not allow the knuckle to hang freely. It is possible to overextend and internally separate each inner CV joint from its housing.**

    Using the special tool, disconnect the upper ball joint from the knuckle.

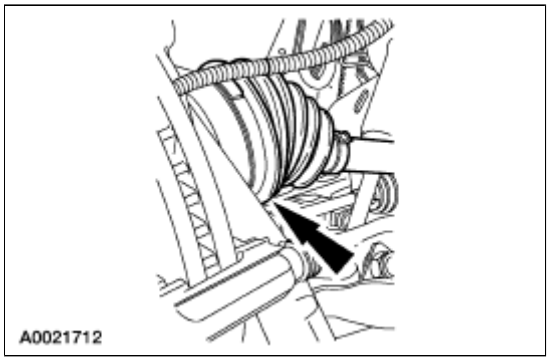


12. **CAUTION: Do not use a hammer to separate the outboard CV joint from the hub. Damage to the threads and internal CV joint components may result.**

    Using the special tool, press the outboard CV joint until it is loose in the hub.



13. Remove the outboard CV joint from the hub.

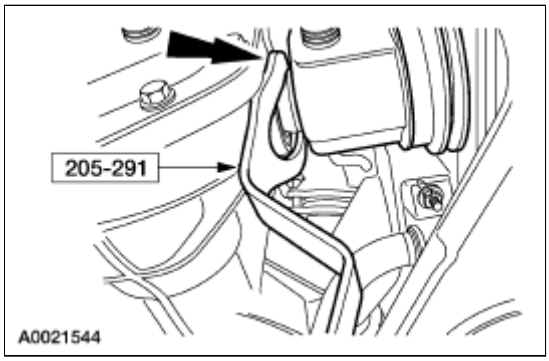


LH halfshaft only

14. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the inboard CV joint housing.**

NOTE: A circlip retains the inboard CV joint housing to the differential side gear in the axle.

Using the special tool, disengage the LH inboard CV joint housing from the differential side gear.

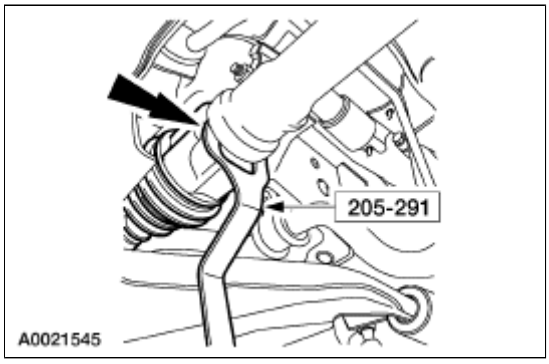


RH halfshaft only

15. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the inboard CV joint housing.**

    NOTE: A circlip retains the inboard CV joint housing to the axle shaft in the axle tube.

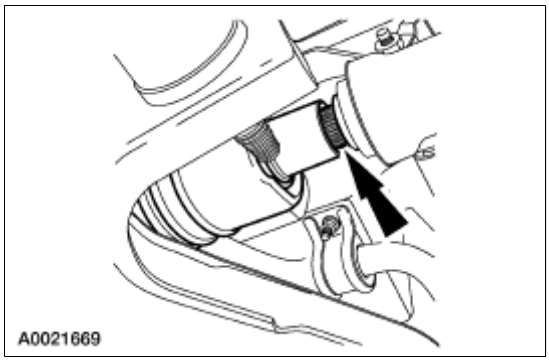
    Using the special tool, disengage the RH inboard CV joint housing from the axle tube.



16. **CAUTION: Do not damage the axle shaft oil seal, the machined sealing surface on the inboard CV joint housing, or the axle shaft splines.**

    CAUTION: Install a new retainer circlip on the outboard splines end of the axle shaft before reseating the axle shaft in the differential side gear.

    Pull the halfshaft and the axle shaft away from the axle tube, and separate the inboard CV joint housing from the axle shaft.



LH/RH halfshaft

17. Remove the halfshaft assembly from the vehicle.

18. **CAUTION: Always install the halfshaft with a new retainer circlip and a new front axle wheel hub retainer.**

    CAUTION: On the RH side, check the retainer circlip engagement after reseating the axle shaft and after installing the halfshaft in the axle. On the LH side, check the retainer circlip engagement after installing the halfshaft in the axle. When seated, the retainer circlip will lock the axle shaft and the inboard CV joint housing to the axle.

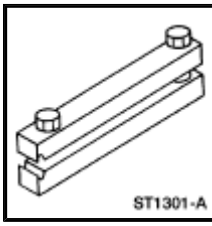
    CAUTION: Never use power tools to tighten the front axle wheel hub retainer.

    NOTE: It may be necessary to support the front suspension lower arm to be able to connect the upper ball joint to the knuckle.

    To install, reverse the removal procedure.

Halfshaft

Special Tool(s)

 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)

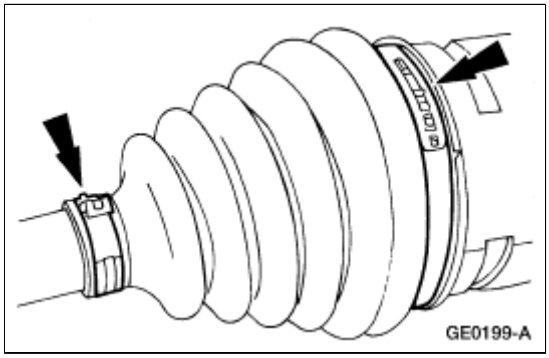
Material

Item	Specification
Ford High Temp Constant Velocity Joint Grease Motorcraft XG-2 or equivalent	ESP-M1C207-A

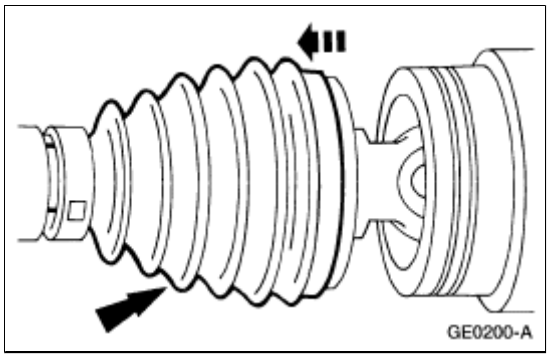
Disassembly

1. Remove the front wheel halfshaft. For additional information, refer to Halfshaft in this section.
2. **CAUTION: Be careful not to damage the halfshaft boot.**

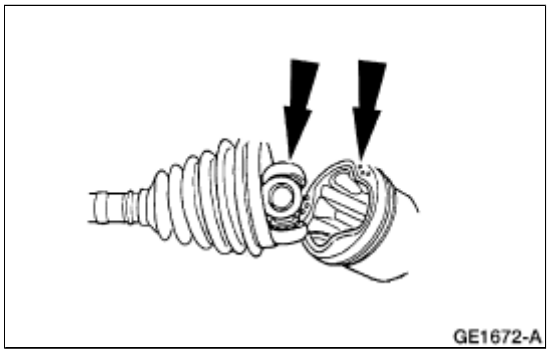
   Remove the two inboard boot clamps.



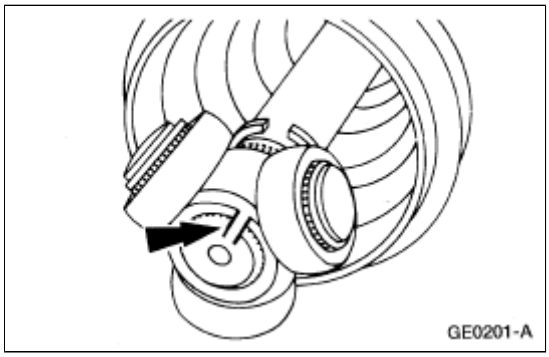
3. Slide the inboard halfshaft boot off the inboard CV joint housing.



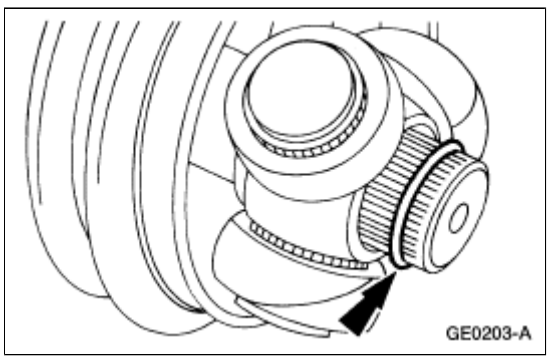
4. Separate the CV joint from the CV joint housing.



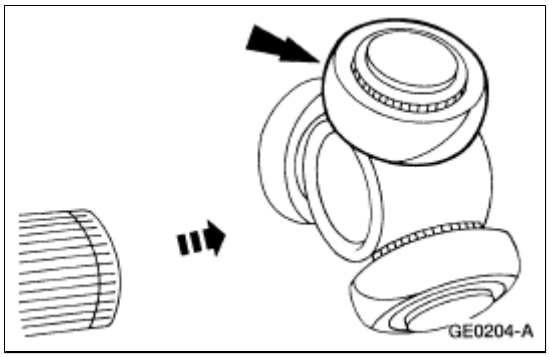
5. Mark the shaft and the inboard CV joint to ease alignment during assembly.



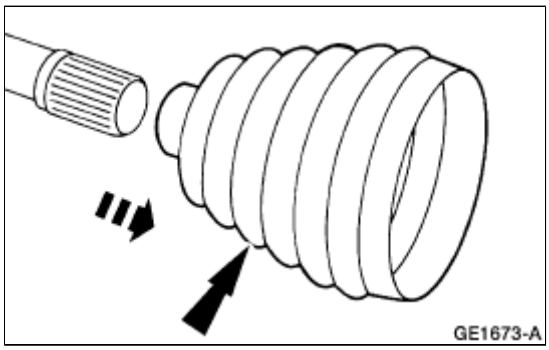
6. Remove the snap ring.



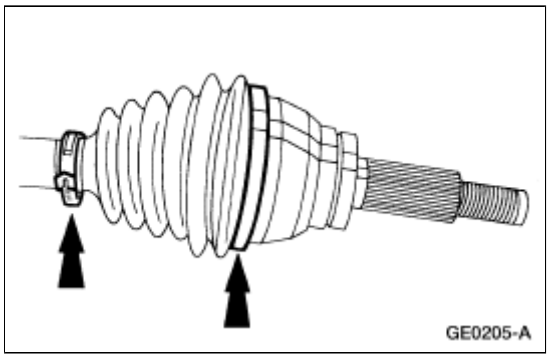
7. Remove the CV joint.



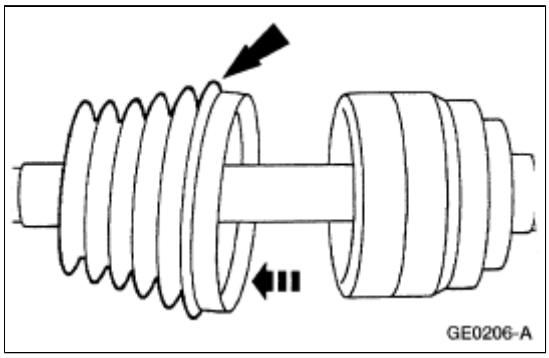
8. Inspect the stop ring for wear or damage. Install a new stop ring as necessary.
9. Remove the inboard halfshaft boot from the shaft assembly.



10. Remove the two outboard boot clamps.



11. Remove the outboard halfshaft boot.

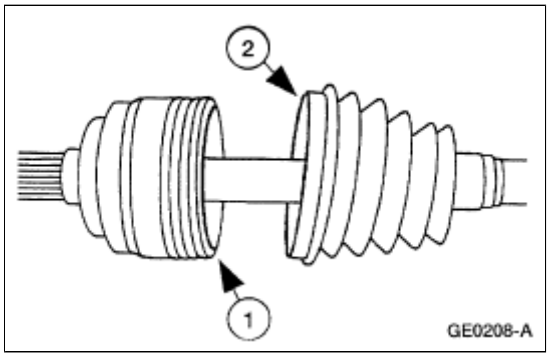


12. **NOTE:** If grease is contaminated, clean and inspect the joint for wear. If worn or damaged, install a new outboard CV joint and shaft assembly.

    Inspect for contaminated grease.

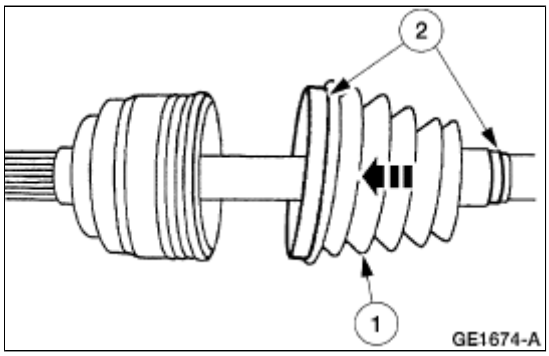
Assembly

1. Pack the outboard CV joint with grease.
    1. Use Ford High Temp Constant Velocity Joint Grease to fill the outboard CV joint.
    2. Spread any remaining grease from the service kit evenly inside the outboard halfshaft boot.



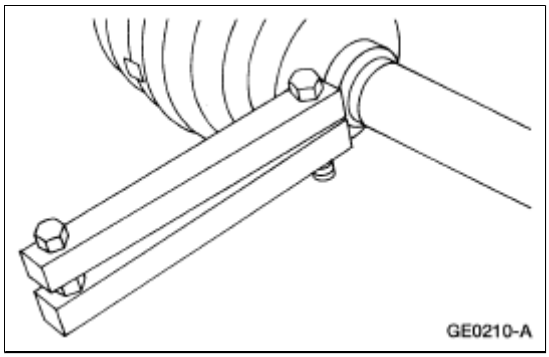
2. **NOTE:** Clean the halfshaft boot mounting surfaces of access grease before positioning the halfshaft boot into place.

    Position the outboard halfshaft boot and outboard boot clamps.
    1. Position the outboard halfshaft boot.
    2. Position the boot clamps on the outboard halfshaft boot.

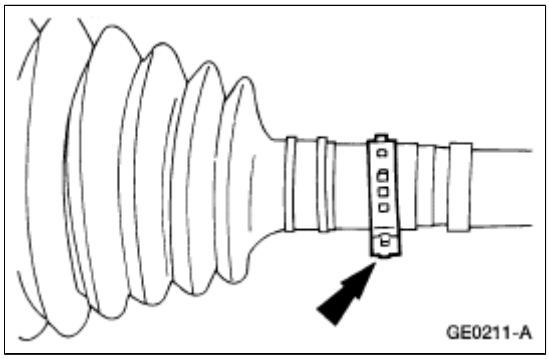


3. **NOTE:** Tighten the through-bolt until the installer is in the closed position.

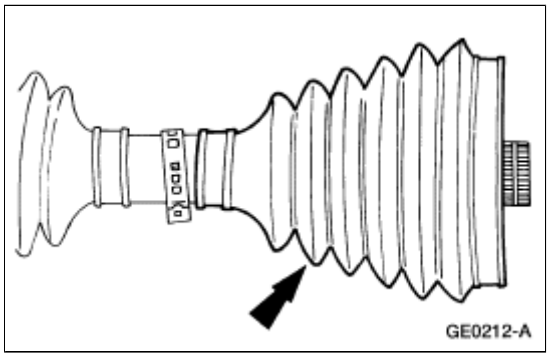
    Use the CV Boot Clamp Installer to install the outboard CV joint boot clamps.



4. Position the boot clamp on the halfshaft.

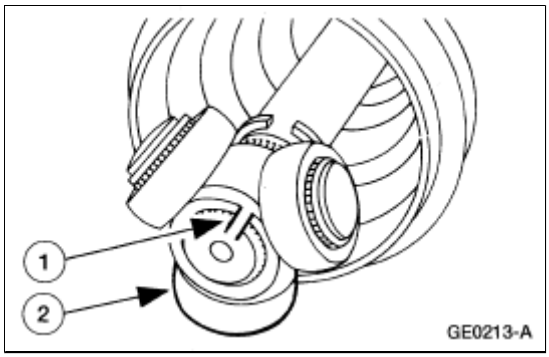


5. Position the inboard halfshaft boot.

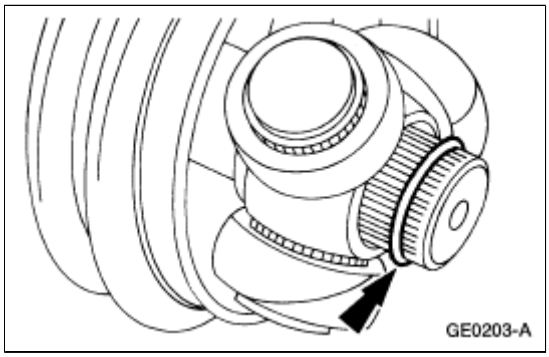


6. Install a new stop ring, if necessary.

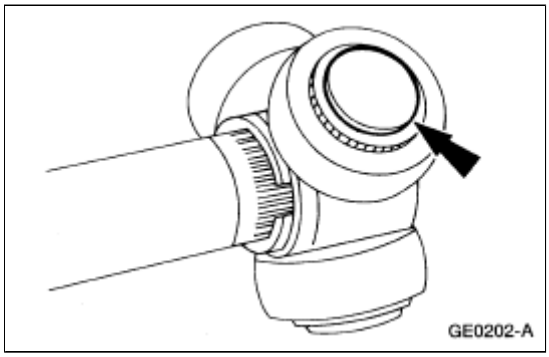
7. Install the CV joint on the halfshaft.
    1. Line up the marks on the halfshaft and the CV joint.
    2. Install the CV joint on the halfshaft.



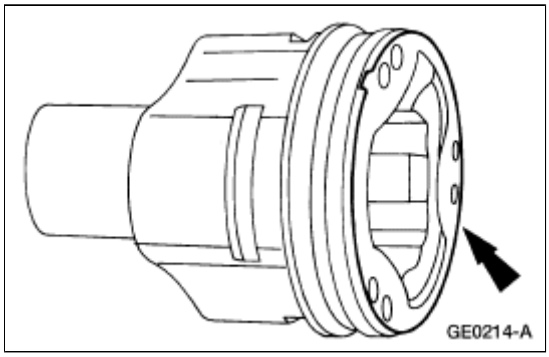
8. Install the snap ring.



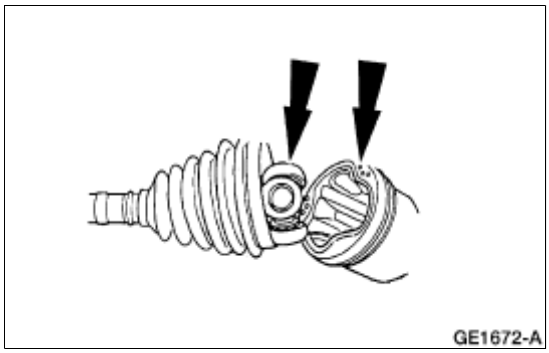
9. Lubricate the three CV joint needle bearings with grease.



10. Fill the inboard CV joint housing with 235 grams of grease.

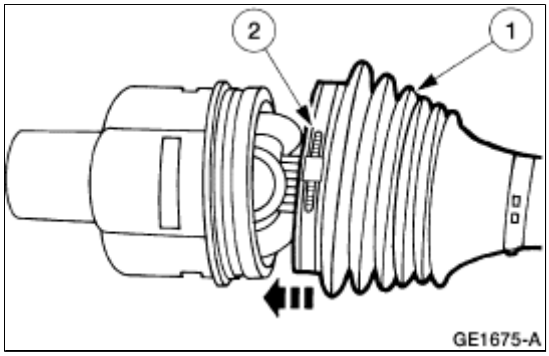


11. Position the CV joint housing onto the CV joint.

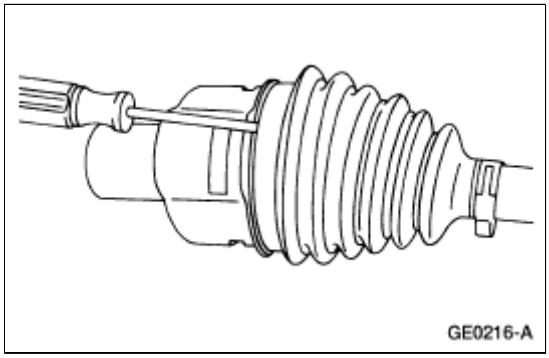


12. **NOTE:** Remove any excess grease from the inboard halfshaft boot mating surface before positioning into place.

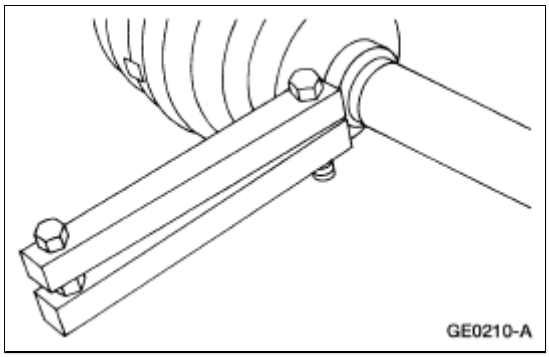
    Position the inboard halfshaft boot and boot clamp.
    1. Position the inboard halfshaft boot into place.
    2. Position the boot clamp.



13. Insert a dulled screwdriver blade to relieve built-up air pressure in the halfshaft boot.



14. Use the CV Boot Clamp Installer to install the inboard boot clamps.



15. Install the front wheel halfshaft. For additional information, refer to Halfshaft in this section.

General Specifications

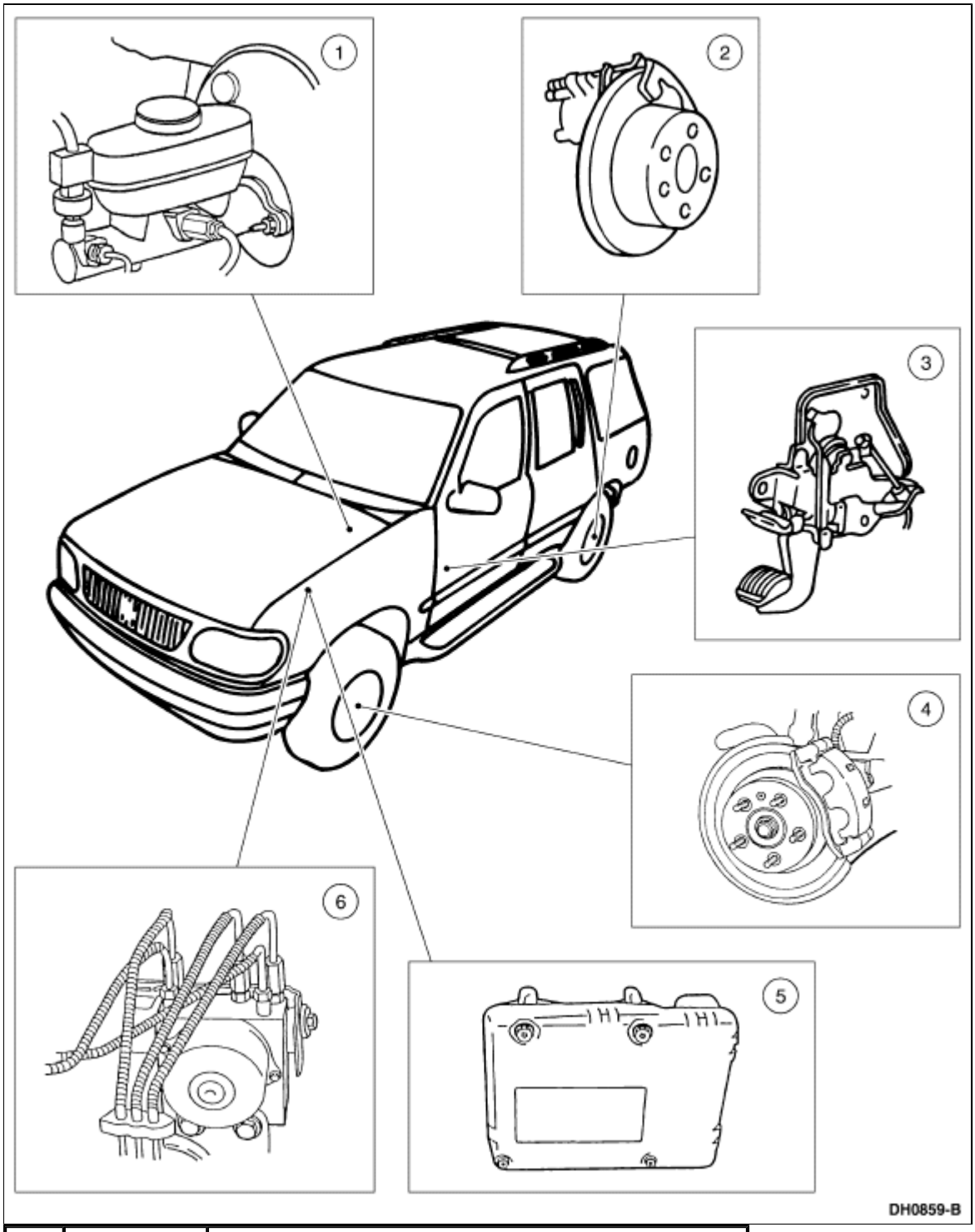
Item	Specification
Lining wear limit (above backing plate or rivets)	1.0 mm (0.040 Inch)
Lubricants	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A DOT 3
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A
Disc Brakes	
Brake disc minimum thickness	Molded into the brake disc
Brake disc maximum runout	0.013 mm (0.0005 Inch)
Brake disc maximum thickness variation	0.0051 mm (0.0002 Inch)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake master cylinder tube fitting, front	15-20	11-14	—
Brake master cylinder tube fitting, rear	15-20	11-14	—
Caliper bleeder screw, rear	20	15	—
Caliper bleeder screw, front	20	15	—
Master cylinder bleeder screw	8-18	—	70-159
Cruise control switch	14-20	10-14	—

Brake System

Component Locator



Item	Part Number	Description
1	2140	Brake master cylinder (fluid control valve on 2-door only)
2	—	Rear disc brake assy
3	2780	Parking brake control
4	—	Front disc brake assy
5	2C219	Anti-lock electronic control module
6	2C215	Anti-lock hydraulic control unit

The vehicle is equipped with a vacuum-assisted power braking system. Refer to Section 206-07 .

The braking system is a front-to-rear split hydraulic system. Refer to Section 206-06 .

The front brakes utilize a dual-piston brake caliper and disc brake system. Refer to Section 206-03 .

The rear brakes utilize a single piston caliper and disc brake system with the parking brake assembly located inside the drum and hat-type brake disc. Refer to Section 206-04 .

The parking brake system is a shoe and drum system that is located inside the drum and hat-type rear brake discs. Refer to Section 206-05 .

A 4-wheel anti-lock brake system (4WABS) is standard. Refer to Section 206-09 .

A fluid control valve, mounted at the rear port of the brake master cylinder, is used on 2-door models only.

Brake System

Refer to Wiring Diagrams Cell 62 , Instrument Cluster for schematic and connector information.

Refer to Wiring Diagrams Cell 97 , Daytime Running Lamps for schematic and connector information.

Inspection and Verification

Preliminary Checks

WARNING: Use of any other than the approved DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not spill brake fluid onto painted surfaces. If spilled, wipe up immediately.

NOTE: Always check the fluid level in the brake master cylinder reservoir (2K478) before performing the test procedures. If the fluid level is not at the correct level, add High Performance DOT 3 Brake Fluid C6AZ-19542-AB or DOT 3 equivalent meeting Ford specification ESA-M6C25-A.

NOTE: Prior to performing any diagnosis, make certain that the brake warning indicator is functional. Refer to Section 413-01 .

A change in brake pedal feel is usually the first indicator of a brake system concern. The change may only be normal ABS function, but is sufficient cause for further investigation. The brake warning indicator in the instrument cluster and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel (1007) is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. This bleeding operation may release the brakes but will not correct the cause of trouble. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

Brake Booster

Inspect all hoses and connections. All unused vacuum connectors should be capped. Hoses and their connections should be correctly secured and in good condition with no holes, soft or collapsed areas.

Road Test

Perform a road test to compare actual vehicle braking performance with the performance standards expected by the driver. The ability of the test driver to make valid comparisons and detect performance deficiencies will depend on experience.

The driver should have a thorough knowledge of brake system operation and accepted general performance guidelines in order to make good comparisons and detect performance problems.

Select a road that is reasonably smooth and level. Gravel or bumpy roads, except to demonstrate ABS function, are not suitable. The surface does not allow the tires to grip the road equally. Avoid crowned roads.

A key factor in evaluating brake concerns is the deceleration rate. This varies from vehicle to vehicle and with changes in operating conditions. It is evident how well the brakes are working after just a few applications.

Visual Inspection Chart

Mechanical	Electrical
• Brake master cylinder • Brake caliper piston • Brake discs • Wheel bearings • Brake pads • Power brake booster • Brake pedal linkage • Booster vacuum hose • Tires	• Parking brake switch • Damaged or corroded wiring harness • Brake master cylinder fluid level switch • Stoplight switch

For low or spongy brake pedal concerns:

- Check and, if necessary, refill the brake master cylinder reservoir.
- Bleed the brake system and retest the brake pedal feel.
- If the brake pedal (2455) is still low or feels spongy, check the wheel bearings. Refer to Section 206-03 (4x2) or Section 204-01B (4x4) for front wheel bearings and Section 205-02 for rear wheel bearings.

For slow or incomplete brake pedal return concern:

- Inspect for binding, damage, correct installation or interference at the brake pedal.
- Check the power brake booster for binding, damage and correct installation.

Vibration When Brakes are Applied

For vibration concerns when brakes are applied, perform the following procedure.

Visually inspect:

- The condition and pressure.
- Suspension bushings and ball joints.

Correct as necessary.

1. Verify and isolate the concern. Brake roughness can be felt in:
    1. the steering wheel.
    2. the seat.
    3. the brake pedal.

2. After verifying the concern, check for related concerns in the:
    1. On-Line Automotive Service Information System (OASIS).
    2. Technical Service Bulletins.

3. Check wheel bearing end-play and correct as necessary.

4. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

    Remove the tire and wheel.

5. Remove the brake caliper.

6. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc. Do not machine a new brake disc.

7. For vehicles with a two-piece brake disc and hub assembly:
    1. Match-mark before disassembly.
    2. Remove the brake disc.
    3. Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
    4. Align the match-marks and reinstall the brake disc on the hub.

8. **CAUTION: Do not use a bench lathe to machine brake discs.**

    NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 in). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

    Using the special tool, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

9. Using a dial indicator, verify that the brake disc lateral runout is now within vehicle specification.

10. Remove any metal chips.

11. Remove the special tool hub adapter.

12. Remove any remaining metal chips from the machining operation.

13. **CAUTION: Do not carry out this step on rear drum-in-hat brake discs.**

    For vehicles with a two-piece brake disc and a non drum-in-hat hub assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from brake disc and hub mounting surfaces and from the ABS sensor.
    - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the mounting surfaces.
    - Using the match-marks, mount the brake disc on the hub.

14. Install the caliper and check brake operation.

Symptom Chart

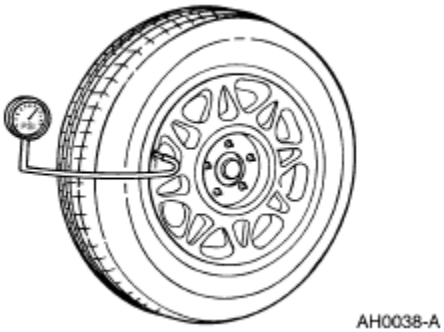
Symptom Chart

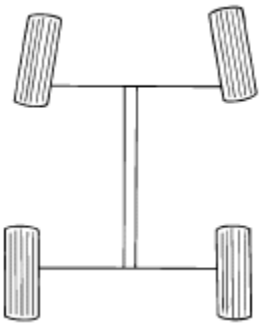
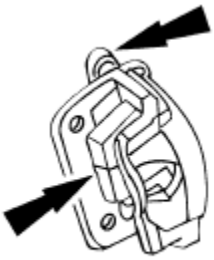
Condition	Possible Sources	Action
• Brakes Pull or Drift	• Tire air pressure. • Wheel alignment. • Brake pads. • Brake components. • Suspension component.	• GO to Pinpoint Test A .
• Red Brake Warning Indicator Always On	• Instrument cluster. • Circuit. • Parking brake. • Brake fluid level.	• GO to Pinpoint Test B .
• Vibration When Brakes Are Applied	• Rear disc brakes. • Front disc brakes.	• REFER to Section 100-04 .
• Brake Pedal Goes Down Fast	• Brake fluid level. • Air in system. • Brake master cylinder. • Normal ABS operation.	• FILL the brake master cylinder reservoir. BLEED the system. • BLEED the system. • PERFORM the brake master cylinder component test in this section. • No action required.
• The Brake Pedal Eases Down Slowly	• Air in system. • Brake master cylinder. • Normal ABS operation.	• BLEED the system. REFER to Bleeding—System in this section. • PERFORM the brake master cylinder component test in this section. • No action required.
• Brakes Lock Up During Light Brake Pedal Force	• Road conditions. • Disc brake component. • Parking brake component. • Anti-lock brake control system. • Fluid control valve.	• TEST on smooth road. • GO to Pinpoint Test C .
• Excessive/Erratic Brake Pedal Travel	• Leak in hydraulic system. • Air in system. • Disc brake caliper. • Brake booster-to-brake master cylinder push rod adjustment. • Brake master cylinder. • Normal ABS operation.	• GO to Pinpoint Test D . • No action required.

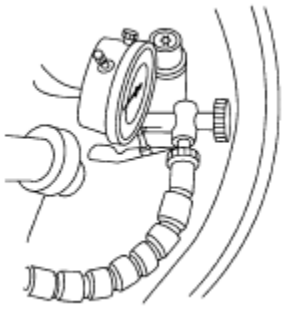
• Brakes Drag	• Parking brake component. • Disc brake caliper. • Brake booster-to-brake master cylinder push rod adjustment. • Brake master cylinder.	• REPAIR or INSTALL new components as necessary. REFER to Section 206-05 . • REPAIR or INSTALL new as necessary. REFER to Section 206-03 . • ADJUST the push rod. REFER to Section 206-07 . • PERFORM the brake master cylinder component test in this section.
• Excessive Brake Pedal Effort	• Power brake booster. • Power brake booster check valve. • Power brake booster hose.	• PERFORM the brake booster component test in this section.
• Red Brake Warning Indicator Inoperative	• Circuit. • Bulb.	• REFER to Section 413-01 .
• Brake Noise	• Disc brake component.	• MACHINE or INSTALL new as necessary. REFER to Section 206-03 or Section 206-04 .

Pinpoint Tests

PINPOINT TEST A: BRAKES PULL OR DRIFT

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE TIRE PRESSURE	
1  AH0038-A	1 Check for excessive wear and measure the air pressure in all four tires. • **Are the tires good and the tire pressure within specifications?** → **Yes**

	GO to A2 . → **No** ADJUST the tire pressure. ROTATE the tires front to rear. INSTALL new tires if excessively worn.
A2 CHECK THE ALIGNMENT	
1  AH0061-A	1 Check for correct camber, caster and toe-in settings. Refer to Section 204-00 . • **Is the alignment set to specification?** → **Yes** INSTALL new disc brake caliper at the affected wheel. TEST the system for normal operation. → **No** GO to A3 .
A3 CHECK THE CALIPER PISTON AND PINS	
1  AH0041-A	1 Check the disc brake caliper pistons and pins for binding or sticking. • **Do the disc brake caliper pistons or pins bind or stick?** → **Yes** REPAIR or INSTALL new components as necessary. → **No** GO to A4 .
A4 INSPECT THE BRAKE PADS	

1 AH0048-A	1 Inspect the brake pads for contamination and wear concerns. • **Are the brake pads OK?** → **Yes** GO to A5 . → **No** INSTALL new brake pads. REFER to Section 206-03 (front) or Section 206-04 (rear).
A5 INSPECT THE BRAKE DISCS AND HUBS	
1  AH0300-A	1 Inspect the brake discs and hubs for excessive runout thickness variation or damage. • **Are the brake discs within specification?** → **Yes** Have the customer duplicate the concern. → **No** REPAIR and INSTALL new brake discs and hubs as necessary.

PINPOINT TEST B: RED BRAKE WARNING INDICATOR ALWAYS ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE BRAKE MASTER CYLINDER FLUID LEVEL SWITCH	
1	

2

Brake Master Cylinder Fluid Level Switch

3

- **Does the brake warning indicator turn on?**

→ **Yes**
GO to B2.

→ **No**
INSTALL new brake master cylinder fluid level switch. TEST the system for normal operation.

B2 CHECK THE PARKING BRAKE SWITCH

1

2

Parking Brake Switch

3

- **Does the red brake warning indicator turn on?**

→ **Yes**
For vehicles without daytime running lamps (DRL), GO to B3. For vehicles equipped with DRL, GO to B4.

→ **No**
INSTALL a new parking brake switch. TEST the system for normal operation.

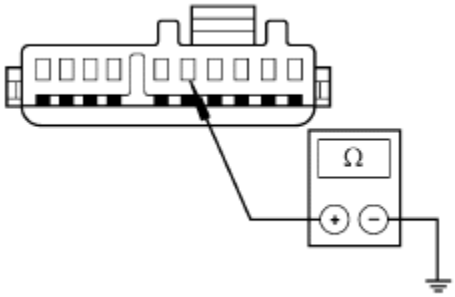
B3 CHECK CIRCUITS 977 (P/W) and 162 (LG/R)

1

2

Instrument Cluster C288

3



3 Measure the resistance between Pin C288-5, Circuit 977 (P/W), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPAIR the instrument cluster. TEST the system for normal operation.

→ **No**
REPAIR Circuit 977 (P/W) or 162 (LG/R). TEST the system for normal operation.

B4 CHECK CIRCUIT 977 (P/W)

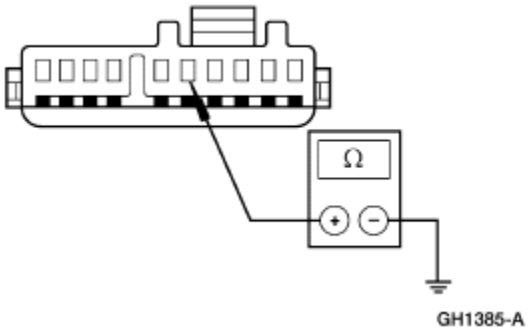
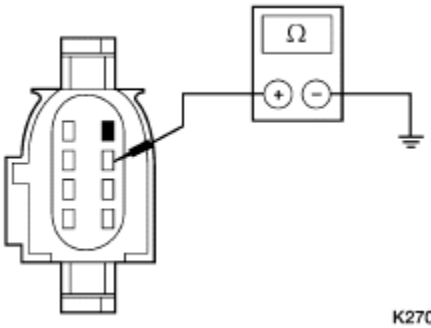
1

2

Instrument Cluster

3

DRL Module

4  GH1385-A	4 Measure the resistance between Pin C288-5, Circuit 977 (P/W), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B5 . → **No** REPAIR Circuit 977 (P/W). TEST the system for normal operation.
B5 CHECK PARKING BRAKE CIRCUIT 162 (LG/R)	
1  K27006-A	1 Measure the resistance between Pin C134-4, Circuit 162 (LG/R), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new DRL module. REFER to Section 417-04 . TEST the system for normal operation. → **No** REPAIR Circuit 162 (LG/R). TEST the system for normal operation.

PINPOINT TEST C: BRAKES LOCK UP DURING LIGHT BRAKE PEDAL FORCE

CONDITIONS	DETAILS/RESULTS/ACTIONS

C1 CHECK FOR BINDING OR STICKING BRAKE COMPONENTS

1

2 Check for binding, damage and correct installation at each wheel brake component.

- **Do any of the components bind or stick?**

→ **Yes**
REPAIR or INSTALL new components as necessary. TEST the system for normal operation.

→ **No**
GO to C2 .

C2 CHECK THE PARKING BRAKE COMPONENTS

1 Check parking brake components for damage, seized condition, and correct adjustment. Refer to Section 206-05 .

- **Are the parking brake components OK?**

→ **Yes**
GO to C3 .

→ **No**
REPAIR or INSTALL new components as necessary. REFER to Section 206-05 . TEST the system for normal operation.

C3 INSPECT THE BRAKE PADS

1 Inspect brake pads for contamination, excessive wear or damage. Refer to Section 206-03 for front disc brake. Refer to Section 206-04 for rear disc brake.

- **Are the brake pads OK?**

→ **Yes**
GO to C4 .

→ **No**
INSTALL new brake pads as necessary. TEST the system for normal operation.

C4 CHECK FOR LOOSE BRAKE COMPONENT MOUNTINGS

1 Check for loose or damaged caliper mounting bolts.

- **Are the component mountings OK?**

→ **Yes**
With fluid control valve, GO to C5 . Without fluid control valve, CHECK the 4-wheel anti-lock brake system (4WABS). REFER to Section 206-09 .

	→ **No** REPAIR as necessary. TEST the system for normal operation.
C5 CHECK THE FLUID CONTROL VALVE	
	1 Replace the fluid control valve with a known good valve. 2 Test the system for normal operation. • **Does the system operate OK now?** → **Yes** Discard the original fluid control valve. → **No** CHECK the four-wheel anti-lock brake system (4WABS). REFER to Section 206-09 .

PINPOINT TEST D: EXCESSIVE/ERRATIC BRAKE PEDAL TRAVEL

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK FOR SPONGY PEDAL	
1 2	3 Operate the brake pedal and note pedal feel. • **Does the brake pedal feel spongy?** → **Yes** BLEED the system. REFER to Bleeding—System in this section. TEST the system for normal operation. → **No** GO to D2 .
D2 CHECK THE BRAKE PEDAL	
	1 Inspect the brake pedal for binding, obstruction or damage. • **Is the brake pedal OK?** → **Yes** GO to D3 .

	→ **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.
D3 CHECK THE BRAKE COMPONENTS	
	1 Inspect the disc brake components for binding, damage, correct installation and contamination. • **Are the disc brake components OK?** → **Yes** GO to D4 . → **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.
D4 CHECK ABS SYSTEM FOR CORRECT FUNCTION	
	1 Check the ABS system. REFER to Section 206-09 . • **Are the disc brake components OK?** → **Yes** INSTALL a new power brake booster. TEST the system for normal operation. → **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.

Component Tests

Brake Booster

1. Check the hydraulic brake system for leaks or insufficient fluid.
2. With the transmission (7003) in NEUTRAL, stop the engine (6007) and apply the parking brake control (2780). Apply the brake pedal several times to exhaust all vacuum in the system.
3. Apply the brake pedal and hold it in the applied position. Start the engine. If the vacuum system is operating, the brake pedal will tend to move downward under constant foot pressure. If no motion is felt, the power brake booster system is not functioning. Continue the test with the following steps.
4. Remove the vacuum booster hose (2A047) from check valve connection. Manifold vacuum must be available at the check valve end of the vacuum booster hose with the engine at idle speed and the transmission in NEUTRAL. If the manifold vacuum is available to the power brake booster, connect the vacuum booster hose to the power brake booster check valve (2365) and repeat Steps 2 and 3 above.
5. Check and if no downward movement of the brake pedal is felt, install a new power brake booster.
6. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine, and let the vehicle stand for 10 minutes. Then apply the brake pedal with approximately 89 N (20 lbs) of force. The brake pedal

feel should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. Refer to Bleeding—System in this section.

Check Valve

The function of the power brake booster check valve is to allow manifold vacuum to enter the power brake booster and prevent the escape of vacuum in case manifold vacuum is lost during sustained full throttle operation.

To test the function of the power brake booster check valve:

- Start and run the engine for at least 10 seconds.
- Operate the brake pedal to check for power assist.
- Disconnect the vacuum booster hose from the power brake booster. Do not remove the power brake booster check valve from the power brake booster.
- There should be enough vacuum retained in the power brake booster for at least one more power-assisted brake operation.

Brake Master Cylinder

Normal Conditions

The following conditions are considered normal and are not indications that the brake master cylinder is in need of service.

Condition 1: During normal operation of the brake master cylinder, the fluid level in the brake master cylinder reservoir will rise during brake application and fall during release. The net fluid level (after brake application and release) will remain unchanged.

Condition 2: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

Condition 3: Fluid level will decrease with pad wear.

Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. Refer to the Symptom Chart for abnormal condition diagnosis.

Bypass Condition Test

1. Disconnect the brake lines at the brake master cylinder.

2. Plug the outlet ports of the brake master cylinder.

3. Apply the brakes. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and must be rebuilt or installed new.

Compensator Port Check

The purpose of the compensator ports in the brake master cylinder is to supply any additional brake fluid required by the system due to brake pad wear and to allow brake fluid returning from the brake lines to the brake master cylinder to enter the brake master cylinder reservoir.

The returning brake fluid will cause a slight turbulence in the brake master cylinder reservoir. Turbulence seen in the brake master cylinder reservoir upon release of the brake pedal is normal and shows that the compensating ports are not plugged.

Bleeding —Components

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1270-A	NGS Flash Cable 418-F120 (007-00531) or Equivalent

Master Cylinder Priming — In-Vehicle or Bench

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

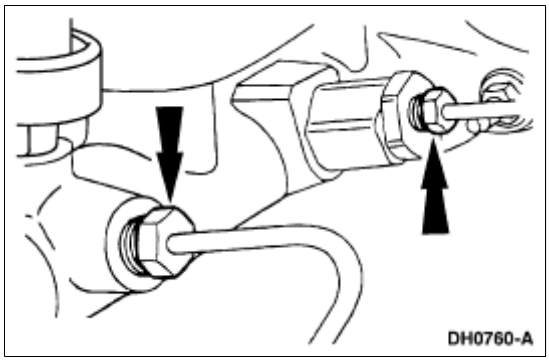
CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

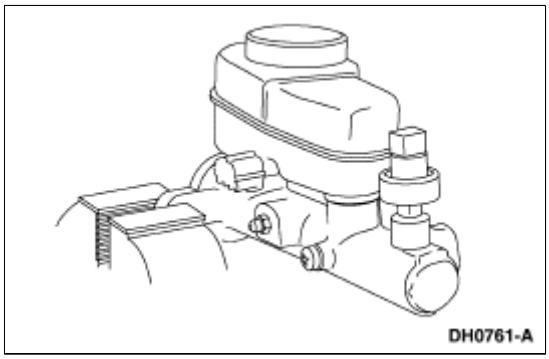
NOTE: When any part of the hydraulic system has been disconnected for repair or installation, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

NOTE: When the brake master cylinder has been installed new or the system has been emptied or partially emptied, it must be primed to prevent air from entering the system.

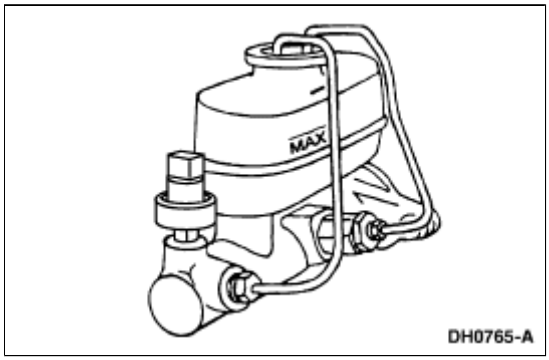
1. For in-vehicle priming, disconnect the brake lines from the brake master cylinder.



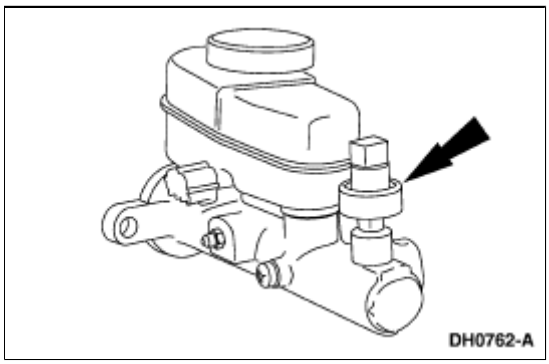
2. For bench priming, mount the brake master cylinder in a vise.



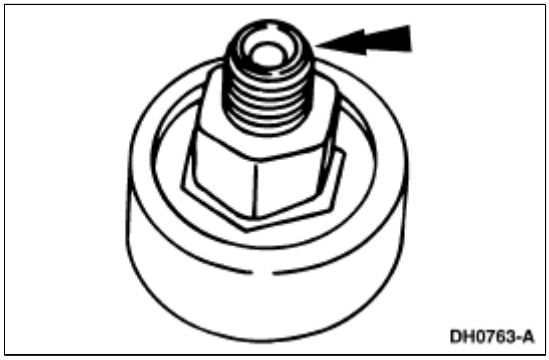
3. Install short brake tubes with the ends bent into the brake master cylinder reservoir.
   - Fill the brake master cylinder reservoir with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or DOT 3 equivalent meeting Ford specification ESA-M6C25-A.



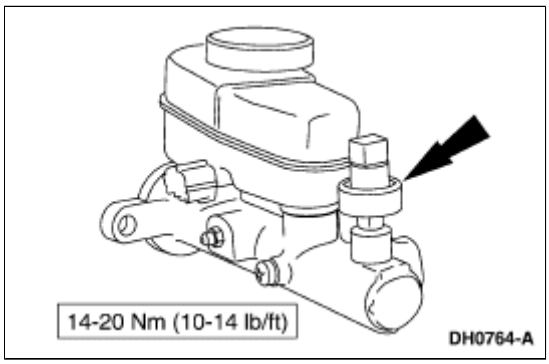
4. For a new brake master cylinder, remove the cruise switch.



5. Fill the cruise switch with the specified brake fluid.



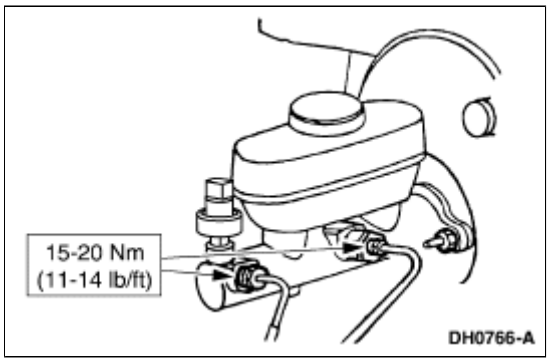
6. Install the cruise switch.



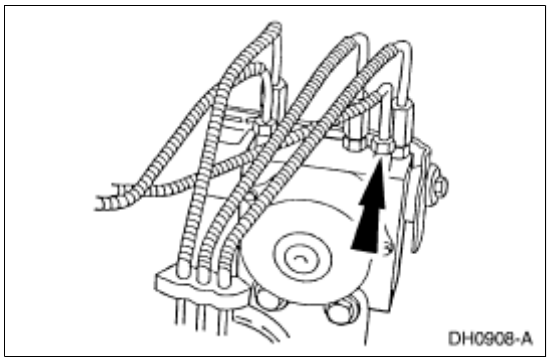
7. Slowly depress the primary piston or, for in-vehicle priming, have an assistant slowly pump the brake pedal until clear brake fluid flows from both brake tubes with no air bubbles.

8. If necessary, install the brake master cylinder into the vehicle. For additional information, refer to Section 206-06 .

9. Remove the short brake tubes and install the master cylinder outlet tubes.



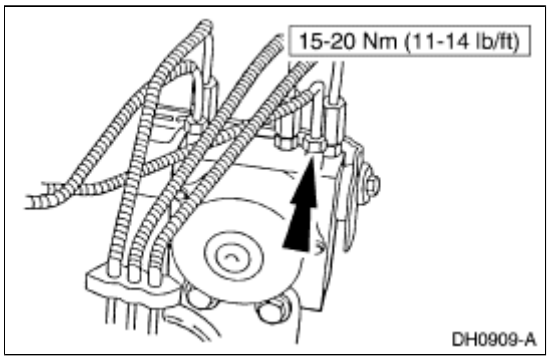
10. Loosen a brake outlet tube at the 4WABS hydraulic control unit (HCU).



11. **NOTE:** Refill the brake master cylinder reservoir as necessary.

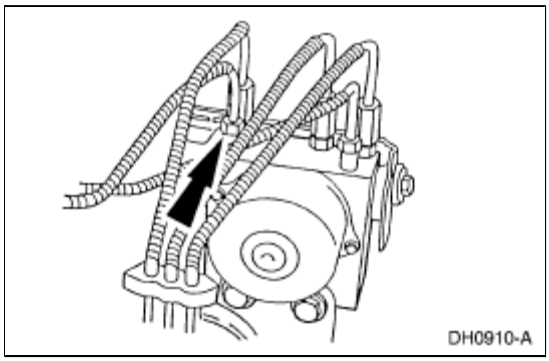
    Have an assistant depress and hold the brake pedal.

12. Tighten the outlet tube fitting at the HCU.

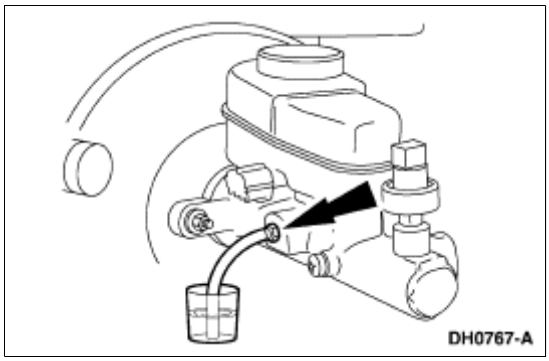


13. Repeat the above three steps until no air bubbles are seen in the expelled brake fluid.

14. Repeat the above four steps for the remaining master cylinder outlet tube.



15. Connect one end of a flexible tube to the master cylinder bleeder screw. Submerge the other end in a container partially filled with the specified brake fluid.

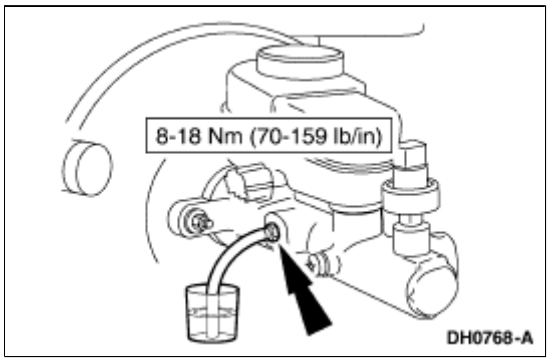


16. Have an assistant pump and then hold firm pressure on the brake pedal.

17. **NOTE:** Refill the brake master cylinder reservoir as necessary.

    Loosen the master cylinder bleeder screw until brake fluid flows out of the drain tube.

18. Tighten the master cylinder bleeder screw.



19. Repeat the above three steps until there are no air bubbles in the expelled brake fluid.

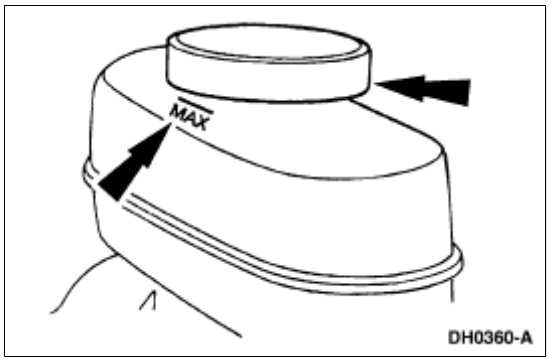
20. Bleed the brake system. For additional information, refer to Bleeding — System in this section.

Four Wheel Anti-Lock Brake System (4WABS) Hydraulic Control Unit (HCU)

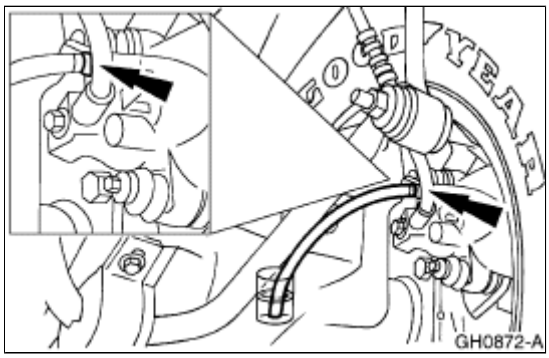
NOTE: This procedure only needs to be performed if the 4-wheel anti-lock brake (4WABS) hydraulic control unit (HCU) has been installed new.

1. Connect the scan tool DCL cable adapter into the vehicle data link connector (DLC) under the dash, and follow the scan tool instructions for bleeding.

2. Clean all dirt from and remove the brake master cylinder filler cap (2162), and fill the brake master cylinder reservoir with the specified brake fluid.



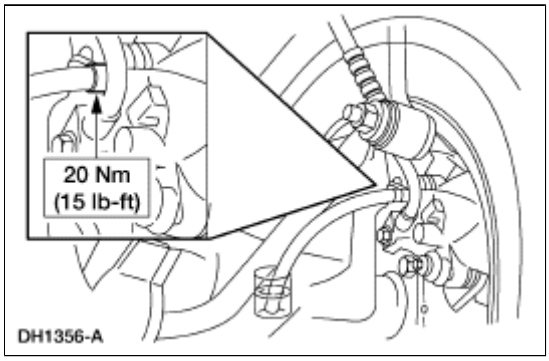
3. Connect a clear drain tube to the RH rear bleeder screw and the other end in a container partially filled with recommended brake fluid.



4. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

5. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

6. Tighten the bleeder screw.



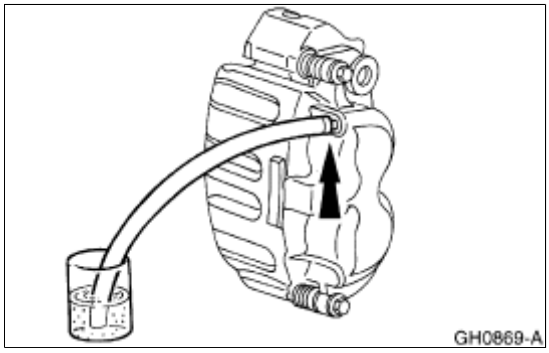
7. Repeat Steps 3-6 for the LH rear bleeder screw, the RH front bleeder screw and the LH front bleeder screw, in that order.

8. Repeat the conventional bleed procedure as outlined in Steps 3-7.

Caliper

1. **NOTE:** It is not necessary to do a complete brake system bleed if only the disc brake caliper was disconnected.

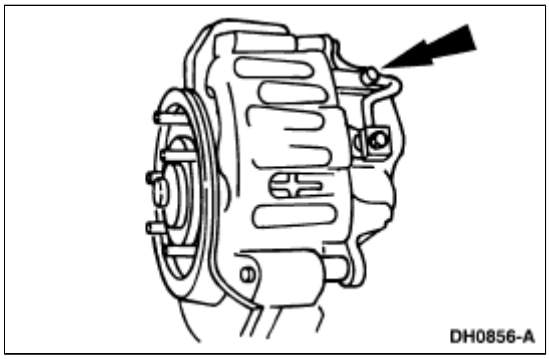
   Place a box end wrench on the disc brake caliper bleeder screw. Attach a rubber drain tube to the disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



2. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

3. Loosen the disc brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the disc brake caliper bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

4. Tighten the disc brake caliper bleeder screw. Refer to Specifications in this section.



Bleeding —System

Manual

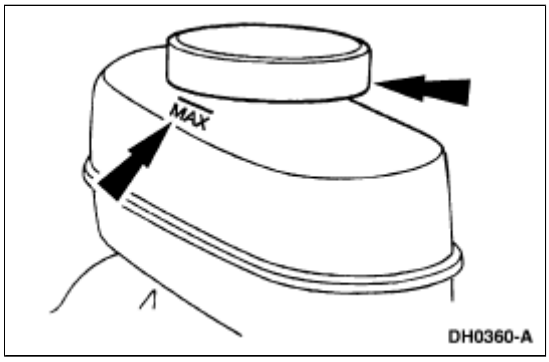
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

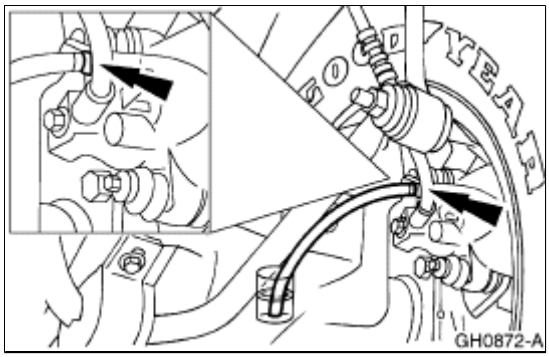
CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.



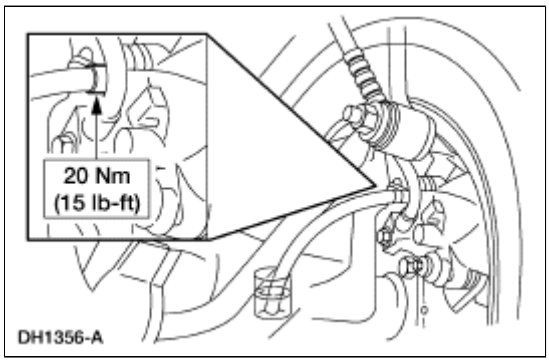
2. Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



3. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

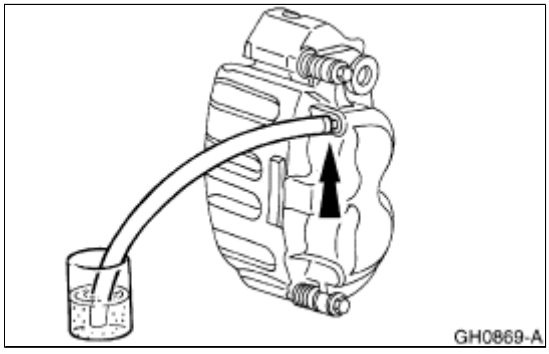
4. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH rear bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

5. Tighten the RH rear bleeder screw.



6. Repeat Steps 2, 3, 4 and 5 for the LH rear bleeder screw.

7. Place a box end wrench on the RH front disc brake caliper bleeder screw. Attach a rubber drain tube to the RH front disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



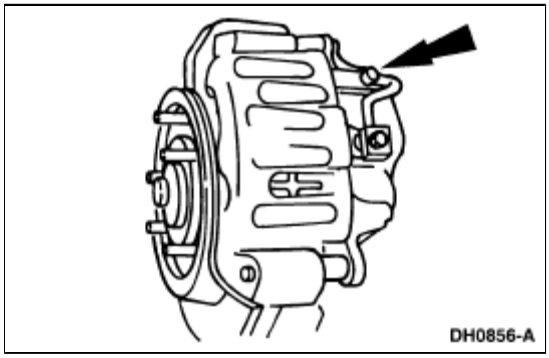
8. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

9. Loosen the RH front disc brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH front disc brake caliper bleeder

screw.

- Repeat until clear, bubble-free fluid comes out.
- Refill the brake master cylinder reservoir as necessary.

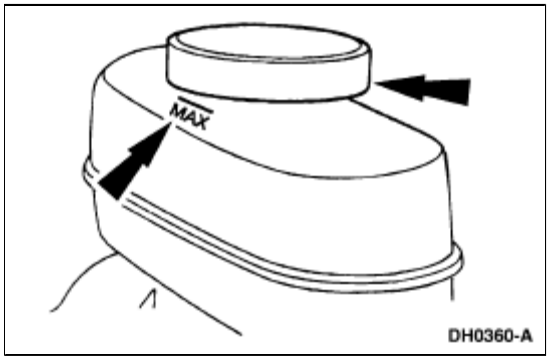
10. Tighten the RH front disc brake caliper bleeder screw. For additional information, refer to Specifications in this section.



11. Repeat Steps 7, 8, 9 and 10 for the LH front disc brake caliper bleeder screw.

Pressure

1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.

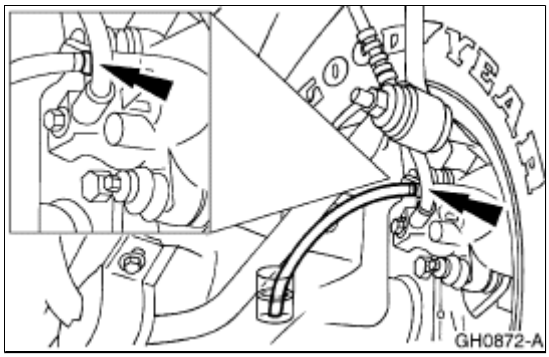


2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

   Install the bleeder adapter to the brake master cylinder reservoir, and attach the bleeder tank hose to the fitting on the adapter.

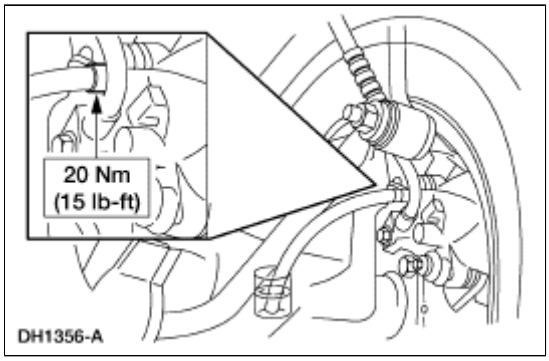
3. **NOTE:** Bleed the longest line first. Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

   Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



4. Open the valve on the bleeder tank.

5. Loosen the RH rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the RH rear bleeder screw and remove the rubber hose.



6. Continue bleeding the rear of the system, going in order from the LH rear bleeder screw to the RH front disc brake caliper bleeder screw ending with the LH front disc brake caliper bleeder screw.

7. Close the bleeder tank valve. Remove the tank hose from the adapter, and remove the adapter.

Hydraulic Leak Check

1. **NOTE:** Brake fluid is water soluble and it is possible that all evidence of fluid leakage has been washed off if the vehicle has been operated in the rain or snow.

   Make sure the brake master cylinder reservoir (2K478) is full.

2. Apply the brakes several times and make sure the brake pedal (2455) feel is not spongy. If necessary, bleed the system. For additional information, refer to Bleeding — System in this section.

3. Verify that the reservoir level is dropping.

4. If the reservoir level is dropping, inspect the brake components, fittings and lines to locate the source of the leak.

General Specifications

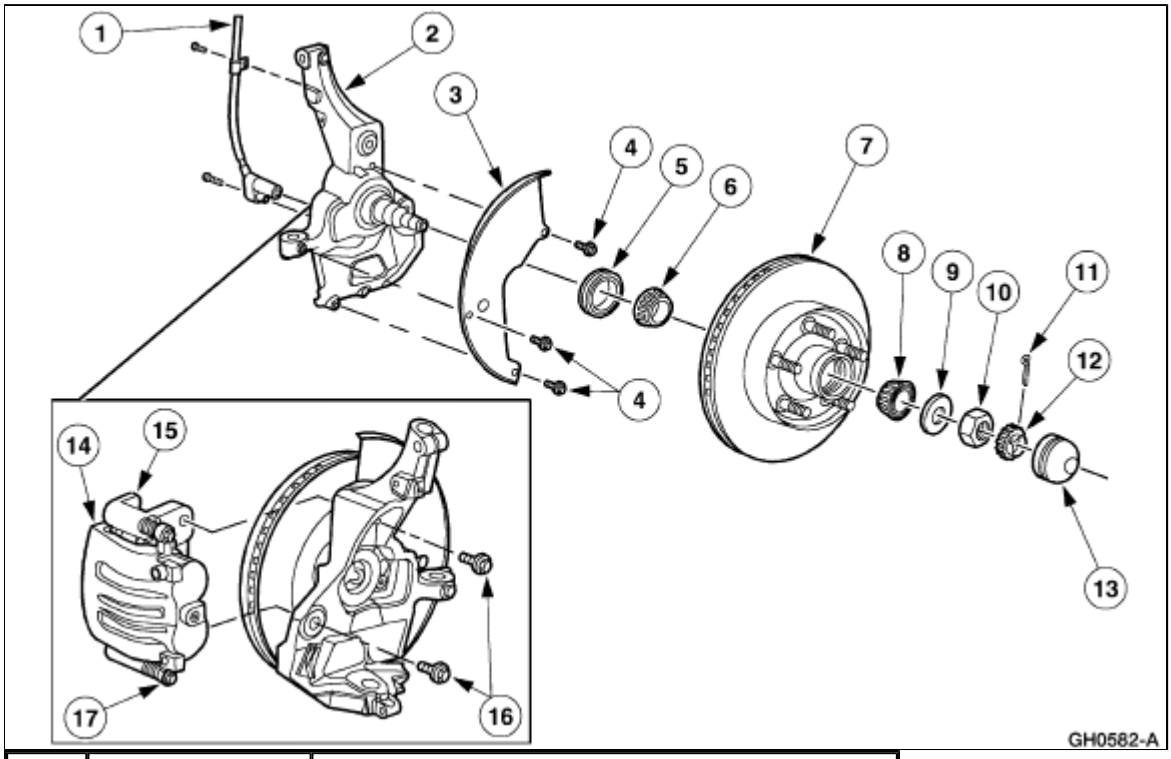
Item	Specification
Disc brake lining wear limit	2.5 mm (0.10 in)
Disc minimum thickness	24.5 mm (0.98 in)

Torque Specifications

Description	Nm	lb-ft
Brake hose bolt	30-40	23-29
Front disc brake caliper anchor plate bolts	98-132	72-97
Disc brake caliper bolts	28-36	21-26
Brake disc shield bolts	10-14	7-10

Front Disc Brake

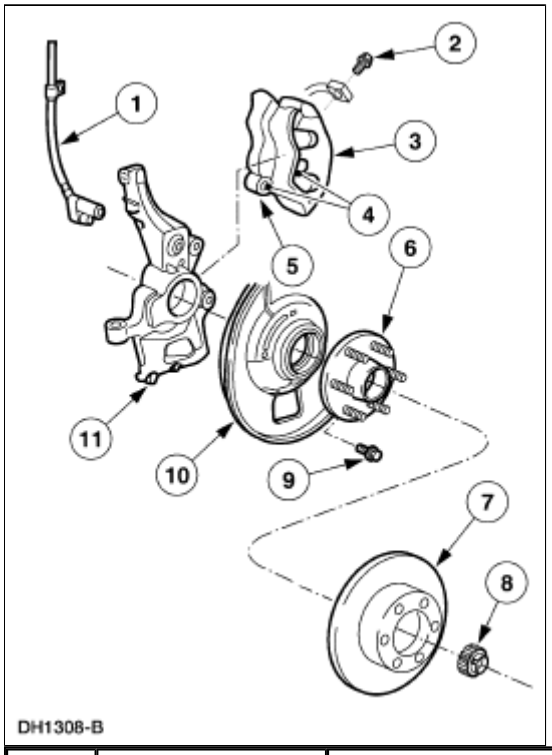
Front Disc Brake Components — 4x2



Item	Part Number	Description
1	2C204	Front brake anti-lock sensor
2	3105	Front wheel spindle
3	2K004	Brake disc shield
4	N611171-S2	Bolt
5	1190	Grease seal
6	1216	Front wheel bearing
7	1102	Brake disc and hub
8	1216	Front wheel bearing
9	1195	Front wheel outer bearing retainer washer
10	374504-S36	Hub spindle nut
11	N642569-S	Cotter pin
12	390622-S	Nut retainer
13	1131	Hub grease cap
14	2B120	Disc brake caliper
15	2B292	Front disc brake caliper anchor plate

16	N805163-S190	Caliper anchor plate bolts
17	2N386	Disc brake caliper bolt

Front Disc Brake Components — 4x4



Item	Part Number	Description
1	2C204	Front brake anti-lock sensor
2	N808236-S36	Front brake hose bolt
3	2B120	Disc brake caliper
4	2001	Pads
5	2B292	Front disc brake caliper anchor plate
6	1104	Wheel hub
7	1125	Brake disc
8	3B477	Front axle wheel hub retainer
9	N611171-S2	Bolt (3 req'd)
10	2K005	Brake disc shield
11	3K186	Front wheel knuckle

On two-wheel drive vehicles:

- The disc brake caliper (2B120) bolts to the anchor plate (2B292).
- The brake disc and hub (1102) is an integrally cast assembly.

On AWD and 4x4 vehicles:

- The disc brake caliper bolts to the front wheel knuckle (3K186).
- A separate brake disc (1125) attaches to the wheel hub (1104).

The disc brake caliper:

- is a pin slider, dual piston type.
- has two caliper pistons (2196).

The caliper has a fluid inlet at the center of the housing. A square section seal fitted into an annular groove in the caliper bore seals against hydraulic pressure, while rubber boots seal the caliper pistons and caliper bore from contamination.

The brake disc shield (2K005):

- bolts to the front wheel knuckle
- protects the bearings and inboard surface of the brake disc.

The pads are:

- contained within the front disc brake caliper anchor plate (2B292).
- held to the front disc brake caliper anchor plate abutments by disc brake anti-rattle clips.

Front Disc Brake

Refer to Section 206-00 .

Pads

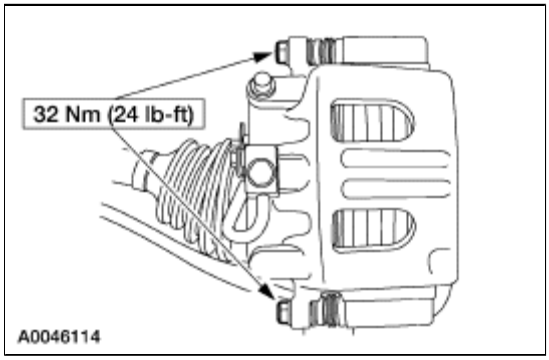
Removal and Installation

1. Remove the brake fluid in the master cylinder reservoir until the reservoir is half full.

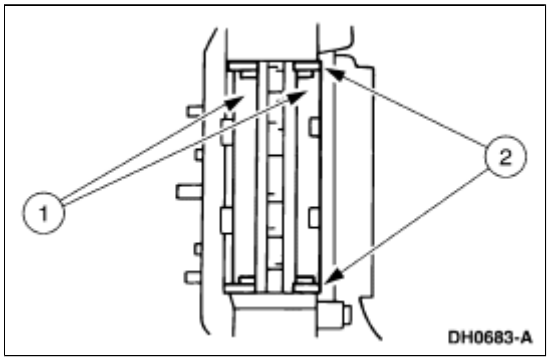
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

3. Position the brake caliper aside.
   - Remove the brake caliper bolts.
   - Position the brake caliper aside and support it.



4. Remove the pads and the stainless slippers.
   1. Remove the pads.
   2. Remove the stainless slippers.



5. Use a suitable suction device to remove the brake fluid from the master cylinder.

6. Clean the anchor plate.

7. The inboard pad has a wear indicator tab. The indicator tab must be oriented toward the brake disc surface.

8. Install the stainless slippers and the pads.
   - Install the new stainless slippers (included in service kit).
   - Install the pads.

9. **NOTE:** The caliper pistons must be compressed using a C-clamp and a wooden block.

   NOTE: Tighten the bottom caliper bolt on the LF side first. Tighten the top caliper bolt on the RF side first.

   Inspect the brake system operation.

10. To install, reverse the removal procedure.

Caliper

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

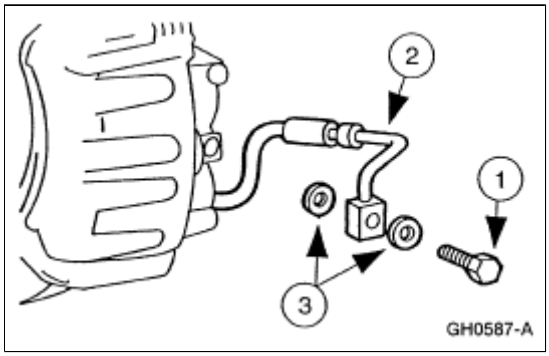
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

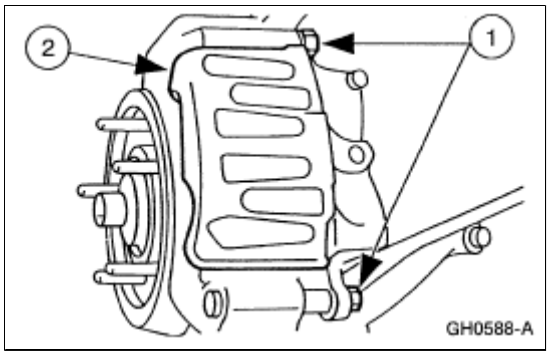
3. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

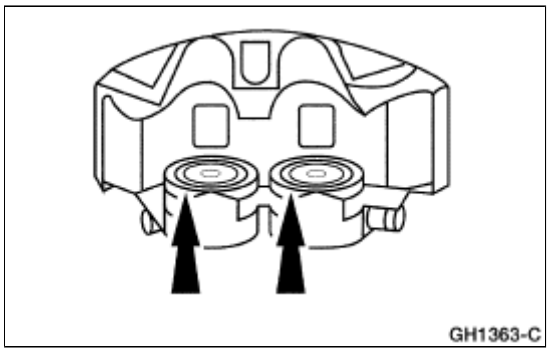
   Disconnect the front brake hose (2078).
   1. Remove the front brake hose bolt.
   2. Disconnect the front brake hose.
   3. Remove and discard the copper washers. Plug the front brake hose.



4. Remove the disc brake caliper (2B120).
   1. Remove the disc brake caliper bolts.
   2. Lift the disc brake caliper off the front disc brake caliper anchor plate (2B292).

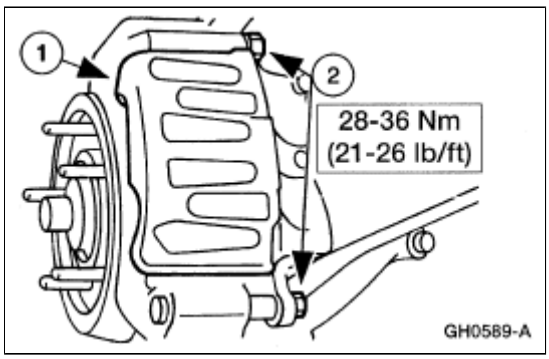


5. Inspect the disc brake caliper for leaks.
    - If leaks are found, disassembly is required. For additional information, refer to Caliper , Disassembly and Assembly in this section.

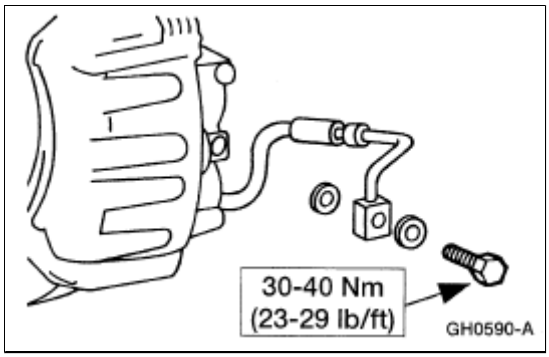


Installation

1. Install the disc brake caliper.
    1. Install the disc brake caliper.
    2. Install the disc brake caliper bolts.



2. Install the front brake hose.
    - Use new copper washers; connect the front brake hose.
    - Install the front brake hose bolt.



3. Bleed the disc brake caliper. For additional information, refer to Section 206-00 .
4. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Install the wheel and tire assembly. For additional information, refer to Section 204-04 .
5. Inspect the brake system operation.

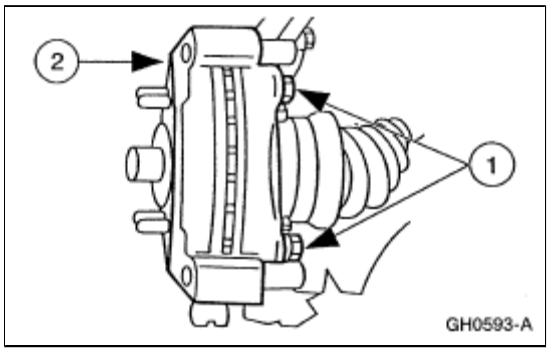
Brake Caliper Anchor Plate

Removal

1. **NOTE:** AWD and 4x4 shown, 4x2 similar.

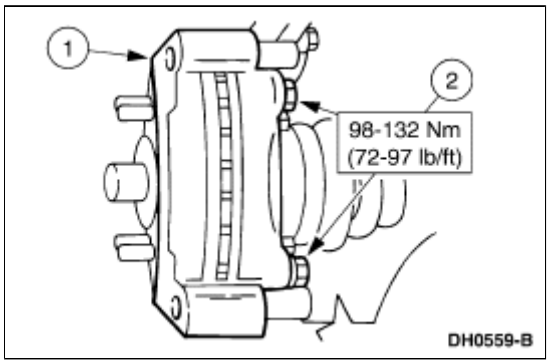
   Remove the pads. For additional information, refer to Pads in this section.

2. Remove the front disc brake caliper anchor plate (2B292).
   1. Remove the two front disc brake caliper anchor plate bolts.
   2. Remove the front disc brake caliper anchor plate.



Installation

1. Install the front disc brake caliper anchor plate.
   1. Position the front disc brake caliper anchor plate.
   2. Install the front disc brake caliper anchor plate bolts.



2. Install the pads. For additional information, refer to Pads in this section.

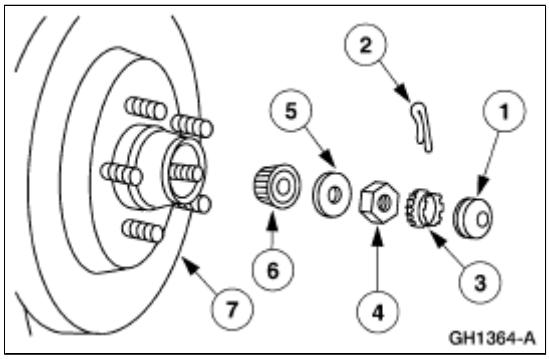
Disc

Removal

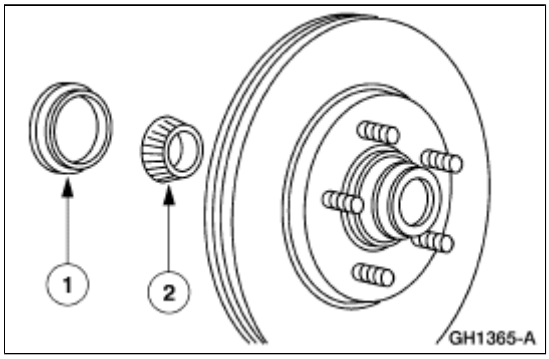
1. Remove the front disc brake caliper anchor plate (2B292). For additional information, refer to Brake Caliper Anchor Plate in this section.

2. On 4x4 vehicles, remove the brake disc (1125).

3. On 4x2 vehicles, remove the brake disc and hub (1102) as follows:
    1. Remove the hub grease cap (1131).
    2. Remove the cotter pin.
    3. Remove the nut retainer.
    4. Remove the spindle nut.
    5. Remove the front wheel outer bearing retainer washer (1195).
    6. Remove the outer front wheel bearing (1216).
    7. Remove the brake disc and hub.



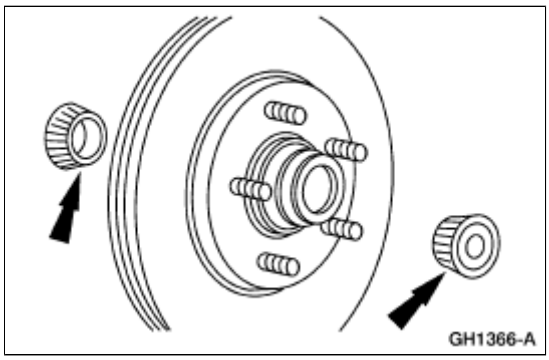
4. Remove the wheel hub grease seal (1190).
    1. Remove the wheel hub grease seal.
    2. Remove the inner front wheel bearing.



Installation

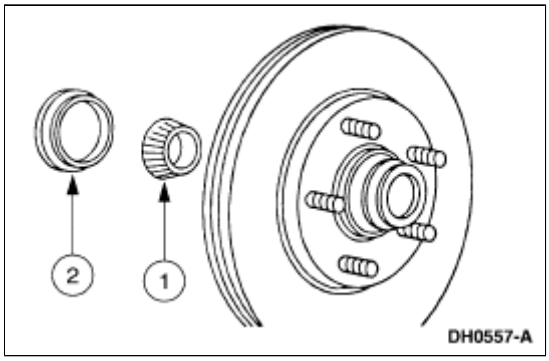
1. On AWD and 4x4 vehicles, position the brake disc to the wheel hub.
    - Use Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent to clean the brake disc.

2. On 4x2 vehicles, thoroughly clean and inspect the front wheel bearings and the brake disc and hub.
    - Use Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent.

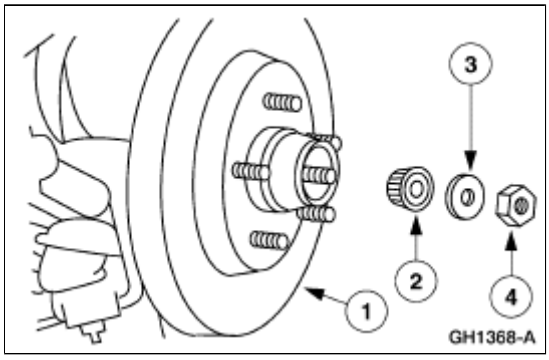


3. On 4x2 vehicles, lubricate the front wheel bearings.
    - Use Premium Long-Life Grease XG-1-C or -K or equivalent meeting Ford specification ESA-M1C75-B.

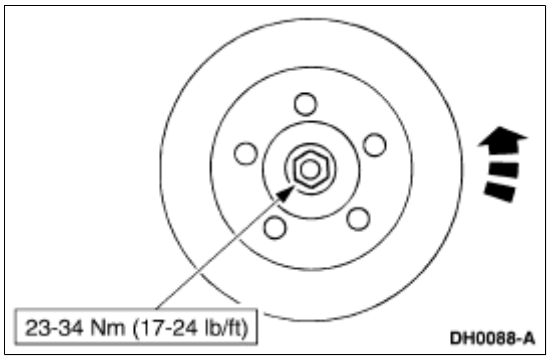
4. On 4x2 vehicles, install a new wheel hub grease seal.
    1. Install the inner front wheel bearing.
    2. Install a new wheel hub grease seal.



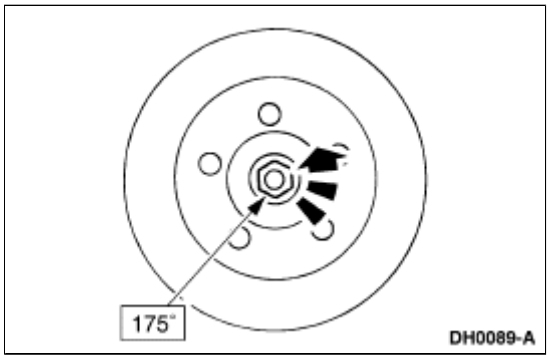
5. On 4x2 vehicles, install the brake disc and hub.
    1. Position the brake disc and hub.
    2. Install the outer front wheel bearing.
    3. Install the front wheel outer bearing retainer washer.
    4. Install the spindle nut.



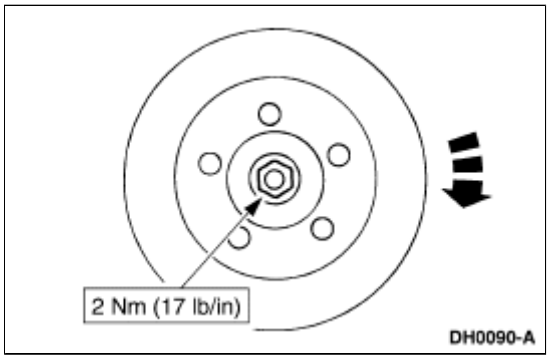
6. Tighten the spindle nut while rotating the brake disc and hub.



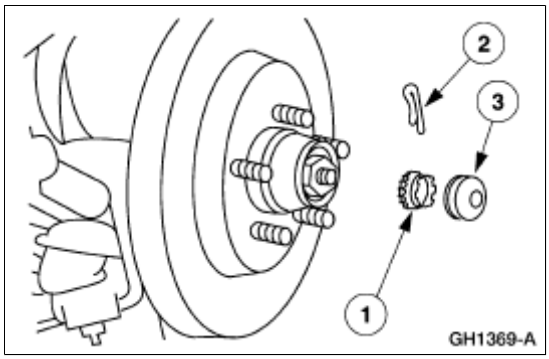
7. Loosen the spindle nut.



8. Tighten the spindle nut while rotating the brake disc and hub.



9. On 4x2 vehicles, install the following components:
    1. Install the nut retainer.
    2. Install the cotter pin.
    3. Install the hub grease cap.



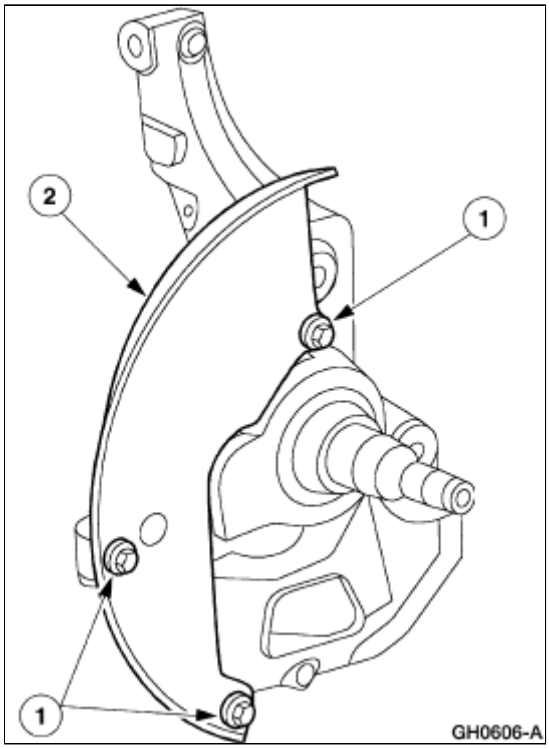
10. Install the front disc brake caliper anchor plate. For additional information, refer to Brake Caliper Anchor Plate in this section.

Shield —4x2

Removal

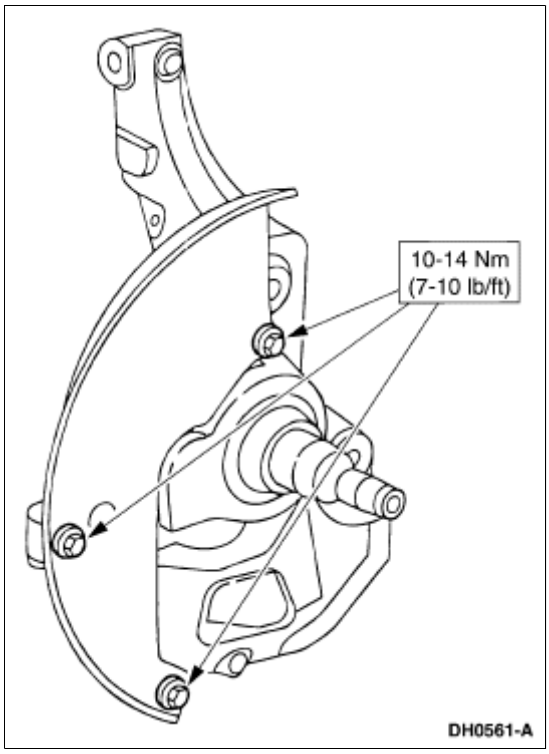
1. Remove the brake disc. For additional information, refer to Disc in this section.

2. Remove the brake disc shield (2K005).
    1. Remove the bolts.
    2. Remove the brake disc shield.



Installation

1. Follow the removal procedure in reverse order.

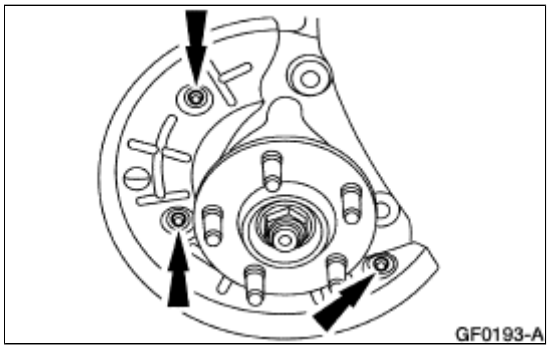

10-14 Nm
(7-10 lb/ft)
DH0561-A

Shield —AWD, 4x4

Removal

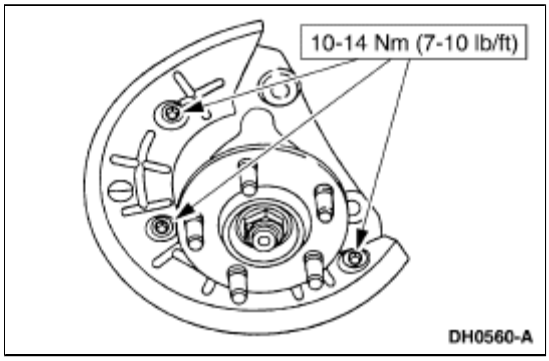
1. Remove the brake disc. For additional information, refer to Disc in this section.

2. Remove the brake disc shield (2K005).
   - Remove the three brake disc shield bolts and remove the brake disc shield.



Installation

1. Follow the removal procedure in reverse order.



Caliper

Disassembly

WARNING: Use of any brake fluid other than approved DOT 3 will cause permanent damage to brake components and will render the brakes inoperative.

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water to induce vomiting. Get medical attention immediately.

CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specification ESA-M6C25A.

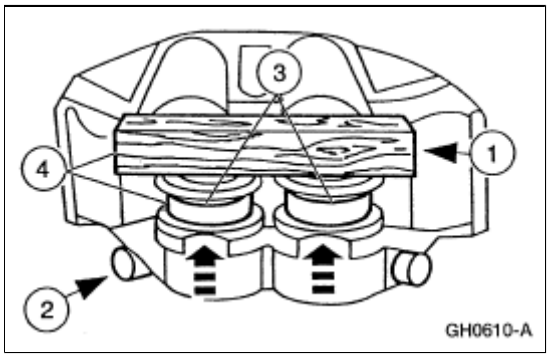
- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

1. Remove the disc brake caliper (2B120). For additional information, refer to Caliper in the Removal and Installation portion in this section.

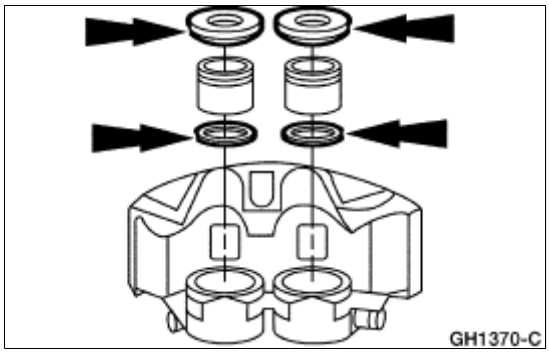
2. Drain remaining brake fluid from the disc brake caliper.

3. Secure the disc brake caliper in a vise.

4. Remove the caliper pistons (2196).
    1. Place a block of wood between the caliper bridge and the caliper pistons.
    2. Apply low air pressure to the fluid port in the disc brake caliper.
    3. Force out the caliper piston to the block of wood.
    4. Remove the block of wood and the caliper pistons.



5. Remove and discard the piston seals and boots.



6. **NOTE:** Do not hone the caliper bores. Pistons are not available for honed caliper bores.

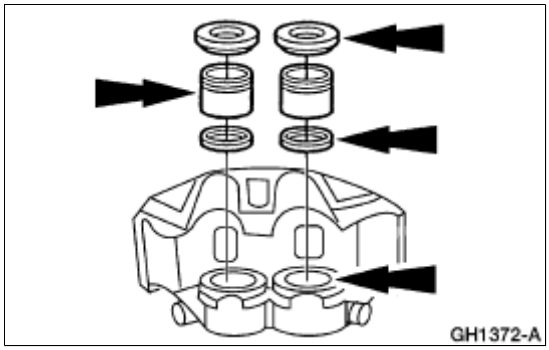
   If the caliper bores are excessively scored or corroded, install a new disc brake caliper.

Assembly

1. **CAUTION: Never reuse piston seals or dust boots.**

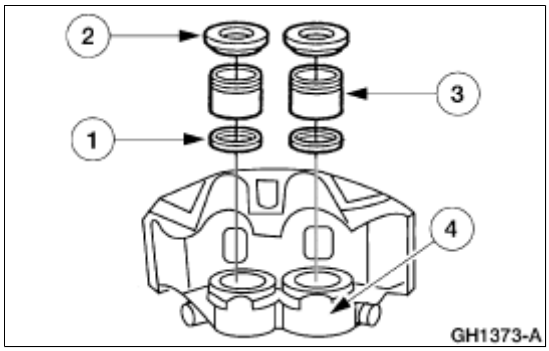
   NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

   Lubricate the piston boot, caliper piston, piston seal, and cylinder bores with High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or DOT 3 equivalent meeting Ford specification ESA-M6C25-A.



2. Install the caliper pistons.
   1. Install the piston seal.
   2. Install the piston boot.
   3. **CAUTION: Be careful not to damage or dislodge the piston seal.**

      Insert the caliper piston.
   4. Press the caliper piston into the caliper bore, being careful not to cock the caliper piston.



3. Install the disc brake caliper. For additional information, refer to Caliper in the Removal and Installation portion in this section.

General Specifications

Item	Specification
Rear disc brake lining minimum thickness	1.0 mm (0.039 in)
Rear brake disc minimum thickness [a]	11 mm (0.44 in)
Rear brake disc maximum allowable runout	0.0051 mm (0.0002 in)
Rear brake disc maximum thickness variation	0.013 mm (0.0005 in)
Lubricants	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A
Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)	ESE-M1C171-A

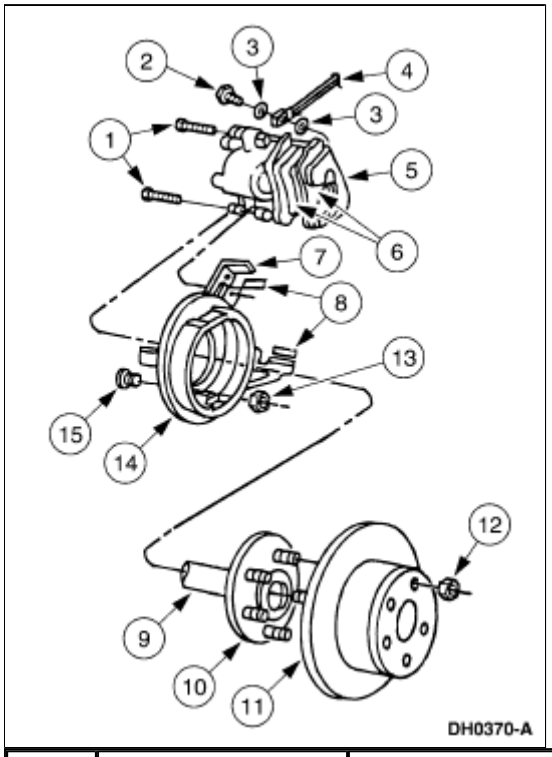
[a] Minimum brake disc thickness is molded into the brake disc.

Torque Specifications

Description	Nm	lb-ft
Brake caliper bolts	27	20
Caliper flow bolt	30-40	23-29
Rear wheel disc brake adapter bolts	108	80

Rear Disc Brake

Rear Disc Brake System Components



Item	Part Number	Description
1	N807146-S101	Brake caliper bolt
2	385116-S2	Flow bolt
3	388949-S	Copper washer (2 req'd)
4	2A442	Rear wheel brake hose
5	2552	Rear disc brake caliper
6	—	Brake pads
7	2C220	Adapter assy
8	2A648	Shoe slippers
9	4234	Axle shaft
10	1107	Wheel stud (5 req'd)
11	2C026	Brake disc
12	—	Keeper nut
13	—	Rear wheel disc brake adapter nut
14	2C220	Rear wheel disc brake adapter
15	—	Rear wheel disc brake adapter bolt

NOTE: The inboard and outboard brake pads are not interchangeable.

The brake disc (2C026) is a solid, full-cast, drum-in-hat type. The rear disc brake caliper (2552) is equipped with a riveted spring clip that secures it to either the rear disc brake caliper piston or the rear disc brake caliper housing.

Rear Disc Brake

Refer to Section 206-00 .

Caliper

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs which can result in shifting of the vehicle during these operations.**

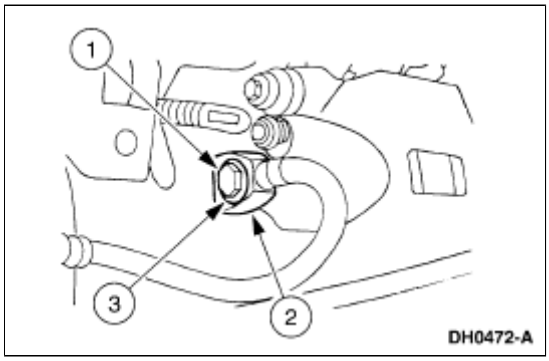
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

3. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

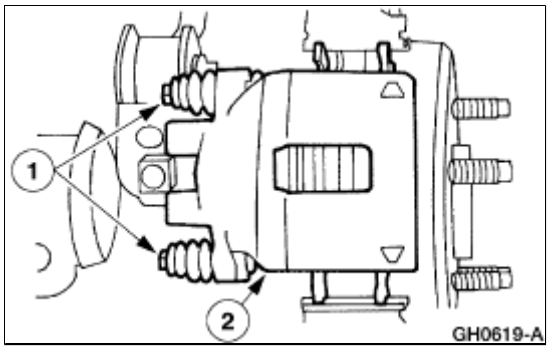
   CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

   Disconnect the brake hose.
   1. Remove bolt.
   2. Disconnect the rear wheel brake hose (2A442).
   3. Remove the copper washers and plug the brake hose.

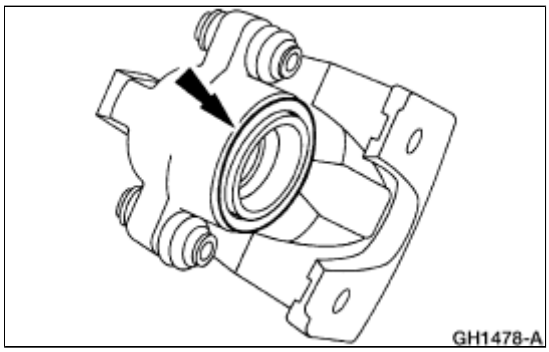


4. **CAUTION: Do not remove the guide pins or guide pin boots unless a problem is suspected. The guide pins are meant to be sealed for life and are not repairable. Use Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford specification ESE-M1C171-A for re-lubing the caliper slide pins. Other greases can swell the guide pin boots, resulting in contamination and accelerated corrosion or wear of the caliper slide pin mechanism.**

   Remove the rear disc brake caliper (2552).
   1. Remove the brake caliper bolts (2W303).
   2. Lift the rear disc brake caliper off the rear disc brake caliper anchor plate (2C220).



5. Inspect the rear disc brake caliper for leaks.
   - If leaks are found, disassembly is required. Refer to Caliper in this section.



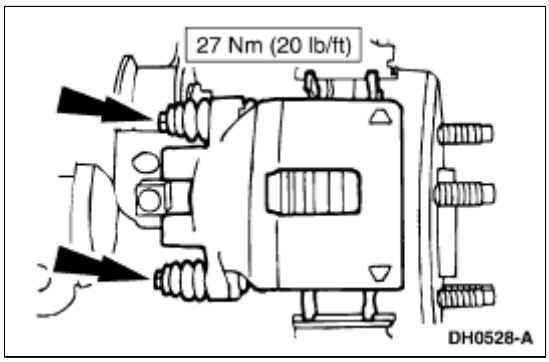
Installation

1. **CAUTION: To prevent interference with rear disc brake caliper operation, install only the correct caliper bolt.**

   NOTE: Make sure the stainless steel shoe slippers are correctly positioned. Install new slippers if worn or damaged.

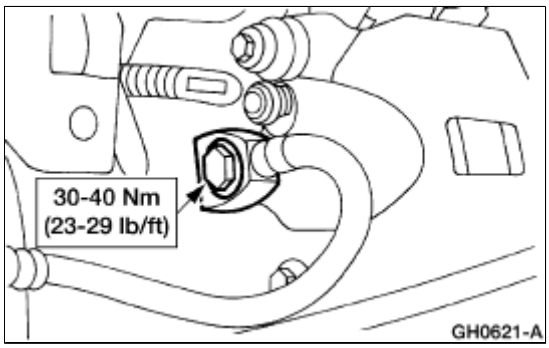
   NOTE: When installed, the locator notch on the brake pads will be located at the upper end of the rear disc brake caliper.

   Install the rear disc brake caliper.



2. Install the rear wheel brake hose.
   - Connect the brake hose and install the caliper flow bolt.

- Use new copper washers.



3. Bleed the disc brake caliper. For additional information, refer to Section 206-00 .
4. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Install the wheel and tire assembly. For additional information, refer to Section 204-04 .
5. Verify correct brake operation.

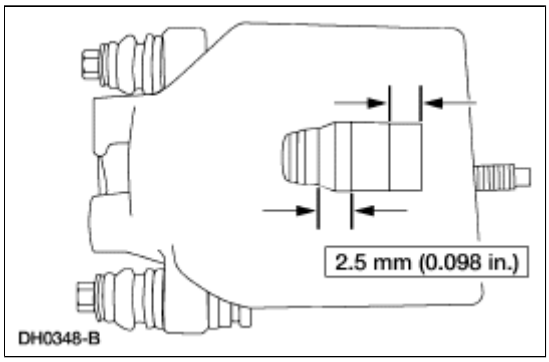
Pads

Removal

1. Remove brake fluid in the master cylinder reservoir until the reservoir is half full.

2. **CAUTION: Replace the pads if worn to or past the specified thickness above the metal backing plate or rivets. Install new pads in complete axle sets.**

   Inspect the brake pads for wear or contamination. Install new pads if worn to or past specification.

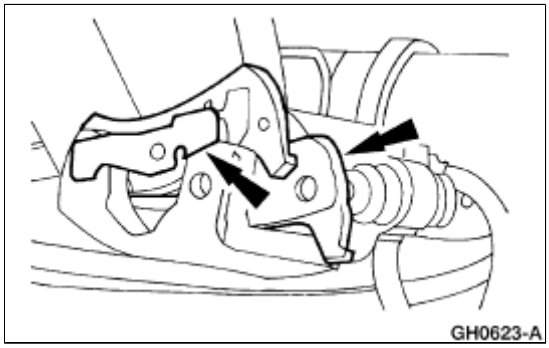


3. **NOTE:** It is not necessary to remove the rear wheel brake hose (2A442) when performing this procedure.

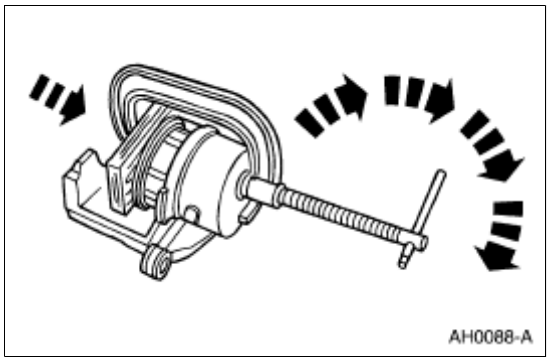
   Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.

4. **CAUTION: Do not allow grease, oil, brake fluid or other contaminants to contact the brake pads.**

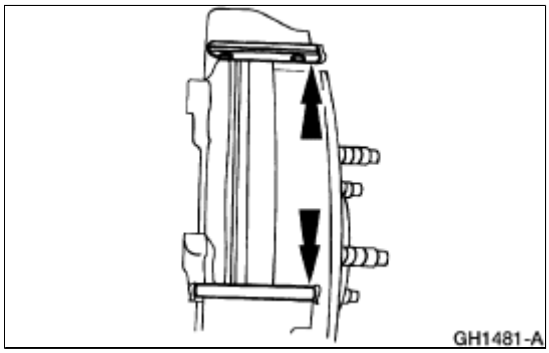
   Remove the brake pads.



5. Retract the caliper piston into the rear disc brake caliper.

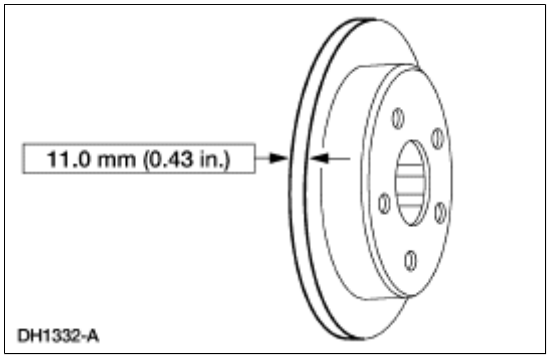


6. Remove the slippers.



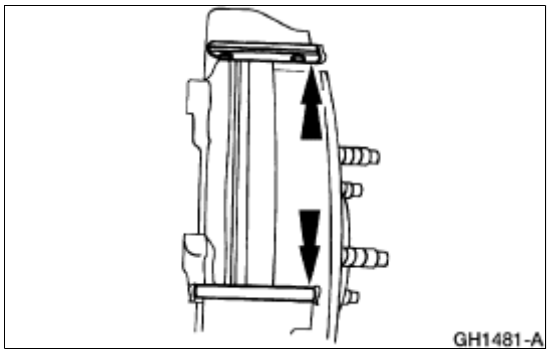
7. **CAUTION: Use a hub-mount brake lathe if necessary to machine the rear brake disc.**

   Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.



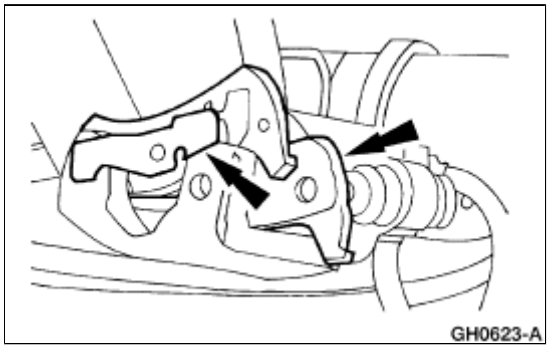
Installation

1. Clean the slipper mating surface, and install the slippers.



2. **CAUTION: Install new brake pads in full axle sets. Do not install new brake pads on only one side of vehicle.**

   Install the brake pads.



3. Install the rear disc brake caliper. For additional information, refer to Caliper in this section.
4. Verify correct brake operation.

Disc

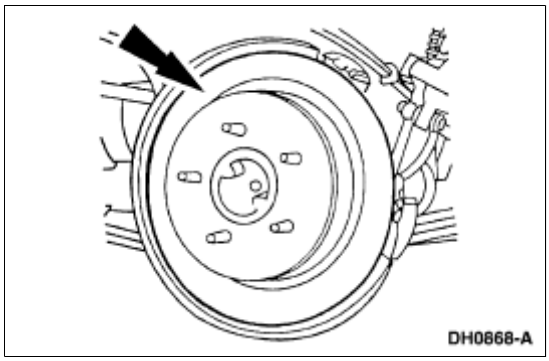
Removal

1. **NOTE:** When removing the rear brake disc (2C026) in this procedure it is not necessary to disconnect the hydraulic lines.

   Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.

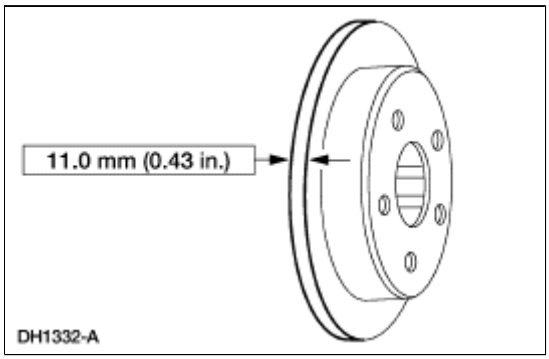
2. **NOTE:** If the rear brake disc binds on the rear parking brake shoe and linings, remove the adjustment hole access plug and contract the parking brake shoe and lining.

   Remove the rear brake disc.



3. **CAUTION: Use a hub-mount brake lathe if necessary to machine the rear brake disc.**

   Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.



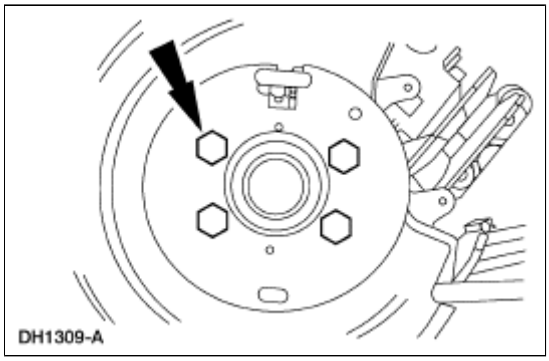
Installation

1. Follow the removal procedure in reverse order.

Adapter

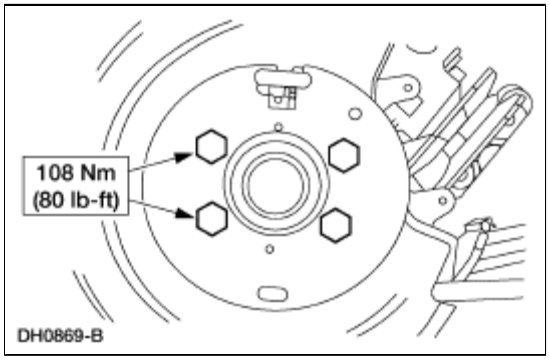
Removal

1. Disconnect the rear parking brake cable guide (2A697). For additional information, refer to Section 206-05 .
2. Remove the axle shaft (4234). For additional information, refer to Section 206-05 .
3. Remove the bolts and the rear wheel disc brake adapter (2C220).



Installation

1. Follow the removal procedure in reverse order.

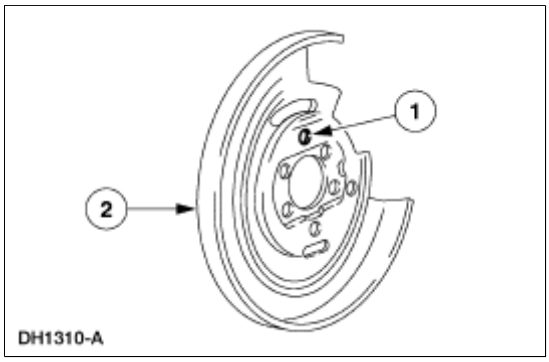


Shield

Removal

1. Remove the rear wheel disc brake adapter (2C220). For additional information, refer to Adapter in this section.

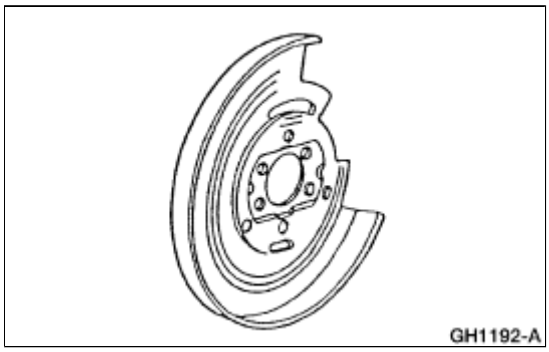
2. Remove the rear wheel disc brake shield (2C028).
    1. Drill out the rivet.
    2. Remove the rear wheel disc brake shield.



Installation

1. **NOTE:** Because the rear wheel disc brake shield is held in position by the four rear wheel disc brake adapter bolts, a new rivet is not required.

   Seal the rivet hole with Clear Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A, and install the rear wheel disc brake shield.



2. Install the rear wheel disc brake adapter. For additional information, refer to Adapter in this section.

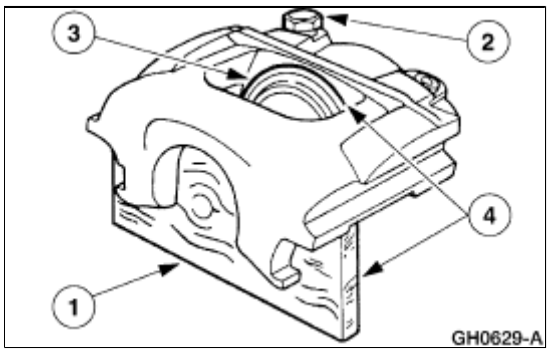
Caliper

Special Tool(s)

ST1255-A	Handle 205-153 (T80T-4000-W)
ST1588-A	Dust Seal Replacer 206-053 (T92P-2588-AH)

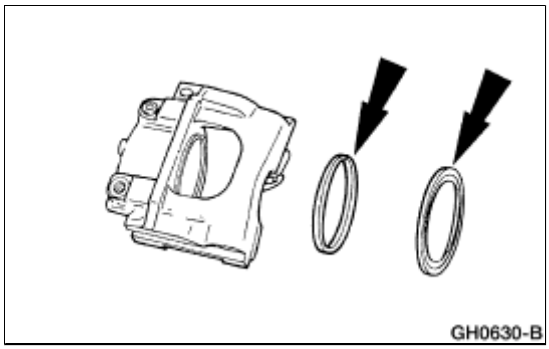
Disassembly

1. Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.
2. Drain the remaining brake fluid from the rear disc brake caliper.
3. Secure the rear disc brake caliper in a vise.
4. Remove the rear disc brake piston.
    1. Place a block of wood between the caliper bridge and the rear disc brake piston.
    2. Apply low air pressure to the fluid port in the rear disc brake caliper.
    3. Force the rear disc brake piston out to the block of wood.
    4. Remove the block of wood and the rear disc brake piston.



5. **NOTE:** Do not hone the cylinder bore. Pistons are not available for honed cylinder bores. If the rear disc brake caliper cylinder bore/piston is excessively scored or corroded, install a new rear disc brake caliper.

    Remove and discard the piston seal and dust boot.

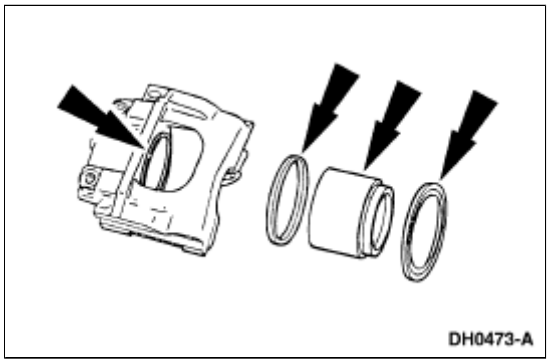


Assembly

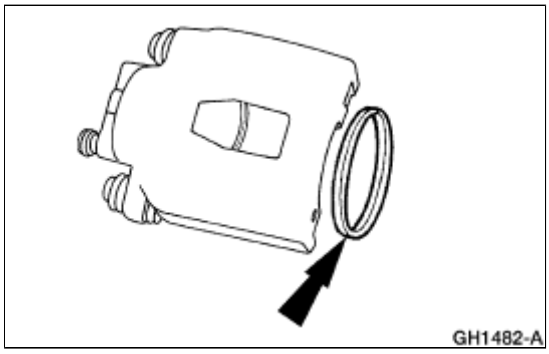
CAUTION: Never reuse the piston seal or dust boot.

NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

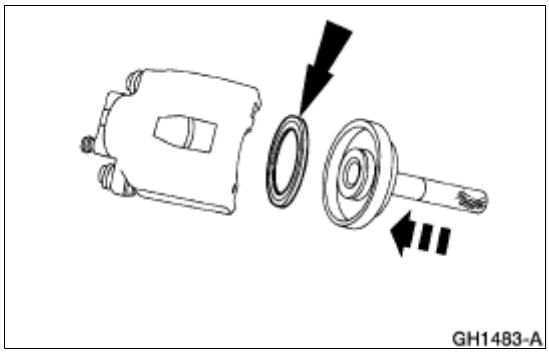
1. Lubricate the following with High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.
   - cylinder bore
   - piston seal
   - rear disc brake piston
   - dust boot



2. Install the piston seal.

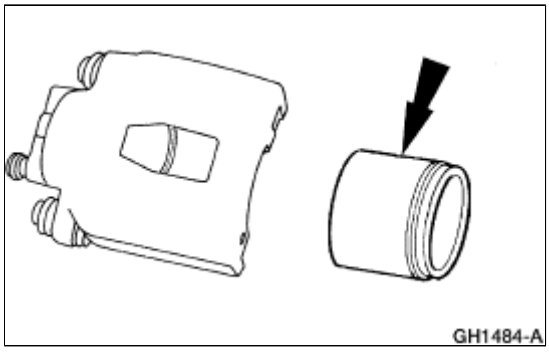


3. Install the dust boot.



4. **CAUTION: Be careful not to damage or dislodge the piston seal.**

   Install the rear disc brake piston.



5. Install the rear disc brake caliper. For additional information, refer to Caliper in this section.

General Specifications

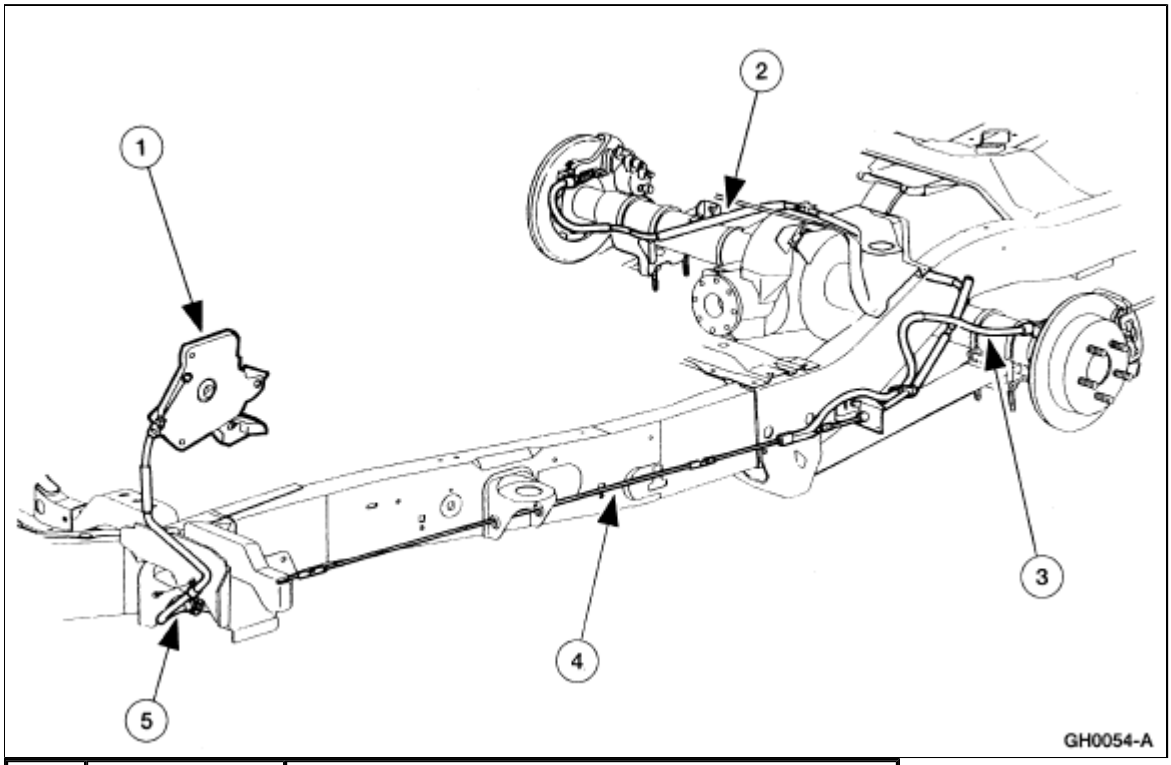
Item	Specification
Parking brake shoes and lining minimum thickness	1.0 mm (0.04 in)
Lubricant	
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Wheel nuts	135	100	—
Parking brake control bolts	17-23	13-17	—
Parking brake cable and conduit clip bolt	15-20	11-14	—
Parking brake cable retainer clip bolt	6-8	—	54-70
Parking brake remote release to instrument panel	2.1-2.9	—	19-25
Rear disc brake caliper to rear disc brake caliper anchor plate bolts	27	20	—
Parking brake cable retainer screws	20	15	—

Parking Brake

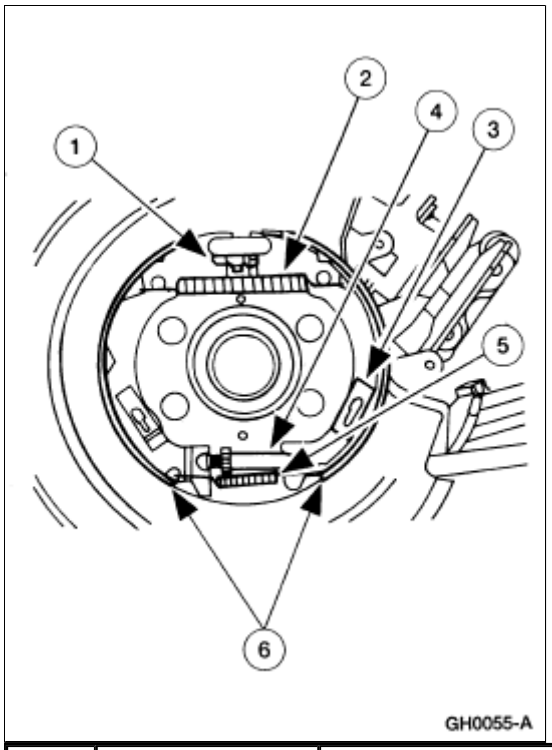
Parking Brake System Components



Item	Part Number	Description
1	2780	Parking brake control
2	2A635	Parking brake rear cable and conduit— (RH)
3	2A809	Parking brake rear cable and conduit— (LH)
4	2A793	Parking brake intermediate cable
5	2853	Front parking brake cable and conduit

The parking brake system is actuated when the parking brake control (2780) is depressed. The parking brake control applies tension to the front parking brake cable and conduit (2853), the parking brake intermediate cable (2A620), and the parking brake cable equalizer (2A602). The parking brake cable equalizer is coupled to the RH parking brake rear cable and conduit (2A635), and the LH parking brake rear cable and conduit. The respective rear brake assemblies are then applied.

Parking Brake Components



Item	Part Number	Description
1	2A637	Parking brake lever (RH)
1	2A638	Parking brake lever (LH)
2	2296	Brake shoe retracting spring
3	2A094	Brake shoe hold-down spring and pin
4	2041	Brake adjuster screw
5	2049	Brake shoe adjusting screw spring
6	2648	Rear brake shoe and lining

The rear wheel disc brake assembly contains a cable actuated parking brake assembly.

If the parking brake control is not fully released, the parking brake signal switch will illuminate the brake warning light.

The parking brake signal switch is mounted on the parking brake control. The switch is held in place by a self-tapping screw and aligned with a locater pin.

Parking Brake

Inspection and Verification

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control (2780) fully released. Check for any damaged cables and install new as necessary. Check the rear brake adjustment or perform brake system diagnosis.

Check the parking brake by depressing the parking brake control pedal. The parking brake must hold the vehicle on an incline by applying pressure to the pedal before it reaches full pedal travel to the floor. If not as specified, check the parking brake system for correct rear brake adjustment, cable operation and parking brake control operation.

Symptom Chart

Parking Brake System

Condition	Possible Sources	Action
• Parking brake will not apply	• Parking brake cable. • Rear shoes and linings. • Parking brake control.	• Go To Pinpoint Test A .
• Parking brake will not release	• Parking brake cable. • Parking brake control. • Rear shoes and linings.	• Go To Pinpoint Test B .

Pinpoint Tests

PINPOINT TEST A: PARKING BRAKE WILL NOT APPLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE PARKING BRAKE CABLE	
	1 Raise and support the vehicle. 2 Inspect for broken or binding parking brake cables. • **Is there a parking brake cable concern?** → **Yes** REPAIR or INSTALL a new parking brake cable as necessary.

	→ **No** GO to A2 .
A2 CHECK THE PARKING BRAKE CONTROL	
	1 Operate the parking brake control. • **Does the parking brake control operate smoothly?** → **Yes** GO to A3 . → **No** REPAIR the binding condition in the parking brake control. TEST the system for normal operation.
A3 CHECK THE PARKING BRAKE COMPONENTS	
	1 Remove the rear brake discs (2C026). Refer to Section 206-04 . 2 Operate the parking brake control and observe the parking brake components. • **Do the parking brake components operate?** → **Yes** CHECK the parking brake shoe and lining clearance to the drum of the brake disc. The minimum thickness on the shoes and lining is 1.0 mm (0.04 in). REFER to Parking Brake Shoes in this section. → **No** REPAIR the worn or damaged parts. TEST the system for normal operation.

PINPOINT TEST B: PARKING BRAKE WILL NOT RELEASE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE PARKING BRAKE CABLE	
	1 Release the parking brake control. 2 If the vehicle cannot be moved, raise and support it. 3 Release the parking brake cable tension. 4 Remove the rear brake disc and disconnect the parking brake rear cable and conduit (2A635). • **Does the parking brake release?** → **Yes** INSPECT the parking brake cable for binding. INSPECT the parking brake control. INSTALL new components as necessary. TEST the system for normal operation. → **No**

	REPAIR the worn or damaged rear brake component. TEST the system for normal operation.

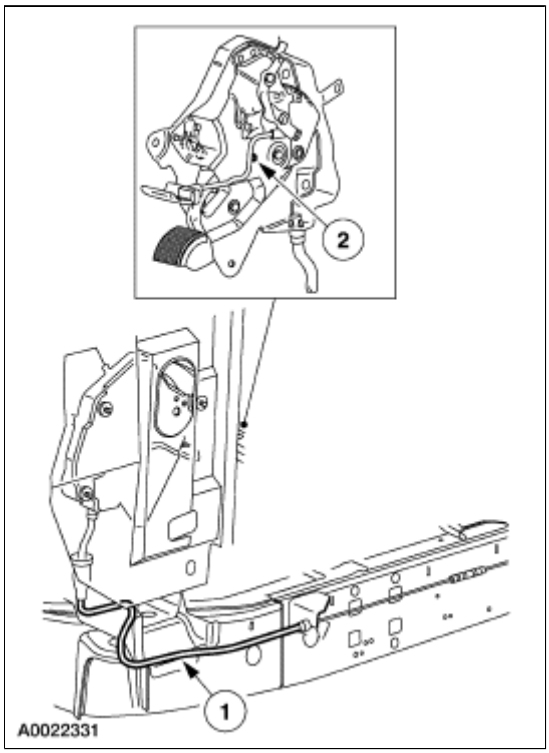
Control

Removal and Installation

1. Remove the LH cowl side trim panel. For additional information, refer to Section 501-05 .

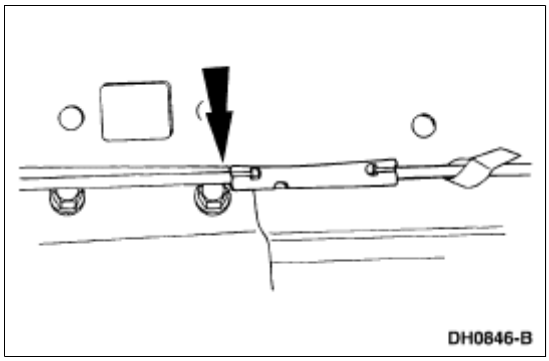
2. **NOTE:** Verify that the parking brake control (2780) is fully released.

   Relieve the tension on the parking brake system.
   1. Pull down on the parking brake intermediate cable (2A793).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer in the parking brake control.

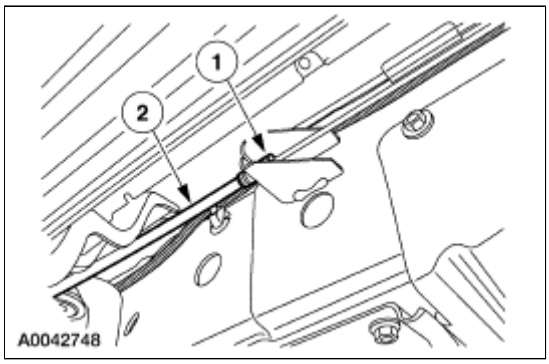


3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Disconnect the front parking brake cable and conduit (2853) at the locating hole end of the connector.

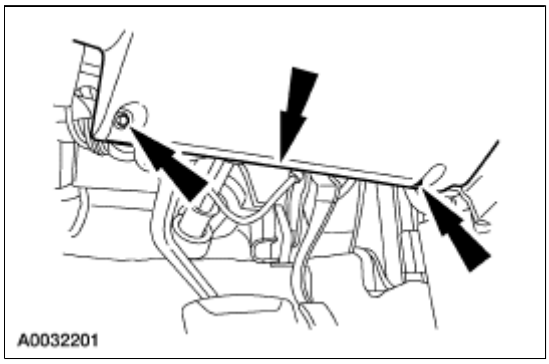


5. Remove the front parking brake cable and conduit from the bracket.
    1. Compress the retainer from the front parking brake cable and conduit from the bracket.
    2. Remove the front parking brake cable and conduit from the bracket.

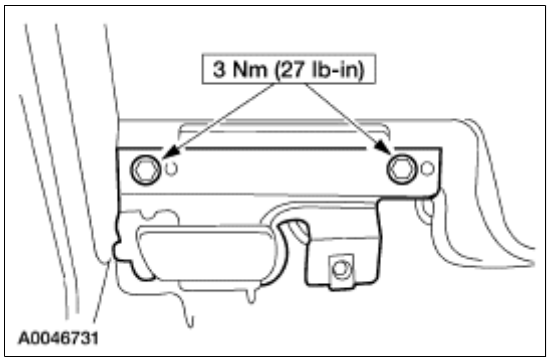


6. Lower the vehicle.

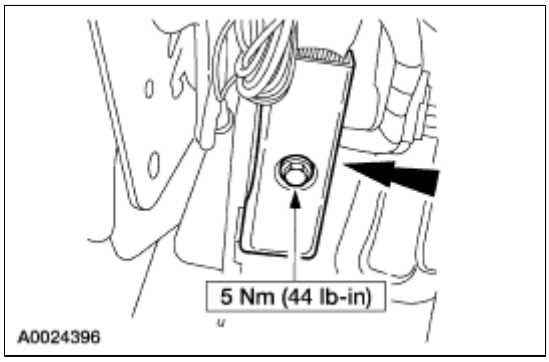
7. Remove the screws and the instrument panel steering column cover.



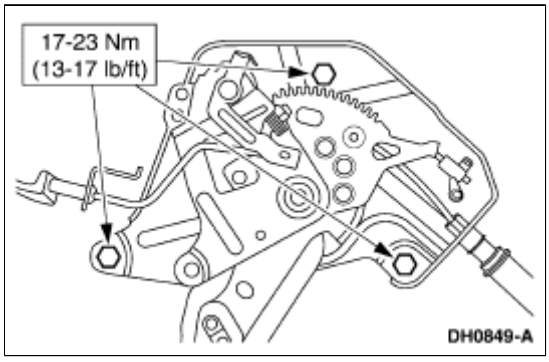
8. Remove the parking brake release mounting bolts.



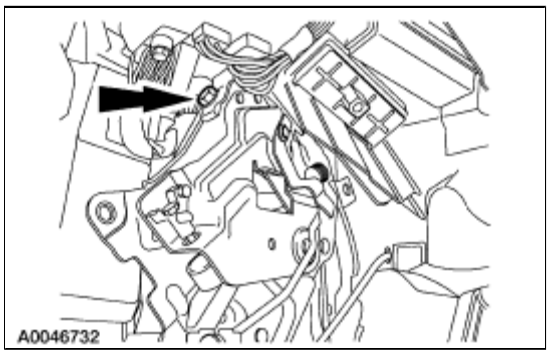
9. Loosen the bolt and disconnect the instrument panel-to-body harness electrical connector.



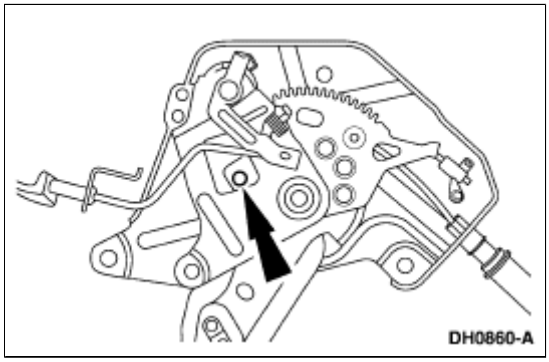
10. Remove the parking brake control and front parking brake cable and conduit.
    - Disconnect the parking brake signal switch electrical connector.
    - Remove the three parking brake control bolts.



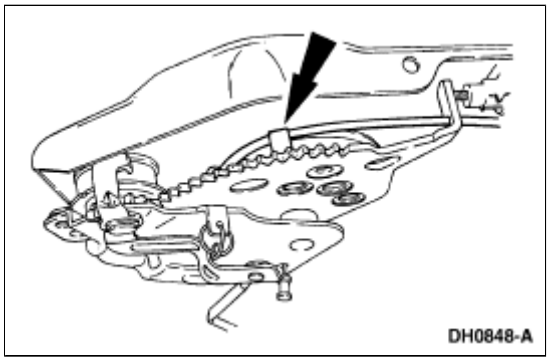
11. Remove the screw and position the bracket and wiring connector aside.



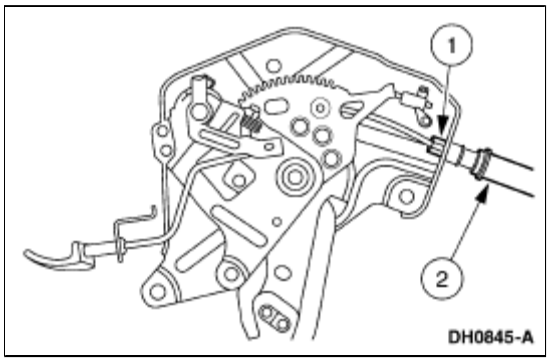
12. Remove the parking brake anchor pin from the parking brake control (2780).



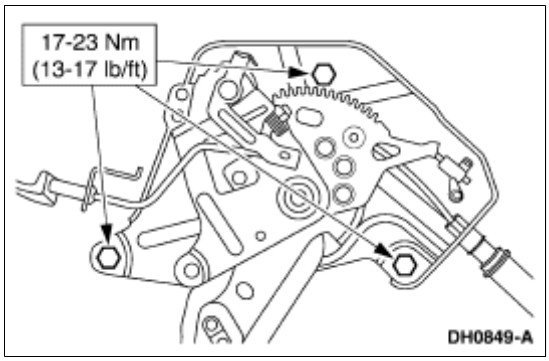
13. Bend the takeup spool tab up.



14. Remove the front parking brake cable and conduit housing.
    1. Compress the front parking brake cable and conduit-to-parking brake control clip.
    2. Remove the front parking brake cable and conduit housing.



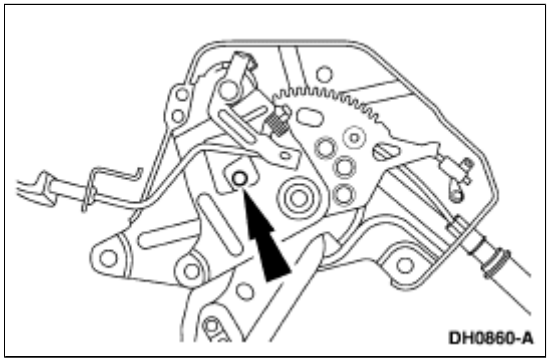
15. To install, reverse the removal procedure.


17-23 Nm
(13-17 lb/ft)
DH0849-A

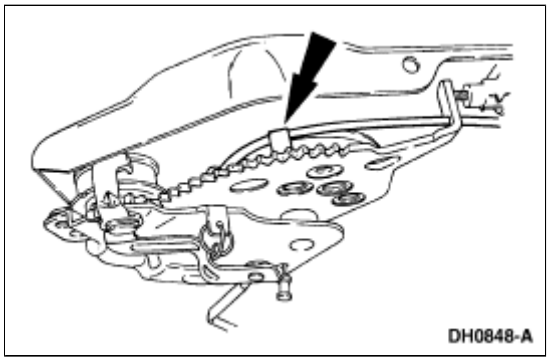
Cable and Conduit —Front

Removal and Installation

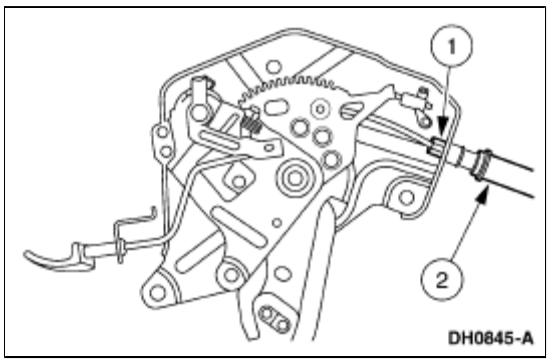
1. Remove the parking brake control. For additional information, refer to Control in this section.
2. Remove the parking brake anchor pin from the parking brake control (2780).



3. Bend the takeup spool tab up.



4. Remove the front parking brake cable and conduit housing.
    1. Compress the front parking brake cable and conduit-to-parking brake control clip.
    2. Remove the front parking brake cable and conduit housing.



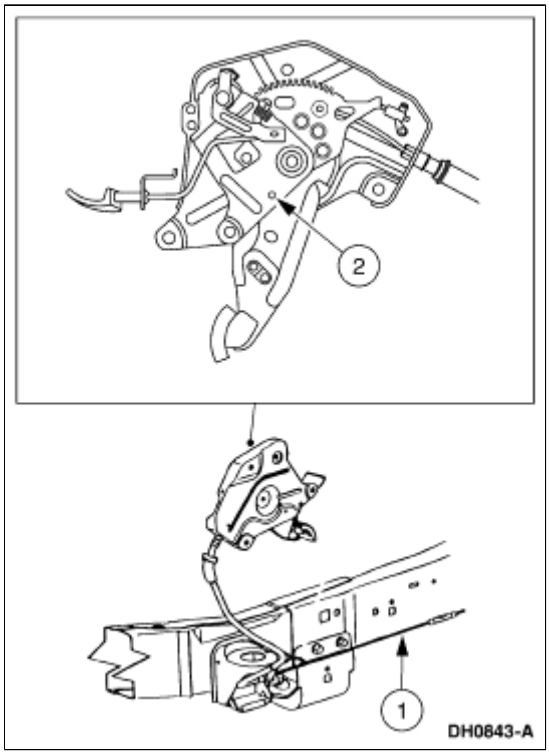
5. To install, reverse the removal procedure.
    - Make sure cable is routed through loop on takeup spool.

Cable and Conduit —Rear

Removal

1. **NOTE:** Make sure the parking brake control (2780) is fully released.

   Relieve the tension on the parking brake system.
   1. Pull the front parking brake cable and conduit (2853).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer.



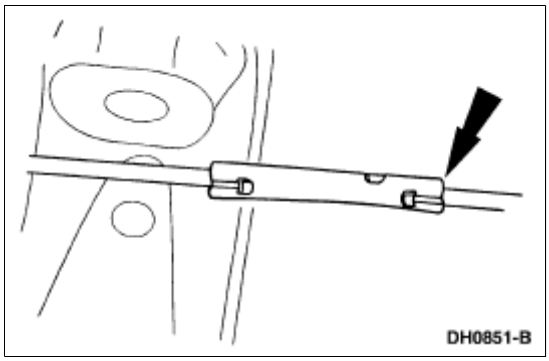
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

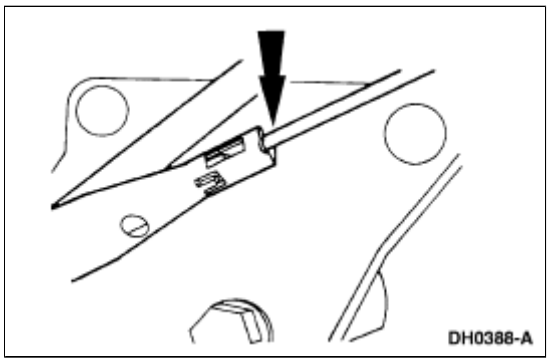
3. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .

4. **NOTE:** Disconnect the parking brake intermediate cable (2A620) from the locating hole end of the connector.

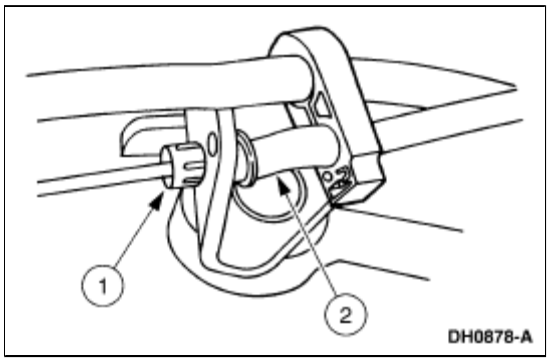
   Disconnect the parking brake intermediate cable from the LH parking brake rear cable and conduit (2A635).



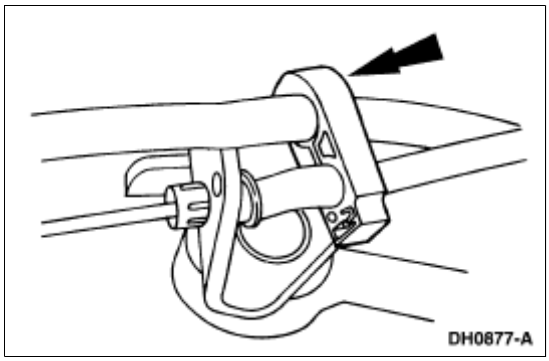
5. Separate the RH parking brake rear cable and conduit from the LH parking brake rear cable and conduit at the parking brake cable equalizer (2A602).



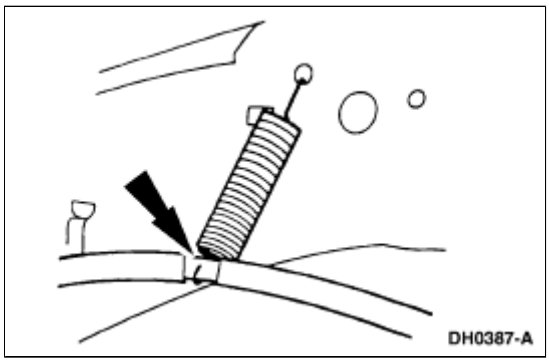
6. Remove the RH parking brake rear cable and conduit from the parking brake cable bracket (2530).
    1. Compress the parking brake cable clip.
    2. Remove the RH parking brake rear cable and conduit from the parking brake cable bracket.



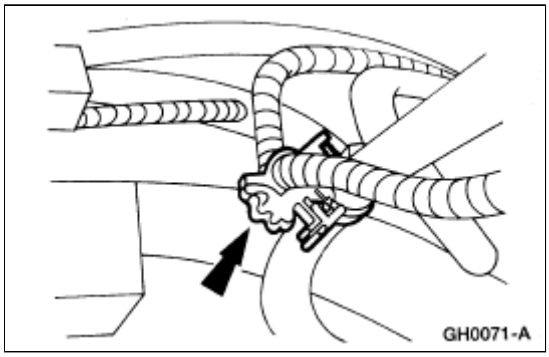
7. Remove the RH parking brake rear cable and conduit to LH parking brake rear cable and conduit clip.



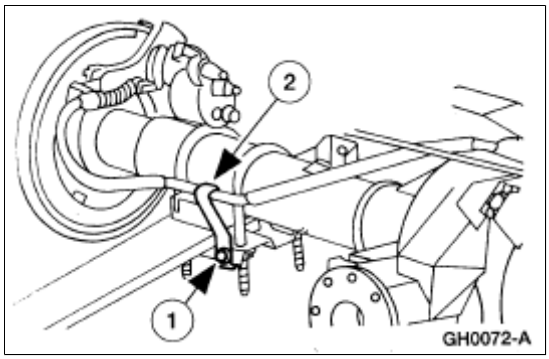
8. Remove the RH parking brake rear cable and conduit from the rear parking brake cable retainer (2A709).



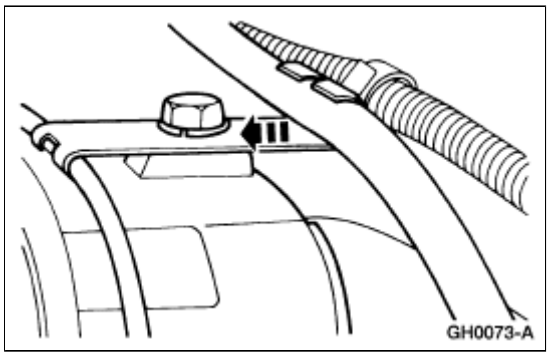
9. Remove the RH parking brake rear cable and conduit to the RH hydraulic brake line clip.



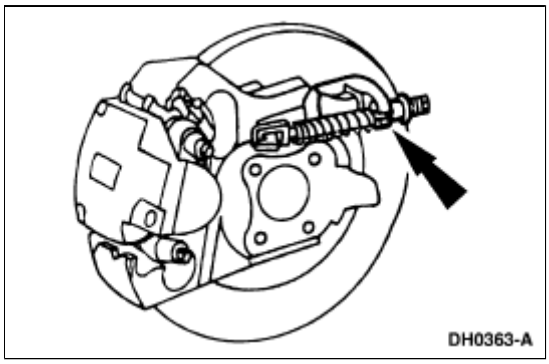
10. Remove the parking brake cable retainer clip (2A826).
    1. Remove the parking brake cable retainer clip bolt.
    2. Remove the parking brake cable retainer clip.



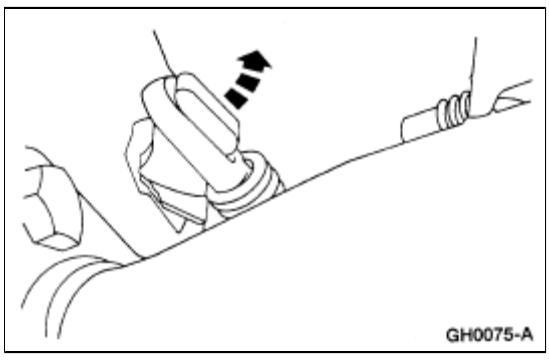
11. Unclip the parking brake rear cable and conduit from the brake line clip on top of the rear axle housing.



12. Compress the retainer and release the parking brake rear cable and conduit from the rear disc brake caliper anchor plate (2C220).

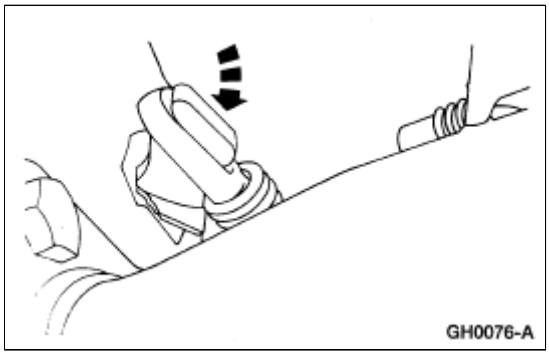


13. Unclip the parking brake rear cable and conduit from the parking brake lever (2A637).

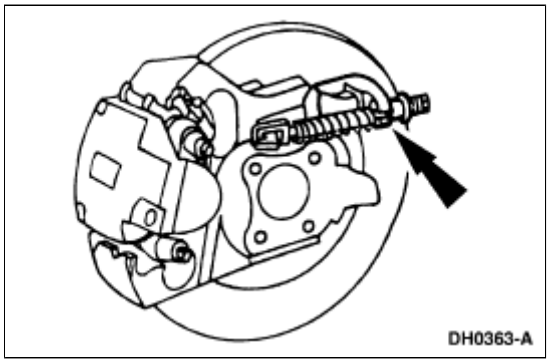


Installation

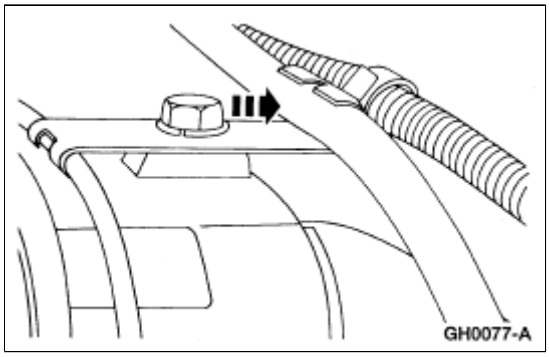
1. Clip the parking brake rear cable and conduit to the parking brake lever.



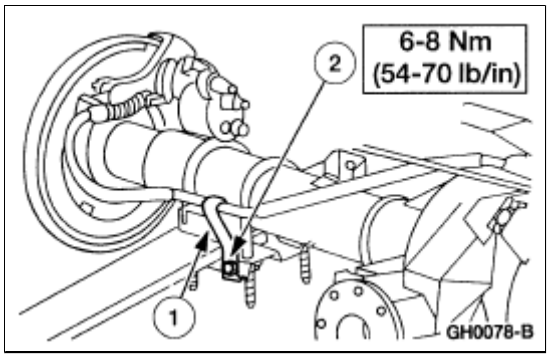
2. Connect the parking brake rear cable and conduit to the rear disc brake caliper anchor plate.



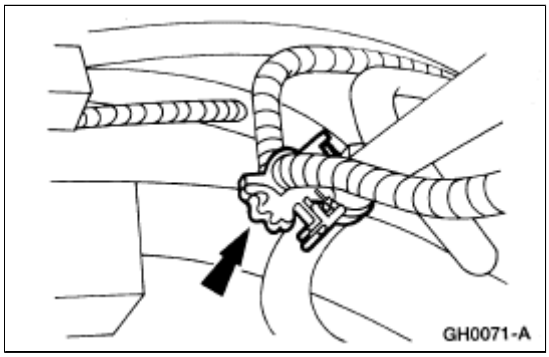
3. Clip the parking brake rear cable and conduit to the brake line clip on top of the rear axle housing.



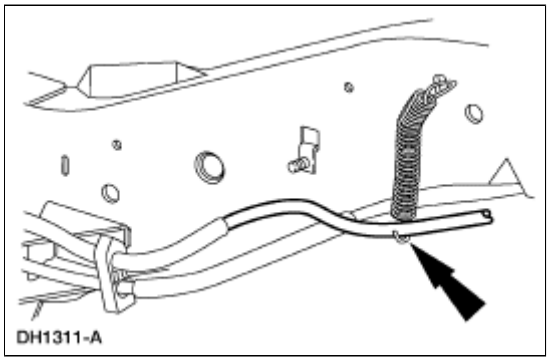
4. Install the parking brake cable retainer clip.
    1. Position the parking brake cable retainer clip.
    2. Install the parking brake cable retainer clip bolt.



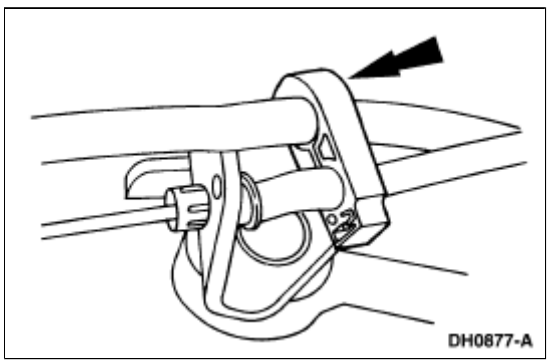
5. Install the RH parking brake rear cable and conduit to the RH hydraulic brake line clip.



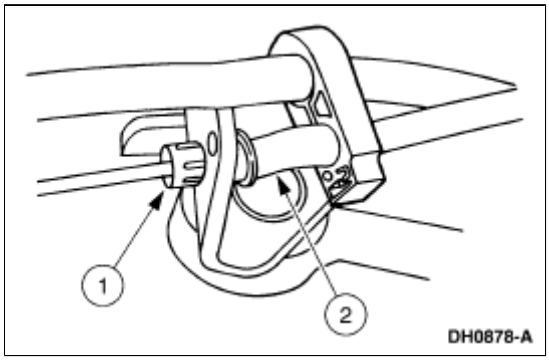
6. Hook the RH parking brake rear cable and conduit to the rear parking brake cable retainer.



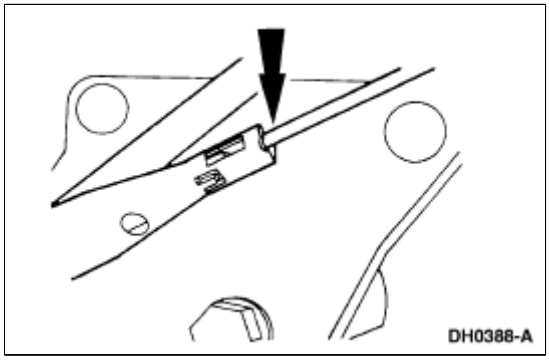
7. Install the RH parking brake rear cable and conduit to the LH parking brake rear cable and conduit clip.



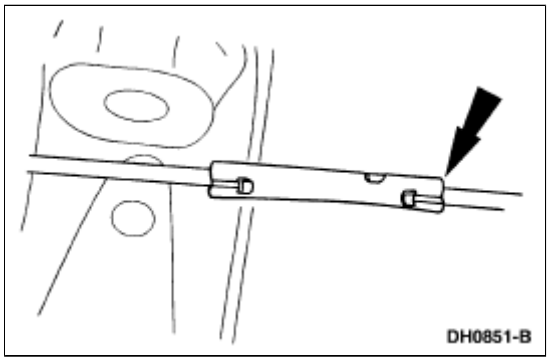
8. Connect the RH parking brake rear cable and conduit to the parking brake cable bracket.
    1. Install the RH parking brake rear cable and conduit to the parking brake cable bracket.
    2. Push the RH parking brake rear cable and conduit into the parking brake cable bracket until the parking brake cable and conduit clip is seated.



9. Connect the RH parking brake rear cable and conduit to the LH parking brake rear cable and conduit at the parking brake cable equalizer.



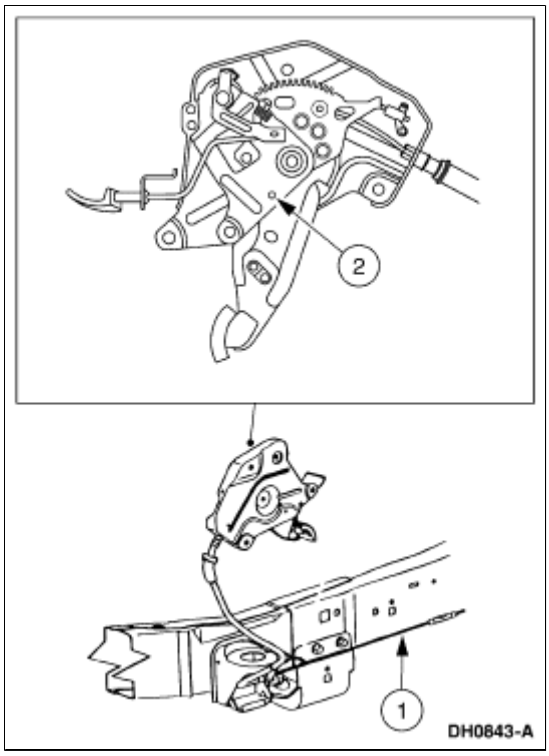
10. Connect the parking brake intermediate cable to the LH parking brake rear cable and conduit.



11. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

12. Apply tension to the parking brake system.
    1. Pull down on the front parking brake cable and conduit.
    2. Remove the retainer.


2
1
DH0843-A

Parking Brake Shoes

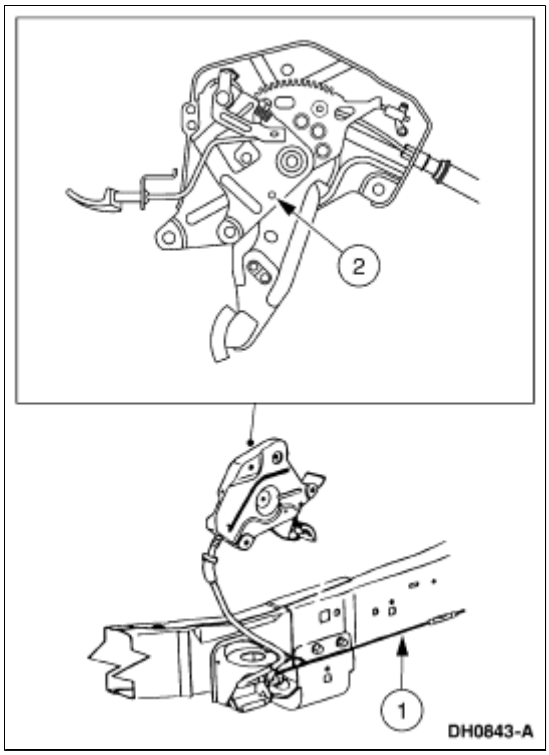
Special Tool(s)

ST1468-A	Brake Adjusting Gauge 206-D002 (D81L-1103-A) or Equivalent

Removal

1. **NOTE:** Make sure the parking brake control (2780) is fully released.

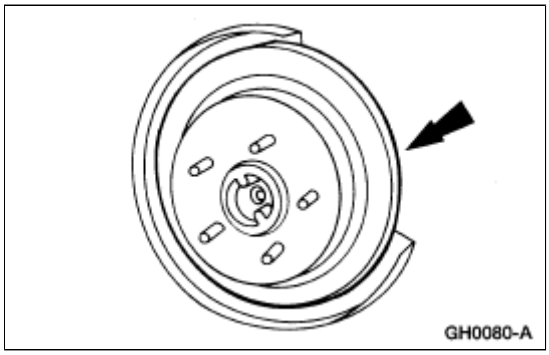
   Relieve the tension on the parking brake system.
   1. Pull the front parking brake cable and conduit (2853).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer.



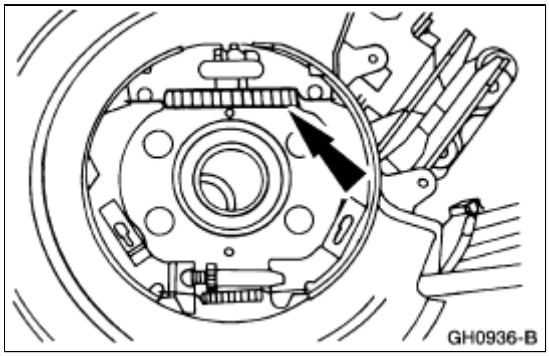
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

Raise and support the vehicle. For additional information, refer to Section 100-02 .

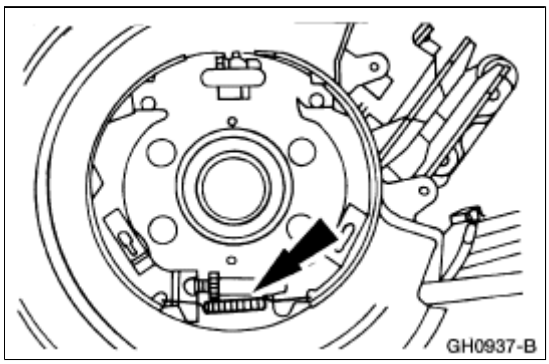
3. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .
4. Remove the rear brake disc (2C026). For additional information, refer to Section 206-04 .



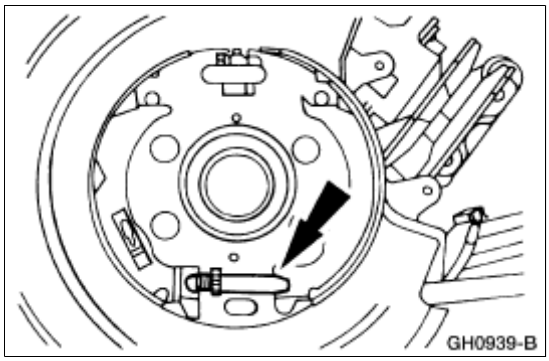
5. Remove the brake shoe retracting spring (2296).



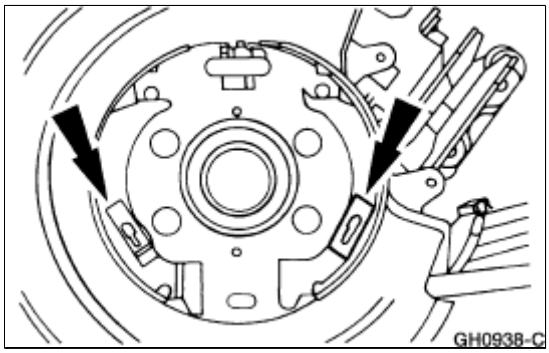
6. Remove the brake shoe adjusting screw spring (2049).



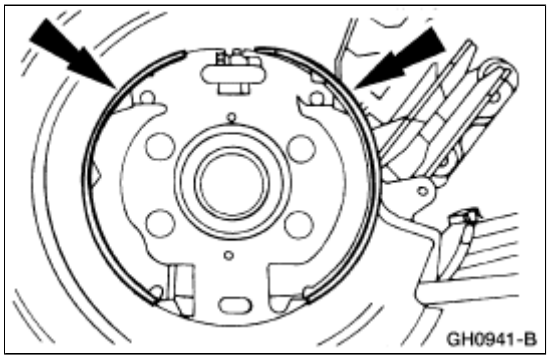
7. Remove the brake adjuster screw (2041).



8. Remove the rear brake shoe hold-down springs (2068).



9. Remove the rear brake shoes and linings (2200) along with the inboard brake shoe retracting spring.

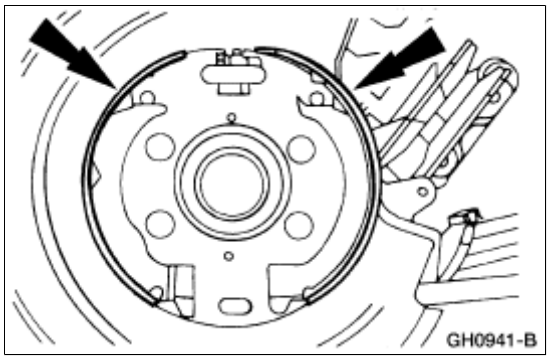


10. Inspect the components for excessive wear or damage and install new as required.

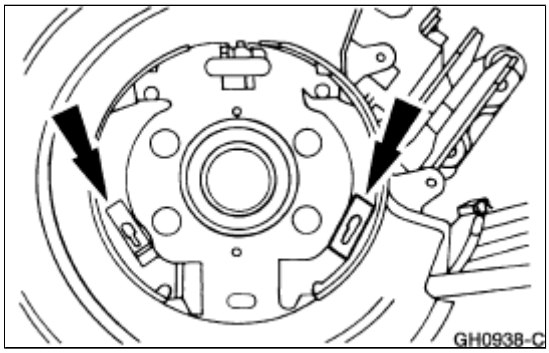
Installation

1. **NOTE:** Lubricate the brake shoe contact point before installation of rear shoes using Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford Specification ESE-M1C171-A.

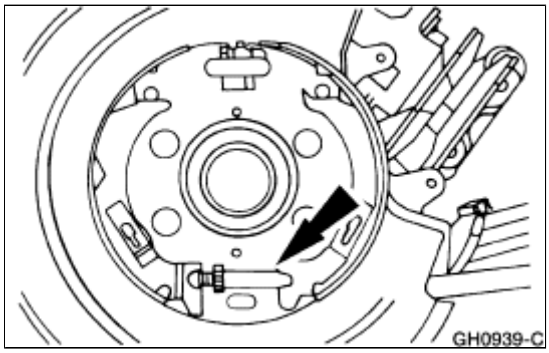
   Install the rear brake shoes and linings along with the inboard brake shoe retracting spring.



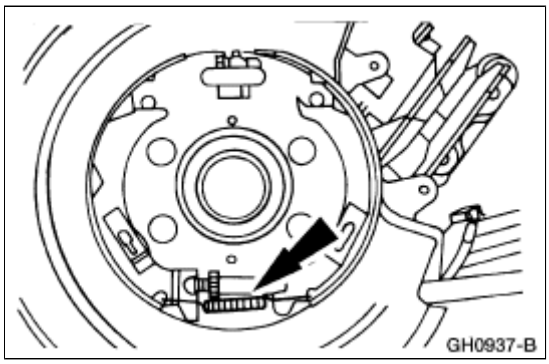
2. Install the brake shoe hold-down springs.



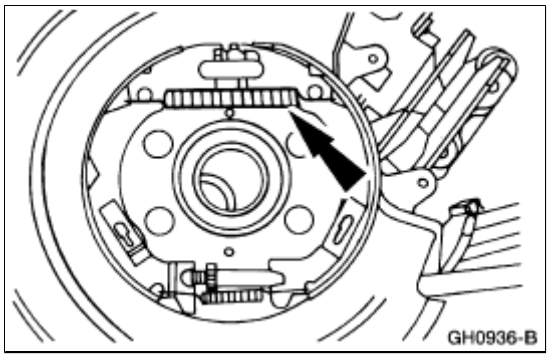
3. Install the brake adjuster screw.



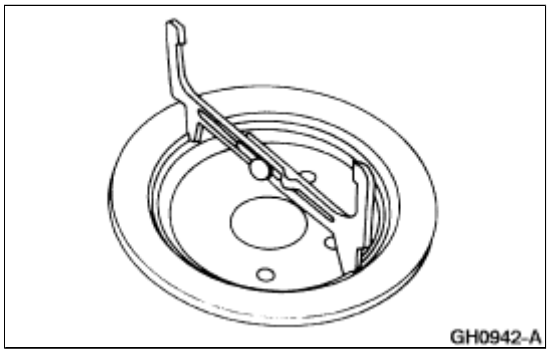
4. Install the brake shoe adjusting screw spring.



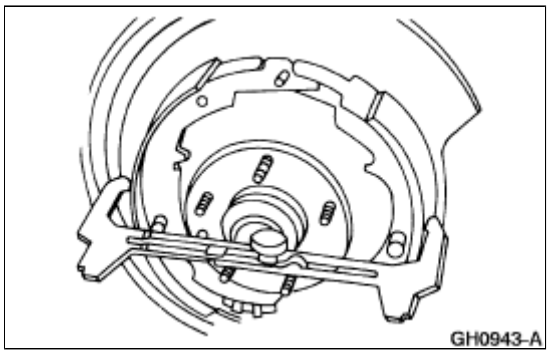
5. Install the outboard brake shoe retracting spring.



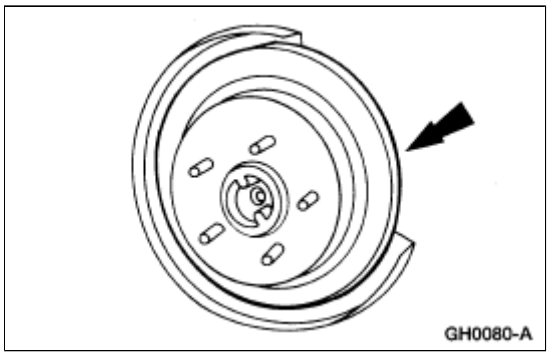
6. Use Brake Adjusting Gauge to measure the inside diameter of the drum portion of the rear brake disc.



7. Use Brake Adjusting Gauge to set the rear brake shoe and lining diameter to 0.5 mm (0.020 in) less than the inside diameter of the drum portion of the rear brake disc.



8. Install the rear brake disc. For additional information, refer to Section 206-04 .



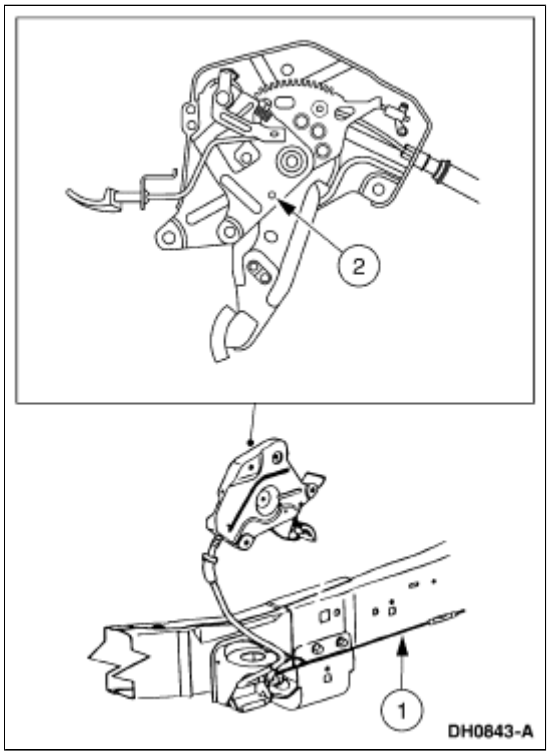
9. **WARNING: Always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal to metal contact at the wheel mounting surfaces can cause the lug nuts to loosen and come off while the vehicle is in motion, causing loss of control.**

   Clean the wheel hub mounting surface.

10. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

11. Apply tension to the parking brake cable system.
    1. Hold the front parking brake cable and conduit taut.
    2. Remove the retainer from the parking brake control.



12. Check the operation of the parking brake.

Bulb —Brake System Warning Indicator

Removal and Installation

For additional information, refer to Section 413-01 .

General Specifications

Item	Specification
Lubricant	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake master cylinder nut	18-27	14-19	—
Master cylinder brake tube nuts	15-20	12-14	—
Brake pedal bracket bolts and nuts	21-29	16-21	—
Brake pedal bracket nuts	21-29	16-21	—
Front brake hose bolt	30-40	23-29	—
Front brake hose bracket	13-17	10-12	—
Front brake tube	15-20	12-14	—
Disc brake caliper bleeder screw	17-24	13-17	—
Rear brake tube fitting	15-20	12-14	—
Brake pressure switch	14-20	11-14	—
Rear brake hose to caliper bolt	30-40	23-29	—
Brake hose bracket to rear axle bolt	13-17	10-12	—
Rear disc brake caliper bleeder screw	17-24	13-17	—
Brake pedal pivot bolt and nut	20-34	15-25	—
Battery ground cable bolt	7-10	—	62-88
Brake pressure control valve	13-22	10-16	—
Master cylinder bleeder screw	8-18	6-13	—

Hydraulic Brake Actuation

This vehicle is equipped with a brake pedal actuated dual brake system. The system consists of the following:

- brake pedal (2455)
- power brake booster (2005)
- brake master cylinder (2140)
- brake pressure control valve (2B091) (2-door vehicles)
- disc brake calipers (2B120)
- rear disc brake calipers (2553)
- brake tubes and hoses
- anti-lock brake system (ABS) components

The dual brake system is split front and rear, with the front wheel brakes comprising one circuit and the rear wheel brakes, the other circuit.

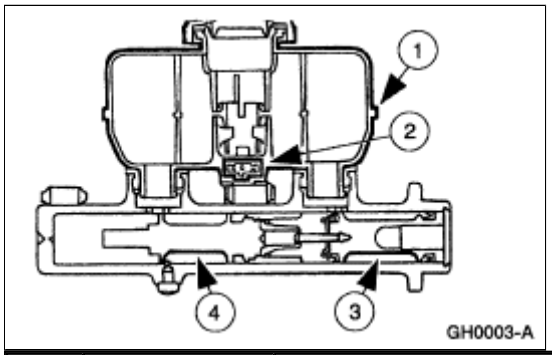
Brake Fluid

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

Clean, fresh Ford High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A is the only brake fluid that should be used in Ford vehicles.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.
- Do not mix different types of brake fluid.

Brake Master Cylinder



Item	Part Number	Description
1	2K478	Brake master cylinder reservoir

2	—	Brake master cylinder fluid level warning switch (part of 2K478)
3	—	Primary piston (part of 2140)
4	—	Secondary piston (part of 2140)

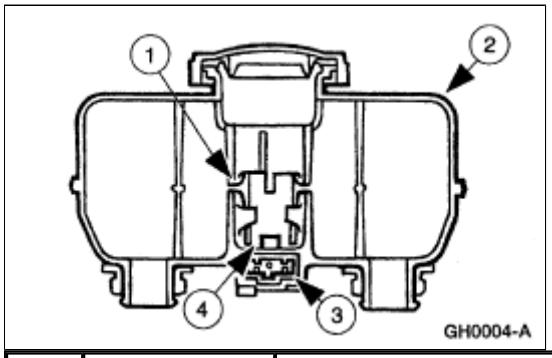
The brake master cylinder is a dual-piston type.

The brake master cylinder is assisted by a power brake booster. For additional information, refer to Section 206-07 .

The following conditions are considered normal and not indications that the brake master cylinder is in need of repair or replacement:

- Low brake fluid level detected without signs of leakage. This condition is caused by displacement of brake fluid from the brake master cylinder reservoir (2K478) into the disc brake calipers/rear disc brake calipers to compensate for normal brake wear. Fill the brake master cylinder reservoir with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.
- A momentary or slight squirt of brake fluid inside the brake master cylinder reservoir upon application of the brake pedal.
- A trace of brake fluid found on the outside of the power brake booster below the brake master cylinder mounting flange. This condition results from the lubricating action of the brake master cylinder wiping seal.

Warning Switch, Brake Fluid Level



Item	Part Number	Description
1	—	Float (part of 2K478)
2	2K478	Brake master cylinder reservoir
3	—	Brake fluid level warning switch (part of 2K478)
4	—	Magnet (part of 2K478)

The brake master cylinder fluid level warning switch is an integral part of the brake master cylinder reservoir. It consists of a float containing a magnet and a reed switch mounted in the bottom of the brake master cylinder reservoir.

When the brake fluid in the brake master cylinder reservoir gets to a predetermined level, the floating magnet actuates the reed switch, causing the red brake warning indicator to illuminate. Loss of brake fluid will cause this system to activate.

Brake Tubes and Hoses

CAUTION: Never use copper tubing. It is subject to fatigue, cracking and corrosion, which could result in brake tube failure.

If a section of brake tube is damaged, the entire section must be installed new with a tube of the same type, size, shape and length.

When installing hydraulic brake tubing, hoses, or connectors, tighten all connections to specifications. After installation, bleed the brake system. For additional information, refer to Section 206-00 .

Hydraulic Brake Actuation

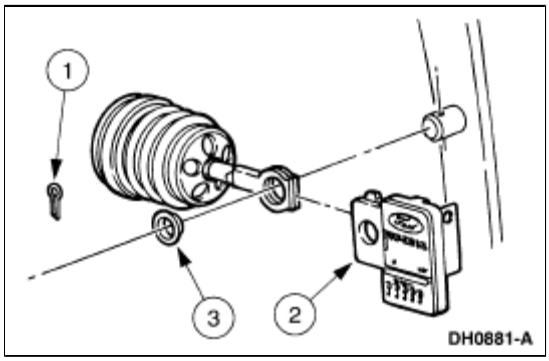
Refer to Section 206-00 .

Pedal and Bracket

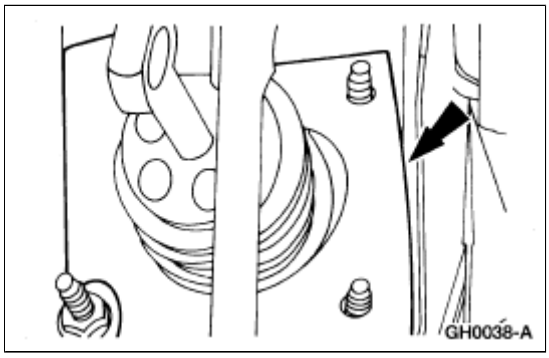
Removal

1. **NOTE:** When removing the stoplight switch (13480), retain the bushing and hairpin clip. They will be required for installation.

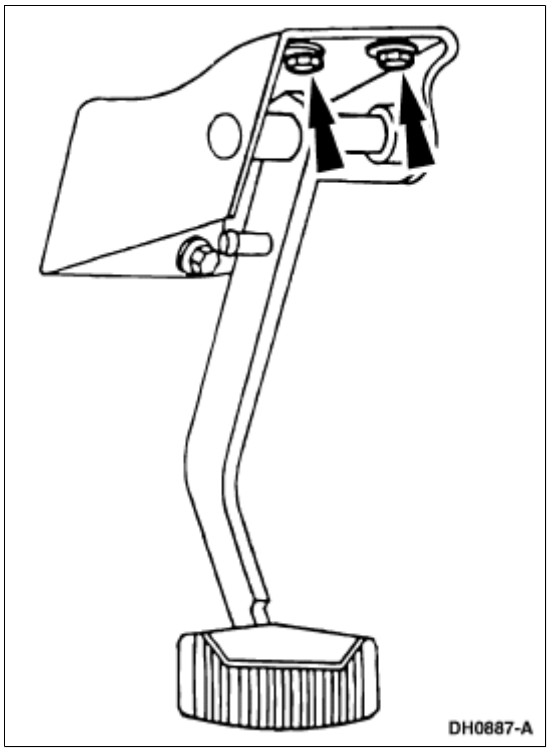
   Disconnect the brake booster push rod.
   1. Remove the hairpin clip.
   2. Separate the stoplight switch and the brake booster push rod from the brake pedal pin.
   3. Remove the brake booster push rod bushing.



2. Remove the bulkhead sound insulator.

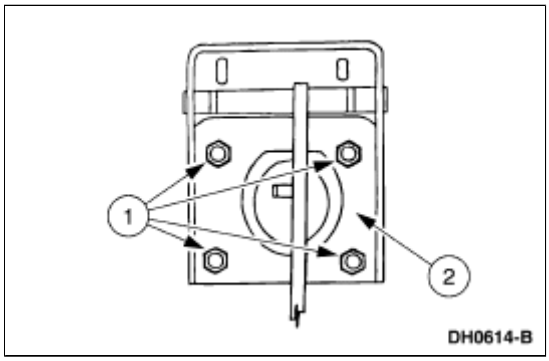


3. Remove the bolts.



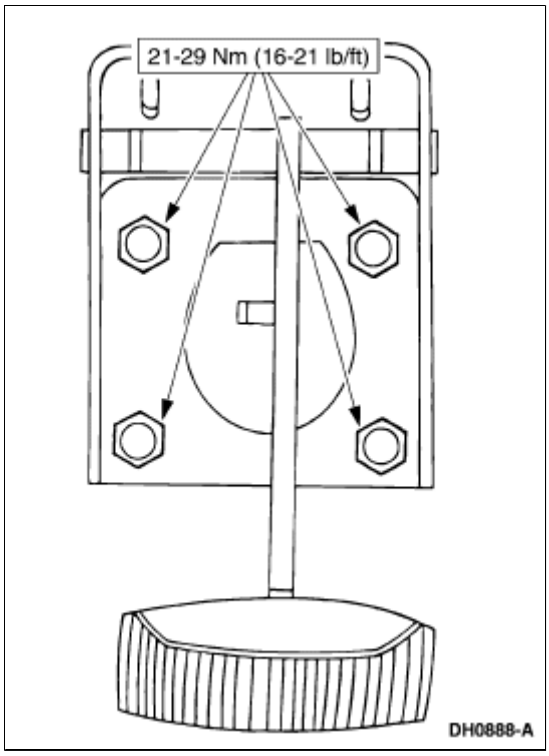
4. **CAUTION: Support the brake master cylinder and power brake booster in the engine compartment.**

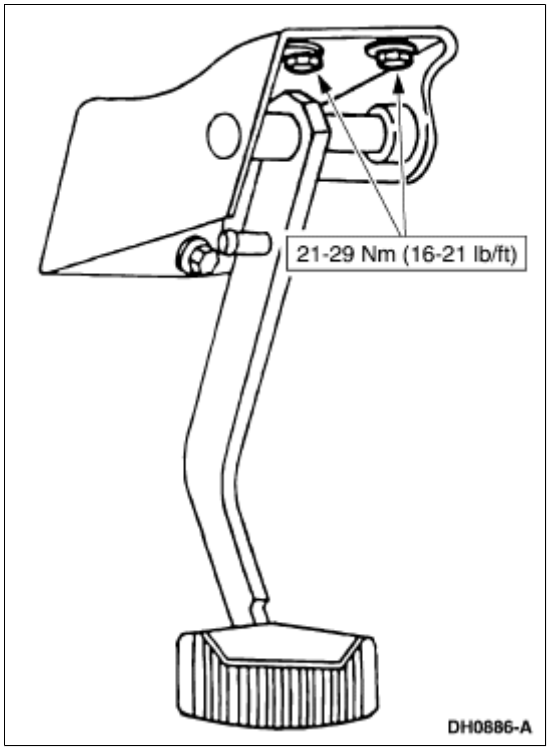
   Remove the brake pedal assembly.
   1. Remove the nuts.
   2. Remove the brake pedal assembly.



Installation

1. Follow the removal procedure in reverse order.


21-29 Nm (16-21 lb/ft)
DH0888-A

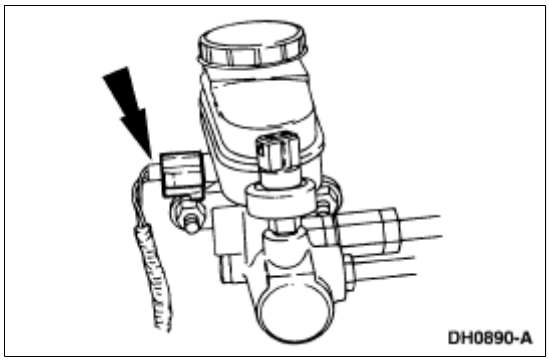

21-29 Nm (16-21 lb/ft)
DH0886-A

Master Cylinder

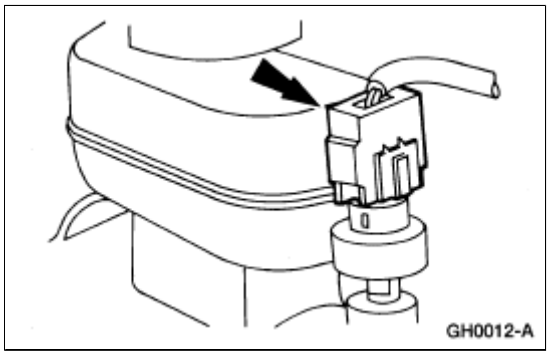
Removal

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

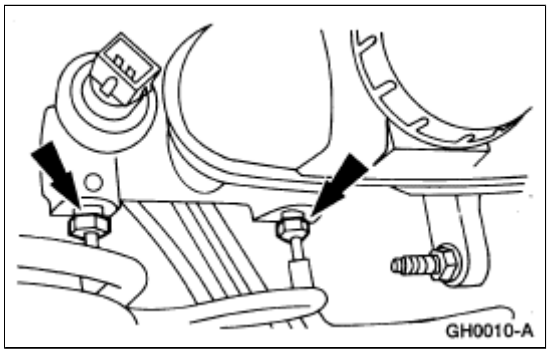
1. Disconnect the brake fluid level warning switch.



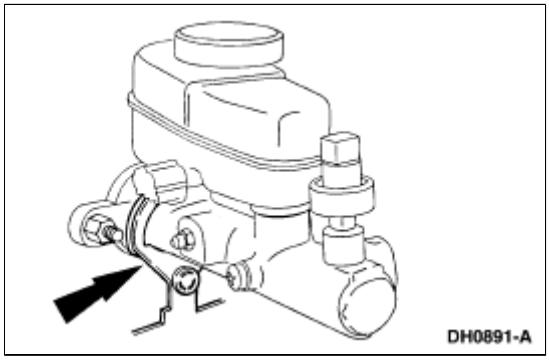
2. On cruise control equipped vehicles, disconnect the brake pressure switch.



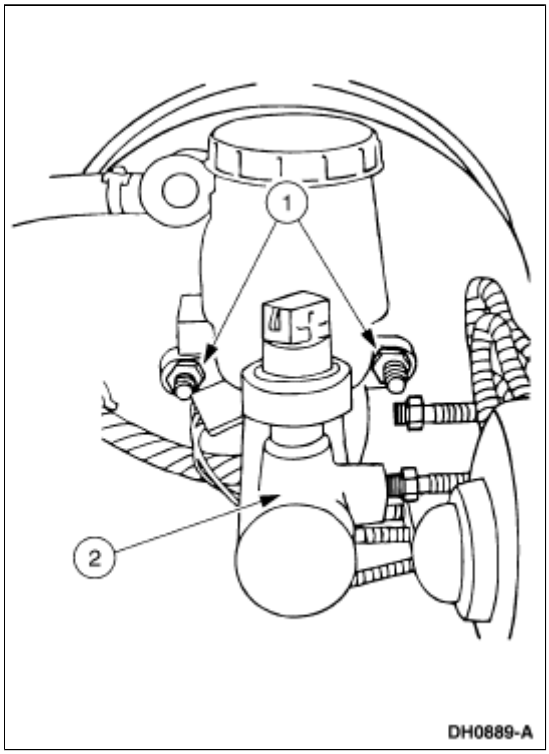
3. Disconnect the two brake lines, and plug the lines and the brake master cylinder ports.



4. On vehicles with 4.0L engine, remove the wiring retainer clip from the master cylinder.

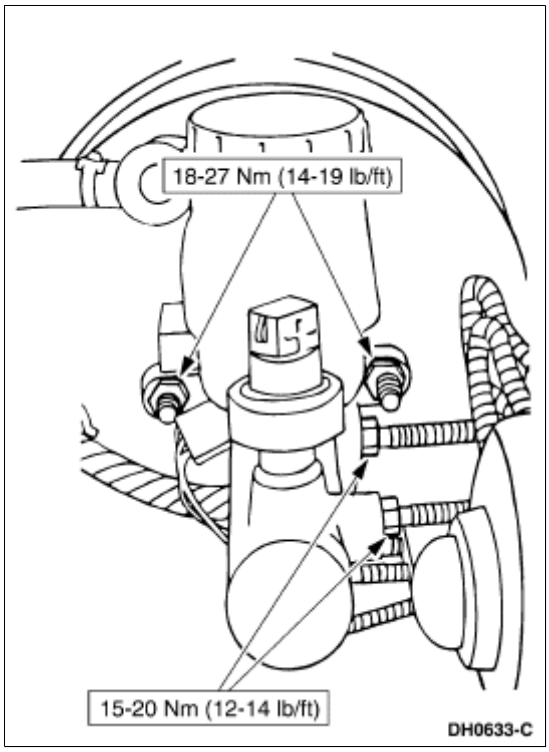


5. Remove the brake master cylinder (2140).
    1. Remove the nuts.
    2. Remove the brake master cylinder.



Installation

1. Follow the removal procedure in reverse order.
    - Bleed the brake master cylinder before installation. For additional information, refer to Section 206-00 .
    - Bleed the brake system. For additional information, refer to Section 206-00 .

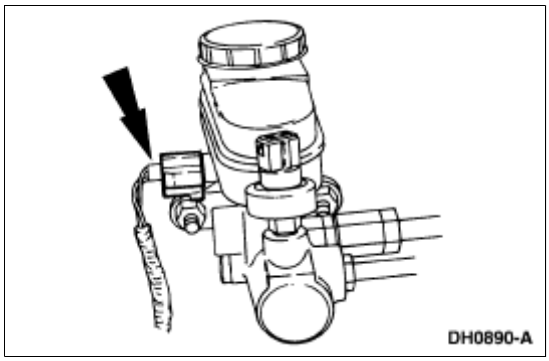

18-27 Nm (14-19 lb/ft)
15-20 Nm (12-14 lb/ft)
DH0633-C

Reservoir

Removal

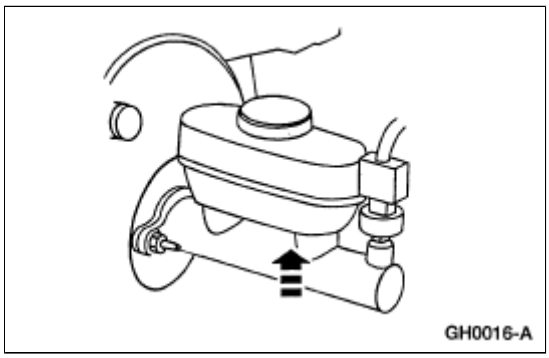
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

1. Disconnect the brake master cylinder fluid level warning switch.



2. Use a suitable suction device to drain the brake master cylinder reservoir (2K478).

3. Carefully pry up on the brake master cylinder reservoir to remove.

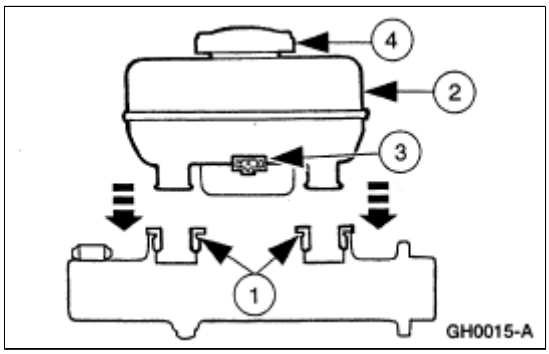


Installation

1. **NOTE:** Whenever installing a new brake master cylinder reservoir, install new grommets.

   Install the brake master cylinder reservoir.
   1. Lubricate the two grommets with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A, and insert the grommets in the brake master cylinder (2140).
   2. Press the brake master cylinder reservoir into the grommets until it snaps.
   3. Connect the brake master cylinder fluid level warning switch.
   4. Fill the brake master cylinder reservoir with High Performance DOT 3 Brake Fluid C6AZ-

19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.



General Specifications

Item	Specification
Power brake booster push rod length	24.89 mm (0.99 in) - 25.37 mm (1.01 in)

Torque Specifications

Description	Nm	lb-ft
Power brake booster nuts	21-29	15-20

Brake Booster

The power brake booster (2005):

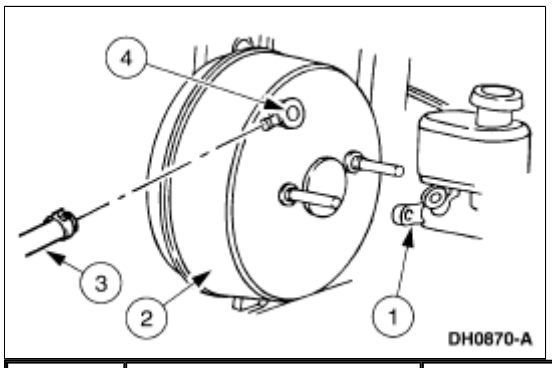
- is a dual diaphragm, vacuum assisted power brake booster.
- is located on the LH side of the bulkhead in the engine compartment, between the brake pedal and brake master cylinder (2140).
- is divided into separate chambers by the diaphragm.
- will not operate if vacuum is restricted or if any of the vacuum related power brake components fail.
- is installed as an assembly.

If the power assist fails, the brake system will continue to operate with increased brake pedal effort.

Hose and Check Valve

The power brake booster check valve:

- is located on the front of the power brake booster.
- is positioned between the power brake booster and the power brake booster hose.
- closes when the engine is turned off.
- in the closed position, traps engine vacuum in the power brake booster.
- retains vacuum to provide several power assisted brake applications with the engine off.



Item	Part Number	Description
1	2140	Master cylinder
2	2005	Brake vacuum booster
3	381298	Vacuum hose
4	2365	Check valve

Power Brake System

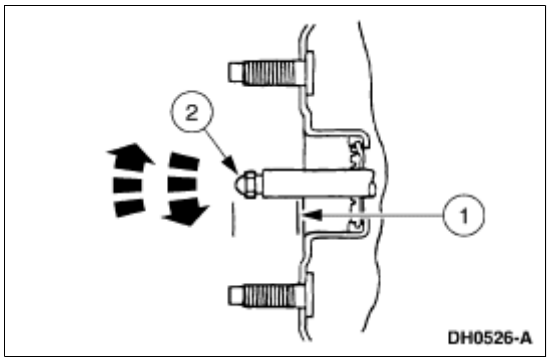
Refer to Section 206-00 .

Push Rod Adjustment

1. Remove the brake master cylinder (2140). For additional information, refer to Section 206-06 .

2. **CAUTION: Do not apply the brake pedal with the master cylinder removed from the booster.**

   Adjust the power brake booster to brake master cylinder push rod, vacuum applied.
   1. Measure the power brake booster to brake master cylinder push rod.
   2. If necessary, adjust the screw to the correct length. Refer to Specifications in this section.



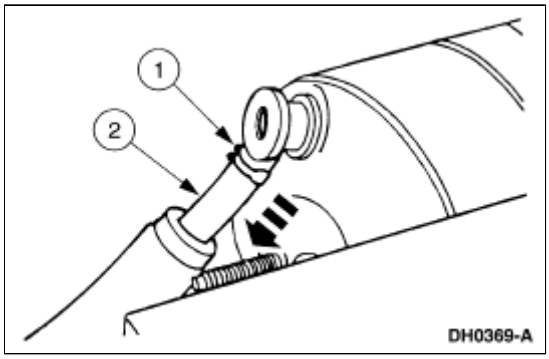
3. Install the brake master cylinder. For additional information, refer to Section 206-06 .

Brake Booster

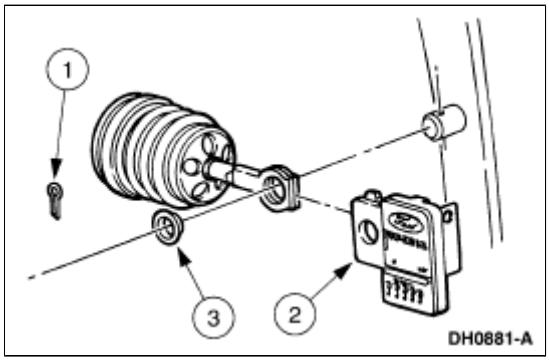
Removal

1. Remove the brake master cylinder (2140). For additional information, refer to Section 206-06 .

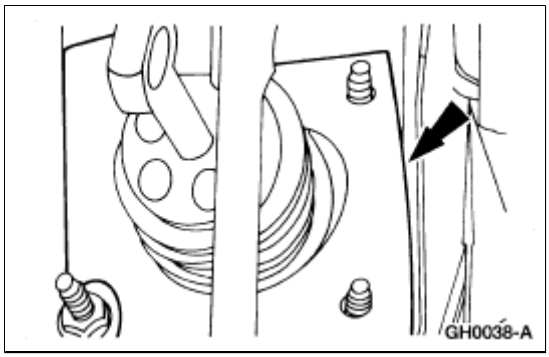
2. Disconnect the power brake booster hose.
    1. Compress the clamp.
    2. Disconnect the power brake booster hose.



3. Disconnect the brake pedal to power brake booster push rod.
    1. Remove the self-locking pin.
    2. Remove the stoplight switch (13480) and the brake booster push rod from the brake pedal pin.
    3. Remove the brake booster push rod bushing.

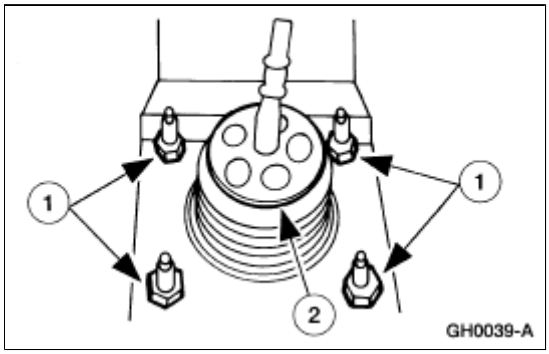


4. Remove the bulkhead sound insulator.



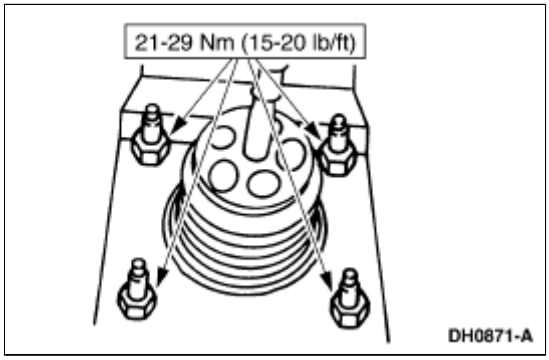
5. **NOTE:** Support the power brake booster (2005).

   Remove the power brake booster.
   1. Remove the nuts.
   2. Remove the power brake booster.



Installation

1. Follow the removal procedure in reverse order.



General Specifications

Item	Specification
High performance rear axle lubricant F1TZ-19580-B	WSL-M2C192-A
High temperature 4x4 front axle and wheel bearing grease E8TZ-19590-A	ESA-M1C198-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module bolts	1.8-1.9	—	—
Brake line to (EHCU) nuts (M10-1)	12-16	—	—
Brake line to (EHCU) nuts (M12-1)	15-18	—	—
Electronic hydraulic control unit bolts	9-13	—	—
Front anti-lock brake sensor bolt (4x2)	8-10	—	71-88
Front anti-lock brake sensor wire retaining bolt (4x4)	7-9	—	62-80
Front anti-lock brake sensor bolt (4x4)	7-9	—	62-80
G-switch nuts	19.1-25.9	—	—
Rear anti-lock brake sensor bolt	27	20	—

Anti-Lock Control —(4WABS)

The anti-lock control system consists of the following components:

- hydraulic control unit (HCU) (2C215)
- anti-lock brake control module (2B373)
- rear anti-lock brake sensor (2C190)
- rear anti-lock brake sensor indicator (4B409)
- G-switch (4x4) (2C341)
- front anti-lock brake sensor (2C204)
- front anti-lock brake sensor indicator (2C182)
- yellow ABS warning indicator (10849)

Anti-Lock Control

Refer to Wiring Diagrams Cell 42 , Anti-Lock Brake System (ABS) for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST1177-A	88 Digital Multimeter or equivalent 105-R0053
ST1449-A	EEC-IV 60-Pin Breakout Box or equivalent 418-005 (014-00322)
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1450-A	Anti-Lock Brake Adapter T97P-50-ALA

Principles of Operation

The anti-lock brake system (ABS) operates as follows:

- When the brakes are applied, fluid is forced from the brake master cylinder outlet ports to the hydraulic control unit (HCU) inlet ports. This pressure is transmitted through three normally open solenoid valves contained inside the HCU through the outlet ports of the HCU to each wheel.
- If the anti-lock brake control module senses a wheel is about to lock, based on anti-lock brake sensor

data, it closes the normally open solenoid valve for that circuit. This prevents any more fluid from entering that circuit.
- The anti-lock brake control module then looks at the anti-lock brake sensor signal from the affected wheel(s) again.
- If that wheel(s) is still decelerating, it opens the closed solenoid valve for that circuit to further reduce hydraulic pressure trapped in the line.
- Once the affected wheel comes back up to speed, the anti-lock brake control module returns the solenoid valves to their normal condition allowing fluid flow to the affected brake.
- The anti-lock brake control module monitors the electromechanical components of the system.
- A malfunction in the anti-lock brake system will cause the anti-lock brake control module to shut off or inhibit the system. However, normal power-assisted braking remains.
- Malfunctions are indicated by the yellow ABS warning indicator in the instrument cluster (10849).
- The anti-lock brake system is self-monitoring. When the ignition switch is turned to the RUN position, the anit-lock brake control module will carry out a preliminary self-check on the anti-lock electrical system indicated by a three-second illumination of the yellow ABS warning indicator in the instrument cluster.
- During vehicle operation, including normal and anti-lock braking, the anti-lock brake control module monitors all electrical anti-lock functions and some hydraulic operations.
- Each time the vehicle is driven, as soon as vehicle speed reaches approximately 20 km/h (12mph), the anti-lock brake control module turns on the pump motor for approximately one-half second. At this time, a mechanical noise may be heard. This is a normal function of the self-check by the anti-lock brake control module.
- Pedal pulsation coupled with noise while braking on loose gravel, bumps, wet or snowy roads is normal and indicates correct functioning of the anti-lock brake system.

Anti-Lock Brake Control Module

NOTE: The anti-lock brake control module must be reconfigured upon replacement. Refer to Section 418-01 .

The anti-lock brake control module is an on-board, diagnostic, non-repairable unit consisting of two microprocessors and the necessary circuitry for their operation. The anti-lock brake control module monitors system operation during normal driving as well as during anti-lock braking.

Anti-lock brake module operation is as follows:

- Under normal driving conditions, the microprocessor produces short test pulses to the solenoid valves that check the electrical system without any mechanical reaction.
- Impending wheel lock conditions trigger signals from the anti-lock brake control module that open and close the appropriate solenoid valves. This results in moderate pulsations in the brake pedal (2455).

During normal braking, the brake pedal feel will be identical to a standard brake system.

Most faults which occur to the anti-lock brake system will be stored as a diagnostic trouble code (DTC) in the keep-alive memory of the anti-lock brake control module. The DTCs can be retrieved by following the on-board diagnostic procedures.

Anti-Lock Brake Sensor

NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590A or equivalent meeting Ford specification ESA-M1C198-A.

The anti-lock brake system uses three variable-reluctance sensors to determine vehicle speed. The anti-lock

brake sensors operate on magnetic induction principle. As the teeth on the anti-lock brake sensor indicator rotate past the stationary sensor, a signal proportional to the speed of the rotation is generated and sent to the anti-lock brake control module through a twisted cable and shielded wiring harness.

G-Switch

The G-switch is used on 4x4 vehicles only. When driven in the 4-wheel drive mode, all four wheels are mechanically linked and a situation could arise in which one wheel locks up and causes all four wheels to lock up and skid. The speed sensors would indicate the vehicle speed as zero. Without the G-switch, the anti-lock brake control module would have no data to compare and would react as if the vehicle were stopped when in fact it is moving.

The G-switch detects and signals the anti-lock brake control module that the vehicle is moving.

Inspection and Verification

NOTE: The anti-lock brake control module must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by applying the brakes under different conditions.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Parking brake cable
• Tire pressure
• Tire size or mismatched tires
	• Blown fuse:
	  ▪ Central junction box (CJB) Fuse 11 (7.5A), Fuse 14 (10A)
	  ▪ Battery junction box (BJB) Maxi-Fuse 3 (50A)
	  ▪ BJB Mini-Fuse 7 (30A)
	• Connectors or connections
	• Harness routing
	• Wire chafing
	• Circuitry open/shorted
	• Indicator bulb

3. If the fault is not visually evident, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915, or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for anti-lock brake control module, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase

the continuous DTCs and carry out self-test diagnostics for the anti-lock brake control module.

6. If the DTCs retrieved are related to the concern, go to Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart.

Warning Lamp Indicator

The anti-lock brake system (ABS) uses the yellow ABS warning indicator to alert the driver of a malfunctions in the ABS.

The yellow ABS warning indicator will come on to warn the driver that the ABS has been turned off due to a symptom that exists in the ABS. Normal power assist braking remains but wheels can lock during a panic stop while the yellow ABS warning indicator is illuminated.

The diagnostic procedures must be followed step-by-step in order to correct the condition.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTCs	Description	Source	Action
B1342	Anti-Lock Brake Control Module Failure	Anti-Lock Brake Control Module	INSTALL a new Anti-lock brake control module; refer to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.
B1485	Brake Pedal Position (BPP) Switch Circuit Failure	Anti-Lock Brake Control Module	IGNORE the DTC. This DTC Applies Only to Traction Control Vehicle.
B1676	Battery Voltage Out Of Range	Anti-Lock Brake Control Module	GO to Pinpoint Test B .
B2141	Vehicle Speed Calibration Data Not Programmed Into Module	Anti-Lock Brake Control Module	CARRY OUT the Calibration Procedure Using the Scan Tool. REPEAT the self-test.
C1095	Hydraulic Pump Motor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test E .
C1102	G-Switch Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test F .
C1145	RF Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1155	LF Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1230	Rear Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1233	LF Anti-Lock Brake Sensor Output Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test D .
C1234	RF Anti-Lock Brake Sensor Output Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test D .
C1237	Rear Anti-Lock Brake Sensor	Anti-Lock Brake	GO to Pinpoint Test D .

	Output Failure	Control Module	

Anti-Lock Brake Control Module Parameter Identification (PID) Index

Anti-Lock Brake Control Module Parameter Identification (PID) Index

PID	Description	Expected Values
CONTABS	Number of Continuous DTCs on ABS	one count per bit
BOO_ABS	Brake Pedal Position (BPP) Switch Input	ON, OFF
ACCLSW1	Acceleration Switch Position 1 Input	ACT, notACT
ACCLSW2	Acceleration Switch Position 2 Input	ACT, notACT
ABSR_O	Rear ABS Outlet Valve	ON, OFF
ABSLF_O	LF ABS Outlet Valve	ON, OFF
ABSRF_O	RF ABS Outlet Valve	ON, OFF
ABSR_I	Rear ABS Inlet Valve	ON, OFF
ABSLF_I	LF ABS Inlet Valve	ON, OFF
ABSRF_I	RF ABS Inlet Valve	ON, OFF
LF_WSPD	LF Wheel Speed	0-255 MPH
RF_WSPD	RF Wheel Speed	0-255 MPH
R_WSPD	Rear Wheel Speed	0-255 MPH
4WDLOW	4WD Low Input	ON, OFF

Anti-Lock Brake Control Module Active Command Index

Anti-Lock Brake Control Module Active Command Index

Active Command	Display	Action
ABS Output Control	PMP MOTOR	ON, OFF
	LF INLET	ON, OFF
	RF INLET	ON, OFF
	R INLET	ON, OFF
	LF OUTLET	ON, OFF
	RF OUTLET	ON, OFF
	R OUTLET	ON, OFF
	ABS POWER	ON, OFF
ABS OUTPUT CONTROL II	ABS ACTIVE	ON, OFF

Symptom Chart

NOTE: Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint Tests.

Symptom Chart

Condition	Possible Sources	Action
• No communication with the anti-lock brake control module	• BJB Fuse 7 (30A). • CJB Fuse 14 (10A). • Circuitry. • Anti-lock brake control module.	• GO to Pinpoint Test A .
• Loss of sensor signal during vehicle deceleration or sensor signal drops out at low speed	• Anti-lock brake sensor indicator. • Sensor output is weak. • Air gap.	• GO to Pinpoint Test D .
• Unwarranted ABS activity	• Circuitry. • Anti-lock brake sensor.	• GO to Pinpoint Test D .
• Maladjusted rear brakes or "grabby" brake shoe or linings	• Rear brake adjustment. • Linings.	• REFER to Section 206-00 .
• Base brake mechanical concern for wheels lock up	• Rear brakes. • Parking brake. • Rear axle seal.	• REFER to Section 206-00 . • REFER to Section 206-05 . • REFER to Section 205-00 .
• Base brake hydraulic concern (soft pedal)	• Brake line or hose, fitting, master cylinder, or brake caliper. • Air in brake system.	• REFER to Section 206-00 .
• Base brake mechanical concern (hard pedal)	• Vacuum boost. • Brake caliper. • Brake line or hose.	• REFER to Section 206-00 .
• Base brake hydraulic concern during medium/hard brake application	• Brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. • Air in brake system.	• REFER to Section 206-00 .
• Base brake mechanical concern during medium/hard brake application	• Vacuum boost. • Wheel cylinder or caliper. • Brake line or hose. • Brake shoe or pad linings.	• REFER to Section 206-00 .
• Base brake mechanical concern for vehicle pulls	• Rear brake. • Caliper. • Brake pad or shoe	• REFER to Section 206-00 .

	wear.	
• Base brake hydraulic concern for vehicle pulls	• Brake line or hose. • Caliper. • Wheel cylinder.	• REFER to Section 206-00 .
• Intermittent loss of voltage to anti-lock brake control module	• Circuitry.	• INSPECT Circuit 601 from ignition switch to anti-lock brake control module harness connector for opens or shorts. REPAIR as necessary.
	• Anti-lock brake control module.	• INSPECT anti-lock brake control module grounds for looseness, corrosion or excessive dirt. REPAIR as necessary.
	• BJB.	• CORRECT condition.
• One wheel locks up; no DTCs recorded	• Base brake.	• REFER to Section 206-00 .
	• Dump valve. • ISO valve.	• INSTALL a new hydraulic control unit.
• The yellow ABS warning indicator does not self-check	• Bulb. • Circuitry. • Instrument cluster. • Anti-lock brake control module.	• GO to Pinpoint Test G .
• Soft or excessive brake pedal	• Brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. • Air in brake system.	• REFER to Section 206-00 .

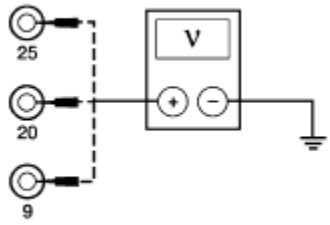
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK CIRCUIT 601 (LB/PK), 534 (YE/LG), AND 483 (RD)	
1 2 Anti-Lock Brake Control Module C186	

4

5



GH2470-A

3 Connect EEC-IV 60-Pin Breakout Box.

5 Measure the voltage between EEC-IV 60-Pin Breakout Box pins, and ground as follows:

EEC-IV 60-Pin Breakout Box Pin	Circuit
20	601 (LB/PK)
25	483 (RD)
9	534 (YE/BK)

- **Are the voltages greater than 10 volts?**

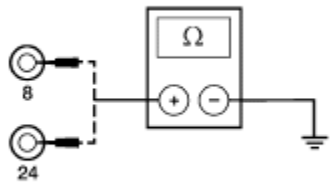
→ **Yes**
GO to A2.

→ **No**
REPAIR circuit(s) in question. TEST the system for normal operation.

A2 CHECK CIRCUIT 57 (BK) FOR AN OPEN

1

2



GH1805-A

2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground.

- **Are the resistances less than 5 ohms?**

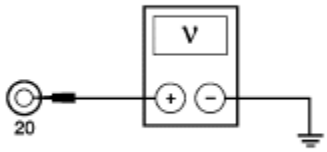
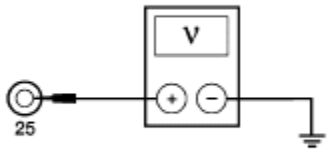
→ **Yes**
REFER to Section 418-00.

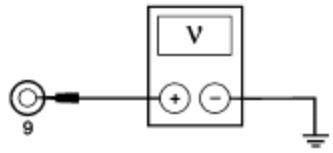
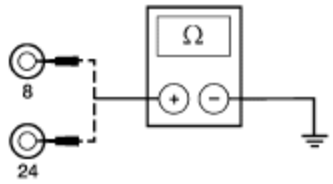
→ **No**

	REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: DTC B1676, BATTERY VOLTAGE OUT OF RANGE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: DTC B1676 is generated when the anti-lock brake control module detects system voltage is less than 9 volts or greater than 19 volts for more than 8 seconds.	
B1 CHECK RECENT VEHICLE HISTORY	
	1 Check recent vehicle history. • **Has the vehicle been jump-started by a tow truck within the past two weeks?** → **Yes** The system is OK. CLEAR the DTCs. REPEAT the self-test. → **No** GO to B2.
B2 CHECK THE BATTERY VOLTAGE	
	1 Measure the voltage between the positive and negative battery posts. • **Is the voltage between 9 and 19 volts?** → **Yes** GO to B3. → **No** REFER to Section 414-00.
B3 CHECK CIRCUIT 601 (LB/PK) FOR PROPER VOLTAGE	
1 2 Anti-Lock Brake Control Module C186 4	3 Connect EEC-IV 60-Pin Breakout Box.

 5  GH2462-A	5 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 20, Circuit 601 (LB/PK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B4 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK CIRCUIT 483 (RD) FOR AN OPEN	
1 2  GH1804-A	2 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 25, Circuit 483 (RD), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B5 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B5 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN	

1  GH1803-A	1 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 9, Circuit 534 (YE/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B6 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B6 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  GH1805-A	1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

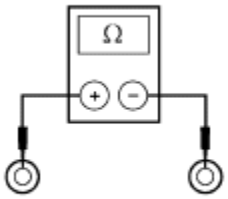
PINPOINT TEST C: DTCs C1145, C1155, AND C1230, ANTI-LOCK BRAKE SENSOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ANTI-LOCK BRAKE SENSOR RESISTANCE AT BREAKOUT BOX	
1	

2

Anti-Lock Brake Control Module C186

4



GH1062-A

3 Connect EEC-IV 60-Pin Breakout Box.

4 Measure the resistance between EEC-IV 60-Pin Breakout Box pins for the suspect anti-lock brake sensor as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box	
	Positive Probe	Negative Probe
LF	17	18
RF	3	4
Rear	22	21

- **Is the resistance between 800 and 1400 ohms (front 4x2), 800 and 2500 ohms (rear), or 380 and 480 ohms (front 4x4)?**

→ **Yes**
GO to C5 .

→ **No**
GO to C2 .

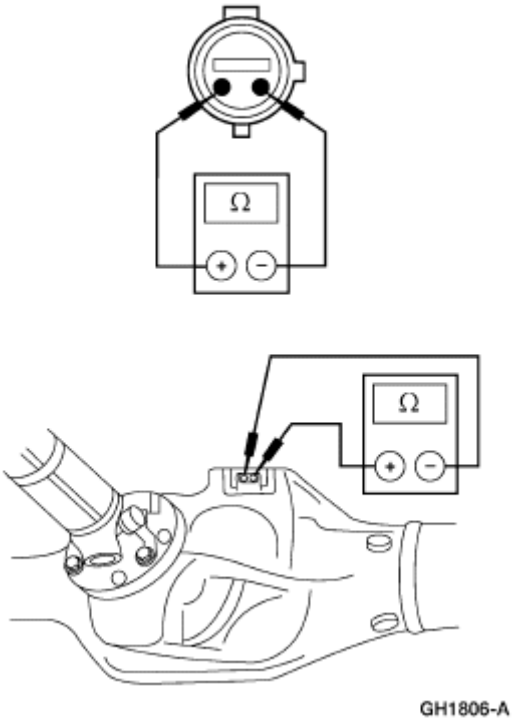
C2 CHECK ANTI-LOCK BRAKE SENSOR RESISTANCE

1

Disconnect Suspect Anti-Lock Brake Sensor

2

2 Measure the resistance between suspect anti-lock brake sensor terminals.



- **Is the resistance between 800 and 1400 ohms (front 4x2), 800 and 3500 ohms (rear), or 380 and 480 ohms (front 4x4)?**

→ **Yes**
GO to C3.

→ **No**
REPLACE suspect anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4.

If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2.

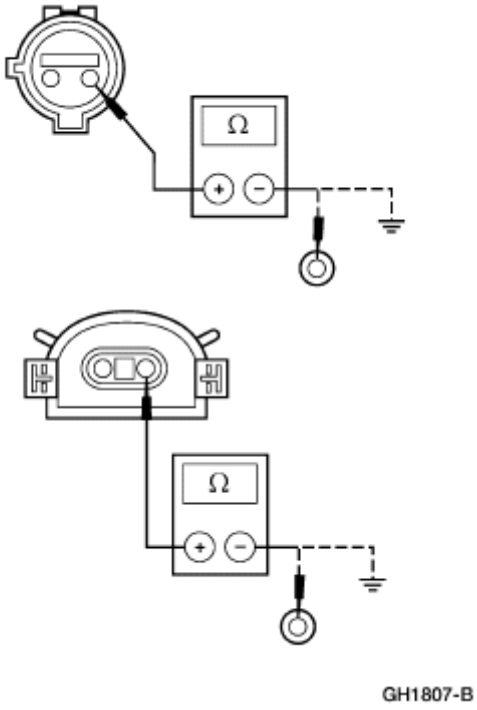
If rear anti-lock brake sensor, REFER to Sensor—Rear. CLEAR the DTCs. REPEAT the self-test.

C3 CHECK CIRCUIT 521 (TN/OG), 514 (YE/RD), OR 523 (RD/PK)

1

1 Measure the resistance between suspect anti-lock brake sensor and EEC-IV 60-Pin Breakout Box; and between suspect anti-lock brake sensor and ground as follows:

Anti-Lock Brake Sensor	Sensor Connector and Circuit	EEC-IV 60-Pin Break-out Box
LF	C188 Pin 2, Circuit 521	17



	(TN/OG)	
RF	C187 Pin 2, Circuit 514 (YE/RD)	3
Rear	C422 Pin 2, Circuit 523 (RD/PK)	21

- **Is the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box less than 5 ohms; and between suspect anti-lock brake sensor, and ground greater than 10,000 ohms?**

→ **Yes**
GO to C4 .

→ **No**
REPAIR the circuit in question. REPEAT the self-test.

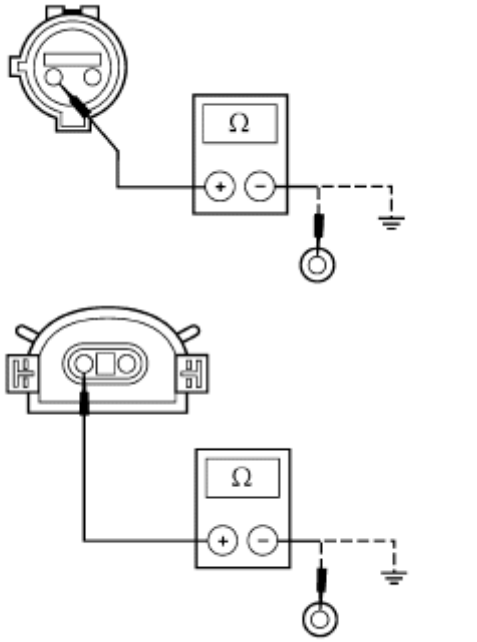
C4 CHECK CIRCUIT 522 (TN/BK), 516 (YE/BK), OR 519 (LG/BK)

1

1 Measure the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box; and between suspect anti-lock brake sensor and ground as follows:

Anti-Lock Brake Sensor	Sensor Connector and Circuit	EEC-IV 60-Pin Break-out Box
LF	C188 Pin 1, Circuit 522 (TN/BK)	18
RF	C187 Pin 1, Circuit 516 (YE/BK)	4
Rear	C422 Pin 1,	22

	Circuit 519 (LG/BK)	



GH1808-B

- **Is the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box less than 5 ohms; and between suspect anti-lock brake sensor, and ground greater than 10,000 ohms?**

→ **Yes**
GO to C8 .

→ **No**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

C5 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO POWER

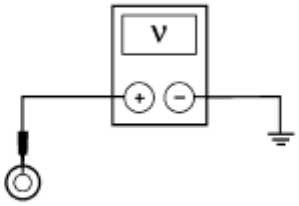
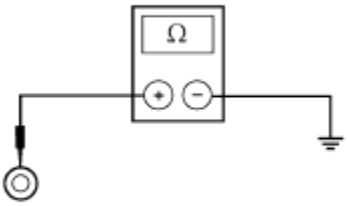
1

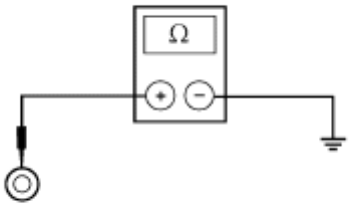
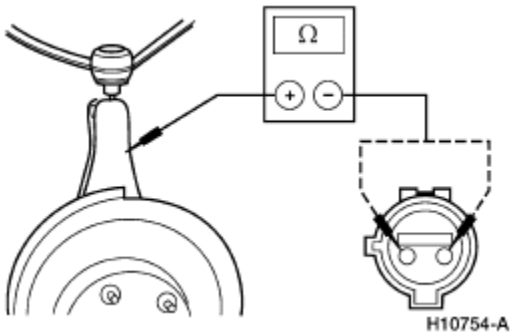
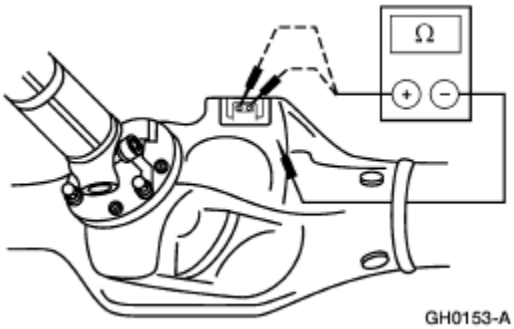
Suspect Anti-Lock Brake Sensor

2

2 Measure the voltage between suspect EEC-IV 60-Pin Breakout Box pins, and ground as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box
LF	17
RF	3

 GH2094-A	Rear 21 • **Is voltage present?** → **Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. → **No** GO to C6 .
C6 CHECK CIRCUIT 521 (TN/OG), 514 (YE/RD), OR 523 (RD/PK), FOR SHORT TO GROUND	
1  GH1066-A	1 Measure the resistance between EEC-IV 60-Pin Breakout Box, and ground for the suspect anti-lock brake sensor as follows: **Anti-Lock Brake Sensor** / **EEC-IV 60-Pin Breakout Box** LF 17 RF 3 Rear 21 • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C7 . → **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C7 CHECK CIRCUIT 522 (TN/BK), 516 (YE/BK), OR 519 (LG/BK) FOR SHORT TO GROUND	
1	1 Measure the resistance between EEC-IV 60-Pin Breakout Box, and ground as follows: **Anti-Lock Brake Sensor** / **EEC-IV 60-Pin Breakout Box** LF 18 RF 4

 GH1066-A	Rear | 22 • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C8 . → **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C8 CHECK FOR SHORT TO SPINDLE	
1  H10754-A	1 If the front anti-lock brake sensor is suspected, measure the resistance between the spindle near the sensor, and both terminals of the anti-lock brake sensor.
2  GH0153-A	2 If the rear anti-lock brake sensor is suspected, measure the resistance between the rear axle housing near the sensor, and both terminals of the anti-lock brake sensor. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C9 .

	→ **No** REPLACE suspect anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . If rear anti-lock brake sensor, REFER to Sensor—Rear . CLEAR the DTCs. REPEAT the self-test.
C9 CHECK WHEEL END ROUTING FOR DAMAGE	
	1 Inspect the anti-lock brake sensor cable at the affected wheel end for chafing or other wiring damage. • **Is damage found?** → **Yes** INSTALL a new anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. → **No** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.

PINPOINT TEST D: DTCS C1233, C1234, AND C1237 ANTI-LOCK BRAKE SENSOR OUTPUT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590A or equivalent meeting Ford specification ESA-M1C198-A.	
D1 CHECK THE ANTI-LOCK BRAKE SENSOR PIDS	
1	
2	2 Monitor the anti-lock brake control module PIDS LF_WSPD, RF_WSPD, and R_WSPD, while driving the vehicle at a constant speed below 20 km/h (12 mph).

	• **Are the anti-lock brake sensor PIDS consistent?** → **Yes** CLEAR the DTCs. If the DTC is received again, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** GO to D2 .
D2 CHECK FOR ANTI-LOCK BRAKE SENSOR DAMAGE AND LOOSENESS	
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.	
1 	2 Raise and support the vehicle. Refer to Section 100-02 . 3 **CAUTION: Examine the anti-lock brake sensor wire carefully with a good light. Failure to verify damage to the anti-lock brake sensor wire will lead to unnecessary component replacement.** Inspect the anti-lock brake sensor mounting for looseness. If the anti-lock brake sensor is suspected, inspect the sensor for corrosion on the rear axle housing boss, or on the front anti-lock brake mounting flange. Clean as necessary. • **Is the anti-lock brake sensor OK?** → **Yes** GO to D3 . → **No** If the anti-lock brake sensor mounting is loose or corroded, REMOVE the anti-lock brake sensor, plug the opening, and thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.CLEAR the DTCs. REPEAT the self-test. If the anti-lock brake sensor is damaged, INSTALL a new the anti-lock brake sensor.

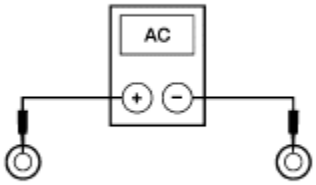
	If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. If rear anti-lock brake sensor, REFER to Sensor—Rear . CLEAR the DTCs. REPEAT the self-test.
D3 CHECK FOR ANTI-LOCK BRAKE SENSOR INDICATOR DAMAGE	
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.	
	1 Remove the anti-lock brake sensor. 2 **CAUTION: Examine the anti-lock brake sensor indicator carefully with a good light. Failure to verify damage to the anti-lock brake sensor indicator will lead to unnecessary component replacement.** Inspect the anti-lock brake sensor indicator for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing. • **Is the anti-lock brake sensor indicator OK?** → **Yes** GO to D4 . → **No** INSTALL a new anti-lock brake sensor indicator. If front anti-lock brake sensor indicator (4x4), REFER to Sensor Indicator—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor indicator (4x2), REFER to Sensor Indicator—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. If rear anti-lock brake sensor indicator, REFER to Sensor Indicator—Rear . CLEAR the DTCs. REPEAT the self-test
D4 CHECK ANTI-LOCK BRAKE SENSOR OUTPUT AT EEC-IV 60-PIN BREAKOUT BOX	
2	1 Lower the vehicle so that all wheels are free to spin.

Anti-Lock Brake Control Module C186

3 Connect EEC-IV 60-Pin Breakout Box.

4

5



GH1952-B

5 While spinning the suspect wheel at a constant speed, measure the AC voltage of the suspect anti-lock brake sensor between EEC-IV 60-Pin Breakout Box pins as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box	
	Positive Probe	Negative Probe
LF	17	18
RF	3	4
Rear	22	21

- **Is the anti-lock brake sensor output between 100 and 3500 mVolts?**

→ **Yes**
INSTALL a new anti-lock brake control module: REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.

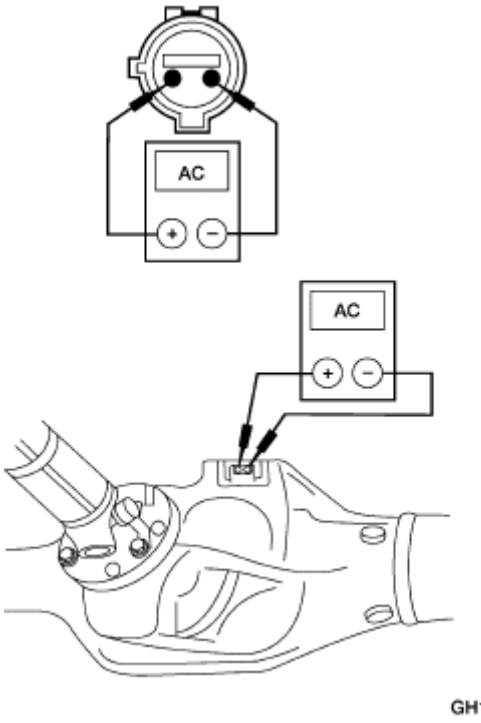
→ **No**
GO to D5 .

D5 CHECK THE ANTI-LOCK BRAKE SENSOR OUTPUT

1

Suspect Anti-Lock Brake Sensor

2 While spinning the suspect wheel at a constant speed, measure the AC voltage between the suspect anti-lock brake sensor terminals.



- **Is the anti-lock brake sensor output between 100 and 3500 mVolts?**

→ **Yes**
REPAIR the suspect anti-lock brake sensor circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.

→ **No**
INSTALL a new anti-lock brake sensor.

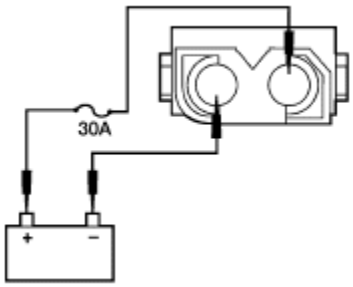
If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test.

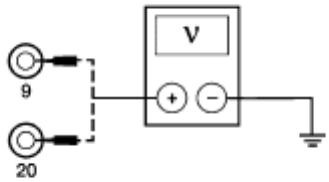
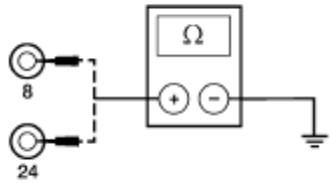
If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTC's. REPEAT the self-test. If rear anti-lock brake sensor; REFER to Sensor—Rear .

PINPOINT TEST E: DTC C1095, HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE ABS PUMP MOTOR	
1	

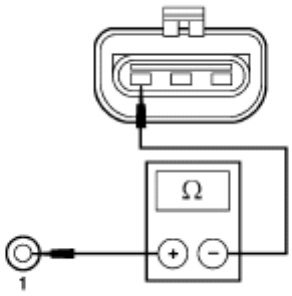
	• **Is the pump motor on constantly?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTCs. REPEAT the self-test. → **No** GO to E2 .
E2 CHECK THE PUMP MOTOR OPERATION	
1 Scan Tool 2 3 	3 Trigger the anti-lock brake control module active command PMP MOTOR ON. • **Does the pump motor operate?** → **Yes** CLEAR the DTC. CHECK the yellow ABS warning indicator while driving the vehicle 32 km/h (20 mph) without brakes applied until the vehicle exceeds 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTCs. REPEAT the self-test. If the yellow ABS warning indicator does not illuminate, CLEAR the DTCs. REPEAT the self-test. → **No** GO to E3 .
E3 CHECK THE PUMP MOTOR	
1	

 2 Pump Motor Connector 3  GH1811-A	3 Connect a fused (30A) jumper wire between positive battery terminal and red ABS pump motor terminal. Connect a jumper wire between the negative battery terminal and brown ABS pump motor terminal. • **Is the ABS pump motor running?** → **Yes** GO to E4 . → **No** INSTALL a new HCU; REFER to Hydraulic Control Unit . CLEAR the DTCs. REPEAT the self-test.
E4 CHECK CIRCUIT 534 (YE/LG) AND CIRCUIT 601 (LB/PK) FOR AN OPEN	
1 2 Anti-Lock Brake Control Module C186 4 5	3 Connect EEC-IV 60-Pin Breakout Box. 5 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 9, Circuit 534 (YE/LG), and ground; and between EEC-IV 60-Pin Breakout

 GH2463-A	Box Pin 20, Circuit 601 (LB/PK), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to E5 . → **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.
E5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1 2  GH1805-A	2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground. • **Are the resistances less 5 ohms ?** → **Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: DTC C1102 — G-SWITCH CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE G-SWITCH	
1 2 3 	2 Monitor and record the anti-lock brake control module PIDS ACCLSW1, and ACCLSW2, while driving the vehicle. 3 Check the table after recording the anti-lock brake control module PIDS ACCLSW1, and ACCLSW2. • **Do the G-switch PIDS toggle between ACT and notACT?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** GO to F2 .
F2 CHECK CIRCUIT 836 (OG/WH) FOR AN OPEN	
1 2 Anti-Lock Brake Control Module C186 3 G-switch C312 4	4 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 1, Circuit 836 (OG/WH), and G-switch C312 Pin 3, Circuit 836 (OG/WH), harness side.



GH2464-A

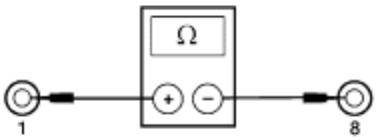
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F3 .

→ **No**
REPAIR the circuit . CLEAR the DTCs. REPEAT the self-test.

F3 CHECK CIRCUIT 836 (OG/WH) FOR SHORT TO GROUND

1



GH2465-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 1, Circuit 836 (OG/WH), and G-switch C312 Pin 8, Circuit 57 (BK), harness side.

- **Is the resistance greater than 10,000 ohms?**

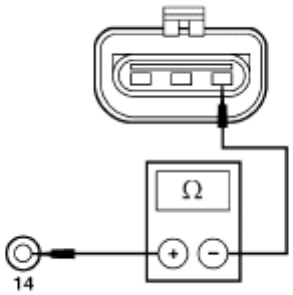
→ **Yes**
GO to F4 .

→ **No**
REPAIR Circuit 836 (OG/WH). CLEAR the DTCs. REPEAT the self-test.

F4 CHECK CIRCUIT 886 (OG/BK) FOR AN OPEN

1

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 14, Circuit 886 (OG/BK), and G-switch C312 Pin 1, Circuit 886 (OG/BK).



GH2466-A

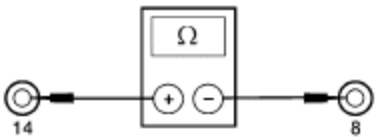
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F5 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

F5 CHECK CIRCUIT 886 (OG/BK) FOR SHORT TO GROUND

1



GH2467-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 14, Circuit 886 (OG/BK), and EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK).

- **Is the resistance greater than 10,000 ohms?**

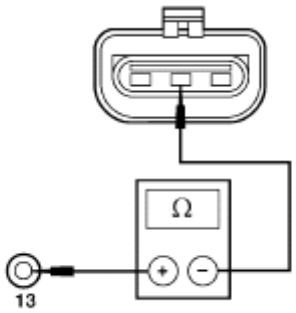
→ **Yes**
GO to F6 .

→ **No**
REPAIR Circuit 886 (OG/BK). CLEAR the DTCs. REPEAT the self-test.

F6 CHECK CIRCUIT 887 (YE) FOR AN OPEN

1

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 13, Circuit 887 (YE), and G-switch C312 Pin 2, Circuit 887 (YE), harness side.



GH2468-B

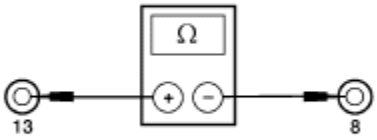
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F7 .

→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

F7 CHECK CIRCUIT 887 (YE) FOR SHORT TO GROUND

1



GH2469-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 13, Circuit 887 (YE), and EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK).

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to F8 .

→ **No**
REPAIR Circuit 887 (YE). CLEAR the DTCs.
REPEAT the self-test.

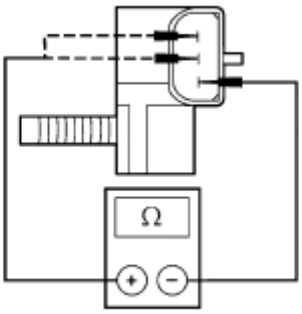
F8 CHECK G-SWITCH, DEFAULT G-SWITCH POSITION

2

1 Place the G-switch on a level surface.

2 **NOTE:** The G-switch must be in the same position it would be in the vehicle.

Measure the resistance between G-switch Pin 1, and Pin 3; and between G-switch Pin 1, and Pin 2 (component side).



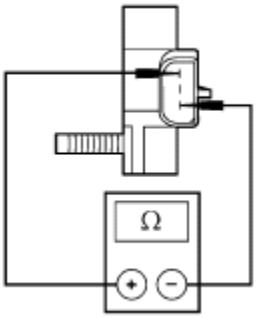
- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to F9 .

→ **No**
INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

F9 CHECK G-SWITCH, FRONT OF G-SWITCH RAISED 38.0 MM (1.5 IN)

2



1 **NOTE:** The arrow on the G-switch points toward the front.

Raise the front of the G-switch 38.0mm (1.5 in).

2 Measure the resistance between G-switch Pin 1, and Pin 3 (component side).

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to F10 .

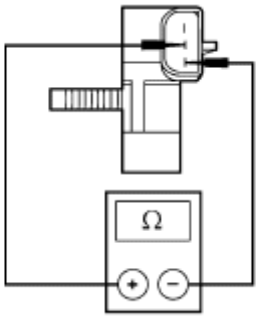
→ **No**
INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

F10 CHECK G-SWITCH, REAR OF G-SWITCH RAISED 25.4 MM (1 IN)

2

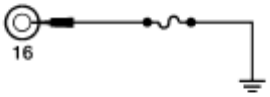
1 Raise the rear of the G-switch 25.4mm (1in).

2 Measure the resistance between G-switch Pin

 GH1923-A	2, and Pin 1 (component side). • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE YELLOW ABS WARNING INDICATOR DOES NOT SELF-CHECK

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE	
1 	
2 Anti-lock Brake Control Module C186	
	3 Connect EEC-IV 60-Pin Breakout Box.
4 	
5	5 Connect a fused (10A) jumper between EEC-IV 60-Pin Breakout Box Pin 16, Circuit 603 (DG), and ground.



GH2471-A

- **Does the yellow ABS warning indicator illuminate?**

→ **Yes**
VERIFY that all repair procedures have been carried out and DTCs have been repaired. INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . TEST the system for normal operation.

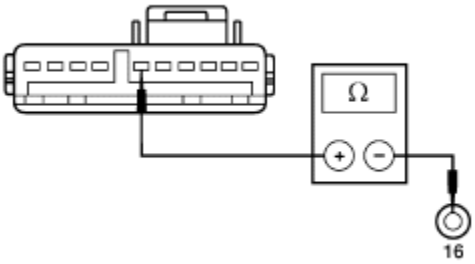
→ **No**
GO to G2 .

G2 CHECK CIRCUIT 603 (DG) FOR AN OPEN

1

Instrument Cluster C288

2



GH1819-A

2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 16, Circuit 603 (DG), and instrument cluster C288 Pin 6, Circuit 603 (DG), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new instrument cluster printed circuit; REFER to Section 413-01 . TEST the system for normal operation.

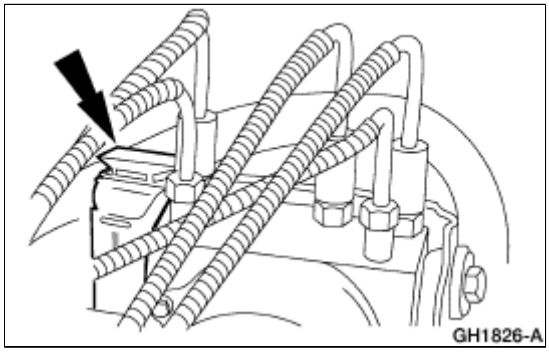
→ **No**
REPAIR the circuit. TEST the system for

	normal operation.

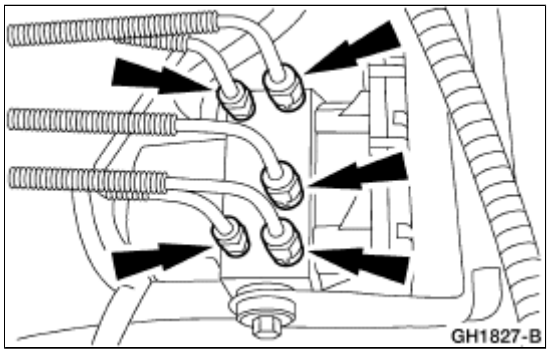
Hydraulic Control Unit

Removal

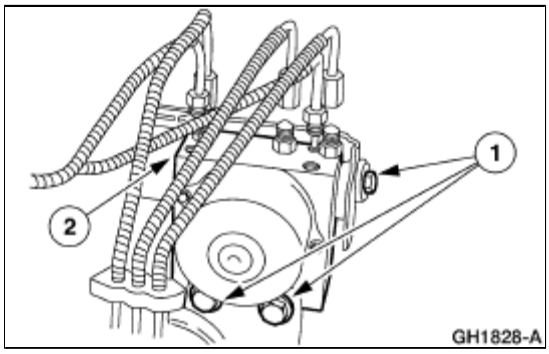
1. Disconnect the battery ground cable.
2. Disconnect the electrical connector by lifting up on the release tab.



3. Disconnect the brake lines from the hydraulic control unit (HCU).



4. Remove the HCU.
    1. Remove the bolts.
    2. Remove the HCU.



5. Remove the anti-lock brake control module.

Installation

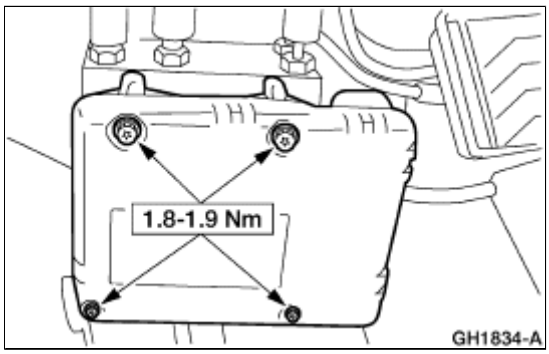
1. **WARNING: Brake fluid contains polyglycol ethers and polyclycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

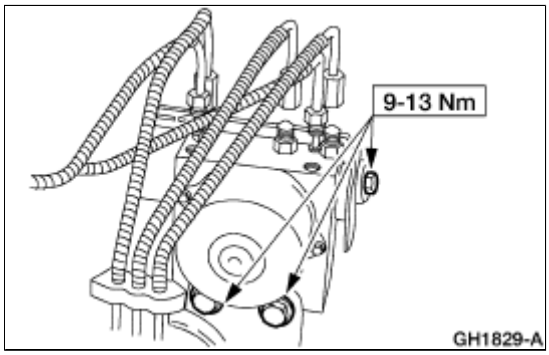
   CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

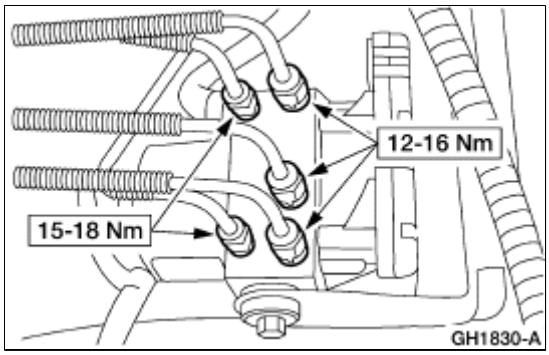
   CAUTION: After the HCU is installed, it is necessary to bleed the hydraulic brake system; refer to Section 206-00 .

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.



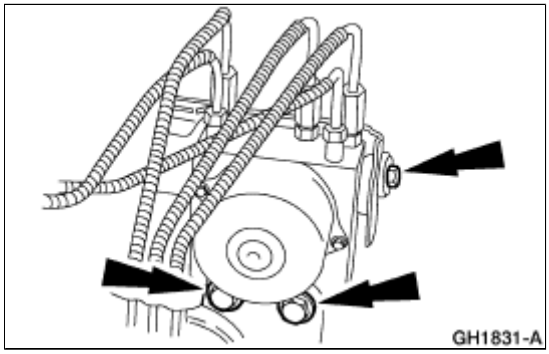



12-16 Nm
15-18 Nm
GH1830-A

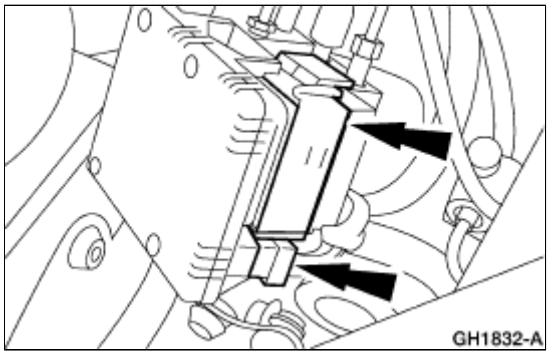
Anti-Lock Brake System (ABS) Module

Removal

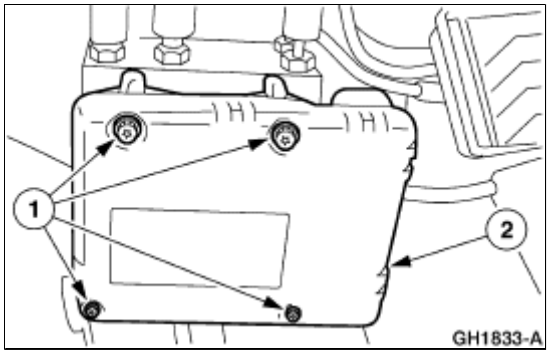
1. Disconnect the battery ground cable.
2. Remove the hydraulic control unit bolts.



3. Disconnect the anti-lock brake control module electrical connectors.



4. Remove the anti-lock brake control module.
    1. Remove the bolts.
    2. Remove the control module.

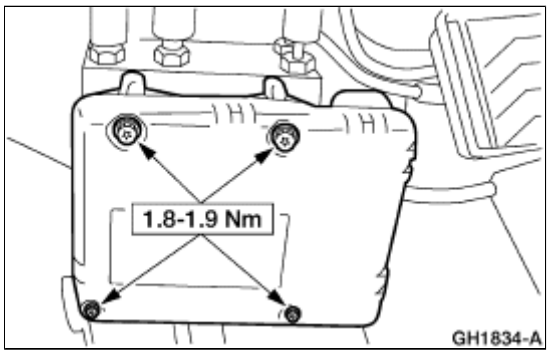


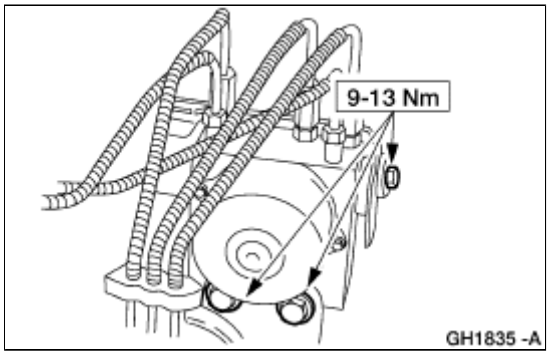
Installation

1. **CAUTION: Once the new module is installed, it is necessary to configure it using the scan tool.**

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.



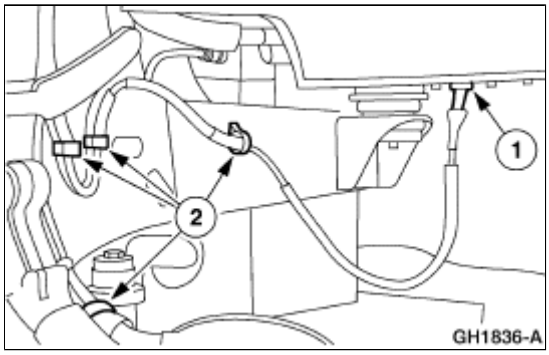


Sensor —Front 4x2

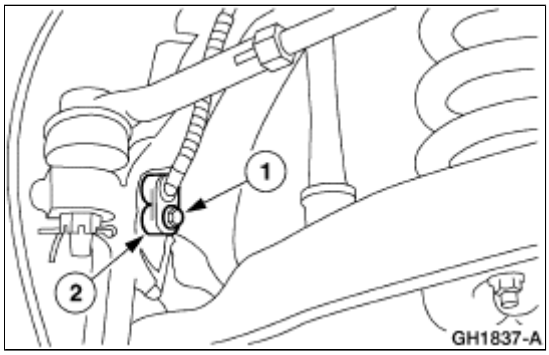
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the front anti-lock brake sensor wire from the vehicle frame.
    1. Disconnect the electrical connector.
    2. Unclip the front anti-lock brake sensor wire from the vehicle frame.

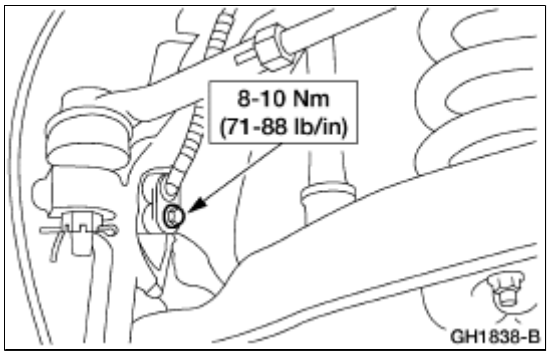


3. Remove the front anti-lock brake sensor.
    1. Remove the bolt.
    2. Remove the front anti-lock brake sensor.



4. **NOTE:** Plug the sensor mount opening and thoroughly clean the mounting surface. Apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A meeting Ford specification ESA-M1C198-A.

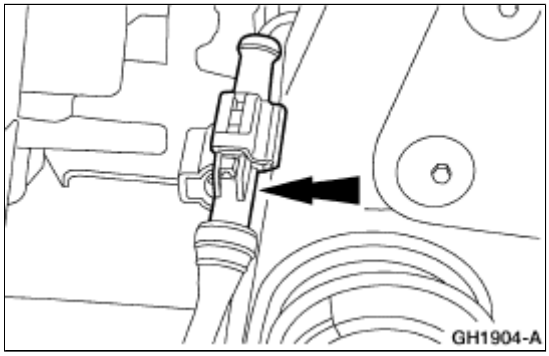
   To install, reverse the removal procedure.


8-10 Nm
(71-88 lb/in)
GH1838-B

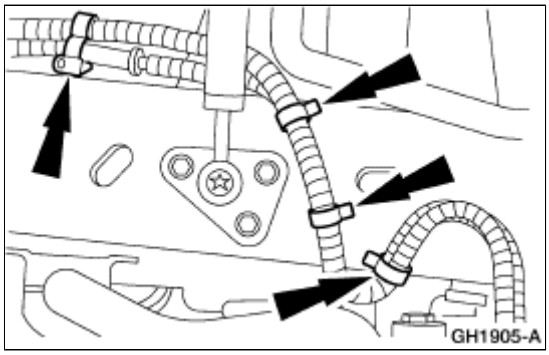
Sensor —Front 4x4

Removal

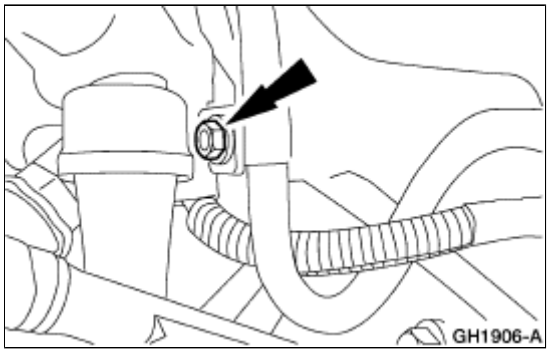
1. Remove the rotor shield; refer to Section 206-03 .
2. Disconnect the front anti-lock brake sensor electrical connector.



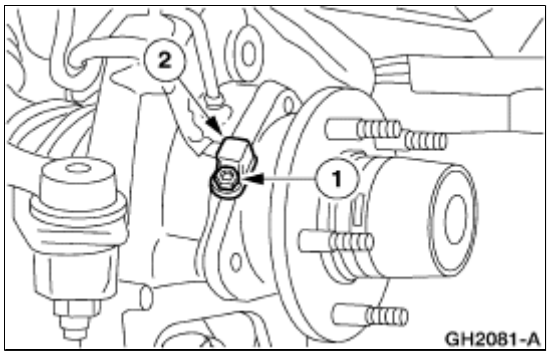
3. Unclip the front anti-lock brake sensor wire from the vehicle frame.



4. Remove the bolt.



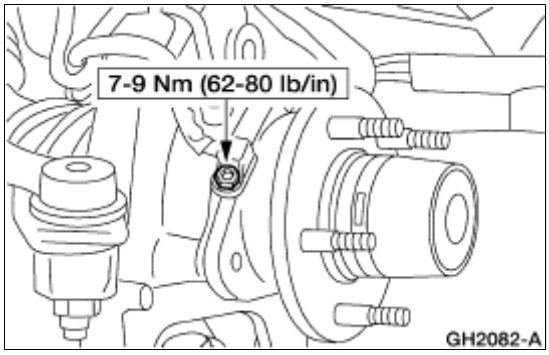
5. Remove the front anti-lock brake sensor.
    1. Remove the bolt.
    2. Remove the front anti-lock brake sensor.

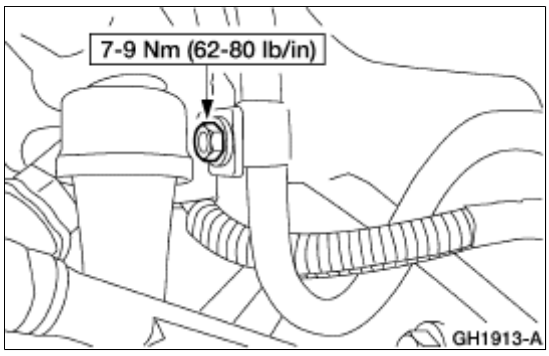


Installation

1. **NOTE:** Plug the sensor mount opening and thoroughly clean the mounting surface. Apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A meeting Ford specification ESA-M1C198-A.

   To install, reverse the removal procedure.





Sensor —Rear

Material

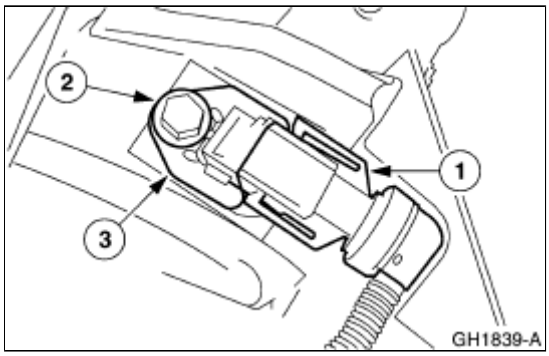
Item	Specification
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent	WSL-M2C192-A

Removal and Installation

1. Raise and support vehicle. For additional information, refer to Section 100-02 .

2. **NOTE:** Clean off dirt and foreign material that may have collected around the rear anti-lock brake sensor before removal.

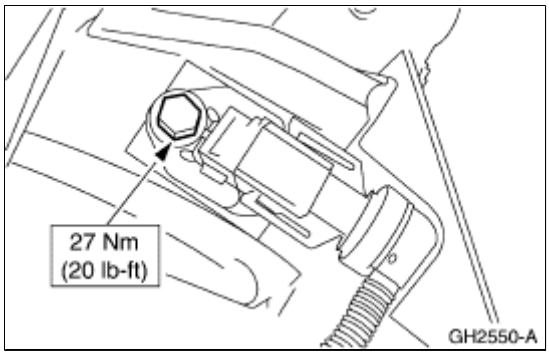
   Remove the rear anti-lock brake sensor.
   1. Disconnect the rear anti-lock brake sensor electrical connector.
   2. Remove the bolt.
   3. Remove the rear anti-lock brake sensor.



3. **NOTE:** Thoroughly clean the mounting surface.

   NOTE: Inspect the anti-lock brake sensor O-ring for damage; lightly lubricate the O-ring with axle lubricant.

   To install, reverse the removal procedure.


27 Nm
(20 lb-ft)
GH2550-A

Sensor Indicator —Front 4x2

Removal and Installation

For additional information, refer to Section 206-03 .

Sensor Indicator —Front 4x4

Removal and Installation

For additional information, refer to Section 204-01B .

Sensor Indicator —Rear

Removal and Installation

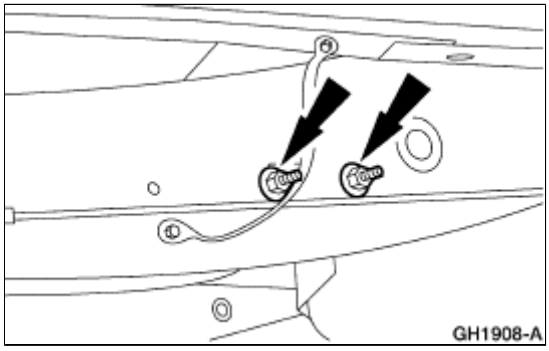
NOTE: The rear anti-lock brake sensor indicator is attached to the differential case.

For additional information, refer to Section 205-02 .

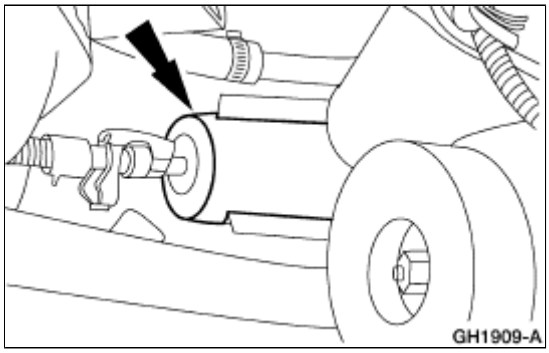
Switch —G

Removal

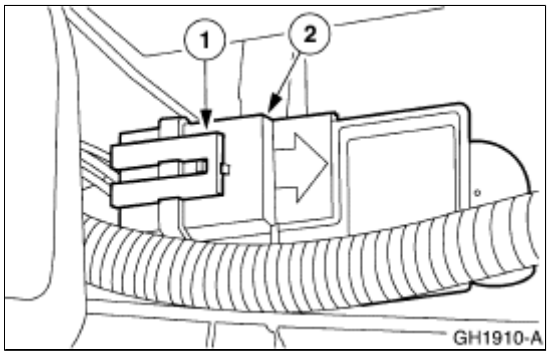
1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the nuts.



3. Unclip the fuel filter from the vehicle frame.

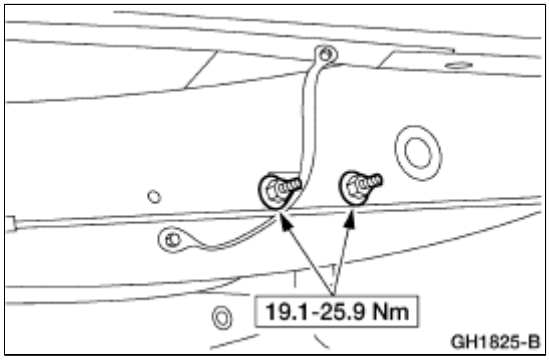


4. Remove the G-switch.
    1. Disconnect the G-switch electrical connector.
    2. Remove the G-switch.



Installation

1. To install, reverse the removal procedure.



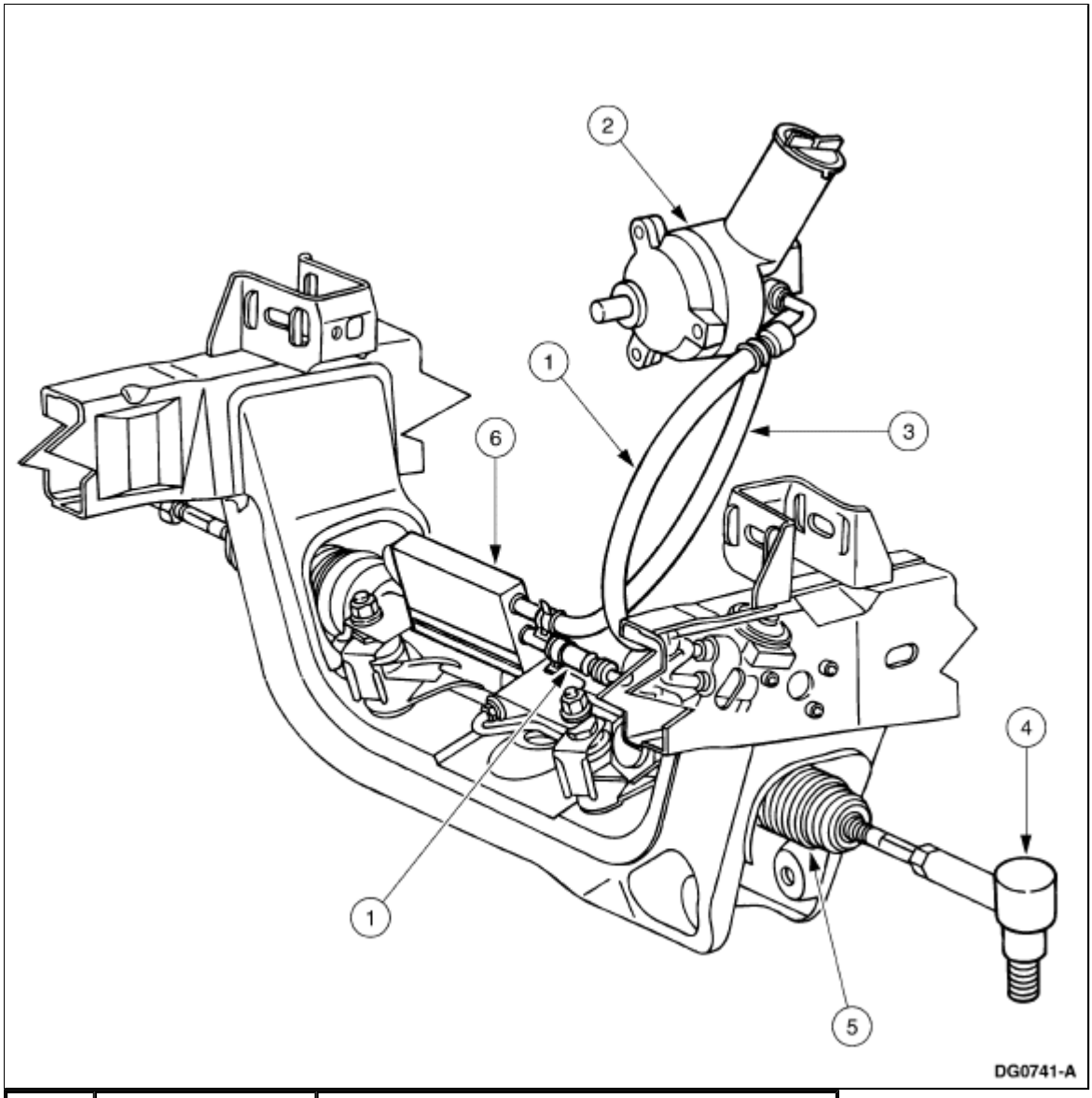
General Specifications

Item	Specification
Steering Wheel Turning Effort	4.5 Kg (10 Lb)
Power Steering Gear	
Type	Rack and Pinion
Steering Gear Turns (Stop to Stop)	3.2/4.0
Tie Rod Articulation Torque	7.25 Kg (16 Lb)
Power Steering Pump	
Type	CII
Flow Rate @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	7.9-9.5 Liters/Minute (2.1-2.5 gpm)
Maximum Pressure @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	1034 kPa (150 psi)
Minimum Flow Rate @ 74°-80°C (165°-175°F), Power Steering Analyzer Set at 5,102 kPa (750 psi) and Engine Speed Set at Idle	3.6 Liters/Minute (0.95 gpm)
Relief Pressure	8,946-10,205 kPa (1,300-1,480 psi)
Type	CIII
Flow Rate @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	8.3-9.8 Liters/Minute (2.2-2.6 gpm)
Maximum Pressure @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	1034 kPa (150 psi)
Minimum Flow Rate @ 74°-80°C (165°-175°F), Power Steering Analyzer Set at 5,102 kPa (750 psi) and Engine Speed Set at Idle	4.35 Liters/Minute (1.15 gpm)
Relief Pressure	8,946-10,205 kPa (1,300-1,480 psi)
Lubricants	
MERCON® Multi-Purpose ATF XT-2-QDX	MERCON®

Steering System

The power steering system has a typical rack-and-pinion design consisting of the following components:

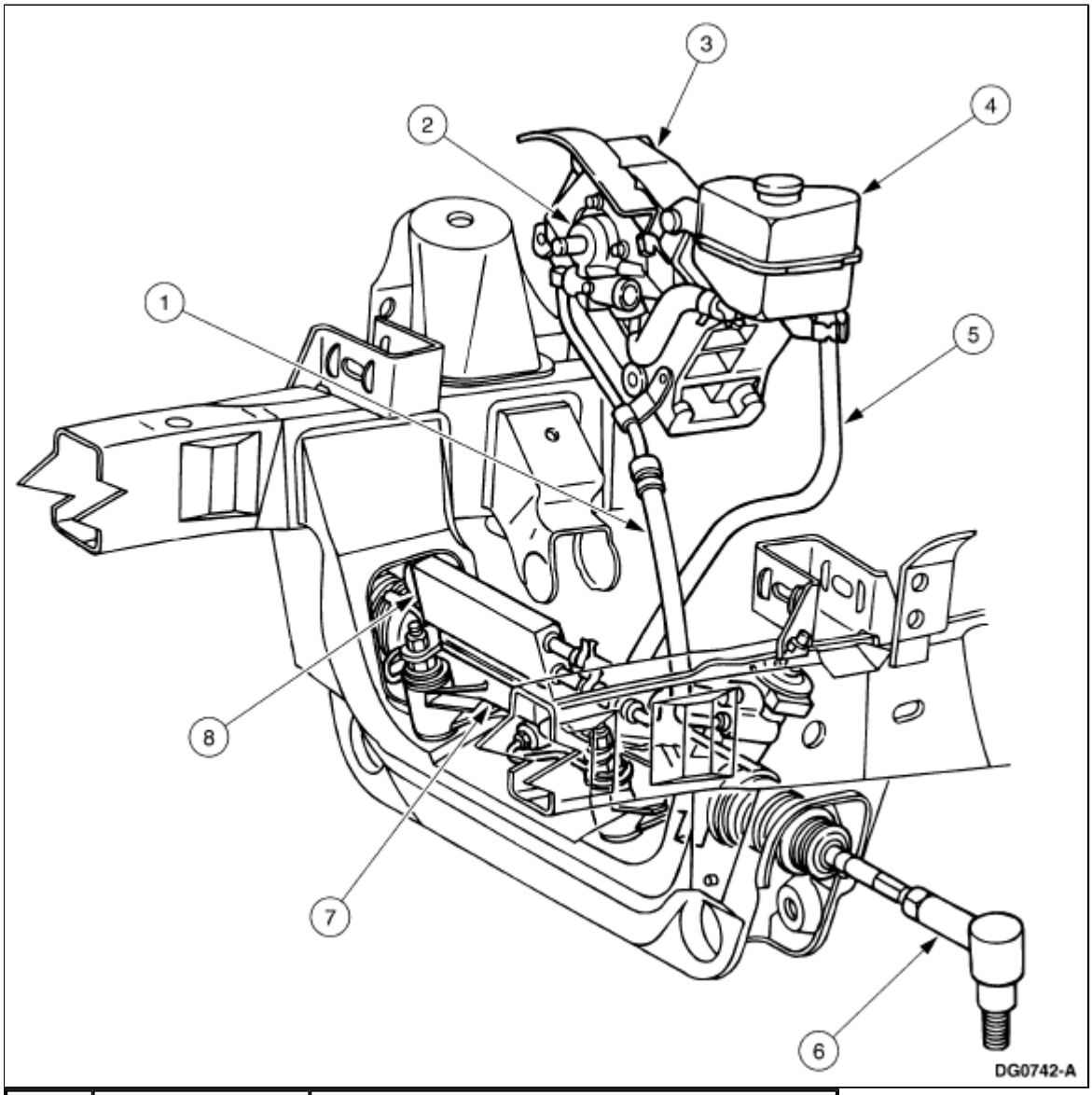
Steering System Components — 4.0 Liter (Push Rod)



Item	Part Number	Description
1	3A719	Power Steering Pressure Hose
2	3A674	Power Steering Pump
3	3A005	Power Steering Return Line Hose
4	3A130	Tie Rod End
5	3504	Steering Gear

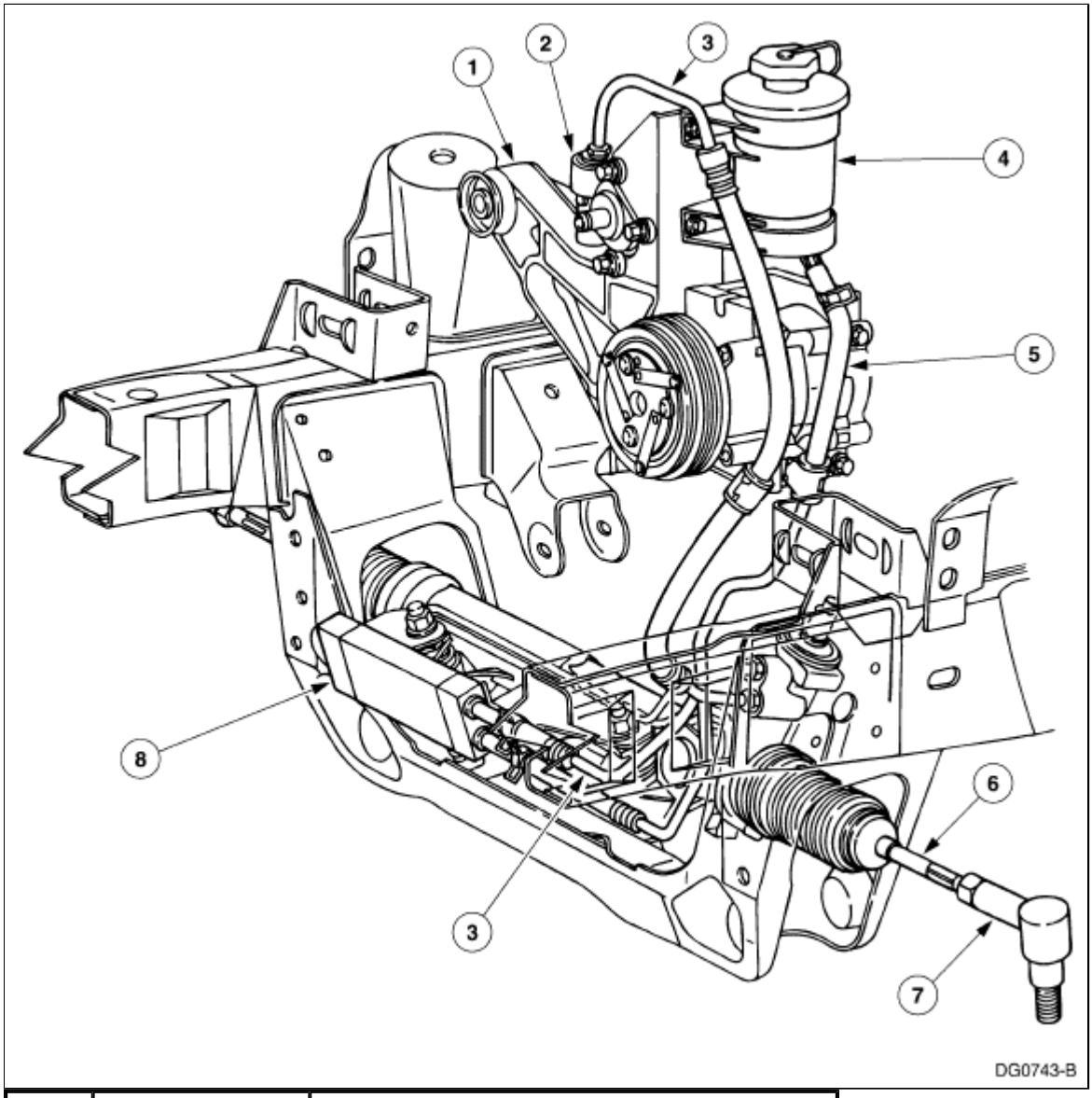
6	3D746	Power Steering Fluid Cooler

Steering System Components — 4.0 Liter SOHC



Item	Part Number	Description
1	3A719	Power Steering Pressure Hose
2	3A674	Power Steering Pump
3	2882	A/C Compressor Mounting Bracket
4	3A697	Power Steering Oil Reservoir
5	3A005	Power Steering Return Line Hose
6	3A130	Tie Rod End
7	3504	Steering Gear
8	3D746	Power Steering Fluid Cooler

Steering System Components — 5.0 Liter



Item	Part Number	Description
1	2882	A/C Compressor Mounting Bracket
2	3A674	Power Steering Pump
3	3A719	Power Steering Pressure Hose
4	3A697	Power Steering Oil Reservoir
5	3A005	Power Steering Return Line Hose
6	3504	Steering Gear
7	3A130	Tie Rod End
8	3D746	Power Steering Fluid Cooler

For information on the power steering oil reservoir (3A697), refer to Section 211-02 .

For information on the steering wheel and column assembly, refer to Section 211-04 .

For information on the power steering fluid lines, refer to Section 211-02 .

For information on the front wheel spindles (4x2), refer to Section 204-01A .

For information on the power steering fluid cooler (3D746), refer to Section 211-02 .

For information on the power steering pump (3A674), refer to Section 211-02 .

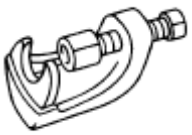
For information on the steering gear (3504), refer to Section 211-02 .

For information on the tie rod end (3A130), refer to Section 211-02 .

For information on the wheel hubs (4x4 or AWD), refer to Section 204-01B .

Steering System

Special Tool(s)

ST1396-A	Dial Thermometer 0-220°F 023-R0007 or Equivalent
ST1177-A	Hand Held Automotive Meter 105-R0053 or Equivalent
ST1477-A	Power Steering Analyzer 211-F001 (014-00207) or Equivalent
ST1689-A	Spring Scale 211-034 (T74P-3504-Y)
ST1398-A	Tach Adapter 418-F102 (007-00061) or Equivalent
 ST1688-A	Tie Rod End Remover Tool 211-001 (TOOL-3290-D) or Equivalent

Inspection and Verification

CAUTION: Do not hold the steering wheel (3600) at the stops for an extended amount of time.

Damage to the power steering pump (3A674) will result.

NOTE: Make the following preliminary checks before repairing the steering system:

1. Verify the customer concern by operating the steering system.

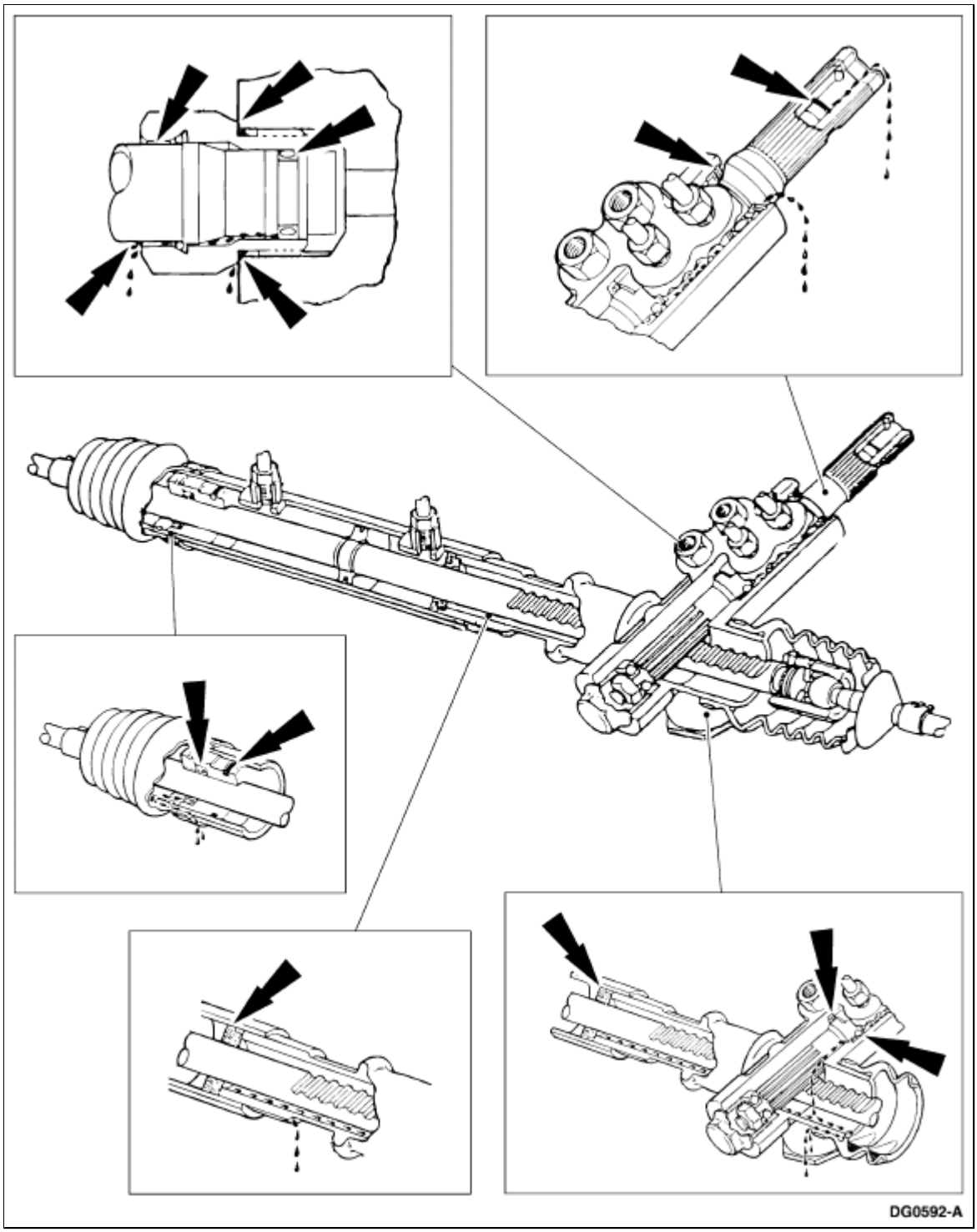
2. Inspect Tires
   - Check the tire pressure; refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification; refer to Section 204-04 .
   - Check the tires for damage or uneven wear; refer to Section 204-04 .

3. Belt and Tensioner Check
   - Refer to Section 303-05 for diagnosis and testing of the accessory drive system.

4. Fluid Level Check
   - Verify that the power steering fluid level is within the appropriate hot or cold range on the dipstick. Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

5. Air Bleeding
   - Verify that there is no air in the power steering system. Run the engine (6007) until it reaches normal operating temperature. Turn the steering wheel to the left and right several times without hitting the stops. If any air bubbles are present, refer to Purging in this section.

External Leak Check — Typical Power Rack-and-Pinion Steering Gear



6. External Leak Check
    - With the ignition switch at OFF, wipe off the power steering pump, power steering pressure hose (3A719), power steering return hose (3A713), power steering fluid cooler and hose assembly and steering gear (3504).
    - With the engine running, turn the steering wheel from stop to stop several times. Do not hold steering wheel at stops. Check for leaks. Repair as necessary if leaks are observed.

7. Turning Effort Check

- Refer to Turning Effort Test under Component Tests in this section.

8. Visually inspect for obvious signs of mechanical damage; refer to the following chart.

Visual Inspection Chart

Mechanical
• Loose tie rod ends • Loose suspension components • Loose steering column shaft universal joints • Loose column intermediate shaft bolts • Steering gear • Binding or misaligned steering column • Power steering pump • Bent or pinched power steering hoses

9. If an obvious cause for an observed or reported malfunction is found, correct the cause (if possible) before proceeding to the next step.

10. If the fault is not visually evident, determine the symptom and proceed to the following symptom chart.

Steering System Symptom Definitions

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road camber).

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Feedback

Feedback is a roughness felt in the steering wheel when the vehicle is driven over rough pavement.

Hard Steering or Lack of Assist

Hard steering or lack of assist is experienced when the steering wheel effort exceeds specifications. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and binding.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving, during very heavy or static parking maneuvers.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Hard Steering or Lack of Assist	• Seized lower steering column shaft U-joints.	• REPLACE the lower steering column shaft; REFER to Section 211-04 .
	• Damaged, fractured steering column bearing (s).	• REPAIR the steering column; REFER to Section 211-04 .
	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
	• Suspension components.	• REFER to Section 204-00 for suspension system diagnosis and testing.
	• Steering gear internal leakage.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive Steering Pump Noise	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive Steering Wheel Play	• Damaged, loose, or worn tie rod end (3A130).	• GO to the Steering Linkage Component Test.

	• Loose, worn or damaged front wheel spindle tie rod (3280). • Damaged/worn steering gear. • Loose, worn or damaged steering column bearing (s). • Loose, worn or damaged lower steering column shaft U-joint(s).	• GO to the Tie Rod Articulation Torque Component Test. • REPLACE the steering gear; REFER to Section 211-02 . • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 . • REPLACE the lower steering column shaft; REFER to Section 211-04 .
• Wander	• Unevenly loaded or overloaded vehicle. • Loose, worn or damaged front wheel spindle tie rod. • Loose, worn or damaged tie rod ends. • Loose or damaged steering gear mounting bolts. • Loose lower steering column shaft U-joint bolts. • Loose, worn or damaged lower steering column shaft U-joints. • Loose, worn or damaged steering column bearing (s). • Suspension components.	• INFORM the customer of improper vehicle loading. • GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REPLACE or TIGHTEN the bolts; REFER to Section 211-02 . • TIGHTEN the bolts; REFER to Section 211-04 . • REPLACE the lower steering column shaft; REFER to Section 211-04 . • REPLACE any unserviceable steering column bearings; REFER to Section 211-04 . • REFER to Section 204-00 for suspension system diagnosis and testing.
• Drift/Pull	• Unevenly loaded or overloaded vehicle. • Wheel alignment. • Loose, worn or damaged front wheel spindle tie rod. • Loose, worn or damaged tie rod ends. • Suspension components.	• INFORM the customer of improper vehicle loading. • ADJUST as required; REFER to Section 204-00 . • GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REFER to Section 204-00 for suspension system diagnosis and testing.

	• The steering gear valve effort out of balance. • Check the brake system for proper operation. • Improper frame/underbody alignment.	• GO to Steering Gear Valve Component Test in this section. • REFER to Section 206-00 . • CORRECT as required; REFER to Frame Dimension Manual.
• Feedback	• Loose, worn or damaged front wheel spindle tie rod. • Loose, worn or damaged tie rod ends. • Loose or damaged steering gear insulators or bolts. • Loose lower steering column shaft U-joint bolts. • Loose suspension bushings, fasteners or ball joints. • Worn or damaged steering column bearing (s).	• GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REPLACE or TIGHTEN the retaining bolts; REFER to Section 211-02 . • TIGHTEN the bolts; REFER to Section 211-04 . • REPLACE as necessary; REFER to Section 204-01A or Section 204-01B . • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 .
• Poor Returnability/Sticky Steering	• Binding lower steering column shaft U-joints. • Loose, worn or damaged front wheel spindle tie rod. • Loose, worn or damaged tie rod ends. • Suspension components. • Binding steering column bearing(s).	• REPLACE the lower steering column shaft; REFER to Section 211-04 . • GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REFER to Section 204-00 for suspension system diagnosis and testing. • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 .
• Shimmy	• Loose, worn or damaged tie rod end. • Loose, worn or damaged front wheel spindle tie rod. • Suspension components.	• GO to the Steering Linkage Component Test. • GO to the Tie Rod Articulation Torque Component Test. • REFER to Section 204-00 for suspension system

		diagnosis and testing.

Component Tests

Steering Linkage

1. **NOTE:** Excessive **vertical** motion of the studs relative to the sockets may indicate excessive wear.

   With the parking brake applied, perform the following:
   - Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets.
   - Watch for loose steering gear mounting.

2. Another method is to raise the front wheels (1007) off the ground, grasp the wheel at the front and rear and watch for excessive play or binding in the joints while trying to steer the wheels.

3. Replace or tighten any worn, damaged, or loose steering components. Refer to the appropriate Group 2 steering section.

Turning Effort Test

NOTE: Make sure that the front wheels are properly aligned and the tire pressure is correct before checking the effort.

1. Park the vehicle on dry concrete and set the parking brake.

2. Insert a thermometer into the power steering oil reservoir (3A697).

3. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Idle the engine for two to three minutes. Turn the steering wheel from stop to stop several times to warm the fluid to 50-60°C (122-140°F).

4. With the engine running, attach Spring Scale to the rim of the steering wheel.

5. Measure the pull required to turn the steering wheel one complete revolution in each direction. Refer to Steering Wheel Turning Effort under General Specifications in this section.

Pump Flow and Pressure Test

WARNING: Do not touch the flowmeter during the test procedure, or severe burns and serious injury may occur.

1. **CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**

   Install the Power Steering Analyzer at the high pressure port of the power steering pump. Make sure the power steering analyzer gate valve is fully open.
   - On some vehicles, the power steering pump high pressure port is inaccessible and the power steering analyzer should then be installed either at the steering gear or at a point in the high pressure line between the power steering pump and the steering gear.

2. Place a dial thermometer in the power steering pump reservoir.

3. Check the power steering fluid level. If necessary, add power steering fluid.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

4. Install a digital tachometer.

5. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Start the engine. Place the transmission in neutral. Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.

6. Set the engine speed to 1500 rpm. Record the flow rate and pressure readings.
   - If the flow rate is below the flow rate specification, the power steering pump may require repair. Continue with the test procedure.
   - If the pressure reading is above the maximum pressure specification, then check power steering hoses for kinks and restrictions.

7. Partially close the gate valve to obtain 750 psi. Set the engine speed at idle. Record the flow rate.
   - If the flow is less than the specified flow rate, then replace the power steering pump.

8. **CAUTION: Do not allow the gate valve to remain closed for more than 5 seconds.**

   Completely close and partially open the gate valve 3 times. Record the pressure relief valve actuation pressure reading.
   - If the pressure does not meet the relief pressure specification, then replace the power steering pump.

9. Set engine speed to 1500 rpm. Record the flow rate.
   - If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from the initial flow rate reading, then replace the power steering pump.

10. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops. Record flow rate and pressure readings at the stops.
    - The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.
    - The flow rate should drop below 1.9 liters/minute (0.5 gallons/minute).

- If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Repair or replace the steering gear as necessary; refer to Section 211-02 .

11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release quickly while watching the pressure gauge.
    - The pressure reading should move from the normal back pressure reading and snap back as the steering wheel is released.
    - If the pressure returns slowly or sticks, the rotary valve in the steering gear is sticking or the steering column is binding. Check the steering column and linkages before servicing the steering gear.

Tie Rod Articulation Torque

1. **NOTE:** This check may be done with the steering gear on or off the vehicle.

   Disconnect the tie rod end from the front wheel spindle; refer to Section 211-02 .

2. Move the front wheel spindle tie rod back and forth three times.

3. Hook Spring Scale over the tie rod end or the threaded portion of the front wheel spindle tie rod and measure the force required to move the front wheel spindle tie rod. Refer to Tie Rod Articulation Torque in General Specifications in this section.

4. If the force required to move the front wheel spindle tie rod does not meet the specifications, replace the front wheel spindle tie rod; refer to Section 211-02 .

Steering Gear Valve

1. With the vehicle in motion, place the transmission in NEUTRAL and turn the engine OFF.
   - If the vehicle does not pull with the engine OFF, repair or replace the steering gear; refer to Section 211-02 .

2. If the vehicle pulls with the engine OFF, cross-switch the front wheels.

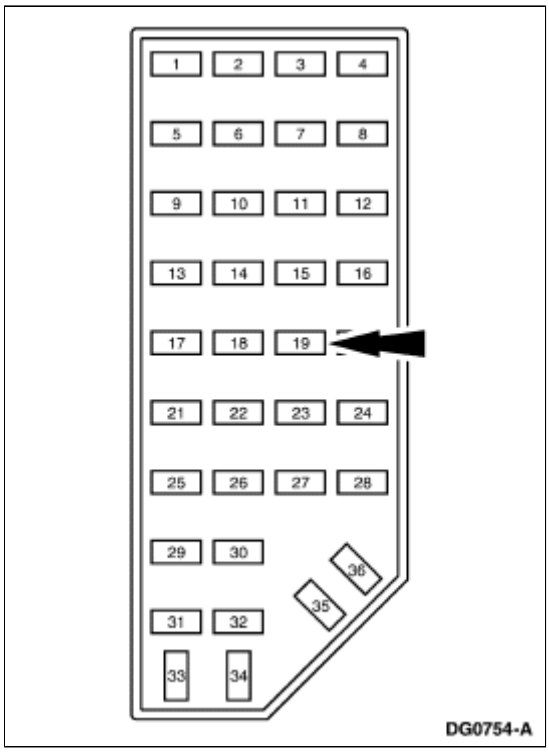
3. If the vehicle pulls to the opposite side, cross-switch the front and rear wheels on the same side.

4. If the vehicle pull direction does not change, check the front suspension components, wheel alignment and frame alignment; refer to Section 204-00 or an appropriate frame dimensions manual.

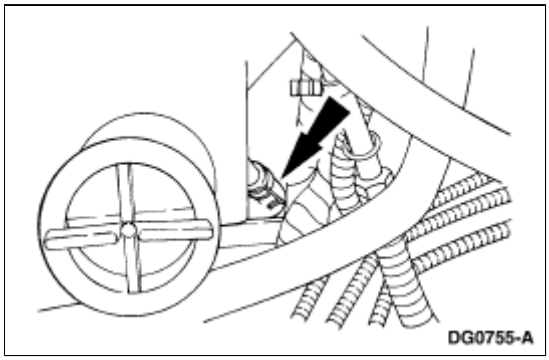
System Flushing

WARNING: Do not mix oil types. Any mixture or any unapproved oil can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.

1. Remove the ignition coil fuse to disable the vehicle.



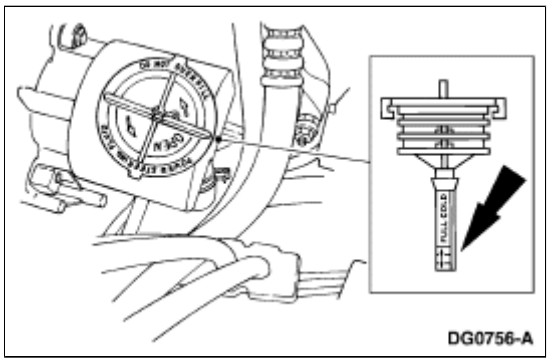
2. Disconnect the power steering return hose. Plug the reservoir.



3. Attach an extension hose between the power steering return hose and an empty container.

4. Raise the front wheels off the floor; for additional information, refer to Section 100-02 .

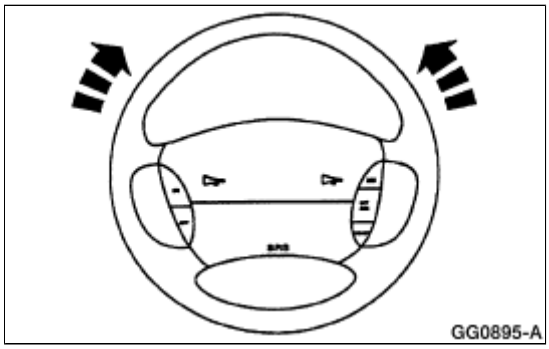
5. Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.



6. **CAUTION: Do not crank the engine for more than 15 seconds at a time. Allow the starter to cool for 1 minute before cranking again. Premature starter failure can occur.**

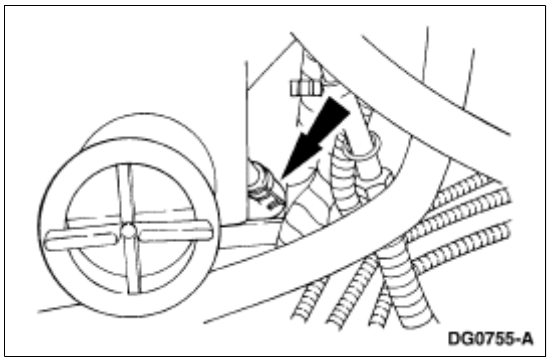
   CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.

   Turn the steering wheel from stop-to-stop while cranking the engine until the fluid exiting the power steering return hose is clear of all contamination and debris.
   - Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent as needed.



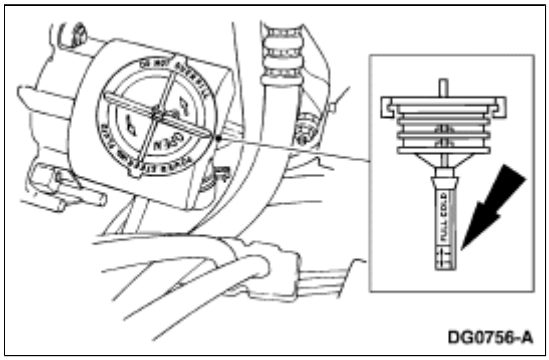
7. Lower the vehicle.

8. Disconnect the extension hose from the power steering return hose. Remove the plug. Attach the power steering return hose to the reservoir.

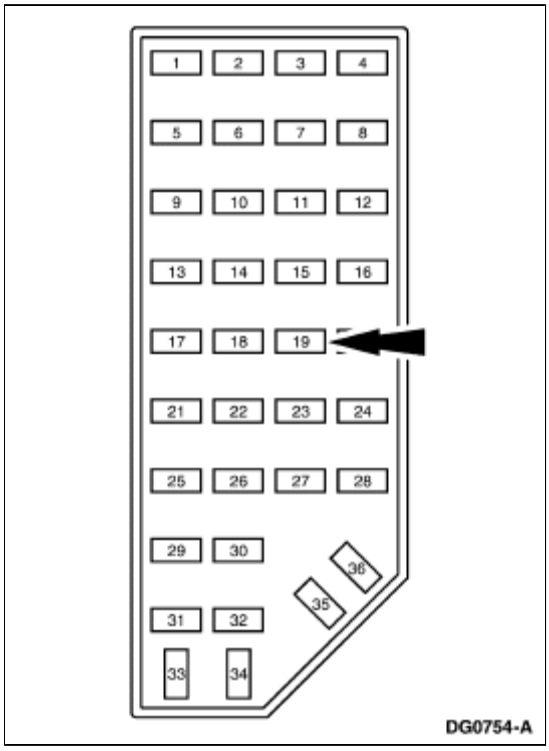


9. **CAUTION: Do not overfill the reservoir.**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

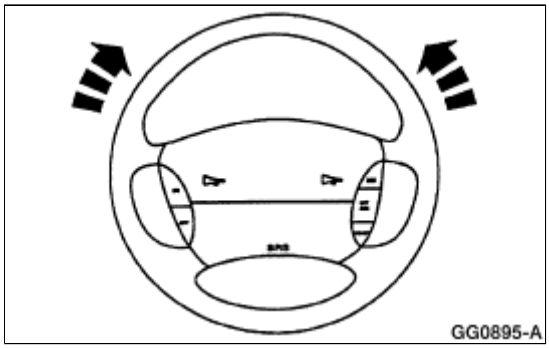


10. Install the ignition coil fuse.



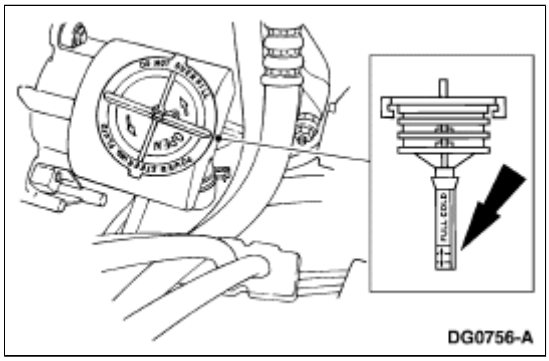
11. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.**

    Start the engine and turn the steering wheel from stop-to-stop.



12. **NOTE:** If the power steering system is noisy and is accompanied by evidence of aerated fluid it will be necessary to purge the power steering system.

    Check the power steering fluid level.



Purging

Special Tool(s)

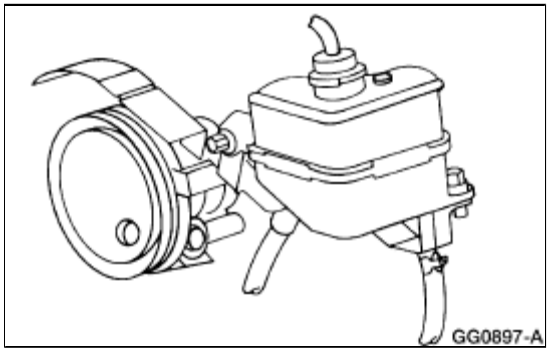
ST1176-A	Vacuum Pump 416-D002 (D95L-7559-A) or Equivalent

CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure could result. The condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

1. **NOTE:** A whine heard from the power steering pump may be caused by air in the system. The power steering purge procedure must be performed prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

   Remove the reservoir cap. Check the fluid.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Tightly insert the stopper of the vacuum pump into the reservoir.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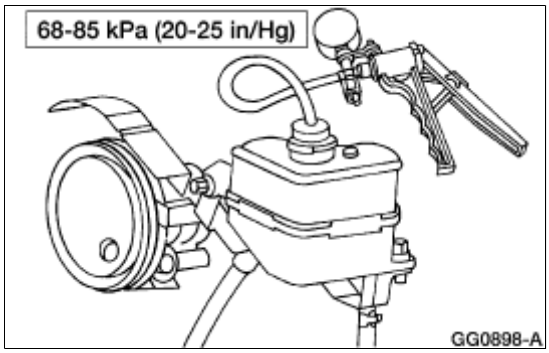
3. Start the vehicle.

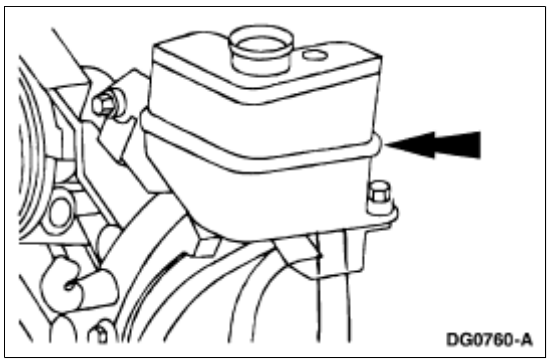
4. Apply maximum vacuum and maintain it for a minimum of three minutes with the engine speed set at idle.



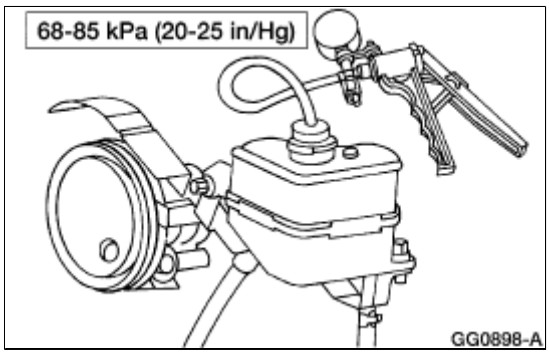
5. Release the vacuum and remove the vacuum pump.

6. **CAUTION: Do not overfill the power steering pump reservoir (3E764).**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

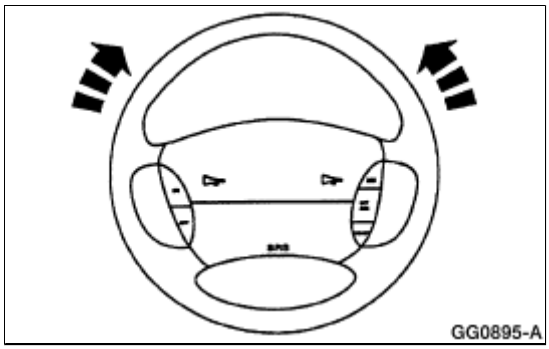


7. Reinstall the vacuum pump. Apply and maintain maximum vacuum.



8. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.**

   Cycle the steering wheel fully to the left and right every 30 seconds for approximately five minutes.

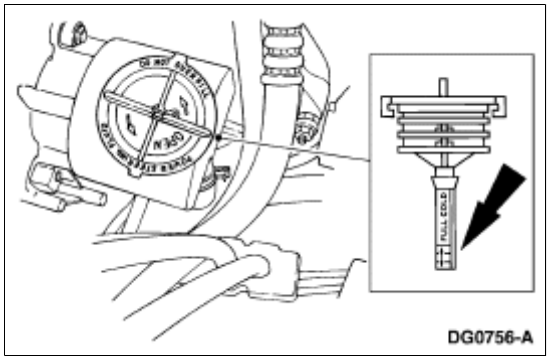


9. Stop the engine, release the vacuum, and remove the vacuum pump.
10. Install the reservoir cap.
11. Check for fluid leaks at all of the connections. If the power steering fluid shows signs of air, repeat this procedure.

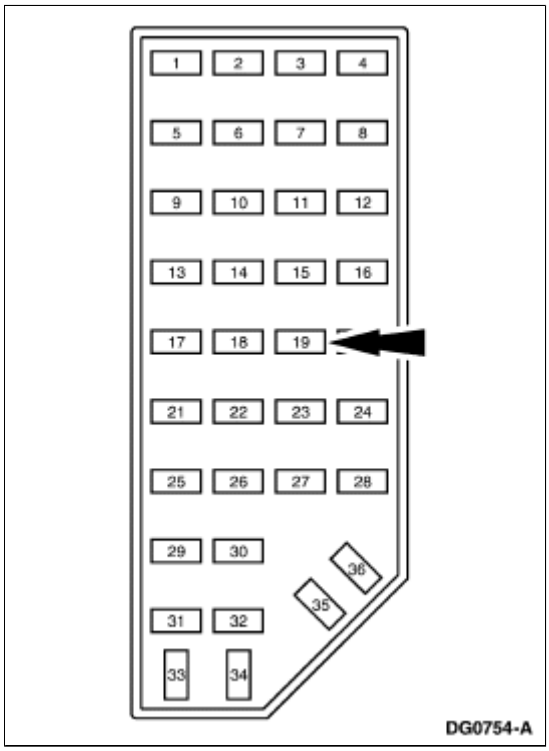
Fill

1. **WARNING: Do not mix oil types, any mixture or any unapproved oil could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or equivalent meeting Ford Specification MERCON®.



2. Remove the ignition coil fuse to disable the vehicle.

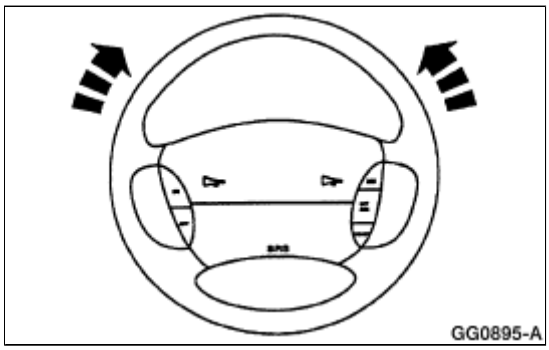


3. Raise the front wheels off the floor; for additional information, refer to Section 100-02 .

4. **CAUTION: Do not crank the engine for more than 15 seconds at a time. Allow the starter to cool for 1 minute before cranking again. Premature starter failure can occur.**

   CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.

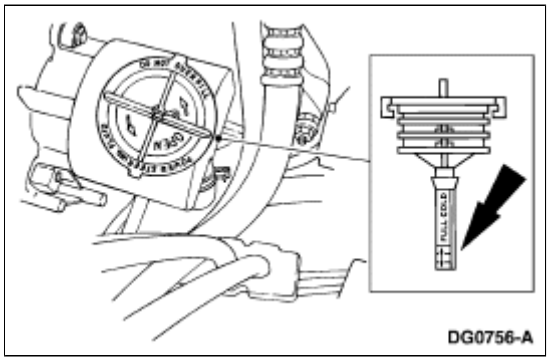
   Turn the steering wheel from stop-to-stop while cranking the engine.



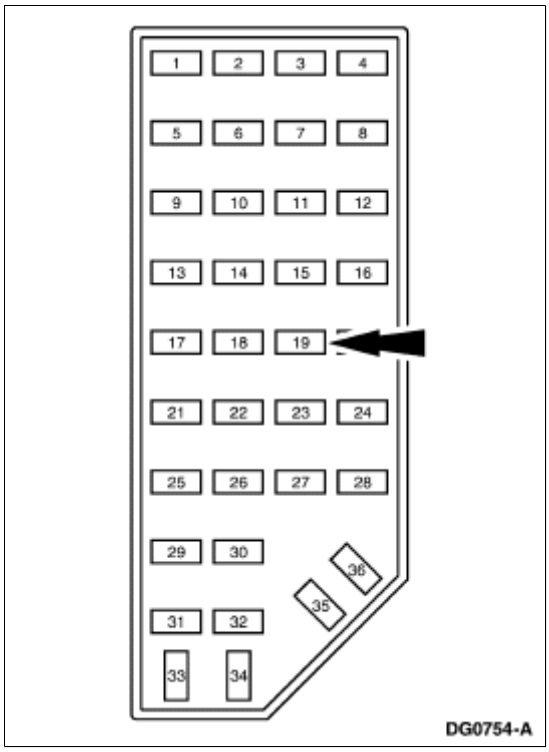
5. Lower the vehicle.

6. **CAUTION: Do not overfill the reservoir.**

   Fill the reservoir.
   - Use motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or equivalent meeting Ford Specification MERCON®.



7. Install the ignition coil fuse.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DG0754-A

General Specifications

Item	Specification
Motorcraft MERCON® ATF	MERCON®

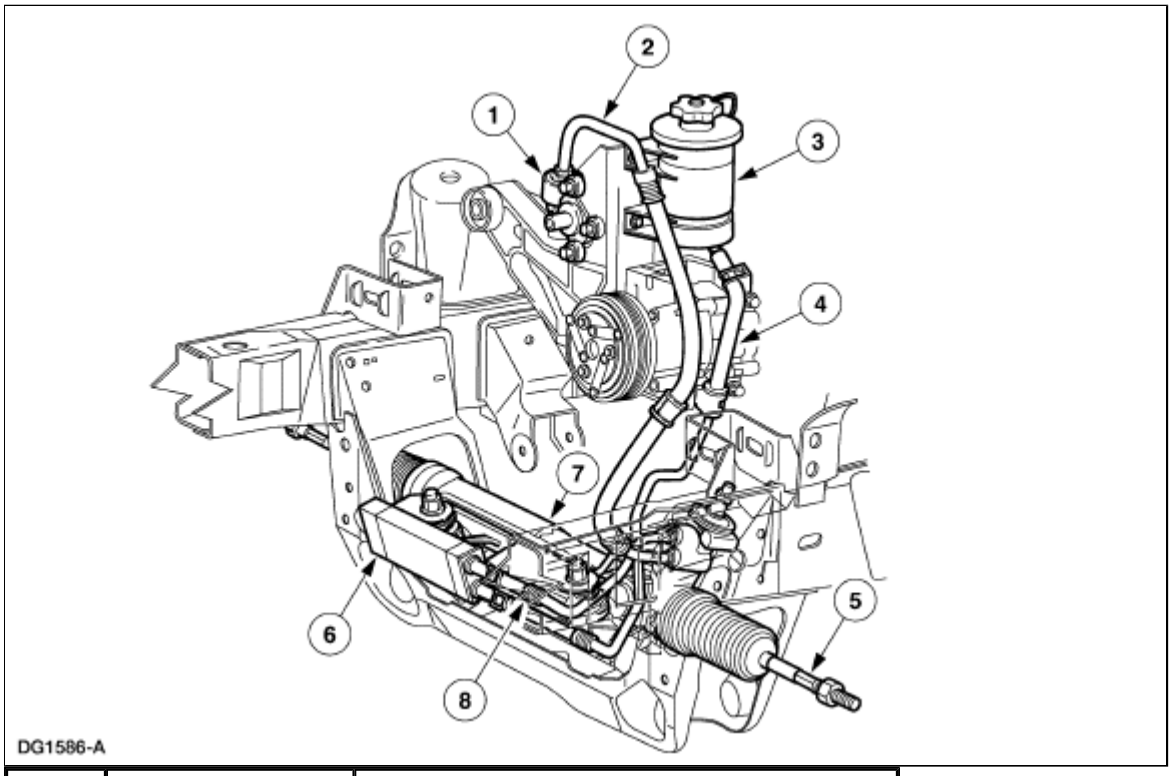
Torque Specifications

Description	Nm	lb-ft
Engine mount nuts (5.0L)	150	111
Front wheel spindle tie-rod ball socket	120	89
Lower intermediate shaft pinch bolt	49	36
Power steering fluid cooler nuts	80	59
Power steering pressure hose to power steering pump (4.0L push rod)	48	35
Power steering pressure hose to power steering pump (5.0L and 4.0L SOHC)	65	48
Power steering pump bolts (4.0L push rod)	48	35
Power steering pump bolts (5.0L and 4.0L SOHC)	25	18
Power steering pump pulley bolts (5.0L and 4.0L SOHC)	25	18
Radiator air deflector bolts	27	20
Steering gear pressure fittings	36	22
Steering gear to crossmember stud bolts and nuts	150	111
Tie-rod end to spindle castellated nuts	90	66
Tie-rod jam nut	80	59

Power Steering

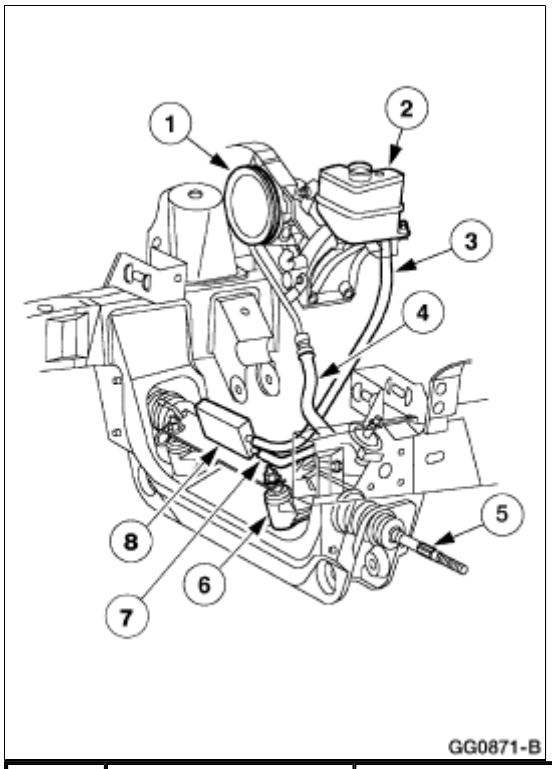
The power steering system is a hydraulic assisted system that reduces the amount of effort required to turn the wheels.

System View — 5.0L Engine



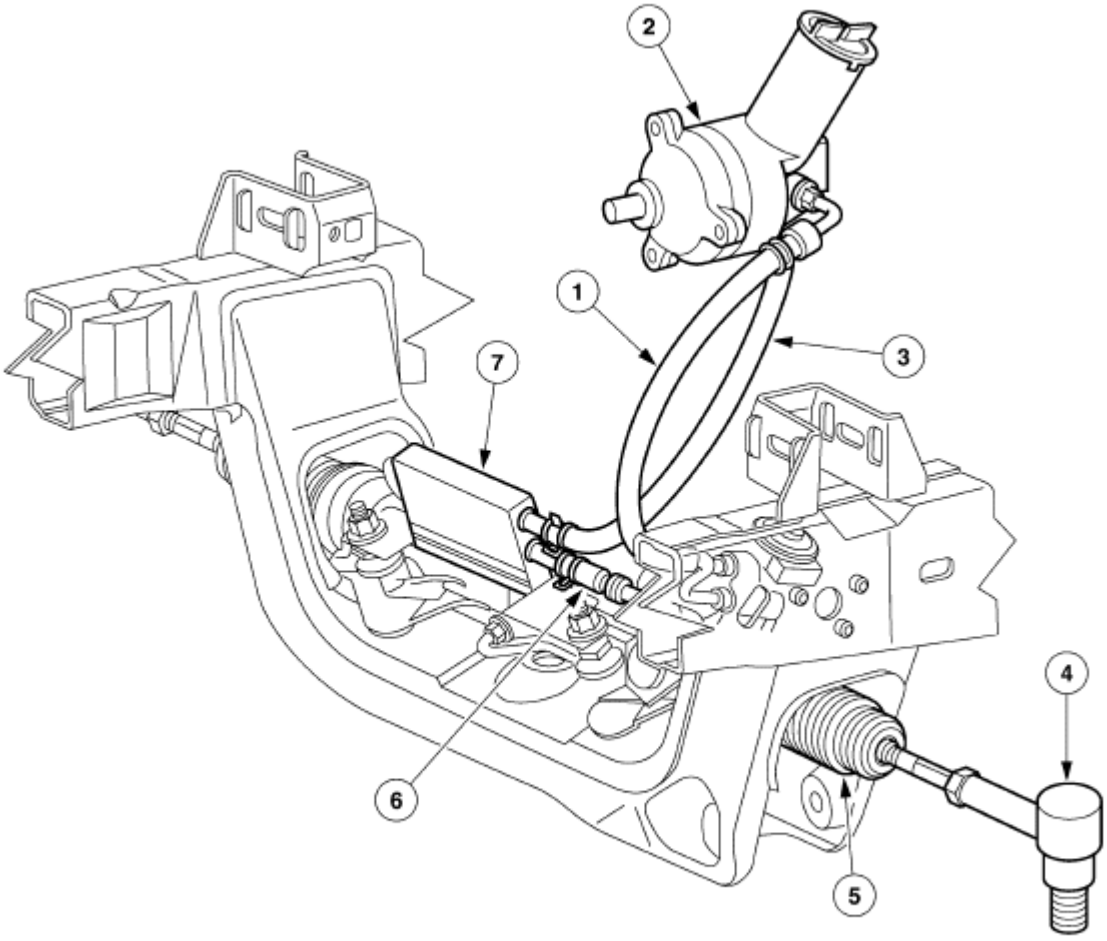
Item	Part Number	Description
1	3A733	Power steering pump pulley
2	3A719	Power steering pressure hose
3	3A697	Power steering oil reservoir
4	3A005	Power steering return line hose
5	3280	Front wheel spindle tie-rod
6	3F780	Power steering fluid cooler
7	3504	Steering gear
8	3A713	Power steering return hose

System View — 4.0L Engine SOHC



Item	Part Number	Description
1	3A733	Power steering pump pulley
2	3A697	Power steering fluid reservoir
3	3A005	Power steering return line hose
4	3A719	Power steering pressure hose
5	3280	Front wheel spindle tie-rod
6	3504	Steering gear
7	3A713	Power steering return hose
8	3F780	Power steering fluid cooler

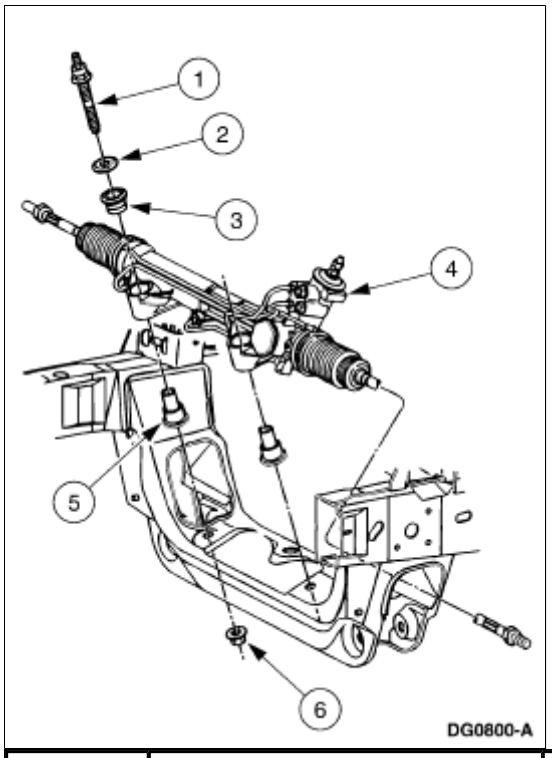
System View — 4.0L Engine (Push Rod)



DG1634-A

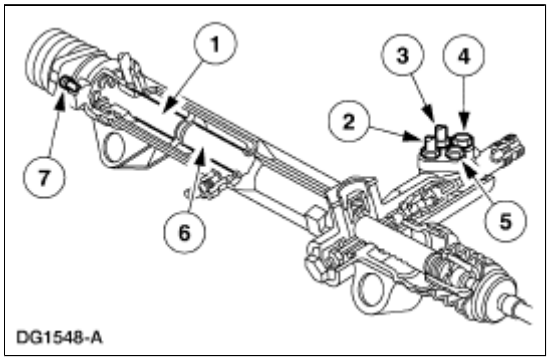
Item	Part Number	Description
1	3A719	Power steering pressure hose
2	3A674	Power steering pump
3	3A005	Power steering return line hose
4	3A130	Tie-rod end
5	3504	Steering gear
6	3A713	Power steering return hose
7	3F780	Power steering fluid cooler

Steering Gear Mounting



Item	Part Number	Description
1	N811762-S60	Stud
2	385935-S36	Washer
3	3K576	Insulator
4	3504	Steering gear
5	3F638	Insulator
6	N8086255-S60	Nut

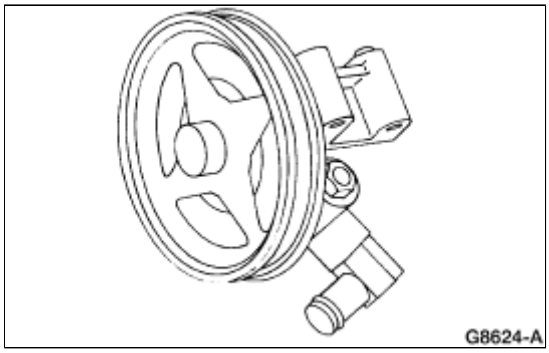
Steering Gear



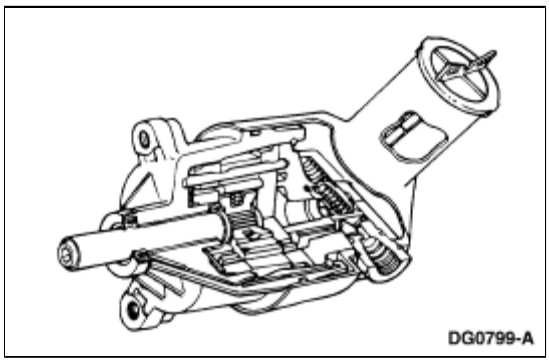
Item	Description
1	Oil flow — left turn
2	To left turn port
3	To right turn port

4	Return port (out)
5	Pressure port (in)
6	Oil flow — right turn
7	Air transfer tube (between bellows)

Power Steering Pump — 4.0L (SOHC) and 5.0L Engines



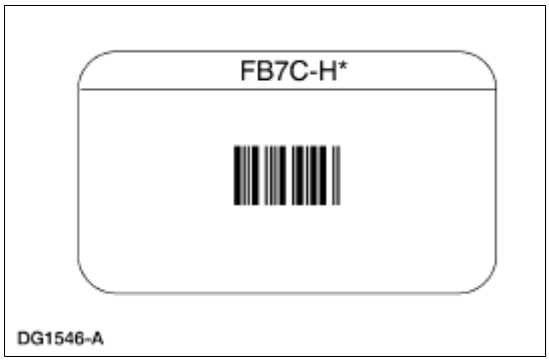
Power Steering Pump — 4.0L Engine (Push Rod)



Steering Gear Identification

CAUTION: Always use the ID code when ordering service parts.

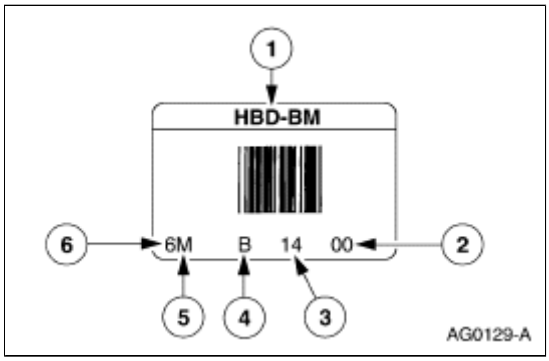
The steering gear identification code is located on a tag attached to the steering gear.



Pump Identification

CAUTION: Always use the ID code when ordering service parts.

The Pump identification code is located on a tag attached to the power steering pump.



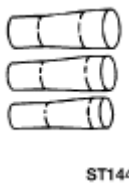
Item	Description
1	Model code
2	For manufacturing purposes only
3	Day of the month
4	Shift
5	Month
6	Year

Power Steering

Refer to Section 211-00 .

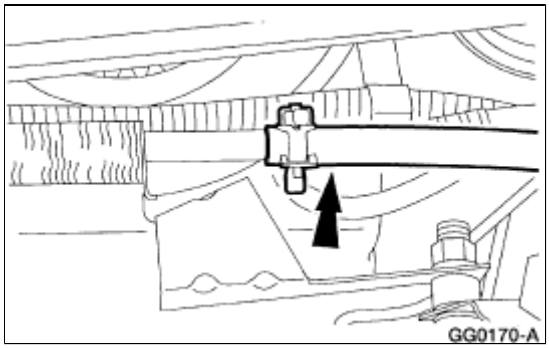
Pump —5.0L Engine

Special Tool(s)

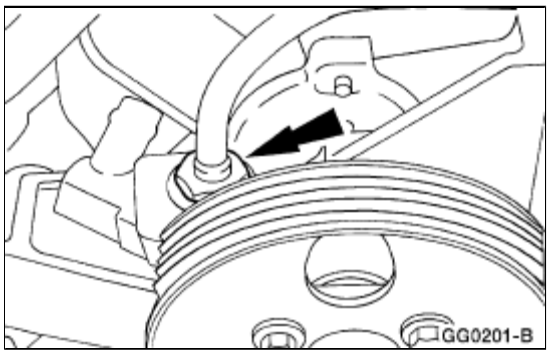
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

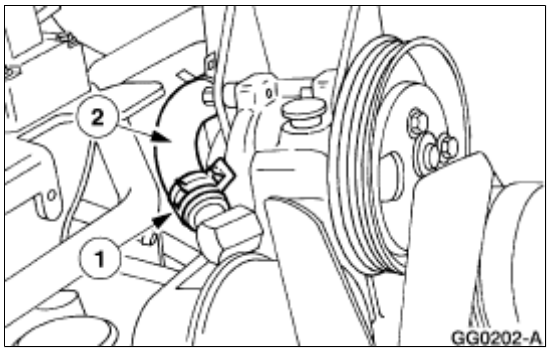
1. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
2. Disconnect the power steering return line hose at the power steering fluid cooler (3F780).
   - Drain the power steering oil reservoir (3A697).



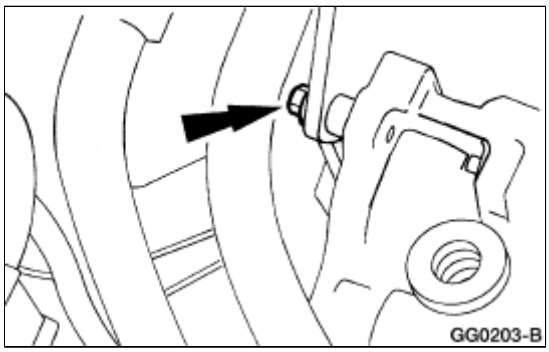
3. Disconnect the power steering pressure hose (3A719) from the power steering pump (3A674).



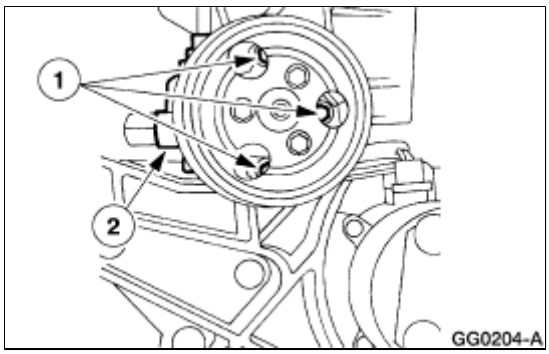
4. Disconnect the power steering oil reservoir outlet hose from the power steering pump.
   1. Compress and move the power steering oil reservoir outlet hose clamp.
   2. Disconnect the power steering oil reservoir outlet hose from the power steering pump.



5. Remove the rear bolt.

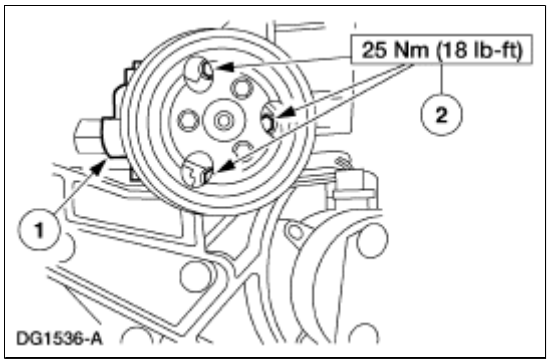


6. Remove the power steering pump.
    1. Remove the three front bolts.
        - Rotate the pulley to access each bolt.
    2. Remove the power steering pump.

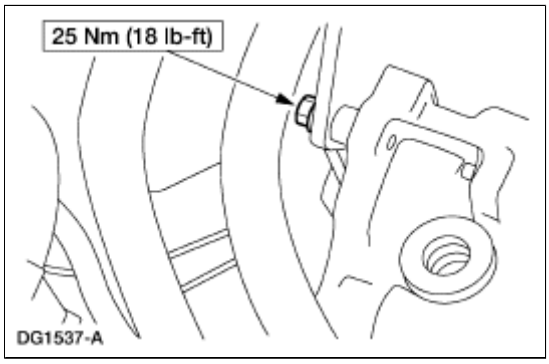


Installation

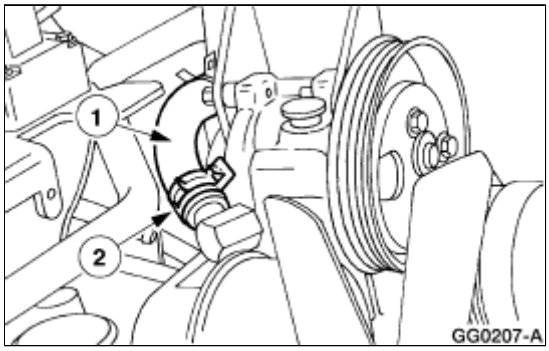
1. Install the power steering pump.
    1. Position the power steering pump.
    2. Install the three front bolts.
        - Rotate the pulley to access each bolt.



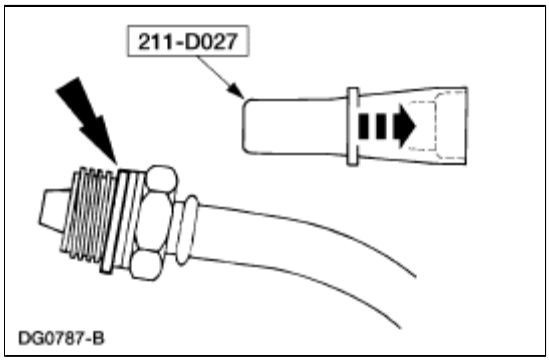
2. Install the rear bolt.



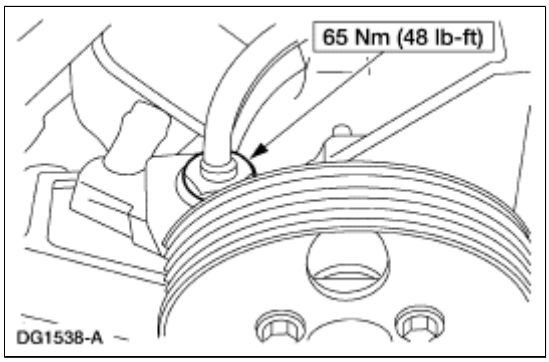
3. Connect the power steering oil reservoir outlet hose to the power steering pump.
    1. Connect the power steering oil reservoir outlet hose to the power steering pump.
    2. Compress and move the power steering oil reservoir outlet hose clamp.



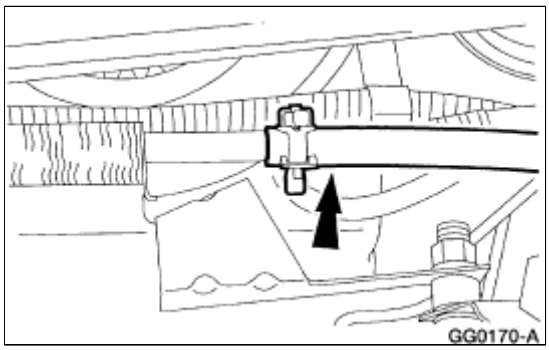
4. Using the special tool, install a new seal on the power steering pressure hose.



5. Connect the power steering pressure hose to the power steering pump.



6. Connect the power steering return line hose to the power steering fluid cooler.

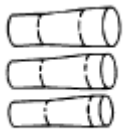


7. Install the drive belt. For additional information, refer Section 303-05 .

8. Fill, and leak check the system. For additional information, refer to Section 211-00 .

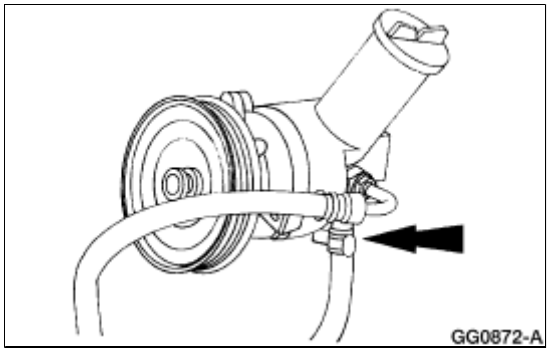
Pump —4.0L Engine (Push Rod)

Special Tool(s)

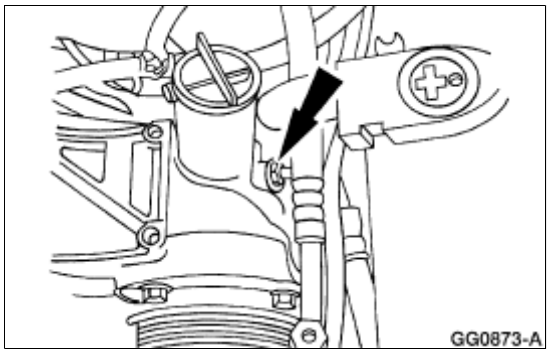
	Steering Pump Pulley Remover 211-016 (T69L-10300-B)
	Steering Pump Pulley Replacer 211-009 (T65P-3A733-C)
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

1. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
2. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
3. Disconnect the power steering return line hose at the power steering pump (3A674).
   - Allow the system to drain.

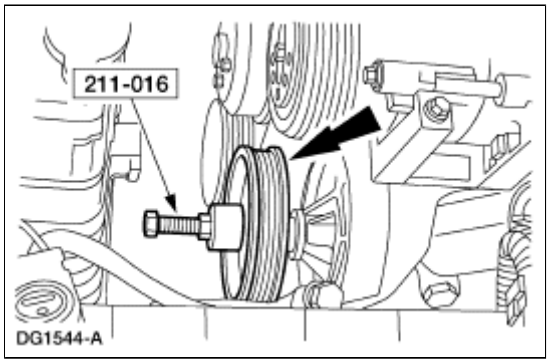


4. Disconnect the power steering pressure hose (3A719) from the power steering pump.

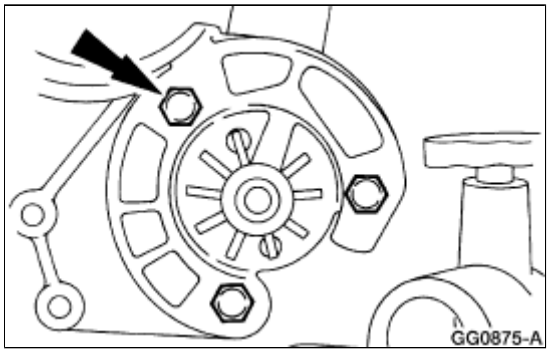


5. **CAUTION: Do not apply pressure on the power steering pump rotor shaft. Pressure will damage internal thrust areas of the power steering pump.**

   Using the special tool, remove the power steering pump pulley (3A733).
   - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, discard the pulley. If there is no paint or one paint mark, use a paint pencil to mark the web area of the pulley near the hub.

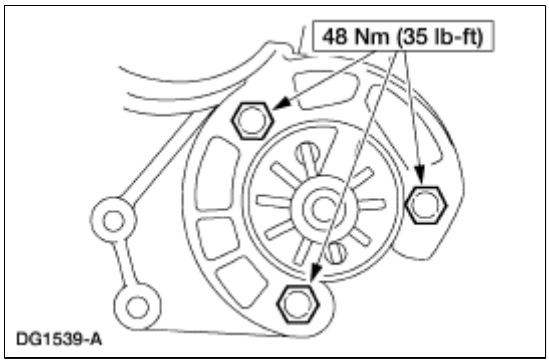


6. Remove the bolts and the power steering pump.



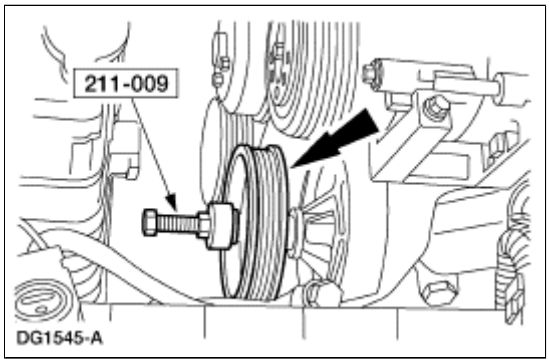
Installation

1. Position the power steering pump and install the bolts.

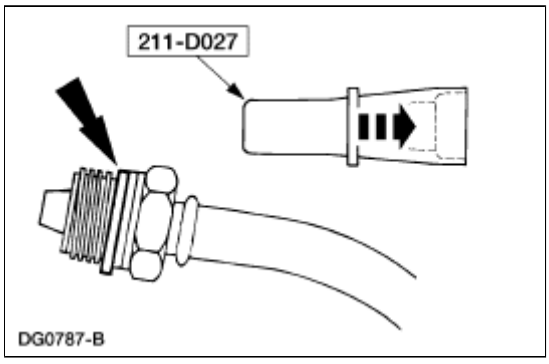


2. **CAUTION: Install a new power steering pump pulley after it has been removed and installed two times.**

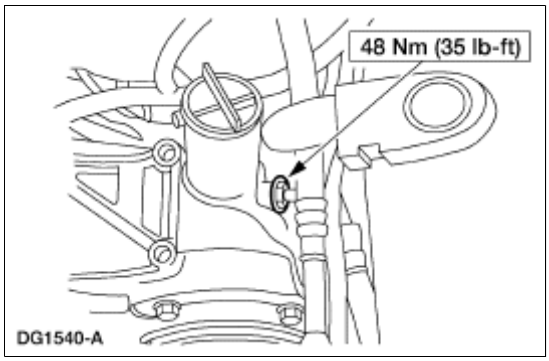
   Using the special tool, install the power steering pump pulley.
   - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, discard the pulley. If there is no paint or one paint mark, use a paint pencil to mark the web area of the pulley near the hub.



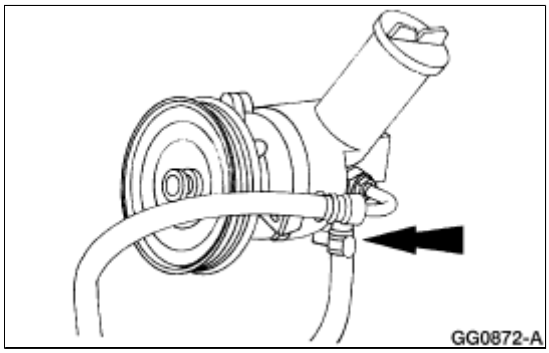
3. Using the special tool, install a new seal on the power steering pressure hose.



4. Connect the power steering pressure hose to the power steering pump.



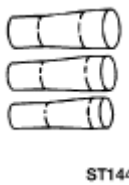
5. Connect the power steering return line hose at the power steering pump.



6. Install the engine cooling fan. For additional information, refer to Section 303-03 .
7. Install the drive belt. For additional information, refer to Section 303-05 .
8. Fill and leak check the system. For additional information, refer to Section 211-00 .

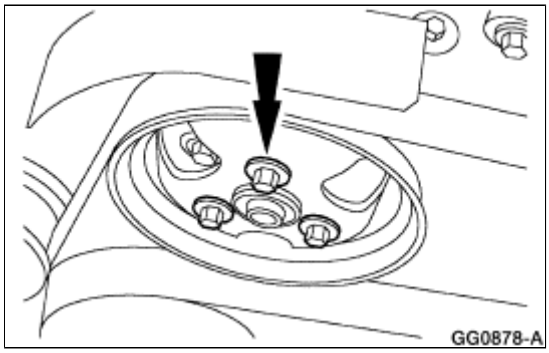
Pump —4.0L Engine (SOHC)

Special Tool(s)

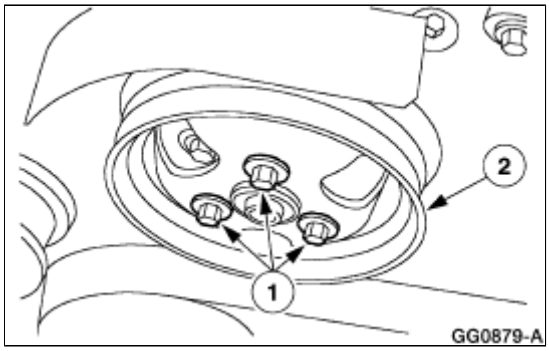
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

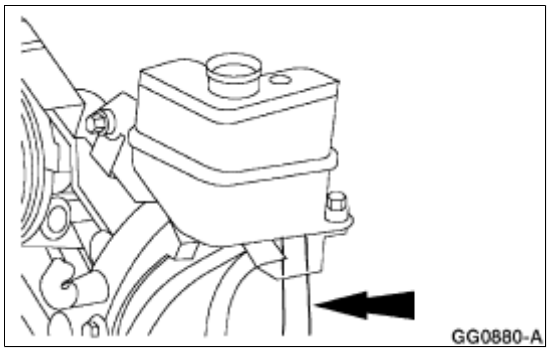
1. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
2. Loosen the power steering pump pulley bolts.



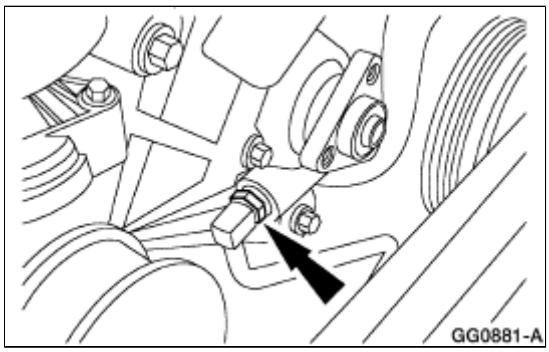
3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Remove the power steering pump pulley (3A733).
    1. Remove the bolts.
    2. Remove the power steering pump pulley.



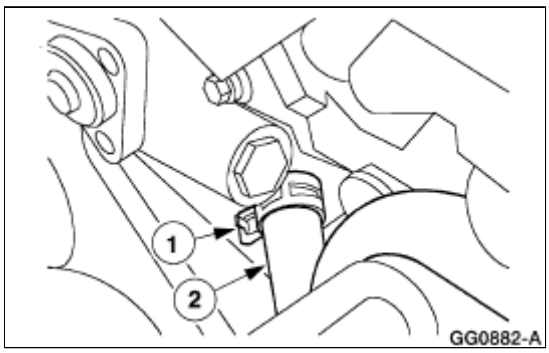
5. Disconnect the power steering return line hose at the power steering fluid reservoir.
    - Allow the system to drain.



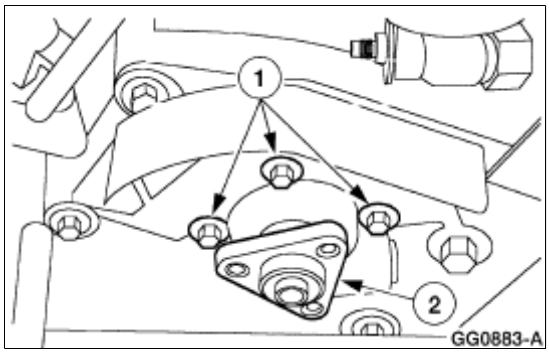
6. Disconnect the power steering pressure hose (3A719) from the power steering pump (3A674).



7. Disconnect the power steering fluid reservoir outlet hose from the power steering pump.
    1. Compress and move the power steering fluid reservoir outlet hose clamp.
    2. Disconnect the power steering fluid reservoir outlet hose from the power steering pump.

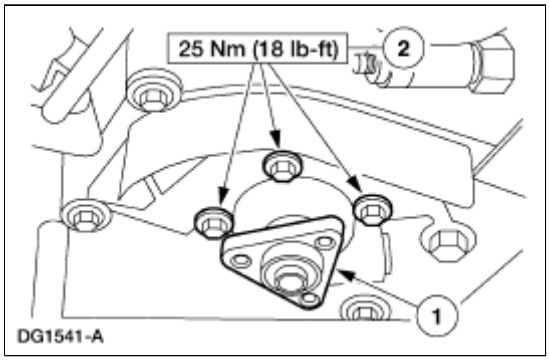


8. Remove the power steering pump.
    1. Remove the bolts.
    2. Remove the power steering pump.

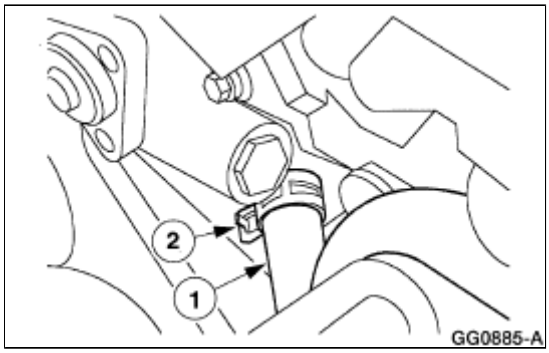


Installation

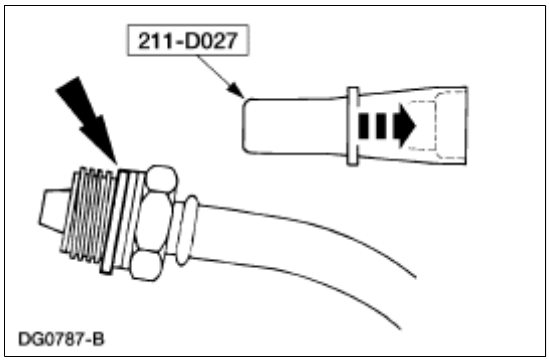
1. Install the power steering pump.
    1. Position the power steering pump.
    2. Install the bolts.



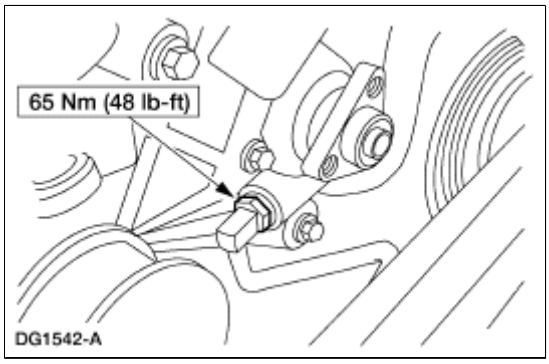
2. Connect the power steering fluid reservoir outlet hose to the power steering pump.
    1. Connect the power steering fluid reservoir outlet hose to the power steering pump.
    2. Compress and move the power steering fluid reservoir outlet hose clamp into place.



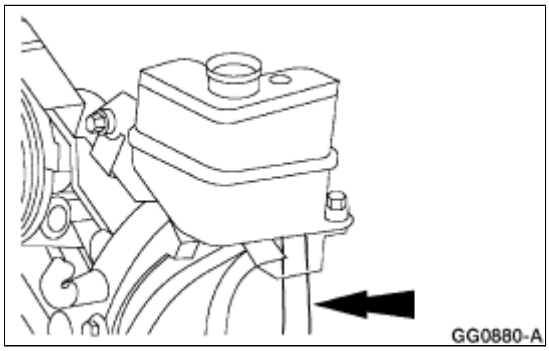
3. Using the special tool, install a new seal on the power steering pressure hose.



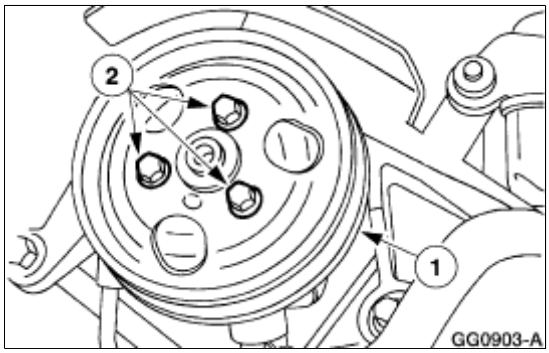
4. Connect the power steering pressure hose to the power steering pump.



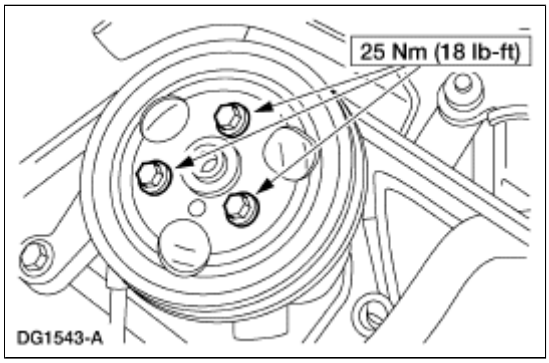
5. Connect the power steering return line hose to the power steering fluid reservoir.



6. Install the power steering pump pulley.
    1. Position the power steering pump pulley.
    2. Install the bolts.



7. Install the drive belt. For additional information, refer to Section 303-05 .
8. Tighten the power steering pump pulley bolts.

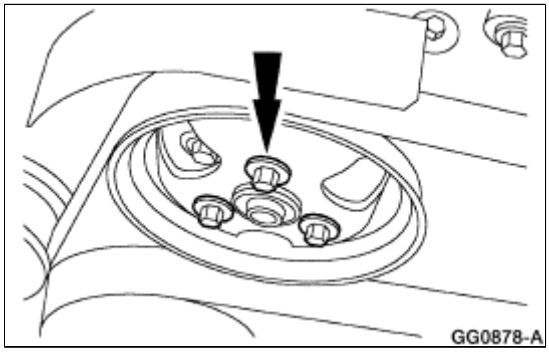


9. Install the engine cooling fan. For additional information, refer to Section 303-03 .
10. Fill, and leak check the system. For additional information, refer to Section 211-00 .

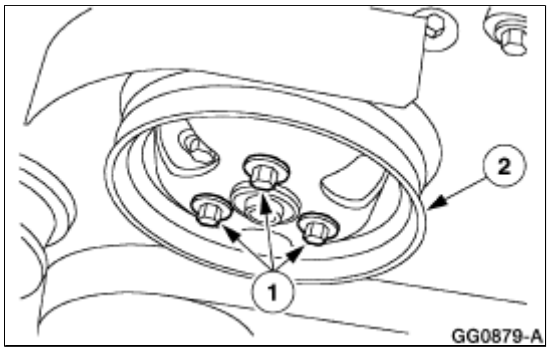
Pulley —Pump, 5.0L Engine and 4.0L Engine (SOHC)

Removal

1. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
2. Loosen the power steering pump pulley bolts.

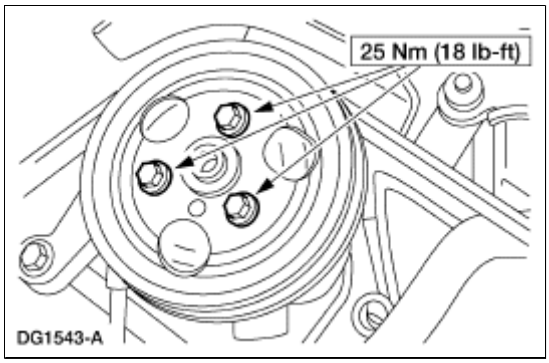


3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Remove the power steering pump pulley (3A733).
    1. Remove the bolts.
    2. Remove the power steering pump pulley.



Installation

1. Follow the removal procedure in reverse order.


25 Nm (18 lb-ft)
DG1543-A

Hose

Special Tool(s)

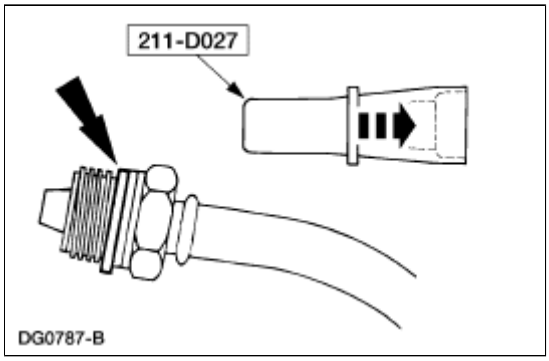
ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

1. Refer to the System View illustration in Description and Operation for the hose routing and retention points.

Installation

1. When connecting a fitting with a seal ring, a new seal ring must be installed.
   - The special tool is used to install the return line connector seal and the pressure line connector seal.

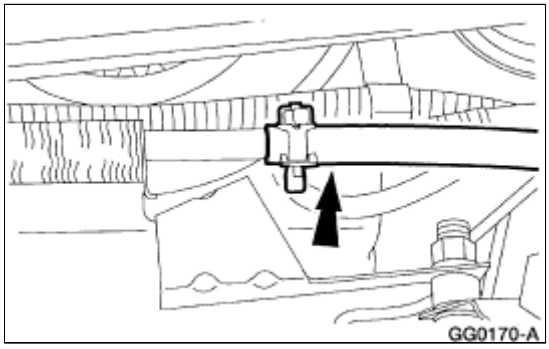


2. Fill and leak check the system. For additional information, refer to Section 211-00 .

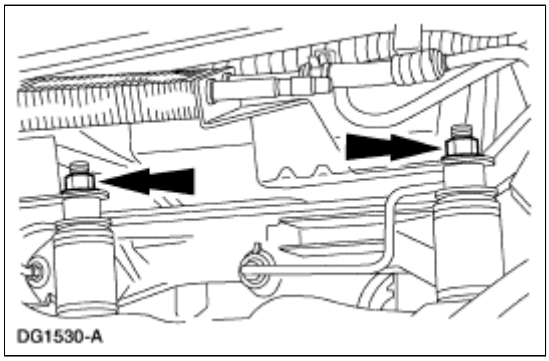
Cooler —Fluid

Removal

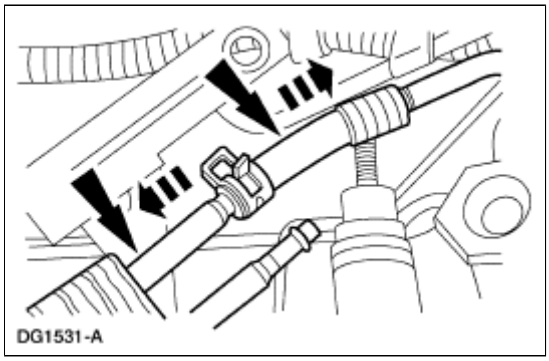
1. Disconnect the power steering return line hose (3A005) at the power steering fluid cooler (3F780).
   - Allow the system to drain.



2. Remove the power steering fluid cooler to crossmember nuts.

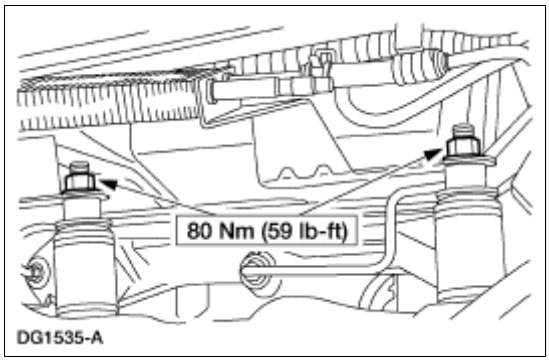


3. Disconnect the power steering return hose (3A713). Remove the power steering fluid cooler.



Installation

1. Follow the removal procedure in reverse order.



2. Fill, and leak check the system. For additional information, refer to Section 211-00 .

Gear —4.0L

Removal

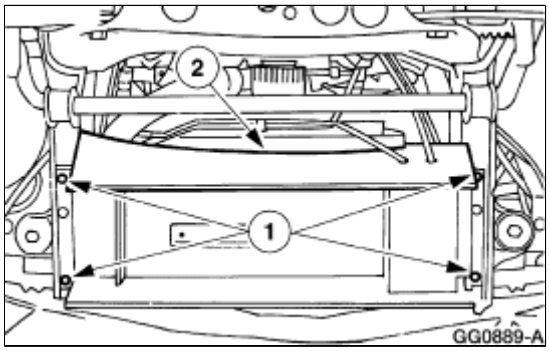
1. Place front wheels in the straight ahead position. Do not lock the steering column.

2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

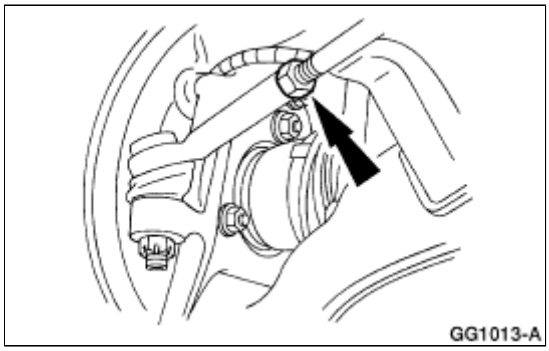
   Raise the vehicle. For additional information, refer to Section 100-02 .

3. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

4. Remove the radiator air deflector (8327).
   1. Remove the bolts.
   2. Remove the radiator air deflector.

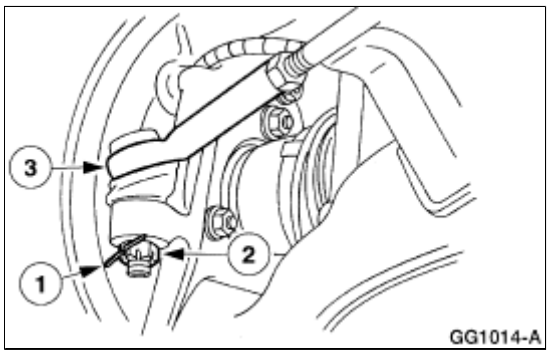


5. Loosen the LH tie-rod end jam nut.

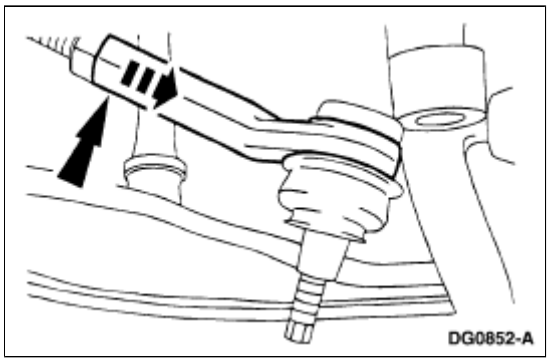


6. Disconnect the tie-rod ends (3A131).
   1. Remove and discard the cotter pins.
   2. Remove the castellated nuts.
   3. Disconnect the tie-rod ends from the steering knuckles.

- Do not damage the tie-rod end boots.

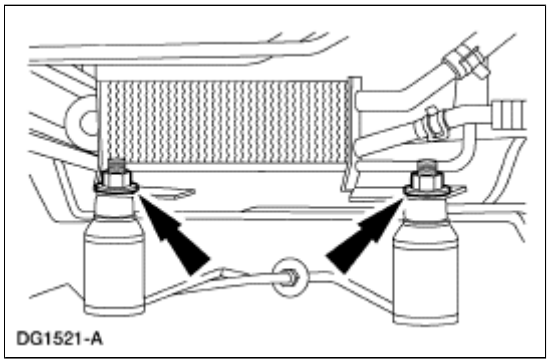


7. Remove the LH tie-rod end.
   - Count and record the number of turns required to remove the tie-rod end.

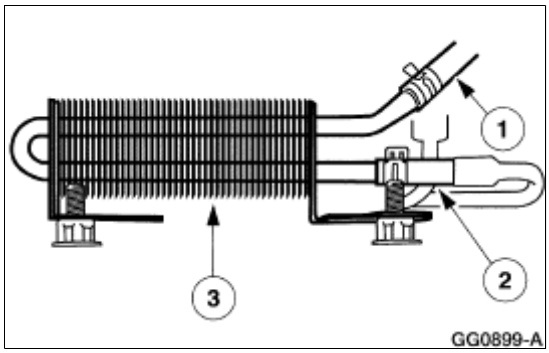


8. Remove the front stabilizer bar (5482). For additional information, refer to Section 204-01A .
   - Mark the driver side end of the stabilizer bar for correct installation.

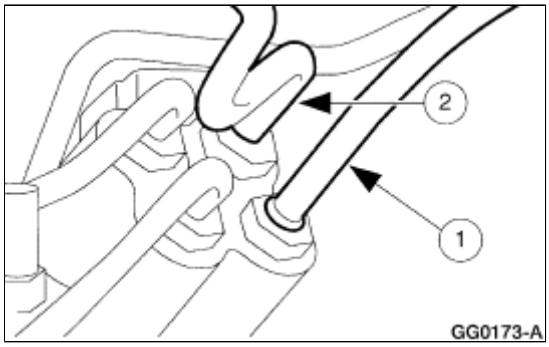
9. Remove the power steering cooler to crossmember nuts.



10. Remove the power steering fluid cooler (3F780).
    1. Separate the power steering fluid return hose (3A713) from the power steering fluid cooler.
       - Allow the system to drain.
    2. Disconnect the power steering return line hose (3A005).
    3. Remove the power steering fluid cooler.

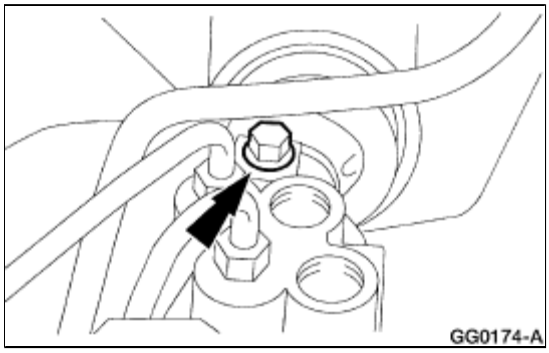


11. Disconnect the lines at the gear.
    1. Disconnect the power steering pressure hose (3A719).
    2. Disconnect the power steering return hose.



12. Plug ends of fluid lines and ports in steering gear to prevent damage and entry of dirt.

13. Rotate the steering column shaft to access the intermediate shaft pinch bolt. Remove the pinch bolt.



14. Lower the vehicle.

15. Turn the steering wheel back to the straight ahead position. Turn the ignition key to the locked position.

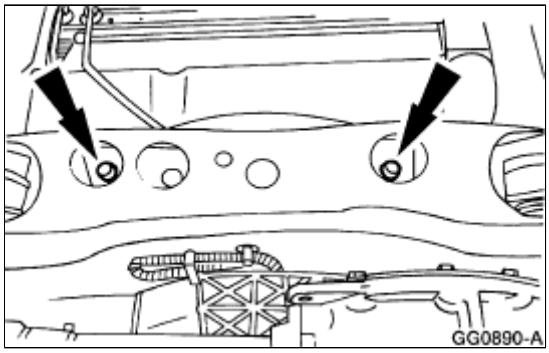
16. Raise the vehicle.

17. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected or damage to the air bag sliding contact will result.**

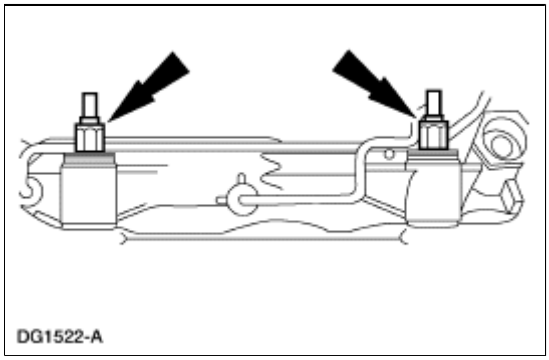
    Disconnect the intermediate shaft from the steering gear input shaft.

18. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

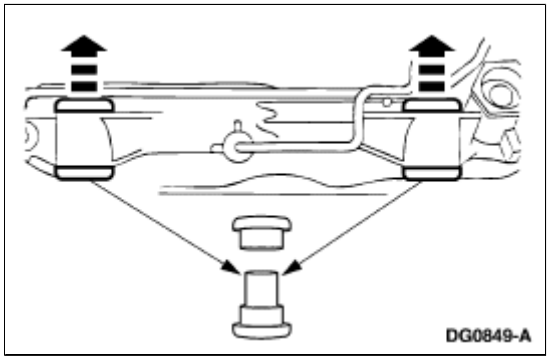
    Remove the nuts.



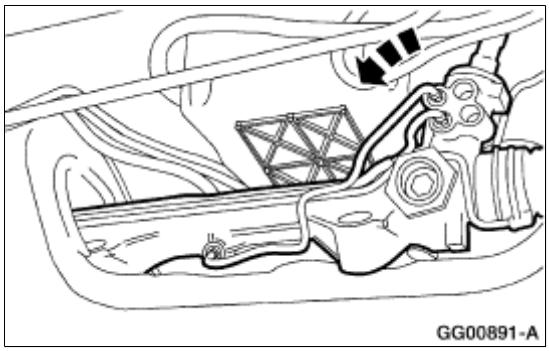
19. Remove the stud bolts and washers.



20. Remove the steering gear to crossmember insulator bushings.

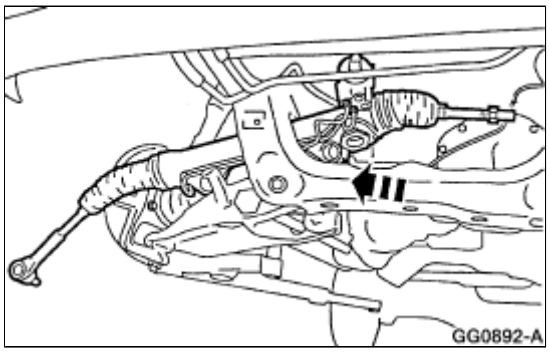


21. Rotate the steering gear control valve housing toward the front of the vehicle.

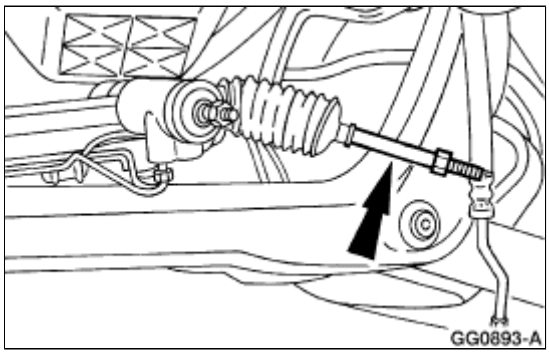


22. Turn the steering gear input shaft to the right until the stop is reached.

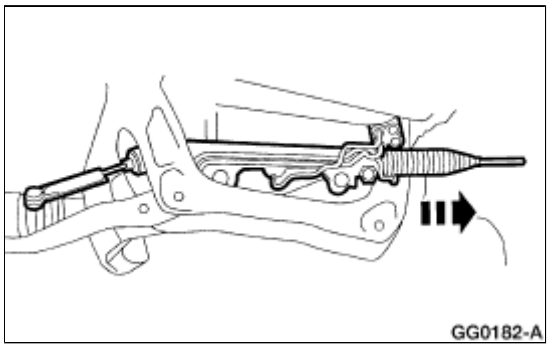
23. Move the steering gear (3504) as far to the RH side of the vehicle as possible.



24. Move the LH front wheel spindle tie-rod (3280) forward to clear the frame crossmember.

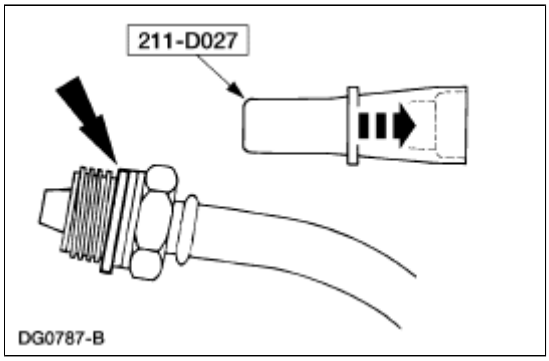


25. Remove the steering gear from the vehicle.



Installation

1. Using the special tool, install new seals on the power steering return hose and power steering pressure hose.



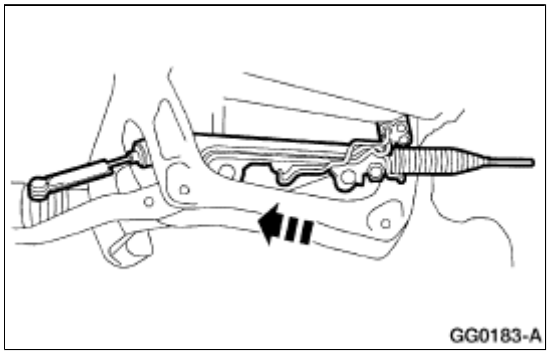
2. **NOTE:** Make sure the steering gear input shaft is turned to the left until the stop is reached.

   NOTE: Handle the steering gear with caution to avoid damage to the fluid transfer tubes and to avoid dimples in the tie-rod boots.

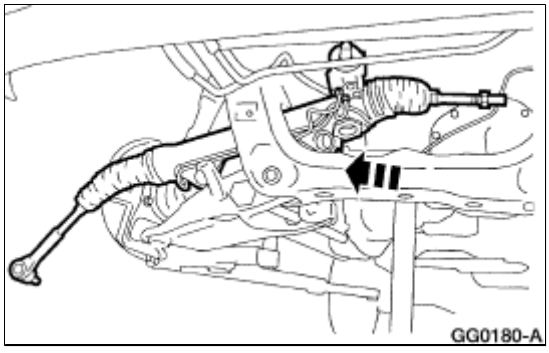
   Turn the steering gear input shaft to the right until the stop is reached. Note the number of turns.

3. **NOTE:** Make sure the steering gear control valve housing is turned toward the front of the vehicle.

   Install the steering gear into the RH opening of the crossmember.

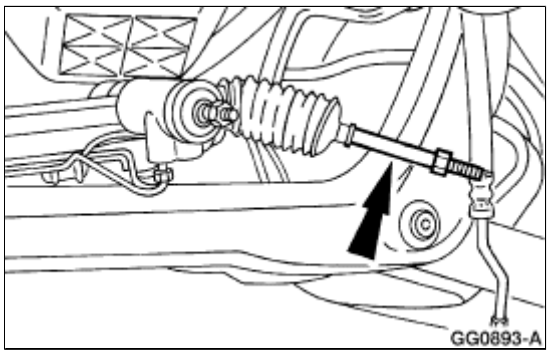


4. Move the steering gear as far to the RH side of the vehicle as possible.



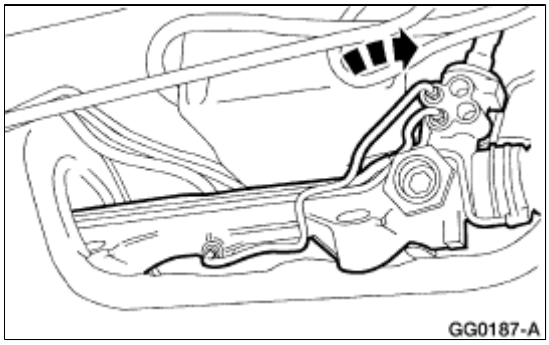
5. Move the LH front wheel spindle tie-rod into the opening in the crossmember and move the steering

gear into position.

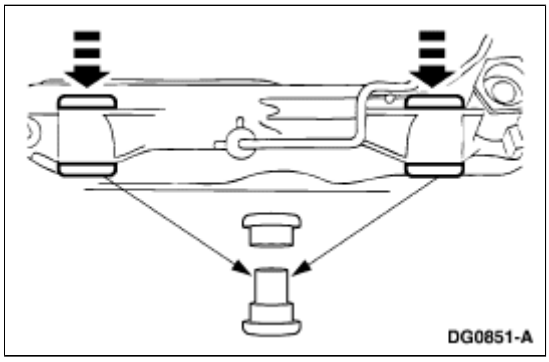


6. To place the steering gear in the straight ahead position, turn the steering gear input shaft to the left by half the number of turns recorded previously.

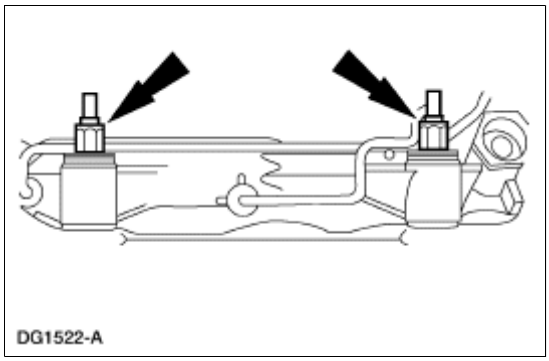
7. Rotate the steering gear control valve housing toward the rear of the vehicle.



8. Install the steering gear to crossmember insulator bushings as shown.
   - The large end of the metal sleeve must be positioned downward.
   - Check that the mounting surfaces on the crossmember are clean and free of debris.

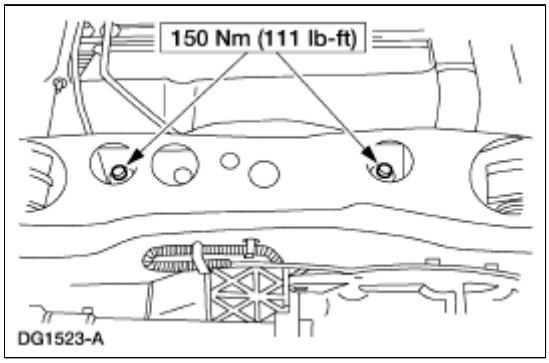


9. Install the steering gear to crossmember washers and stud bolts.
   - For additional information on correct mounting hardware orientation, refer to Power Steering in the Description and Operation portion of this section.
   - The dished side of the washers face down.



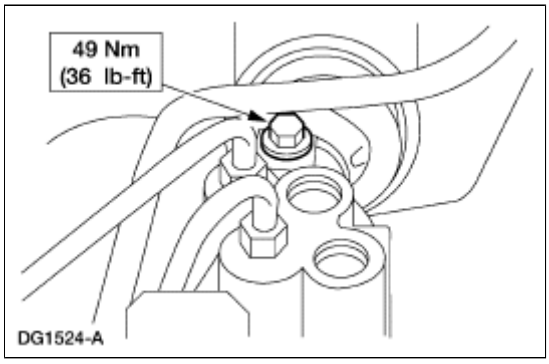
10. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

    Install the nuts.

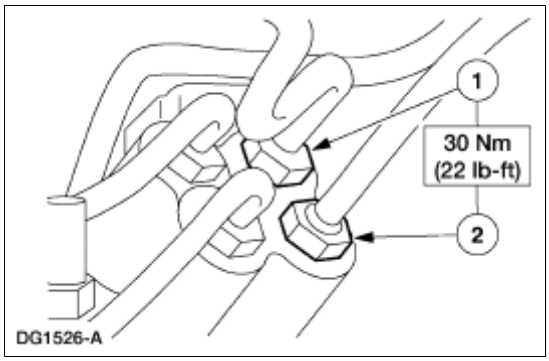


11. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected or damage to the air bag sliding contact will result.**

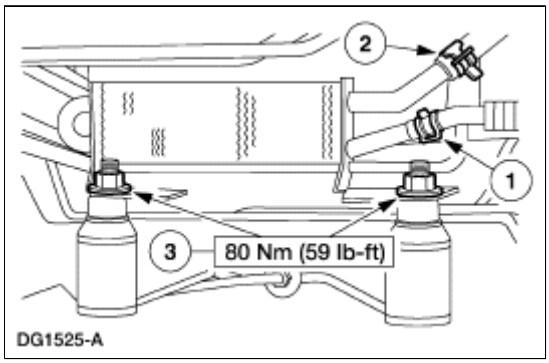
    Connect the intermediate shaft to the steering gear input shaft. Install the pinch bolt.



12. Install the steering gear fluid lines.
    1. Install the power steering return hose and then tighten tube nut.
    2. Install the power steering pressure hose and tighten the tube nut.

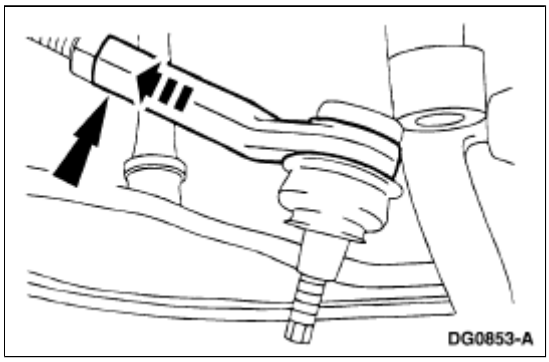


13. Install the power steering fluid cooler.
    1. Connect the power steering return line hose.
    2. Connect the power steering return hose.
    3. Position the power steering fluid cooler and install the nuts.

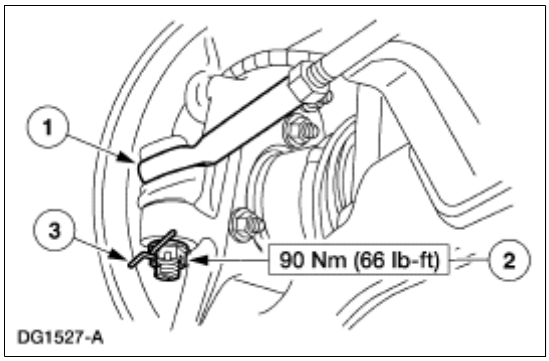


14. Install the front stabilizer bar. For additional information, refer to Section 204-01A .
    - Orientate the front stabilizer bar as noted during removal.

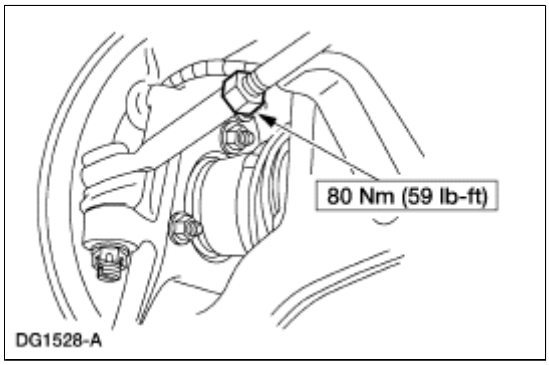
15. Install the LH tie-rod end on the front wheel spindle tie-rod.
    - Rotate the tie-rod end the number of turns recorded during removal.



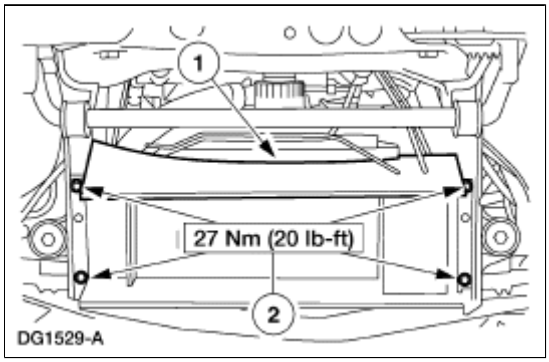
16. Connect the tie-rod ends to the steering knuckles.
    1. Position the tie-rod ends on the steering knuckles.
    2. Install the castellated nuts.
    3. Install the new cotter pins.
    - Check that the brake dust shields are not bent and are not in contact with the outer tie-rod boot seals.



17. Tighten the tie-rod jam nuts.



18. Install the radiator air deflector.
    1. Position the radiator air deflector.
    2. Install the bolts.



19. Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

20. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Lower the vehicle.

21. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .

22. Check the wheel alignment. For additional information, refer to Section 204-00 .

Gear —5.0L

Removal

1. Place the front wheels in the straight ahead position. Do not lock the steering column.

2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

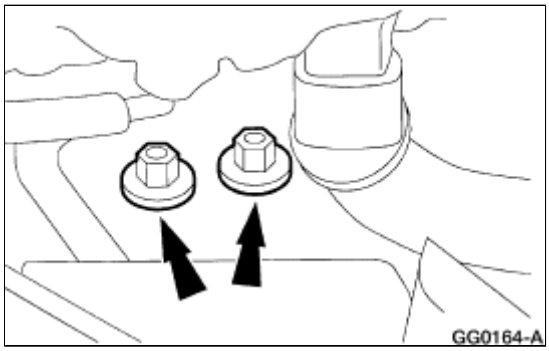
   Raise the vehicle. For additional information, refer to Section 100-02 .

3. Remove the engine oil cooler. For additional information, refer to Section 303-01C .

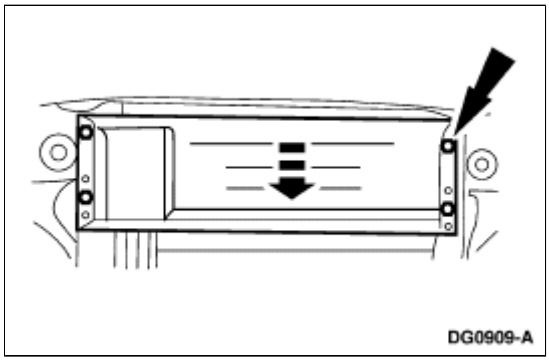
4. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

5. Remove the inner fender splash shields.

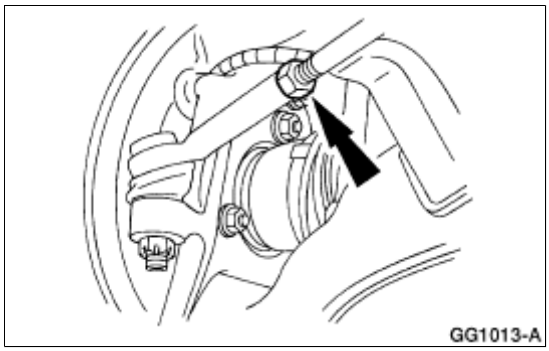
6. Remove the top motor mount nuts.



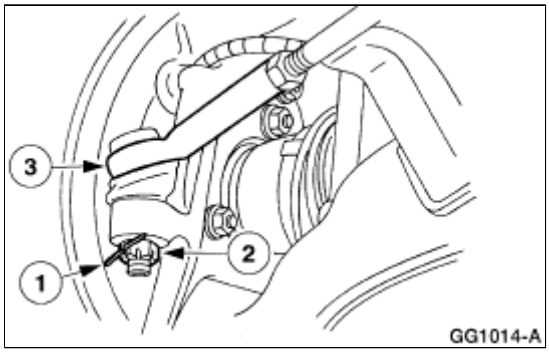
7. Remove the bolts and the radiator air deflector (8327).



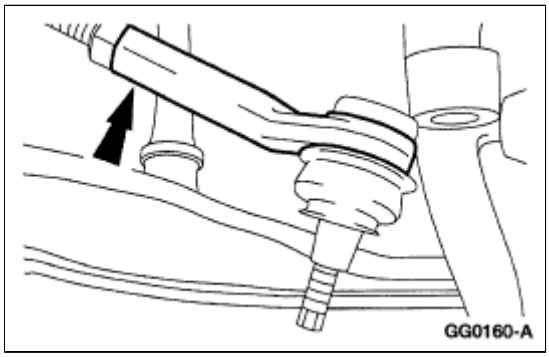
8. Loosen the LH tie-rod end jam nuts.



9. Disconnect the tie-rod ends (3A131).
    1. Remove and discard the cotter pins.
    2. Remove the castellated nuts.
    3. Separate the tie-rod ends from the steering knuckles. Do not damage the tie-rod end seals.

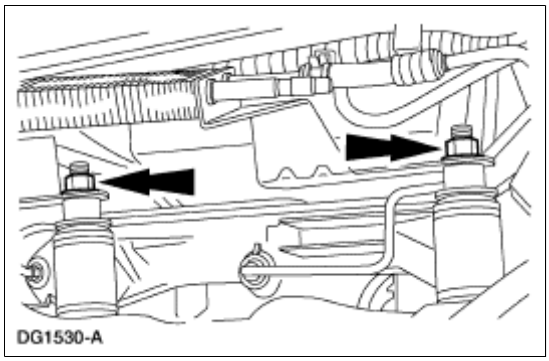


10. Remove the LH tie-rod end.
    - Count and record the number of turns required to remove the LH tie-rod end.

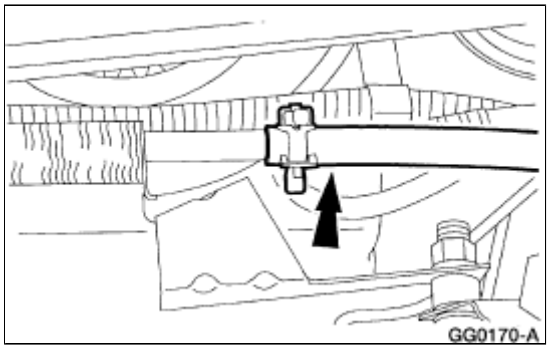


11. Remove the front stabilizer bar (5482). For additional information, refer to Section 204-01A .
    - Mark the driver side end of the stabilizer bar for correct installation.

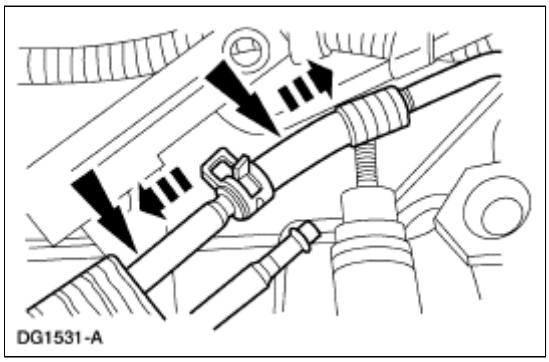
12. Remove the power steering fluid cooler to crossmember nuts.



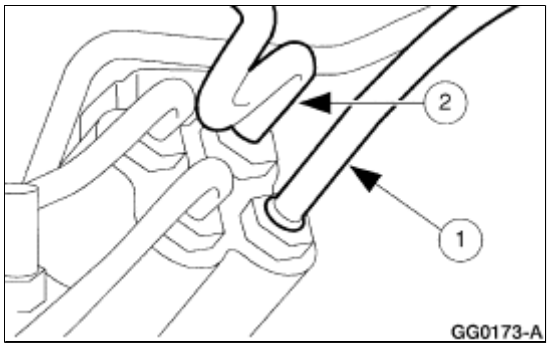
13. Disconnect the power steering return line hose (3A005) at the power steering fluid cooler (3F780).
    - Allow the system to drain.



14. Disconnect the power steering return hose (3A713) and remove the power steering fluid cooler.

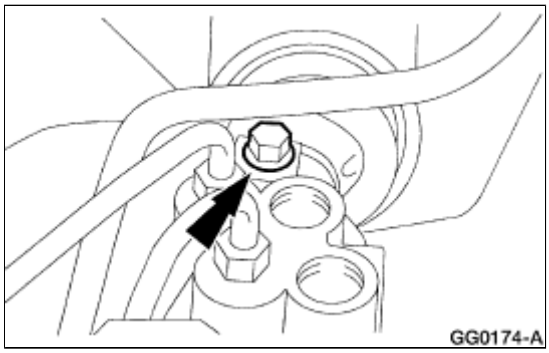


15. Disconnect the steering gear lines.
    1. Disconnect the power steering pressure hose (3A719).
    2. Disconnect the power steering return hose.



16. Plug the ends of all fluid lines removed and ports in steering gear to prevent damage and entry of dirt.

17. Rotate the steering column shaft to access the Intermediate shaft pinch bolt. Remove the pinch bolt.



18. Lower the vehicle.

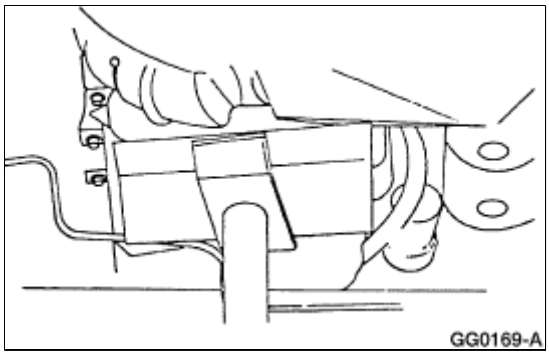
19. Turn the steering wheel back to the straight ahead position. Turn the ignition key to the locked position.

20. Raise the vehicle.

21. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the air bag sliding contact will result.**

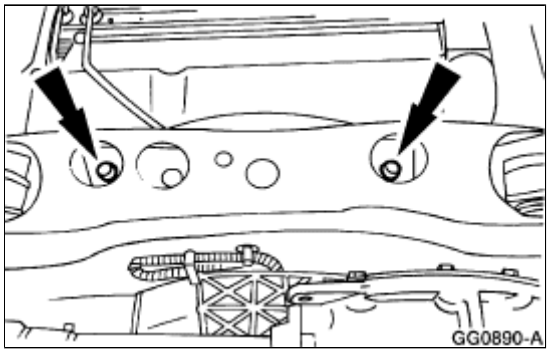
    Disconnect the intermediate shaft from the steering gear input shaft.

22. Raise the engine.
    - Position a block of wood between a screw jack and the bottom of the oil pan to avoid damaging the oil pan while raising the engine.

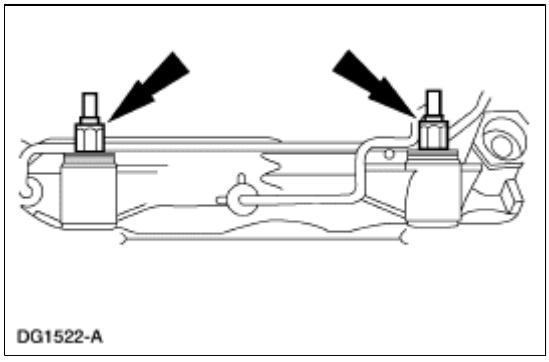


23. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

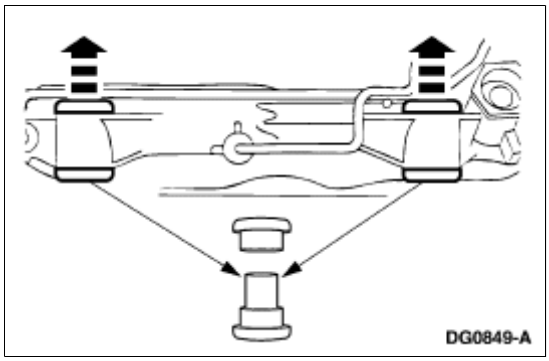
    Remove the nuts.



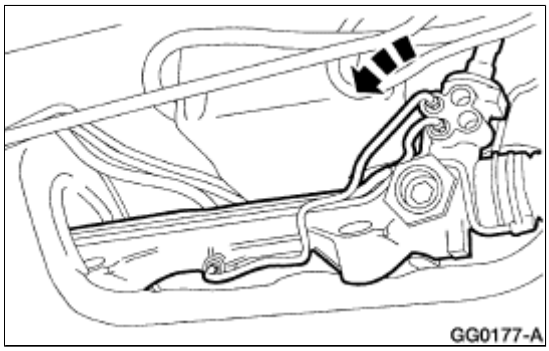
24. Remove the stud bolts and washers.



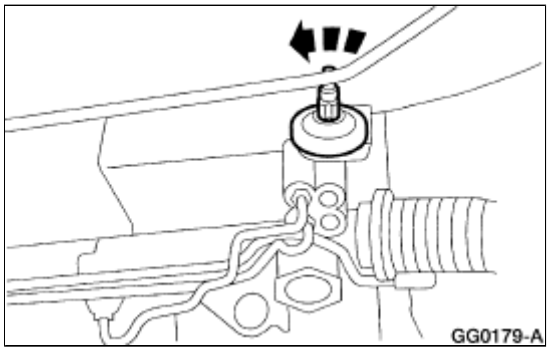
25. Remove the steering gear to crossmember insulator bushings.



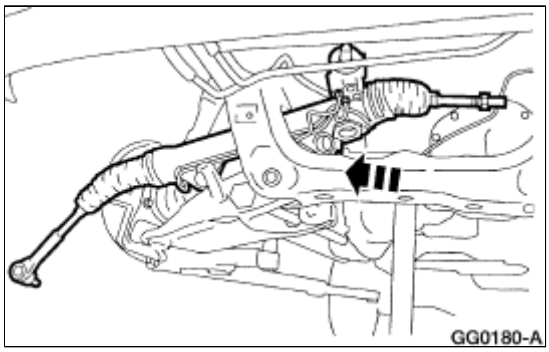
26. Rotate the steering gear control valve housing toward the front of the vehicle.



27. Turn the steering gear input shaft to the right until the stop is reached.

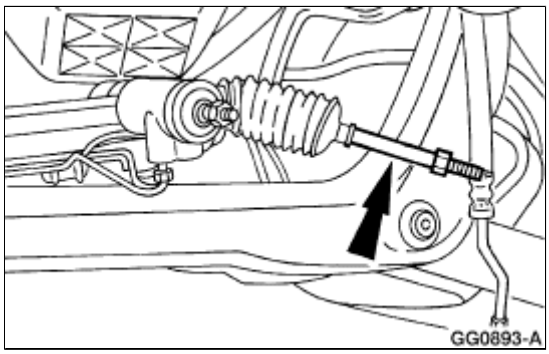


28. Move the steering gear (3504) as far to the RH side of the vehicle as possible.

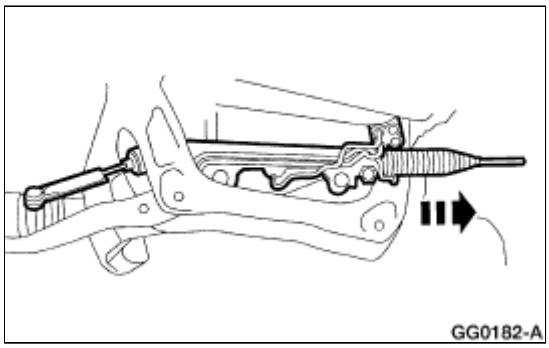


29. Move the LH front wheel spindle tie-rod (3280) forward to clear the crossmember. Turn the steering

gear input shaft to the left until the stop is reached.

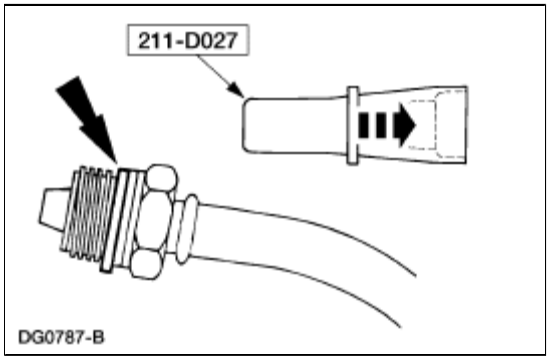


30. Remove the steering gear from the vehicle.



Installation

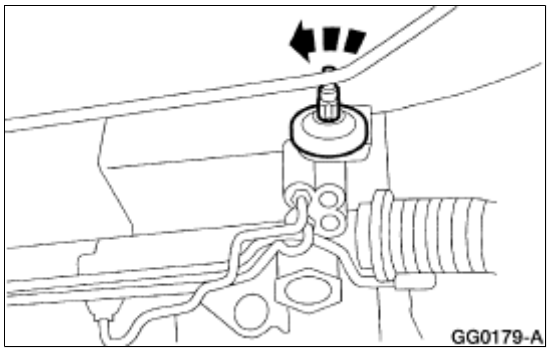
1. Using the special tool, install new seals on the power steering return hose and power steering pressure hose.



2. **NOTE:** Make sure the steering gear input shaft is turned to the left until the stop is reached.

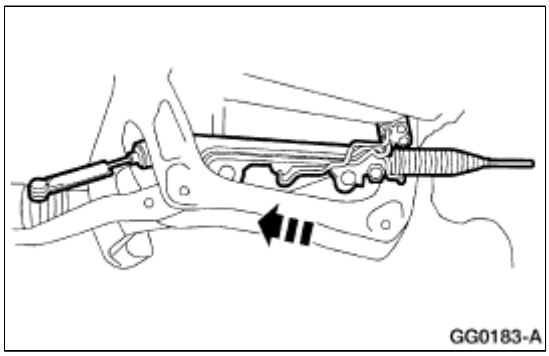
   NOTE: Handle the steering gear with caution to avoid damage to fluid transfer tubes and to avoid dimples in the tie-rod boots.

   Turn the steering gear input shaft to the right until the stop is reached. Note the number of turns required.

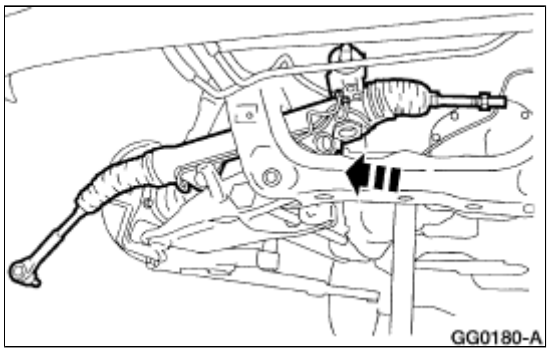


3. **NOTE:** Make sure the steering gear control valve housing is turned toward the front of the vehicle.

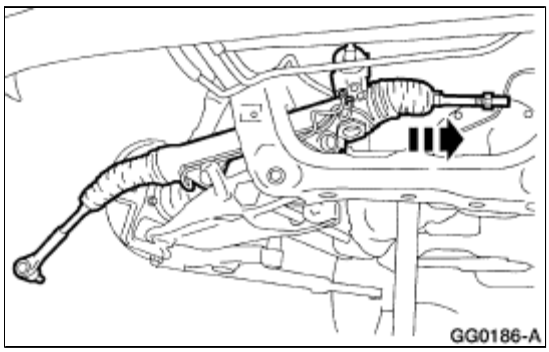
   Install the steering gear into the RH opening of the crossmember.



4. Move the steering gear as far to the RH side of the vehicle as possible.

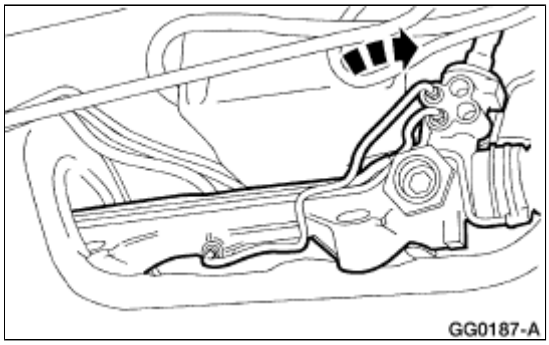


5. Move the LH front wheel spindle tie-rod into the opening in the crossmember and move the steering gear into position.

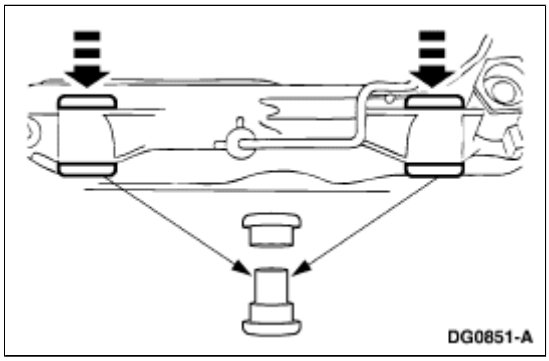


6. To place the steering gear in the straight ahead position, turn the steering gear input shaft to the left by half the number of turns recorded previously.

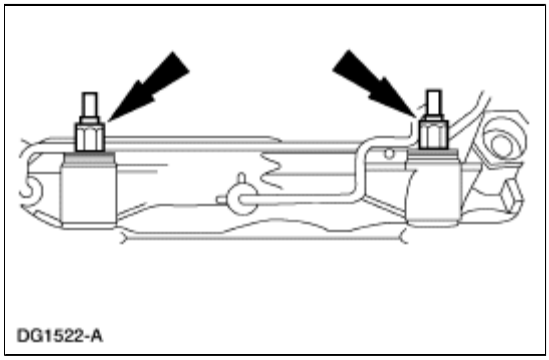
7. Rotate the steering gear control valve housing toward the rear of the vehicle.



8. Install the steering gear to crossmember insulator bushings as shown.
   - The large end of metal sleeve must be positioned downward.
   - Check that the mounting surfaces on the crossmember are clean and free of debris.

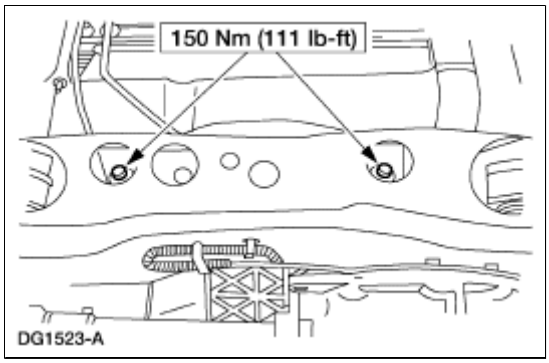


9. Install the steering gear to crossmember washers and stud bolts.
   - For additional information on correct mounting hardware orientation, refer to Power Steering in the Description and Operation portion of this section.



10. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

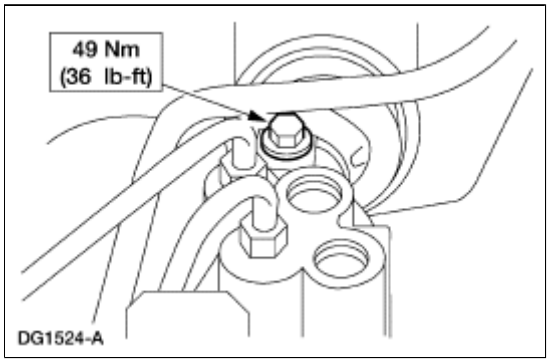
    Install the nuts.



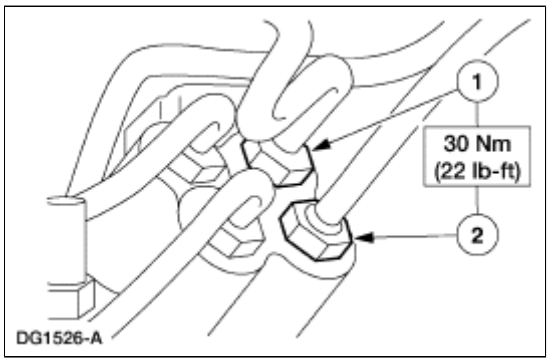
11. Lower the engine (6007).

12. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the air bag sliding contact (14A664) will result.**

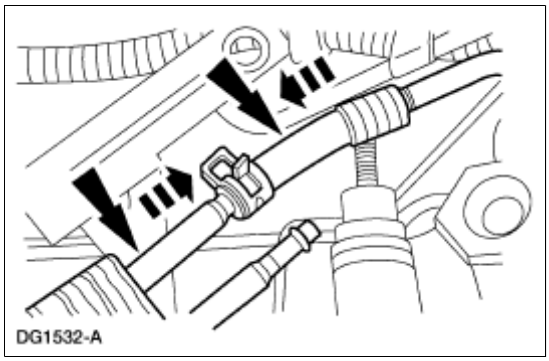
    Connect the intermediate shaft to the steering gear input shaft. Install the pinch bolt.



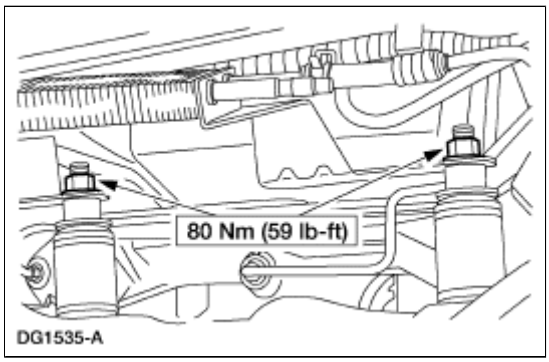
13. Connect the steering gear fluid lines.
    1. Connect the power steering return hose.
    2. Connect the power steering pressure hose.



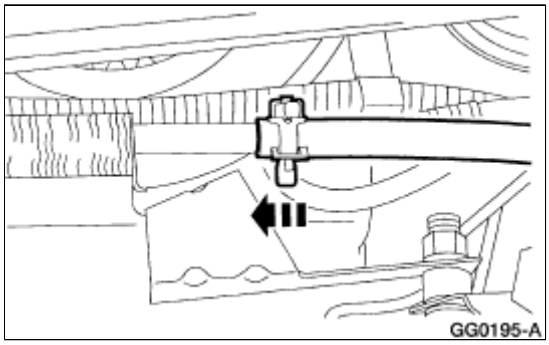
14. Connect the power steering return hose to the power steering fluid cooler.



15. Position the power steering fluid cooler and install the power steering fluid cooler to crossmember nuts.



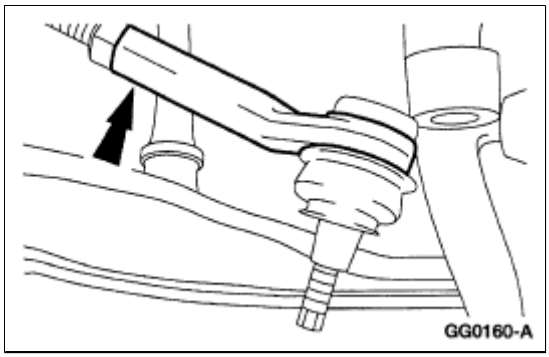
16. Connect the power steering return line hose to the power steering fluid cooler.



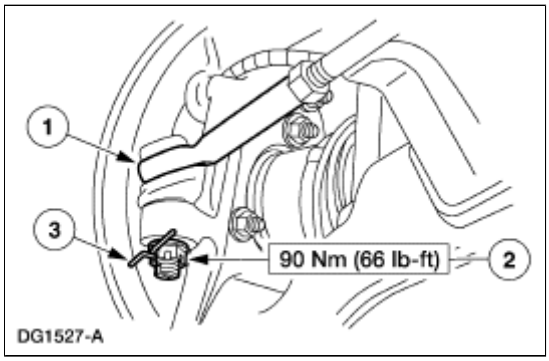
17. Install the engine oil cooler. For additional information, refer to Section 303-01C .

18. Install the front stabilizer bar. For additional information, refer to Section 204-01A .
    - Orientate the front stabilizer bar as noted during removal.

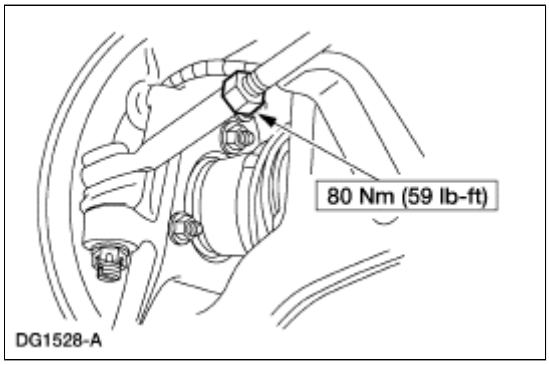
19. Install the tie-rod end.
    - Rotate the tie-rod end the number of turns recorded during removal.



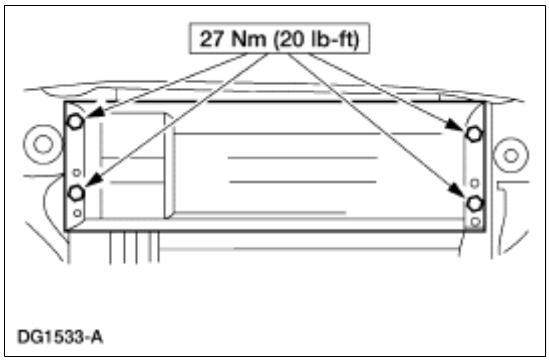
20. Connect the tie-rod ends to the steering knuckles.
    1. Position the tie-rod ends to the steering knuckles.
    2. Install the castellated nuts.
    3. Install the new cotter pins.
    - Check that brake dust shields are not bent and are not in contact with the outer tie-rod boot seals.



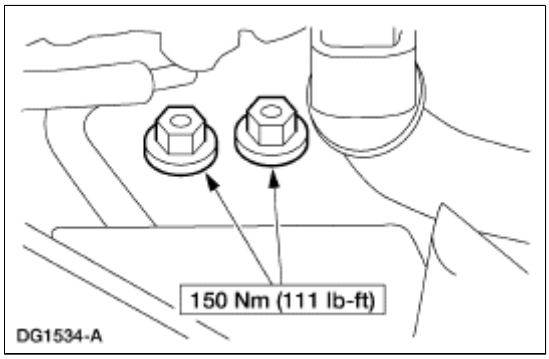
21. Tighten the LH tie-rod end jam nut.



22. Install the radiator air deflector.



23. Install the top engine mount nuts.



24. Install the inner fender splash shields.
25. Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
26. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Lower the vehicle.
27. Refill and bleed the engine cooling system. For additional information, refer to Section 303-03 .
28. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .
29. Check the wheel alignment. For additional information, refer to Section 204-00 .

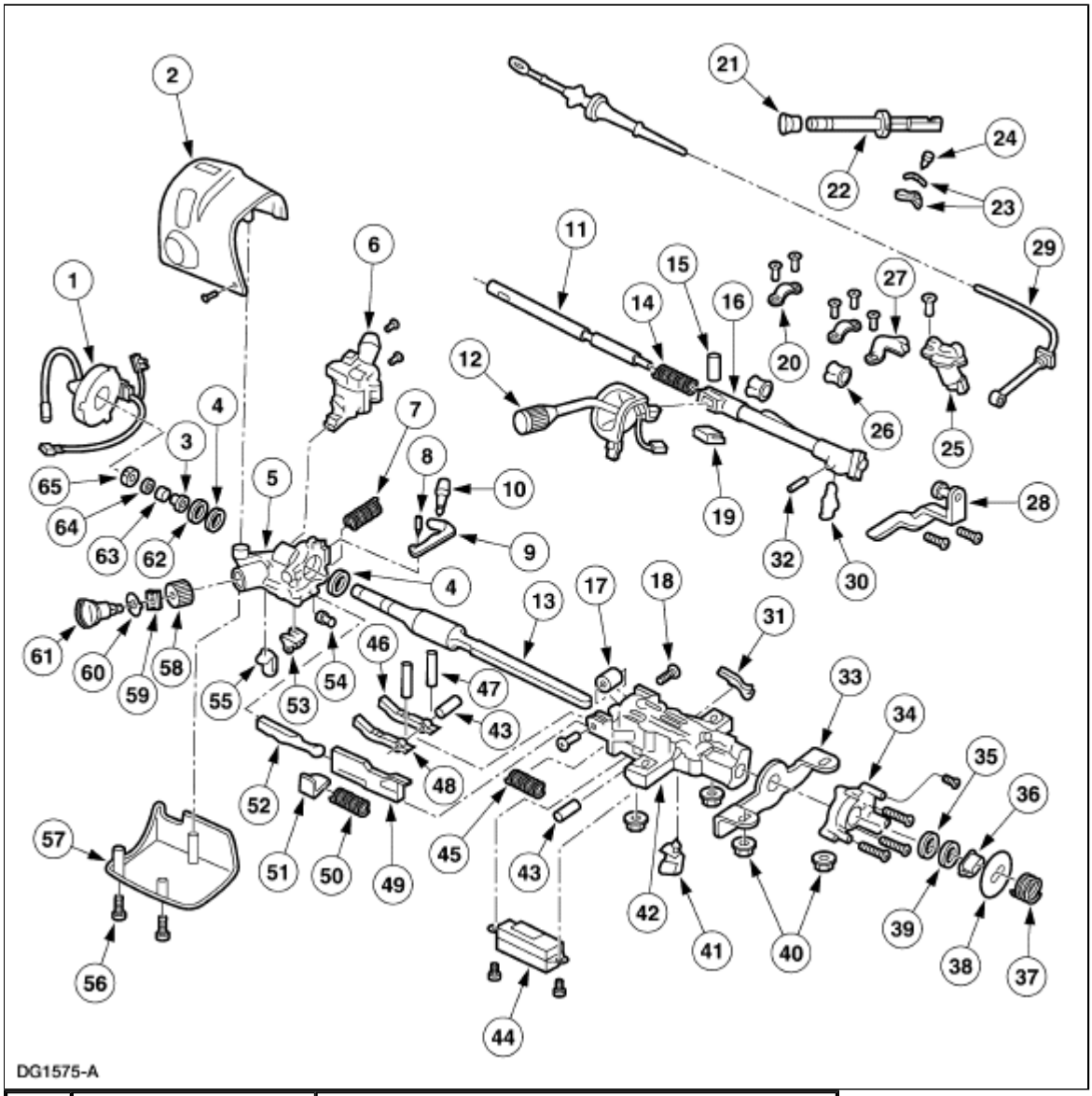
General Specifications

Item	Specification
Lubricants	
Steering Gear Grease C3AZ-19578-A	ESW-M1C87-A
Rust Penetrant and Inhibitor F2AZ-19A501-A	ESR-M99G56-A
Ignition Lock Grease FOAZ-19584-A	ESA-M1C232-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake shift interlock solenoid bolts	9	—	80
Hood latch release handle screws	2.7-3.7	—	25-33
Ignition switch bolts	6	—	53
Instrument panel steering column cover screws	2.1-2.9	—	19-25
Instrument panel steering column opening cover reinforcement screws	7.6-10.4	—	67-92
Intermediate shaft to lower intermediate shaft bolt	41-55	30-40	—
Lock cylinder housing screws	22	16	—
Multi-function switch screws	2.1-2.9	—	19-25
Parking brake release handle screws	2.1-2.9	—	19-25
Shift tube bolts	9	—	80
Shock absorber electronic steering sensor bolts	1	—	10
Steering column lower bearing retainer bolts	9	—	80
Steering column retaining nuts	13-17	10-13	—
Steering wheel bolt	41-46	25-34	—
Transmission selector lever arm and support bolts	15	11	—
Upper intermediate shaft to steering column bolt	26-34	19-25	—

Steering Column



Item	Part Number	Description
1	14A664	Air bag sliding contact
2	3530	Upper steering column shroud
3	3518	Steering column bearing sleeve
4	3517	Steering column bearing
5	3511	Steering column lock cylinder housing
6	13K359	Multi-function switch
7	N808114	Pin
8	N805857	Steering column release lever pin

9	3D544	Steering column release lever
10	3F609	Tilt wheel handle and shank
11	7361	Column shift selector lever plunger
12	7210	Gearshift lever
13	3D657	Steering column shaft
14	7B071	Transmission control selector lever plunger spring
15	7G357	Gearshift lever pin
16	7212	Transmission column shift selector tube
17	3C549	Steering column spacer (fixed column)
18	N806582	Tilt column pivot screw
19	7C464	Transmission control selector lever spring clip
20	7E400	Gearshift tube bushing clamp
21	—	Spacer (fixed column)
22	3E729	Steering shaft (fixed column)
23	3F527	Lever assembly (manual transmission)
24	3F530	Pin (manual transmission)
25	3F752	Brake shift interlock solenoid
26	7335	Gearshift lever socket bushing
27	7A216	Transmission shift selector position insert
28	7302	Transmission selector lever arm and support
29	7E395	Shift cable and bracket
30	7210	Gearshift lever
31	3E691	Steering column lock pawl
32	7W441	Gearshift lever pin
33	3676	Steering column instrument panel bracket
34	3D681	Steering column lower bearing retainer
35	3518	Steering column bearing sleeve
36	3L539	Steering column bearing tolerance ring
37	3C674	Steering column lower bearing spring
38	3C131	Suspension height sensor control ring
39	3517	Steering column bearing
40	N806423-S56	Steering column retaining nuts
41	14A163	Wiring harness retainer
42	3F723	Steering actuator housing
43	3B663	Steering column lock lever pin
44	11572	Ignition switch
45	3D655	Steering column position spring
46	3D653-LH, 3B662-	Steering column lock lever

	RH	
47	3B768	Steering column position lock spring
48	3B661	Steering column locking lever
49	3E715	Lower steering column lock actuator
50	3E696	Steering column lock spring
51	3E691	Steering column lock pawl
52	3E723	Upper steering column lock lever actuator
53	3E695	Steering column lock cam
54	3D656	Steering column tilt flange bumper
55	14A163	Wiring harness retainer
56	391727-S304	Shroud screws
57	3530	Steering column shroud
58	3E717	Steering column lock gear
59	3E700	Steering column lock housing bearing
60	3C610	Bearing retainer
61	11582	Ignition switch lock cylinder
62	3L539	Steering column tolerance ring
63	3520	Steering column upper bearing spring
64	3C610	Snap ring
65	13318	Turn indicator cancel cam

NOTE: All fasteners are important because they can affect the performance of vital parts and systems. Incorrect installation of the fasteners can result in major repair expenses. New fasteners with the same part number must be installed if replacement becomes necessary. Do not use a new part of lesser quality or substitute a design. Torque values must be used as specified during assembly to make sure these parts function correctly.

The body of the steering column (3C529) is made of magnesium die castings. The steering column is attached to a support that is an integral part of the instrument panel. The lower attachments of the steering column are through a bracket that bends during collapse. The upper attachments are through plastic shear modules that separate from the main casting during collapse. A clip and washer are attached to the shear modules to reduce steering column shake and to assist in installation of the steering column.

Steering Column

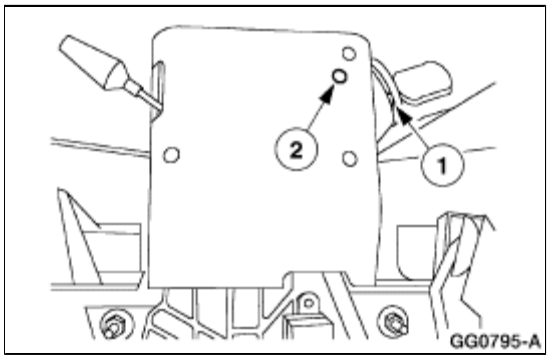
Refer to Section 211-00 .

Ignition Switch Lock Cylinder —Functional Lock Cylinder

Removal

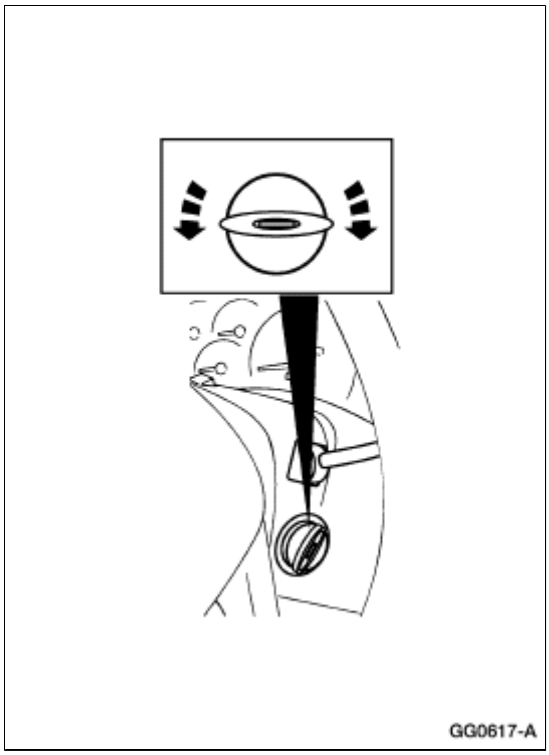
1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the ignition switch lock cylinder (11582).
    1. Insert the ignition key and turn to the RUN position.
    2. Press the ignition switch lock cylinder release pin while pulling out the ignition switch lock cylinder.



Installation

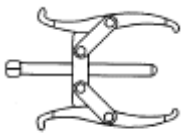
1. Follow the removal procedure in reverse order.
    - Verify ignition switch lock cylinder operation.



2. Prove out the air bag system. For additional information, refer to Section 501-20B .

Wheel

Special Tool(s)

 ST1321-A	2-Jaw Puller 205-116 (T77F-4220-B1)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door

latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

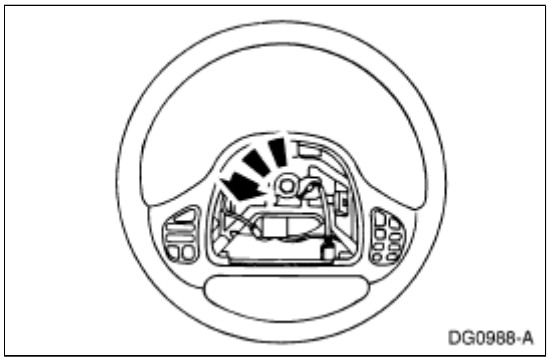
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

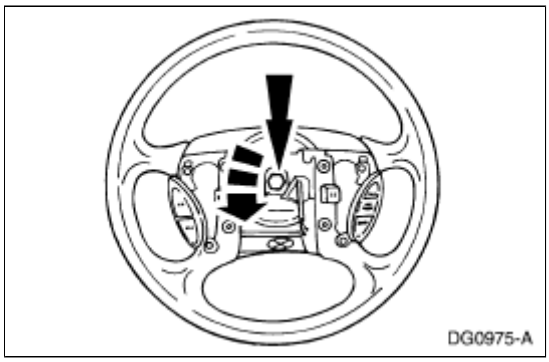
NOTE: Make sure the wheels (1007) are in the straight-ahead position.

1. Disconnect the battery cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
   - Disconnect the battery ground cable.
   - Disconnect the battery to starter relay cable.

2. Remove the driver air bag module. For additional information, refer to Section 501-20B .

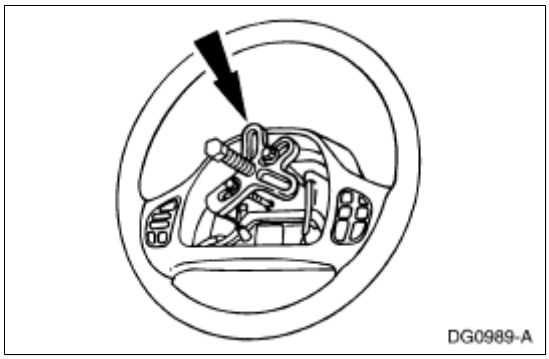
3. Remove the steering wheel bolt.

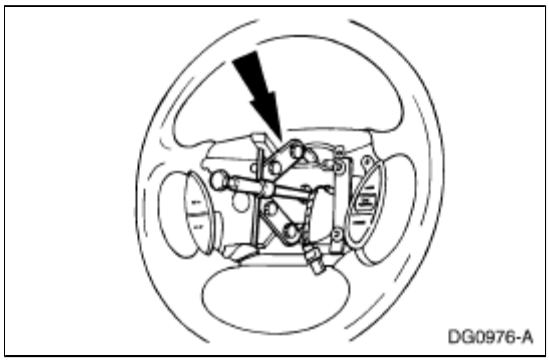




4. **CAUTION: Removing the steering wheel without using a puller can damage the column bearings.**

   Use the 2-Jaw Puller to remove the steering wheel (3600).





5. Remove and discard the original steering wheel bolt.

6. Remove the steering wheel while routing the wires from the air bag sliding contact through the steering wheel.

Installation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

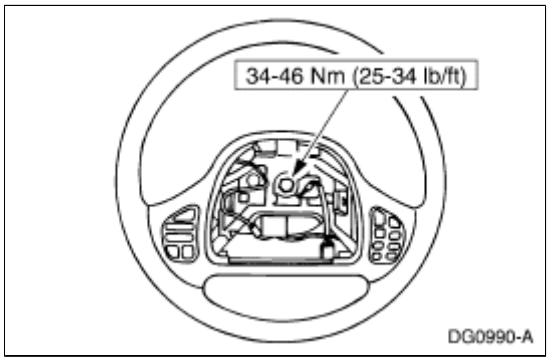
WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

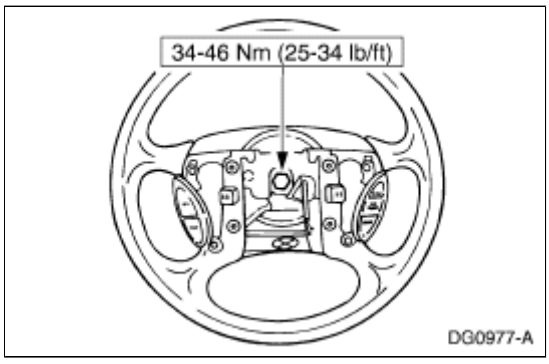
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

1. Follow the removal procedure in reverse order.





2. Connect the battery cables. For additional information, refer to Section 414-01 .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

Air Bag Sliding Contact

Removal and Installation

For additional information, refer to Section 501-20B .

Column

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

1. Disconnect the battery cables (14301) and wait at least one minute. For additional information, refer

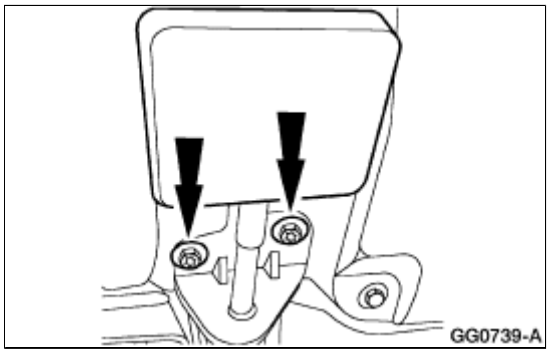
to Section 414-01 .

1. Remove the battery ground cable.
2. Remove the battery to starter relay cable.

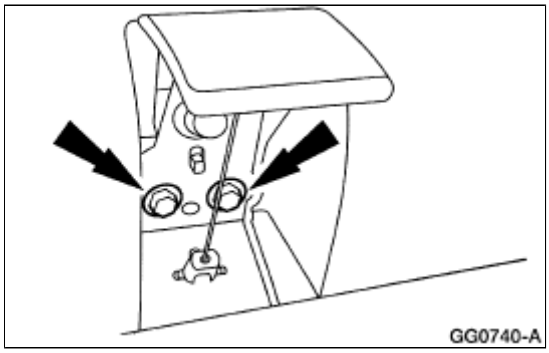
2. **NOTE:** Make sure the front wheels (1007) are in the straight-ahead position.

   Remove the steering wheel (3600). For additional information, refer to Wheel in this section.

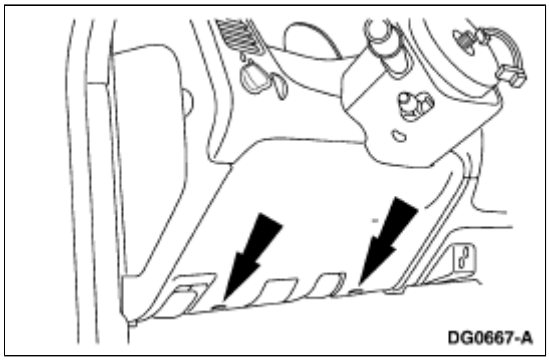
3. Remove the screws and position the parking brake release handle aside.



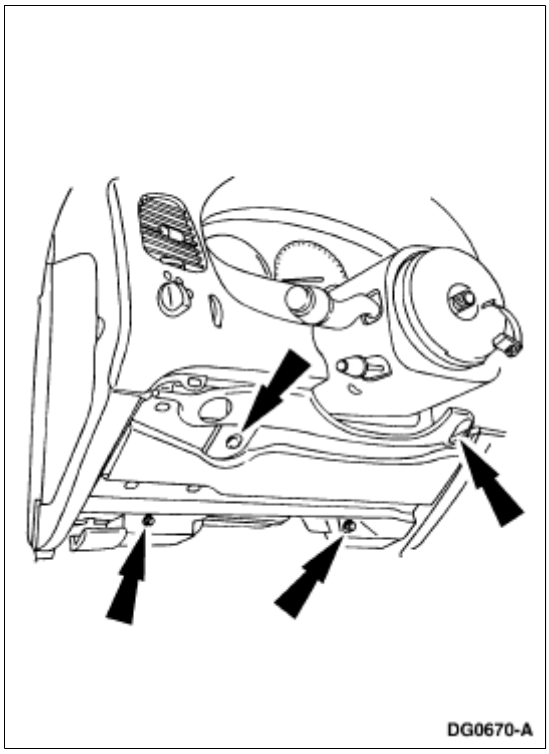
4. Remove the screws and position the hood release aside.



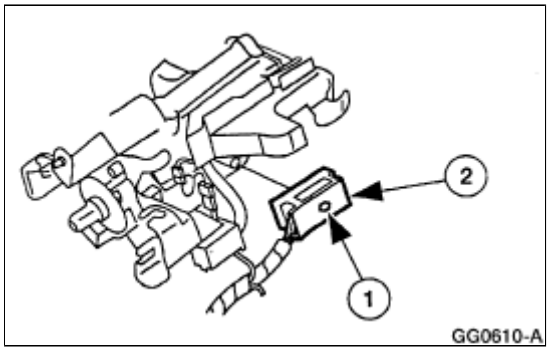
5. Remove two screws and the instrument panel steering column cover (04459).



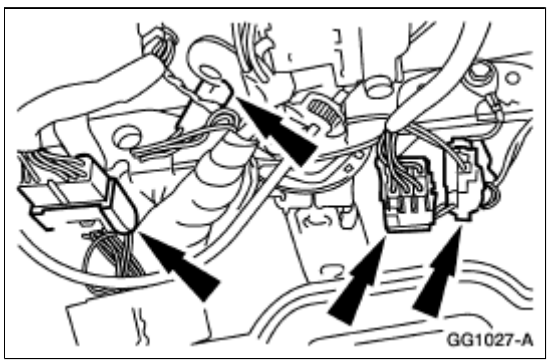
6. Remove the instrument panel steering column opening cover reinforcement (04502).



7. Disconnect the ignition switch electrical connector.
    1. Remove the bolt.
    2. Disconnect the electrical connector.

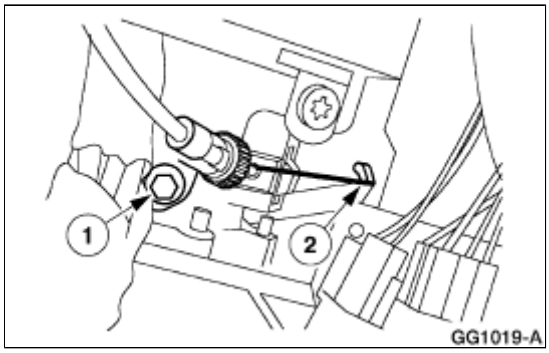


8. Disconnect the electrical connectors.

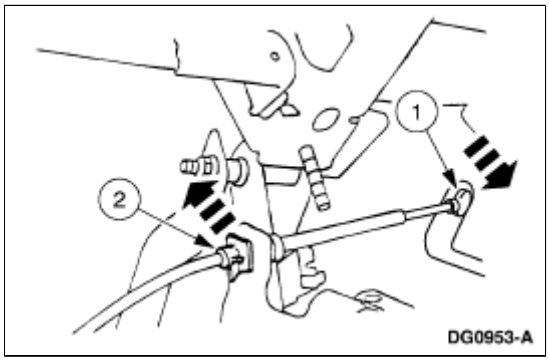


9. On automatic transmission vehicles, remove the transmission range indicator (PRND21) from the

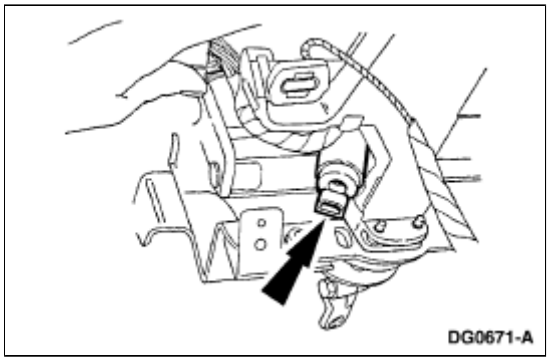
steering column (3C529).
1. Remove the bolt.
2. Remove the indicator cable.



10. On automatic transmission vehicles, disconnect the shift cable from the steering column.
    1. Disconnect the shift cable from the steering column shift tube lever.
    2. Disconnect the shift cable from the steering column bracket.

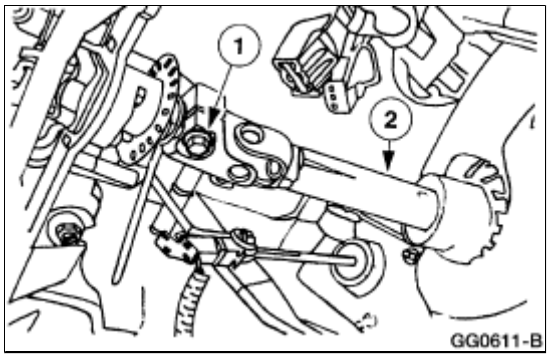


11. Disconnect the brake shift interlock solenoid electrical connector.

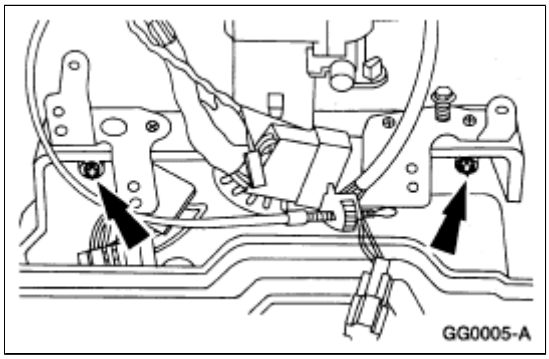


12. Remove the air bag sliding contact. For additional information, refer to Section 501-20B .

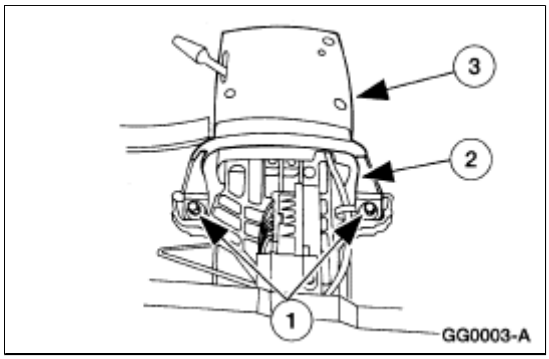
13. Remove the upper intermediate steering shaft to column shaft bolt.
    1. Remove and discard the steering column shaft pinch bolt.
    2. Slide the intermediate shaft yoke from the steering column.



14. Remove the lower steering column nuts.



15. Remove the steering column.
    1. Remove the nuts.
    2. Remove the steering column support.
    3. Remove the steering column.



Installation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will

reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

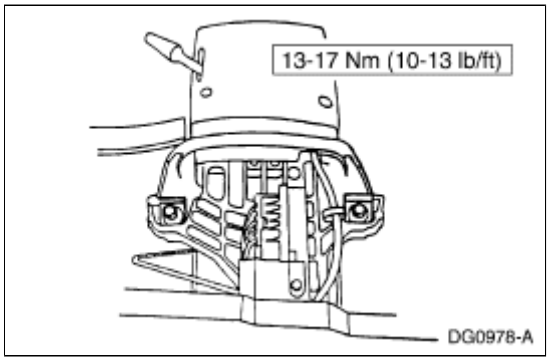
WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

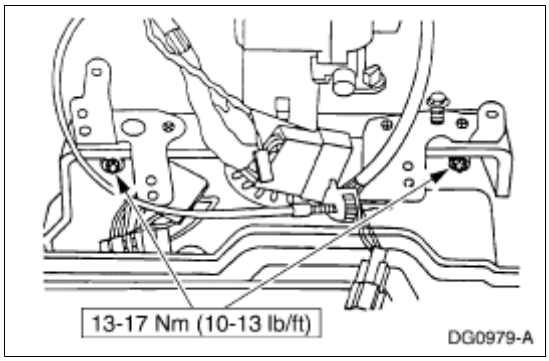
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

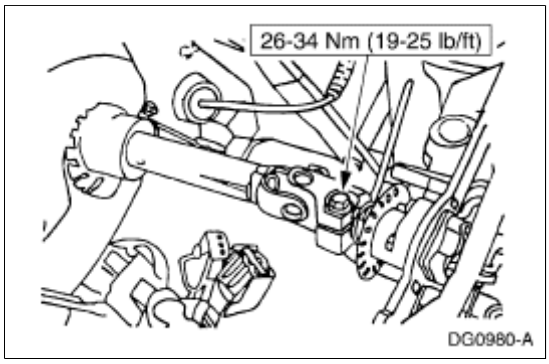
The side air bag sensors are located at or near the base of the B-pillar.

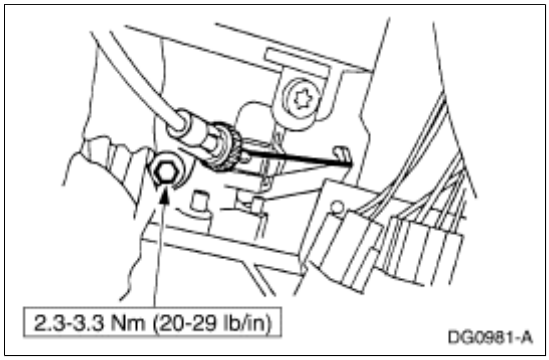
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

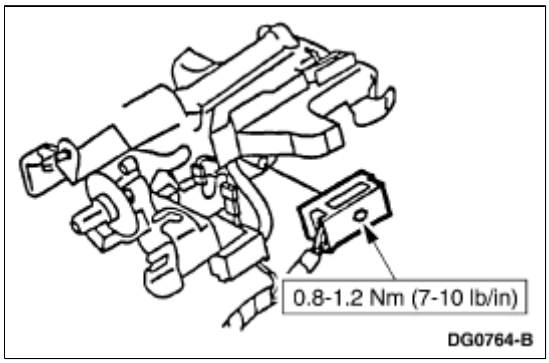
1. Follow the removal procedure in reverse order.
    - Use a new pinch bolt.

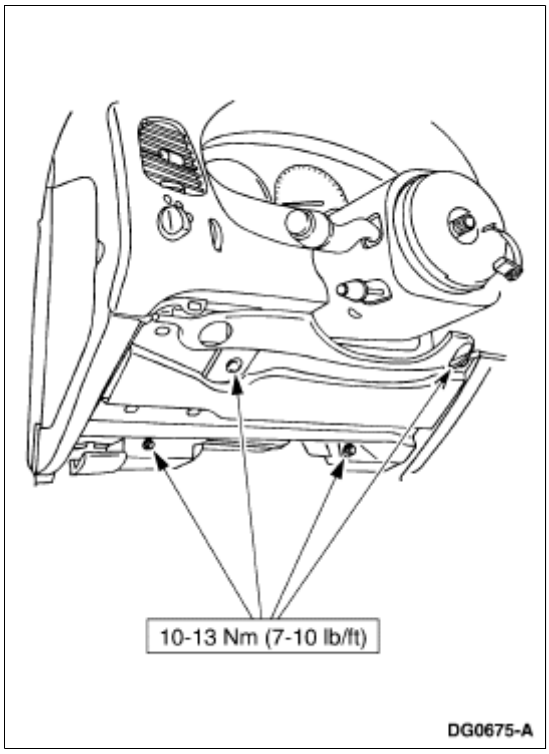


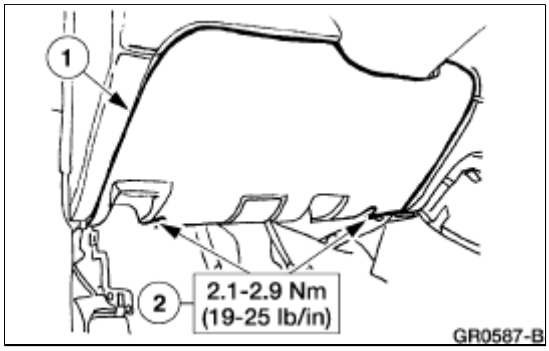

13-17 Nm (10-13 lb/ft)
DG0979-A

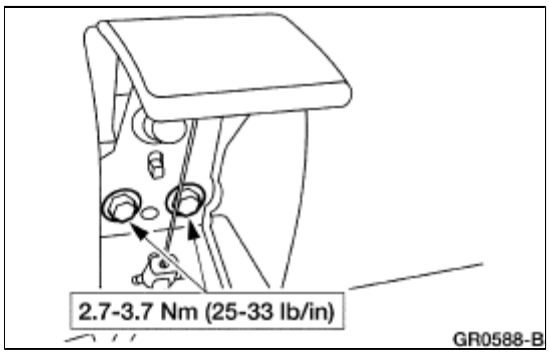

26-34 Nm (19-25 lb/ft)
DG0980-A

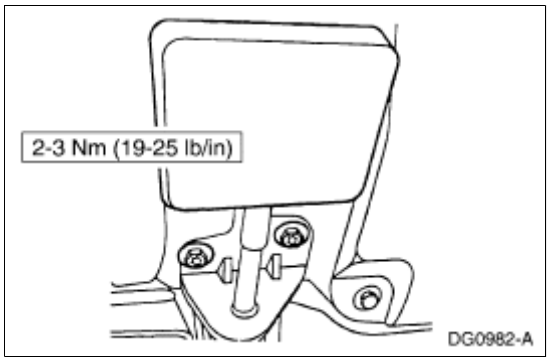

2.3-3.3 Nm (20-29 lb/in)
DG0981-A


0.8-1.2 Nm (7-10 lb/in)
DG0764-B


10-13 Nm (7-10 lb/ft)
DG0675-A


1
2
2.1-2.9 Nm
(19-25 lb/in)
GR0587-B


2.7-3.7 Nm (25-33 lb/in)
GR0588-B


2-3 Nm (19-25 lb/in)
DG0982-A

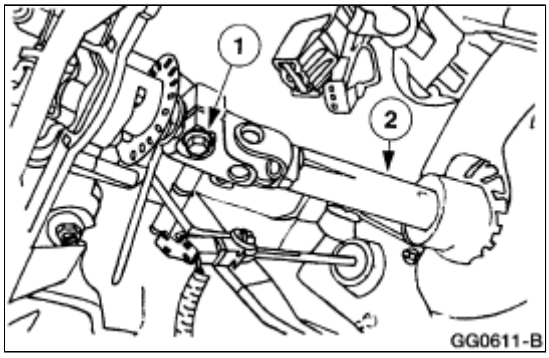
Steering Column Sensor Ring

Removal

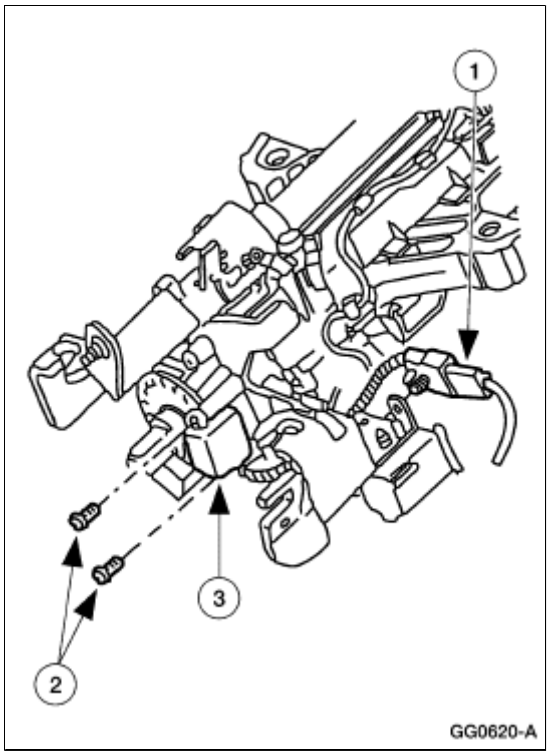
CAUTION: The steering column must be in the locked position, or the lower end of the column wired in such a way that the steering column does not rotate, resulting in damage to the air bag sliding contact (14A664).

NOTE: Discard the upper intermediate shaft to steering column shaft bolt upon removal. Do not reuse; install a new bolt.

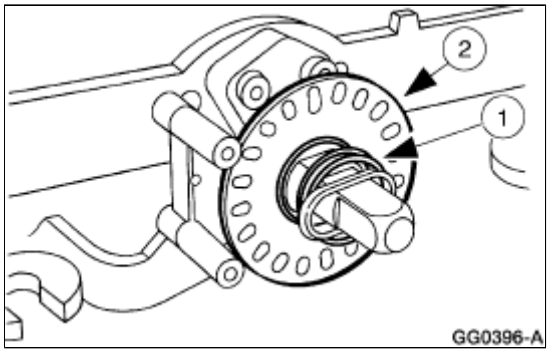
1. Remove the upper intermediate steering shaft to column shaft bolt.
    1. Remove and discard the steering column shaft pinch bolt.
    2. Slide the intermediate shaft yoke from the steering column.



2. Remove the shock absorber electronic steering sensor (18B015).
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the shock absorber electronic steering sensor.



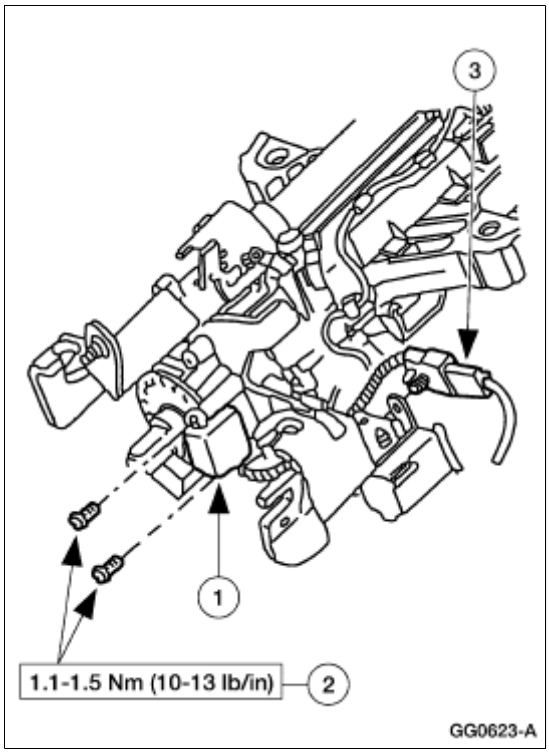
3. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



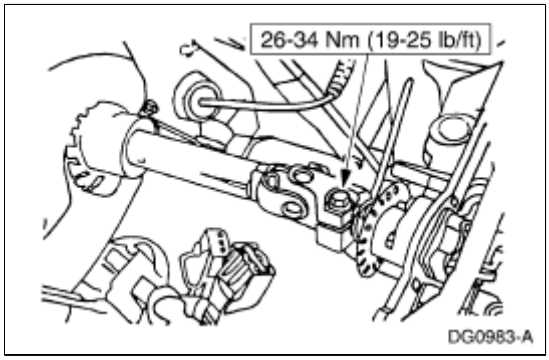
Installation

1. Follow the removal procedure in reverse order.

2. Install the shock absorber electronic steering sensor.
    1. Position the shock absorber electronic steering sensor.
    2. Install the screws.
    3. Connect the electrical connector.



3. Use a new pinch bolt.



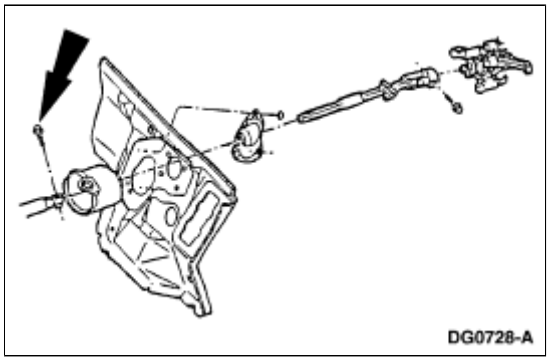
Steering Column Shaft

Removal

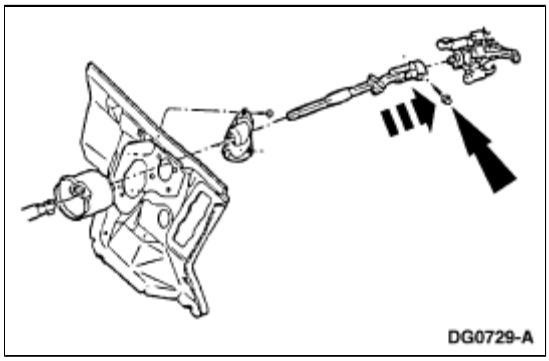
1. **CAUTION: The steering column must be in the locked position, or the lower end of the steering column is to be secured or wired in such a way as to prevent the steering column from rotating, resulting in damage to the air bag sliding contact (14A664).**

   NOTE: Discard the upper intermediate shaft to steering column shaft bolt and the upper intermediate shaft to lower steering column shaft bolt upon removal. Do not reuse; install new bolts.

   Remove the bolt securing the upper intermediate shaft to the lower intermediate shaft, at the midpoint connection. Collapse the lower shaft. Discard original bolt.
   - Use a new pinch bolt.

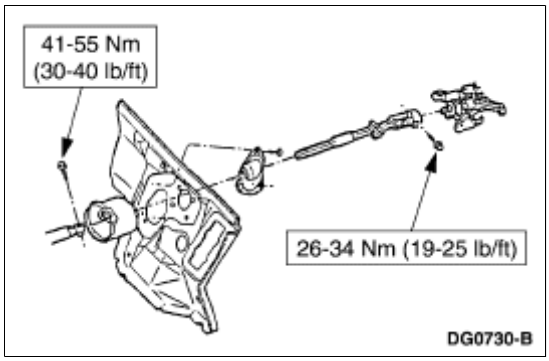


2. Remove the bolt securing the upper intermediate shaft to the steering column assembly. Remove the intermediate shaft from inside the vehicle. Discard the original bolt.



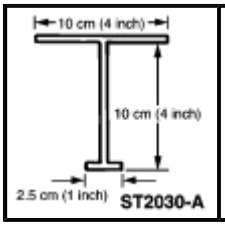
Installation

1. Follow the removal procedure in reverse order.


41-55 Nm
(30-40 lb/ft)
26-34 Nm (19-25 lb/ft)
DG0730-B

Steering Column —Manual Transmission

Special Tool(s)

	Steering Column Locking Lever Tool (Shop Fabricated)

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door

latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

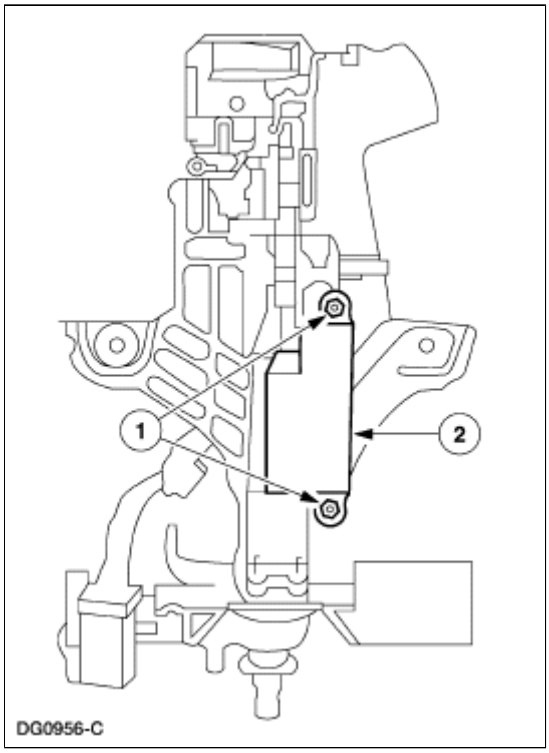
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

All vehicles

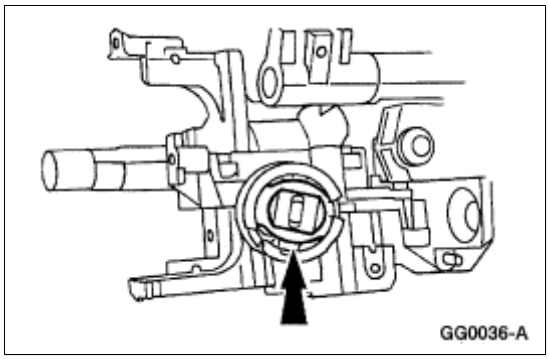
1. Remove the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or to Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

2. Remove the steering column (3C529). For additional information, refer to Column in this section.

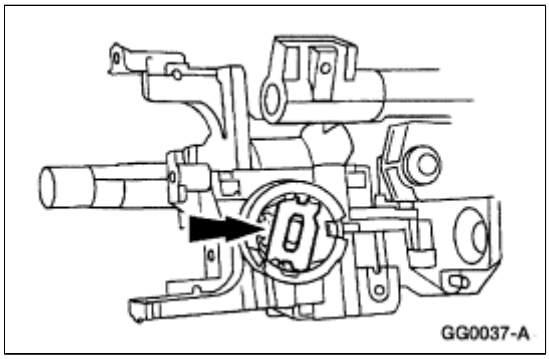
3. Remove the ignition switch (11572).
    1. Remove the ignition switch bolts.
    2. Remove the ignition switch.



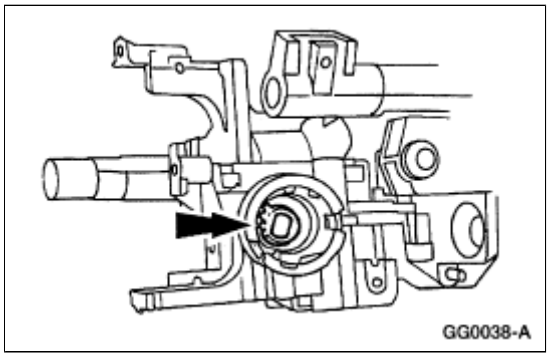
4. Remove the bearing retainer (3C610).



5. Remove the steering column lock housing bearing (3E700).

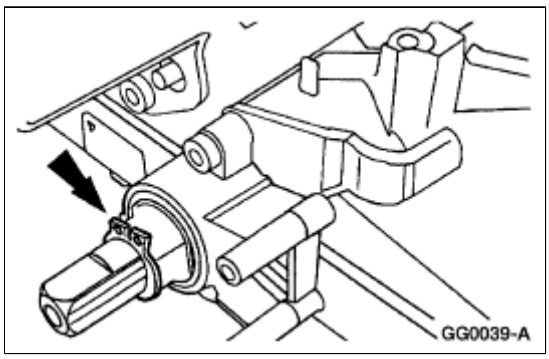


6. Remove the steering column lock gear (3E717).



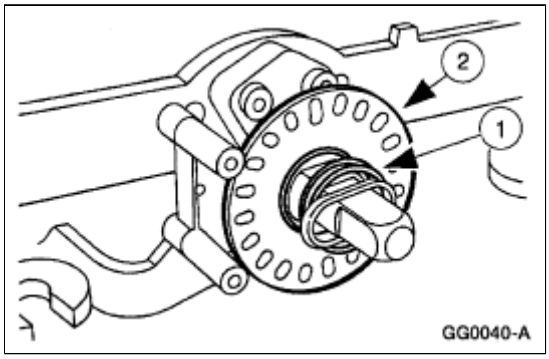
Vehicles with fixed steering columns

7. Remove the snap ring from the bottom of the steering column shaft.



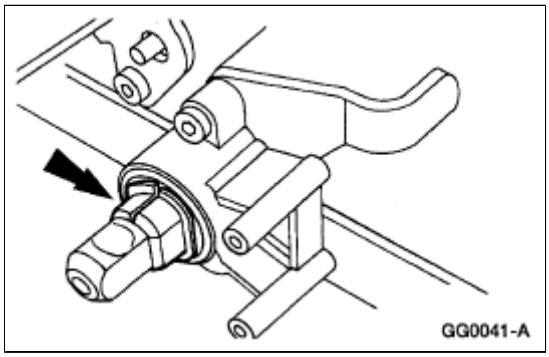
Vehicles with tilt steering columns

8. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



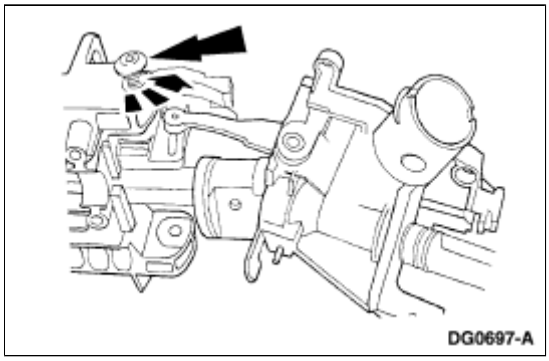
All vehicles

9. Remove the steering column bearing tolerance ring (3L539) from the steering column shaft.



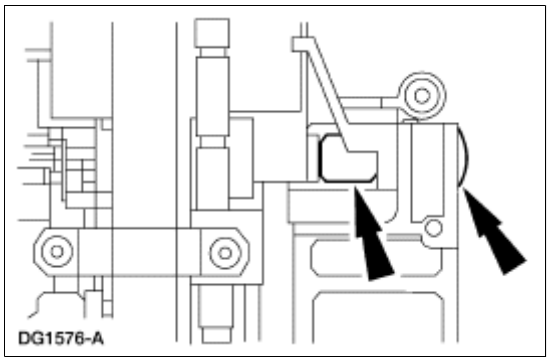
Vehicles with tilt steering columns

10. Remove the lock cylinder housing screws.



Vehicles with fixed steering columns

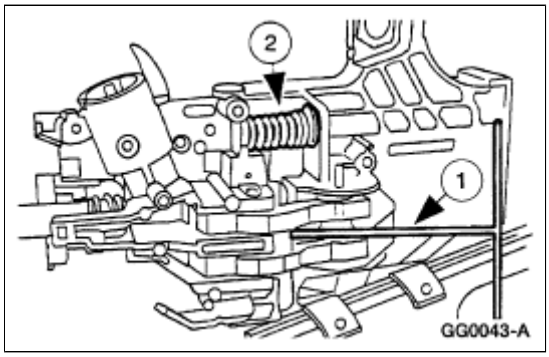
11. Remove the two lock cylinder housing screws and the steering column spacer (3C549).



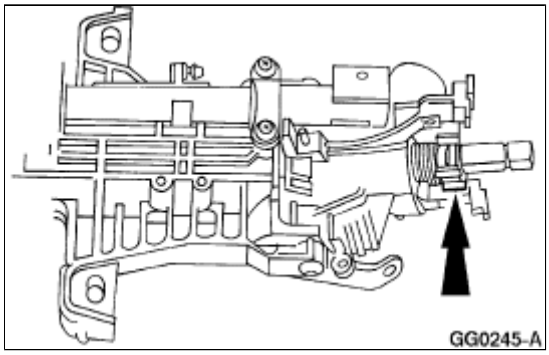
All vehicles

12. **WARNING: Steering column position spring is under tension and can come out with great force.**

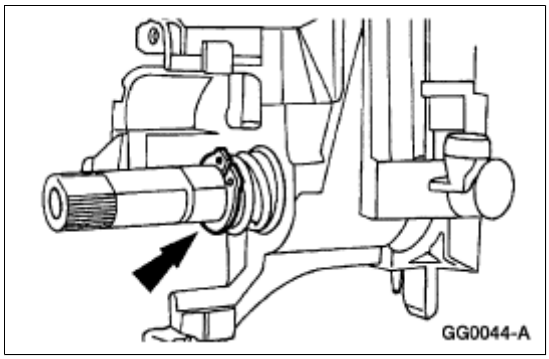
    Remove the lock cylinder housing and the steering column shaft from the steering actuator housing (3F723).
    1. Pry up on the steering column lock left hand levers (3D653) using a shop fabricated tool.
    2. On tilt steering columns, remove the steering column position spring (3D655).



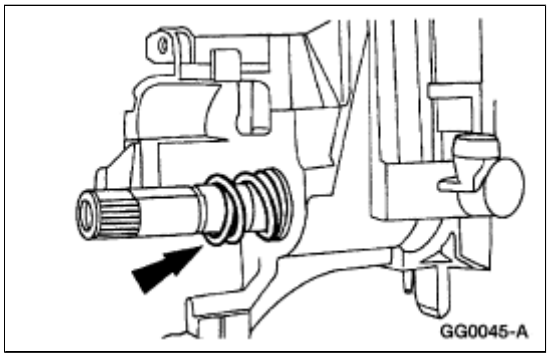
13. Remove the turn signal cancel cam.



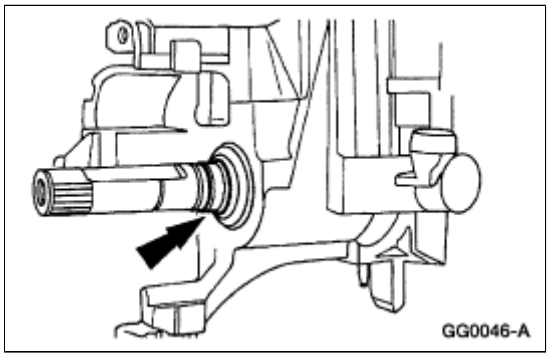
14. Remove the snap ring.



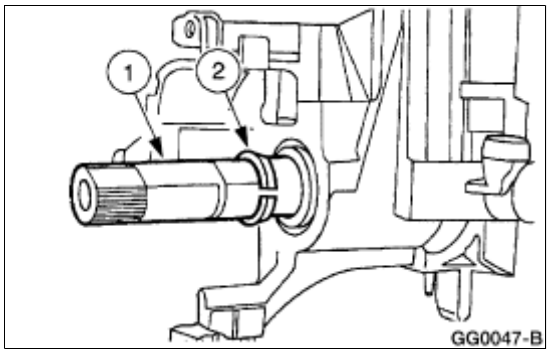
15. Remove the steering column upper bearing spring (3520).



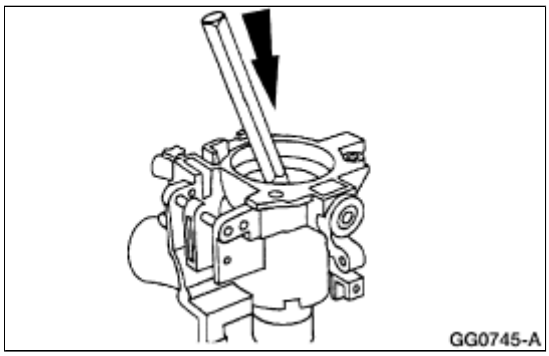
16. Remove the steering column bearing sleeve (3518).



17. Remove the steering column bearing tolerance ring.
    1. Slide the steering column shaft in toward the steering column lock cylinder housing (3511), then out.
    2. Slide the steering column bearing tolerance ring off the steering column shaft.

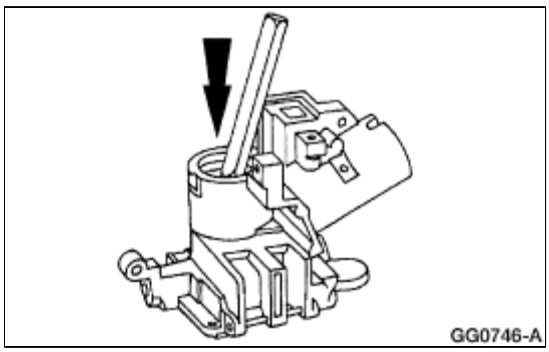


18. Using a suitable punch, remove the steering column bearing (3517) from the steering column lock cylinder housing.



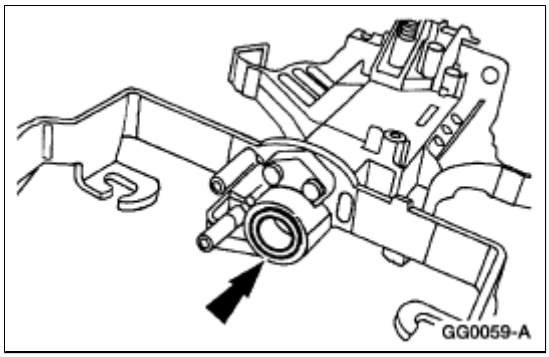
Vehicles with tilt steering columns

19. Use a suitable punch to remove the steering column bearing from the steering column lock cylinder housing.

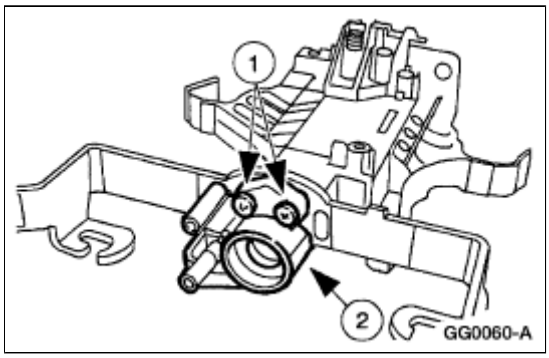


All vehicles

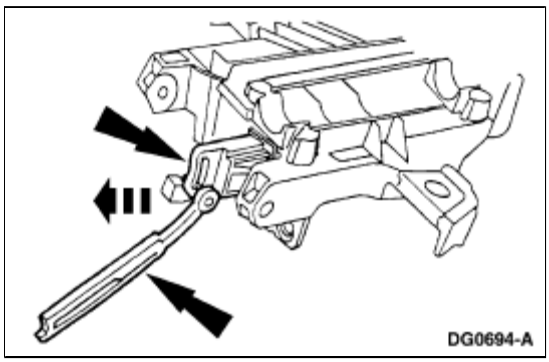
20. Remove the steering column bearing and sleeve.



21. Remove the steering column lower bearing retainer (3D681).
    1. Remove the three bolts.
    2. Remove the steering column lower bearing retainer.



22. Remove the upper steering column lock lever actuator (3E715) and the lower steering column lock lever actuator.



Assembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will

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WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

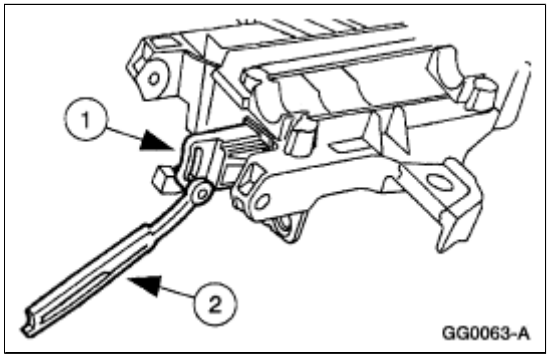
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

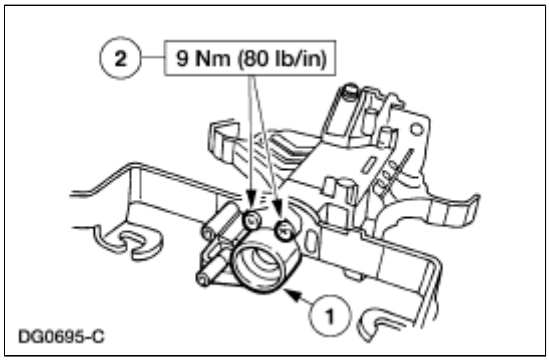
All vehicles

1. Install the steering column lock lever actuator.
    1. Lubricate the steering column lock lever actuator with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.
    2. Install the steering column lock lever actuator.



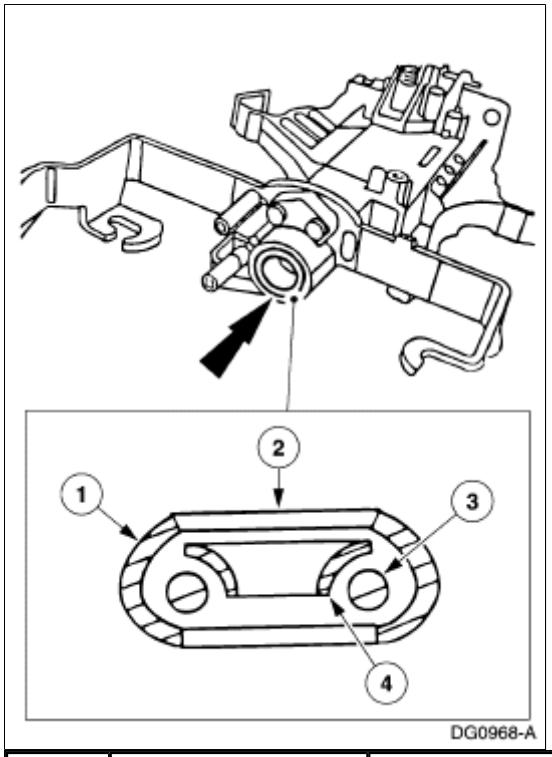
2. Install the steering column lower bearing retainer.

1. Position the steering column lower bearing retainer.
2. Install the three bolts.



3. **NOTE:** The "UP" position of the bearing must be facing forward, toward the engine.

   Install the steering column bearing and sleeve.



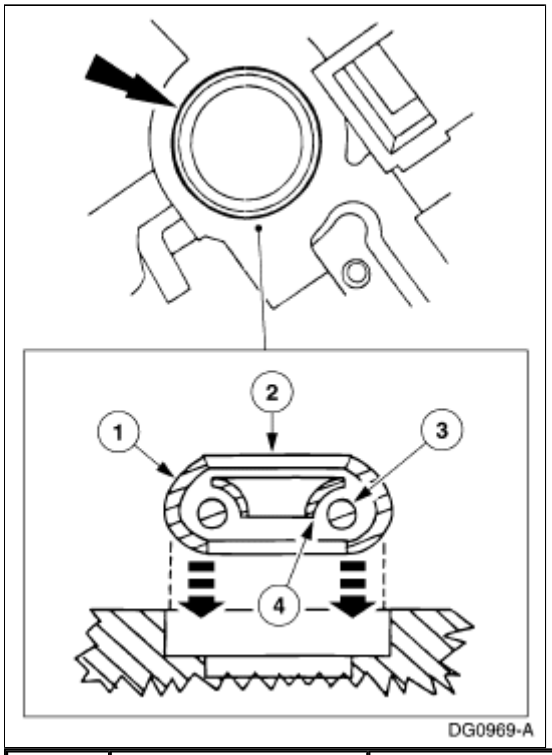
Item	Part Number	Description
1	—	Outer race
2	3517	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

4. Install the steering column bearing and sleeve so that the inner race is visible when installed.

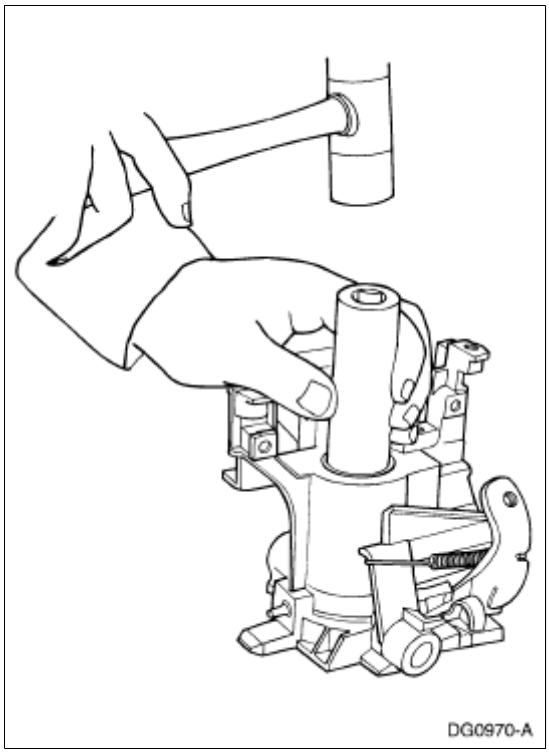
5. **CAUTION: Install the steering column bearing so that the inner race is visible when installed.**

NOTE: Use an appropriate bearing installer or socket.

Install the steering column bearing on the steering column lock cylinder housing.



Item	Part Number	Description
1	—	Outer race
2	—	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

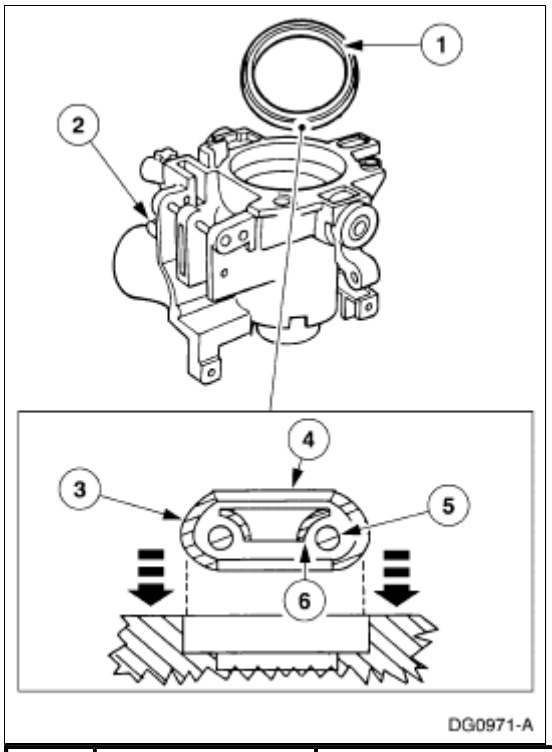


Vehicles with tilt steering columns

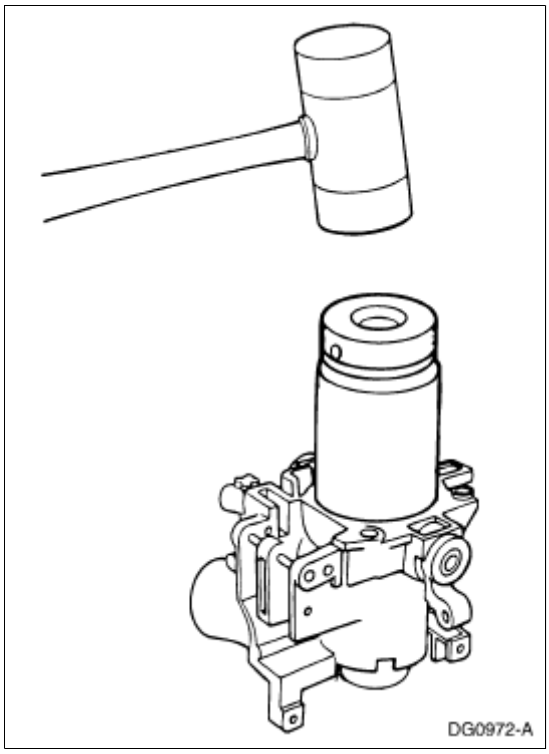
6. **CAUTION: Install the steering column bearing so that the inner race is visible when installed.**

   NOTE: Use an appropriate bearing installer or socket.

   Install the steering column bearing on the steering column lock cylinder housing.

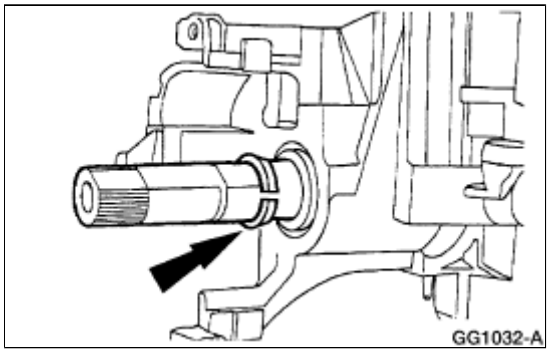


Item	Part Number	Description
1	—	Bearing slot
2	3511	Steering column lock cylinder housing
3	—	Outer race
4	—	Bearing (in the "UP" position)
5	—	Ball
6	—	Inner race

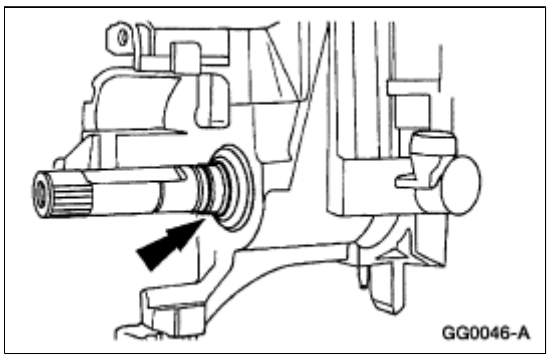


All vehicles

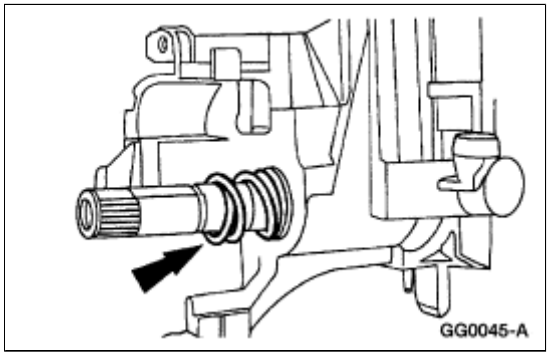
7. Position the steering column shaft in the steering column lock cylinder housing.
    - Install the steering column bearing tolerance ring on the steering column shaft.



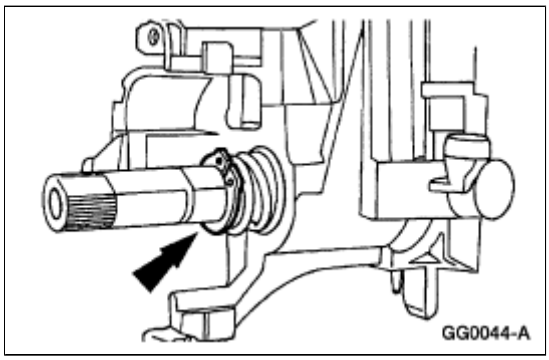
8. Install the steering column bearing sleeve.



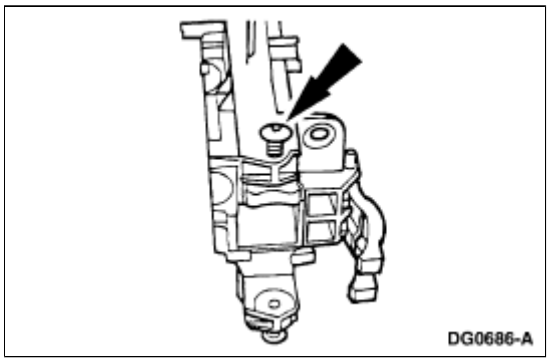
9. Install the steering column upper bearing spring.



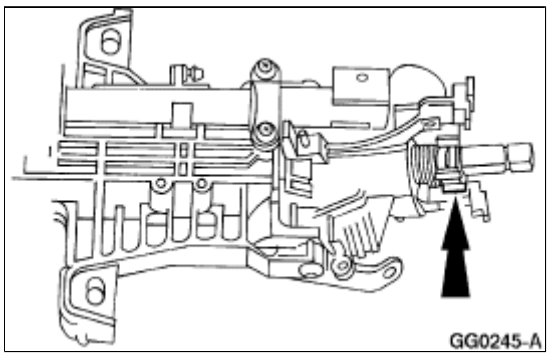
10. Install the snap ring.



11. Install the lock cylinder housing screws loosely and position the steering actuator housing in a vise.

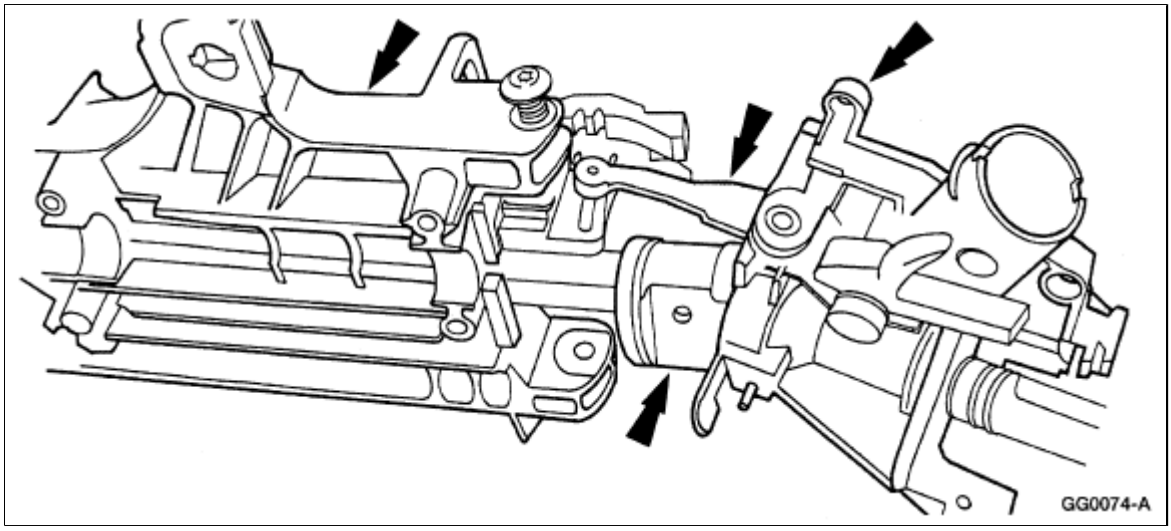


12. Install the turn signal cancel cam.

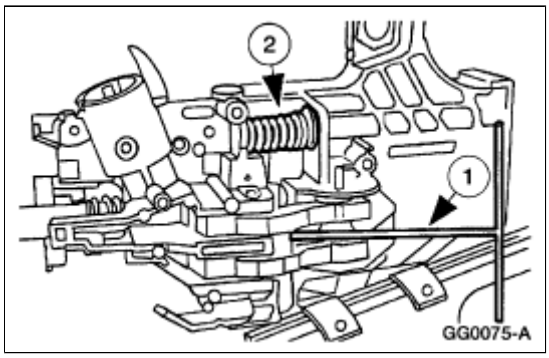


13. **NOTE:** Lubricate the lock cylinder housing bushings with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.

    Position the steering column lock cylinder housing and the steering column shaft on the steering actuator housing.
    - Make sure the upper and lower steering column lock actuators are aligned.

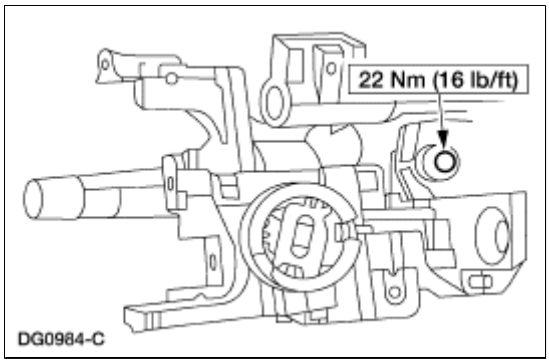


14. Position the steering column locking levers (3B661) on the steering actuator housing.
    1. Use a shop fabricated tool.
    2. On tilt steering columns, install and compress the steering column position spring.



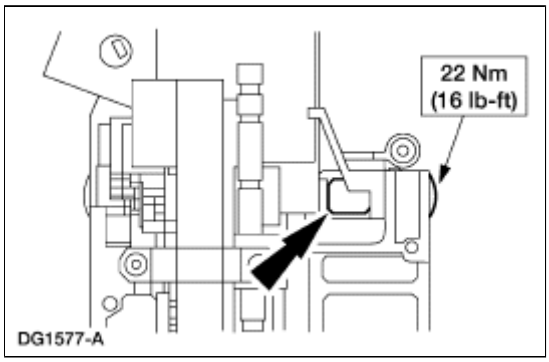
Vehicles with tilt steering columns

15. Tighten the lock cylinder housing screws.



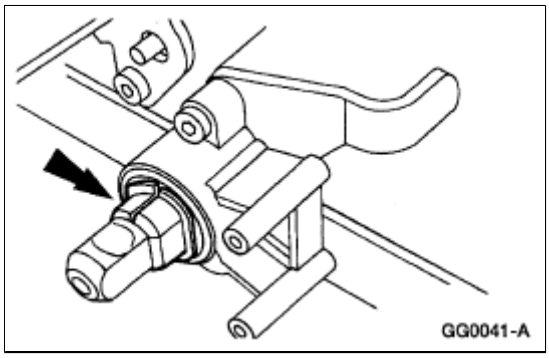
Vehicles with fixed steering columns

16. Install the steering column spacer (3C549). Tighten the two lock cylinder housing screws.
    - The steering column spacer is installed on the LH side of the steering column.



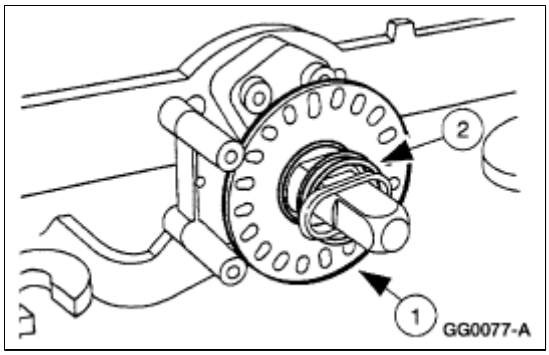
All vehicles

17. Install the steering column bearing tolerance ring.



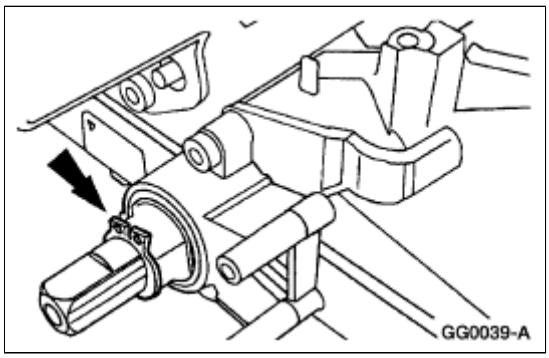
Vehicles with tilt steering columns

18. Install the sensor ring.
    1. Install the sensor ring.
    2. Install the steering column lower bearing spring.



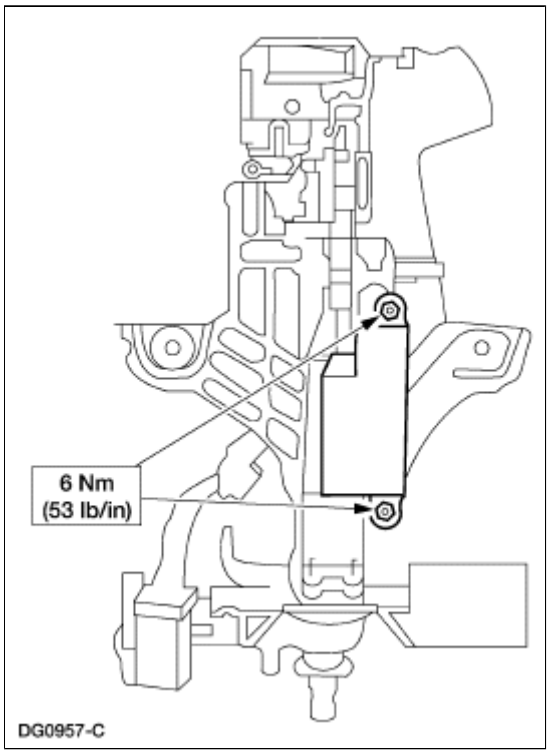
Vehicles with fixed steering columns

19. Install the snap ring.



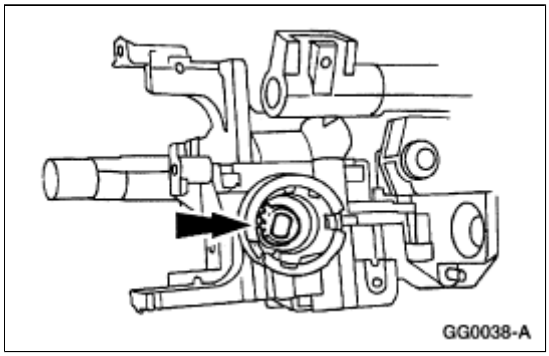
All vehicles

20. Install the ignition switch. Tighten bolts to specification.

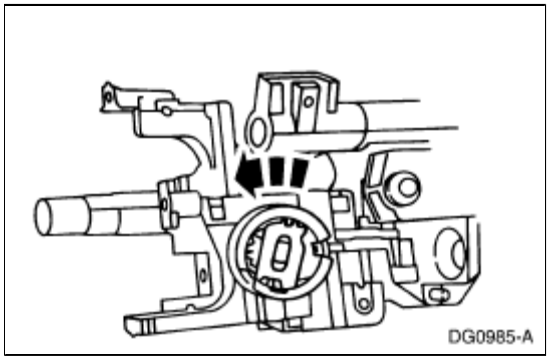


21. **NOTE:** The narrow section of the keyhole in the lock gear should be in the one o'clock position.

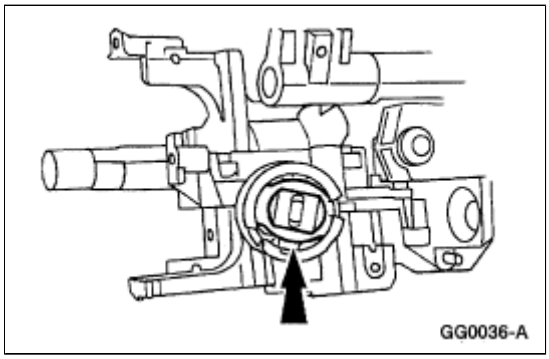
    Install the steering column lock gear.
    - Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to coat the steering column lock gear.



22. Install the steering column lock housing bearing.
    - The narrow section of the keyhole should be in the one o'clock position, with the tab inboard at the three o'clock position, and rotate it counterclockwise.
    - Lubricate the steering column lock housing bearing with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.



23. Install the steering column upper bearing retainer firmly to engage the four retention tabs into the lock housing.



24. Install the steering column. For additional information, refer to Column in this section.

25. Install the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder

in this section.

Steering Column —Automatic Transmission

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

All vehicles

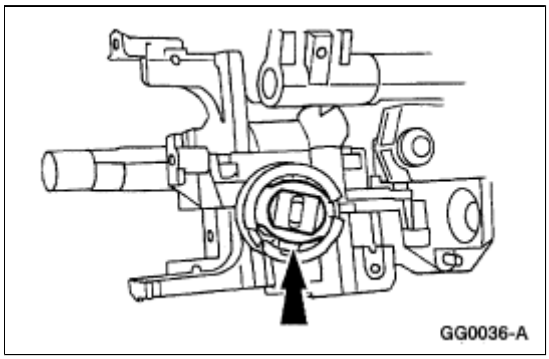
1. Remove the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

2. Remove the air bag sliding contact. For additional information, refer to Section 501-20B .

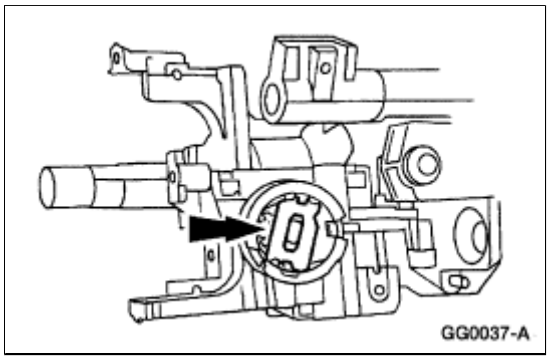
3. Remove the steering column (3C529). For additional information, refer to Column in this section.

4. **CAUTION: Carefully note the position of the steering column lock gear, bearing and retainer prior to removal.**

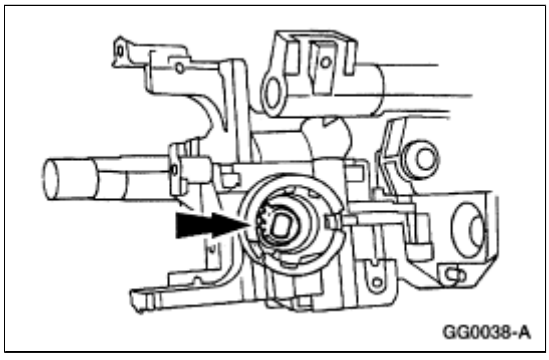
   Remove the bearing retainer (3C610).



5. Remove the steering column lock housing bearing (3E700).

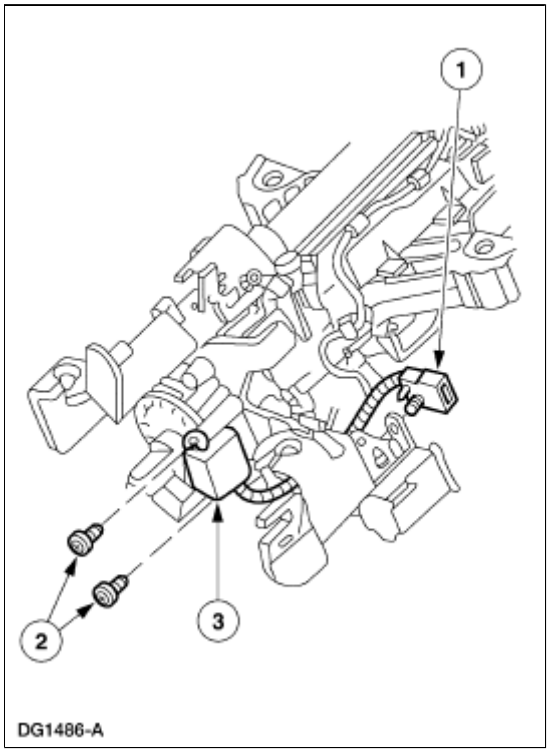


6. Remove the steering column lock gear (3E717).

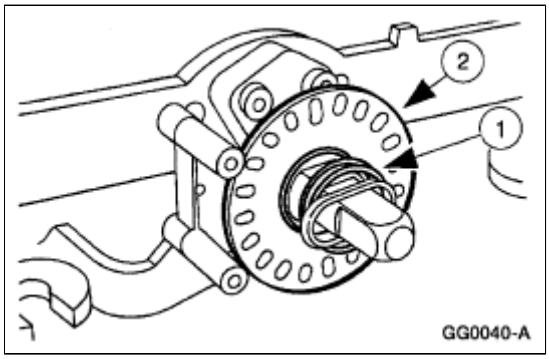


Vehicles with tilt steering columns

7. Remove the shock absorber electronic steering sensor (18B015).
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the shock absorber electronic steering sensor.

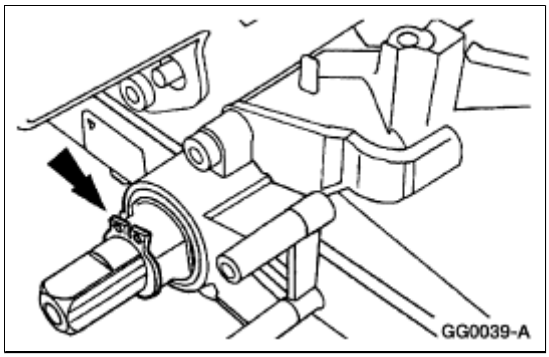


8. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



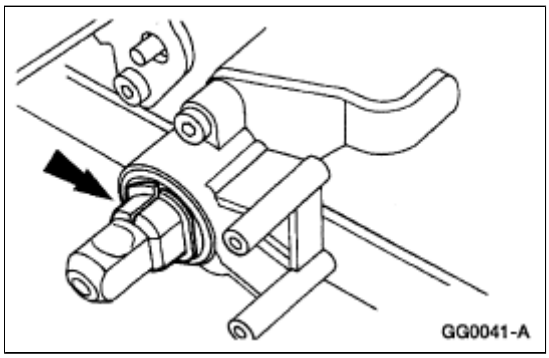
Vehicles with fixed steering columns

9. Remove the snap ring from the bottom of the steering column shaft.



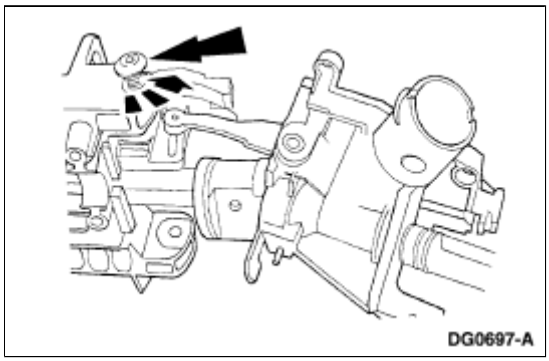
All vehicles

10. Remove the steering column bearing tolerance ring (3L539) from the steering column shaft.



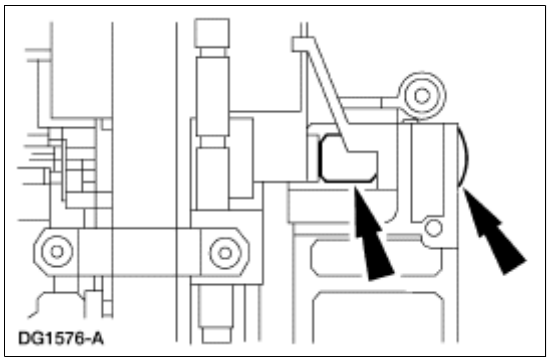
Vehicles with tilt steering columns

11. Remove the two lock cylinder housing pivot screws.



Vehicles with fixed steering columns

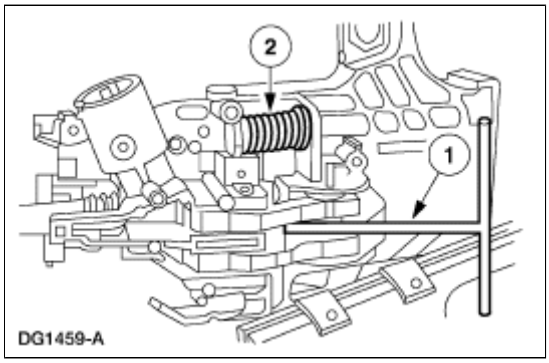
12. Remove the two lock cylinder housing screws and the steering column spacer (3C549).



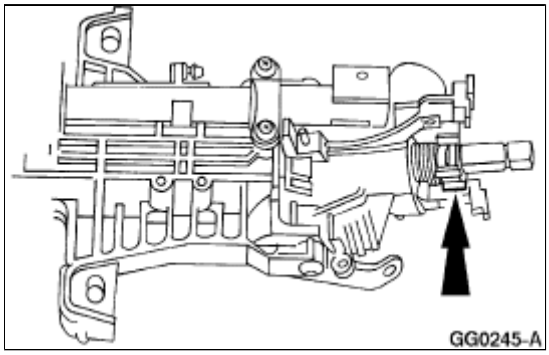
All vehicles

13. **WARNING: The steering column position spring is under tension and can come out with great force.**

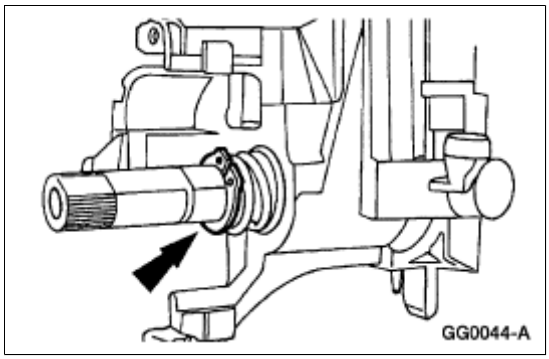
    Remove the steering column lock cylinder housing (3511) and the steering column shaft from the steering actuator housing (3F723).
    1. Pry up on the steering column locking levers (3B661) using a shop fabricated tool.
    2. On tilt steering columns, remove the steering column position spring (3D655).



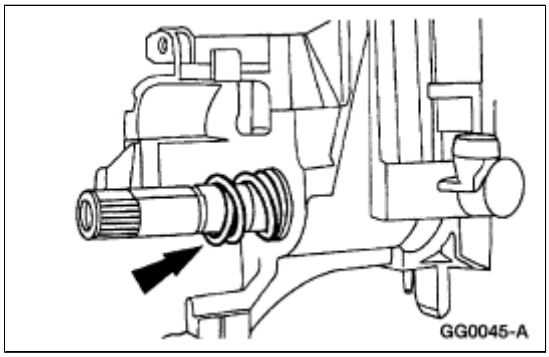
14. Remove the turn signal cancel cam.



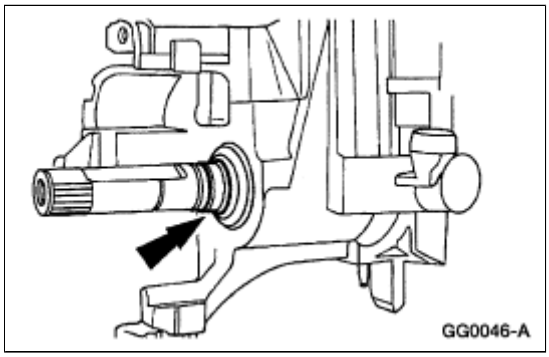
15. Remove the snap ring.



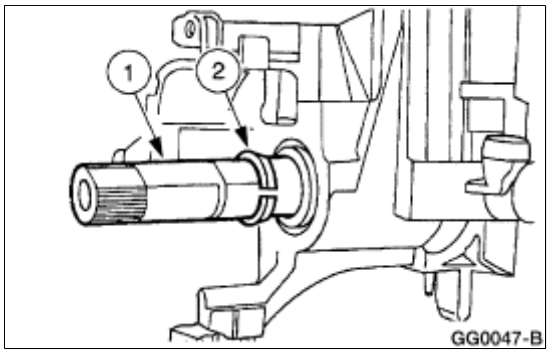
16. Remove the steering column upper bearing spring (3520).



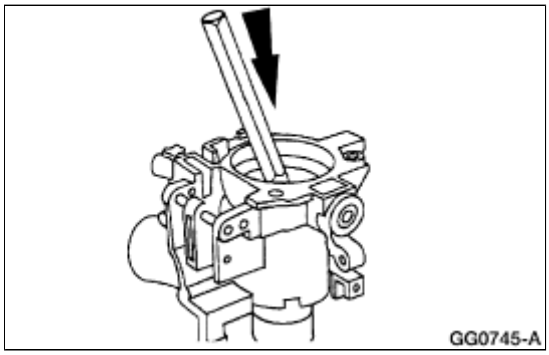
17. Remove the steering column bearing sleeve (3518).



18. Remove the steering column bearing tolerance ring.
    1. Slide the steering column shaft in toward the steering column lock cylinder housing, then out.
    2. Slide the steering column bearing tolerance ring off the steering column shaft.

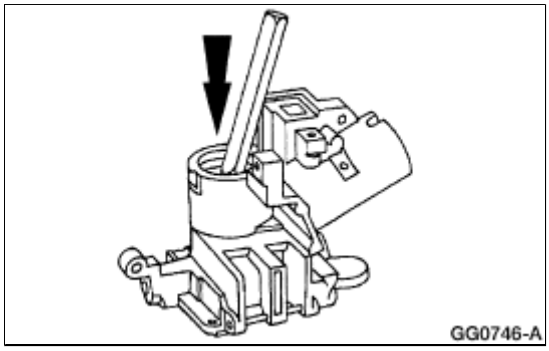


19. Using a suitable punch, remove the steering column bearing (3517) from the steering column lock cylinder housing.



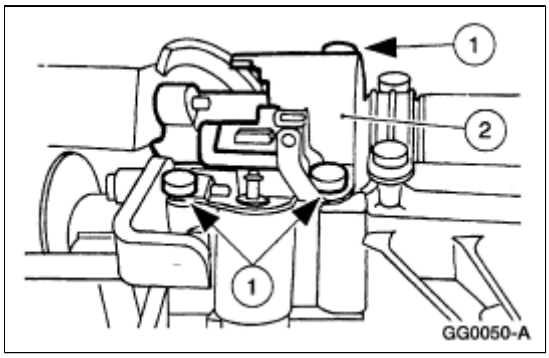
Vehicles with tilt steering columns

20. Use a suitable punch to remove the steering column bearing from the steering column lock cylinder housing.

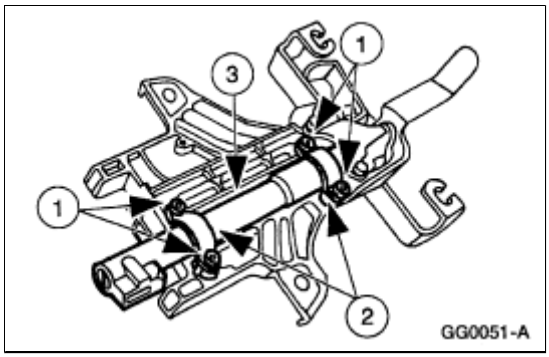


All vehicles

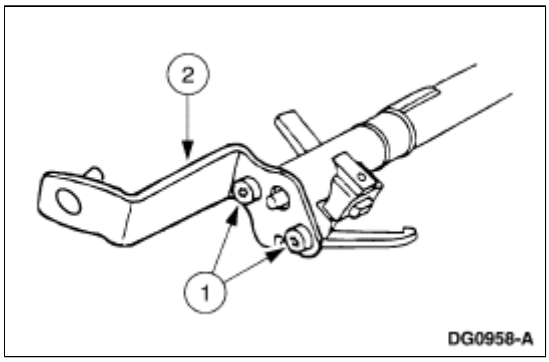
21. Remove the brake shift interlock solenoid.
    1. Remove the three bolts.
    2. Remove the brake shift interlock solenoid.



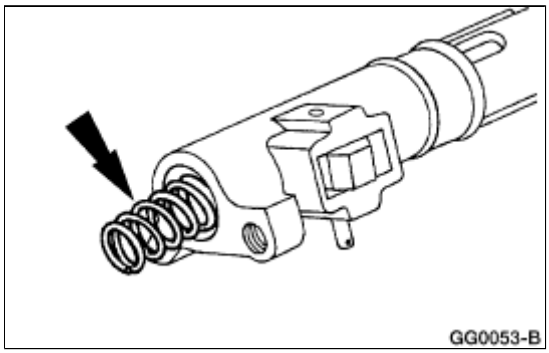
22. Remove the shift tube.
    1. Remove the four bolts.
    2. Remove the two shift tube clamps.
    3. Remove the shift tube.



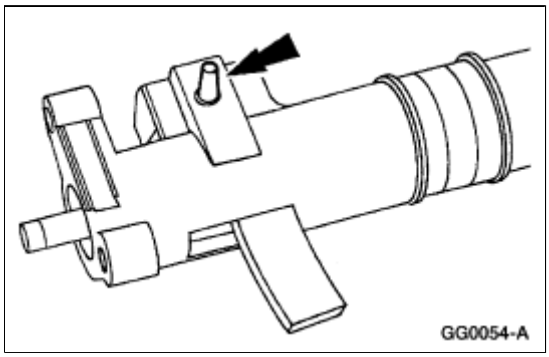
23. Remove the transmission selector lever arm and support (7302).
    1. Remove the two bolts.
    2. Remove the transmission selector lever arm and support.



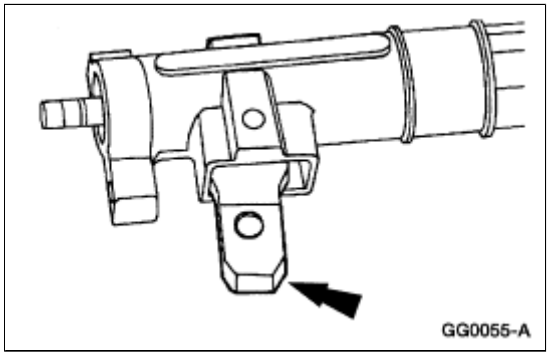
24. Remove the gearshift selector tube spring (7379).



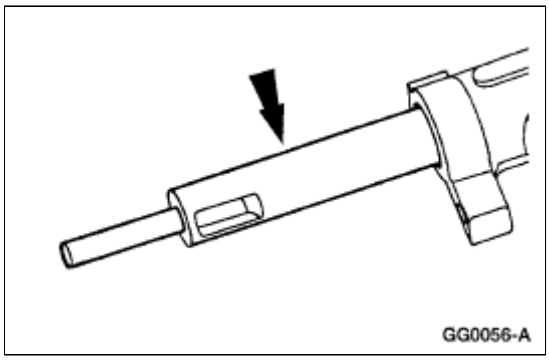
25. Drive out the gearshift lever pin (7W441) from the shift tube.



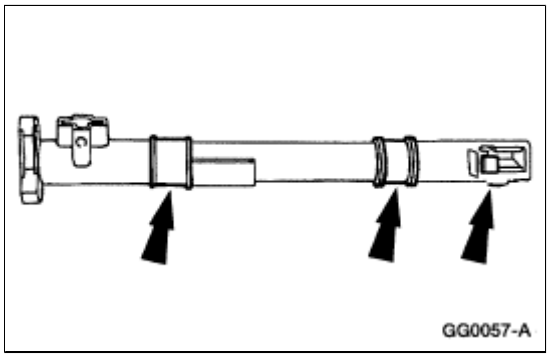
26. Remove the gearshift lever (7210).



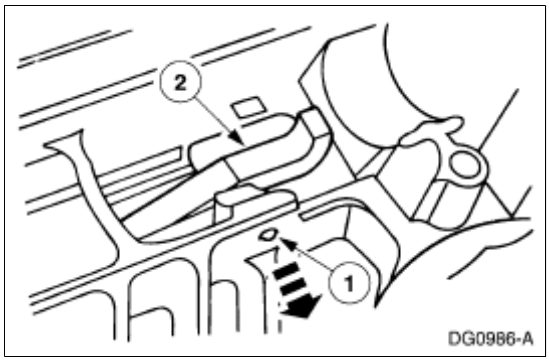
27. Remove the column shift selector lever plunger (7361).
    - If it is bent, install a new column shift selector lever plunger.



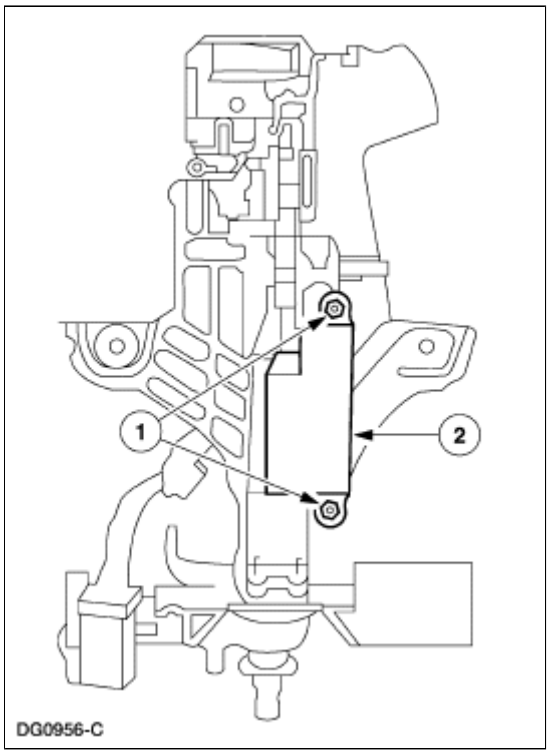
28. Remove the two gearshift lever socket bushings and the transmission control selector lever spring clip.



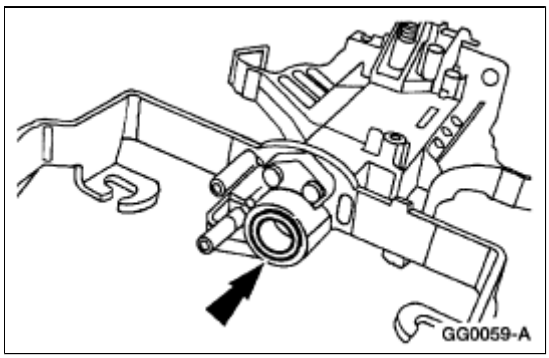
29. Remove the steering column lock pawl (3E691).
    1. Drive out the steering column lock lever pin.
    2. Remove the steering column lock pawl.



30. Remove the ignition switch (11572).
    1. Remove the bolts.
    2. Remove the ignition switch.

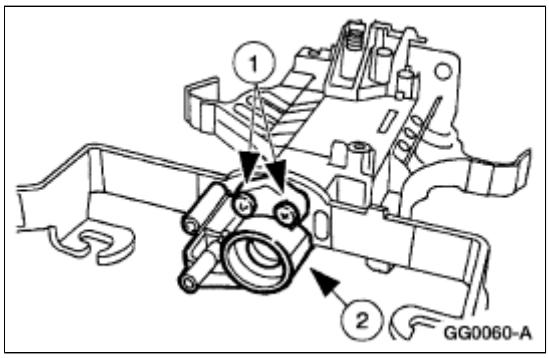


31. Remove the lower steering column bearing and sleeve.

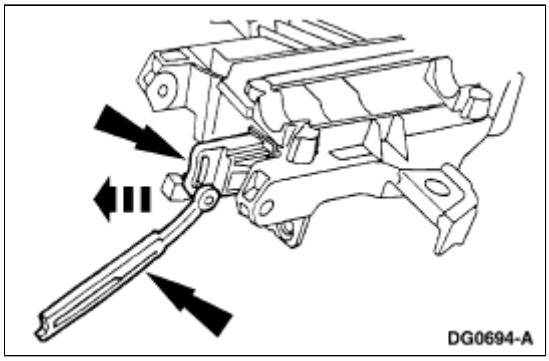


32. Remove the steering column lower bearing retainer.

1. Remove the three bolts.
2. Remove the steering column lower bearing retainer.



33. Remove the upper steering column lock actuator and the lower steering column lock actuator.



Assembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

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WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

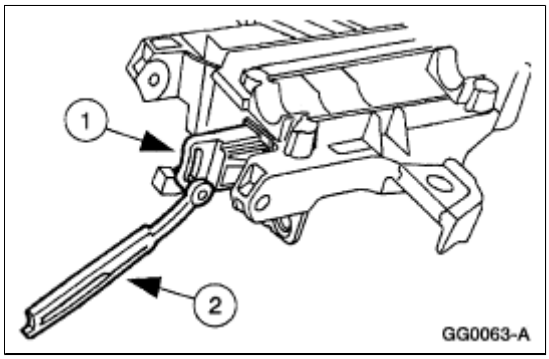
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

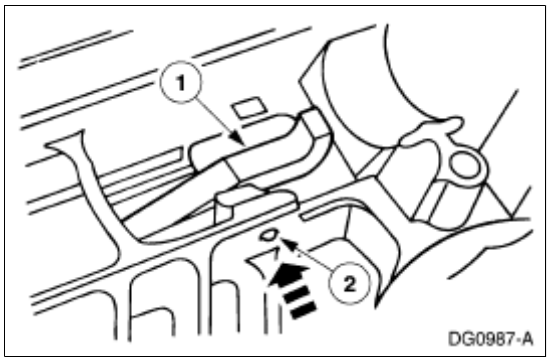
All vehicles

1. Install the steering column lock actuators.
    1. Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to lubricate the steering column lock actuators.
    2. Install the steering column lock actuators.

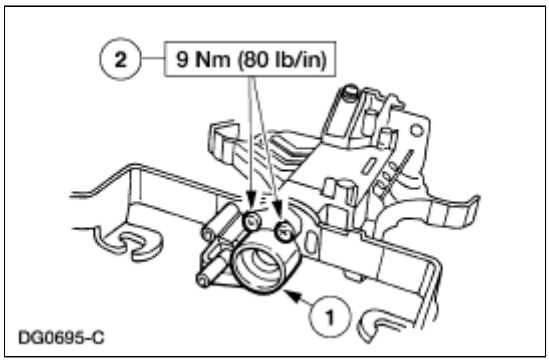


2. **NOTE:** Coat all surfaces with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C282-A.

    Install the steering column lock pawl.
    1. Position the steering column lock pawl.
    2. Drive in the steering column lock lever pin (3B663).



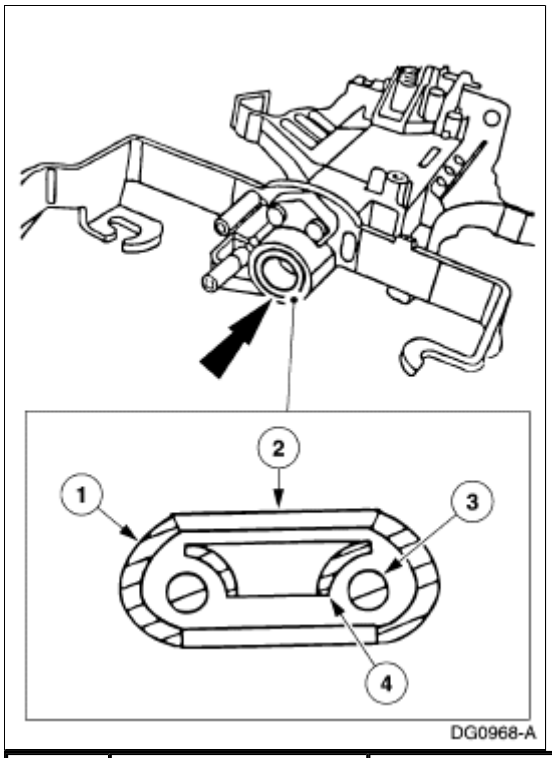
3. Install the steering column lower bearing retainer (3D681).
    1. Position the steering column lower bearing retainer.
    2. Install the three bolts.



4. **NOTE:** The "UP" position of the bearing must be facing forward, toward the engine.

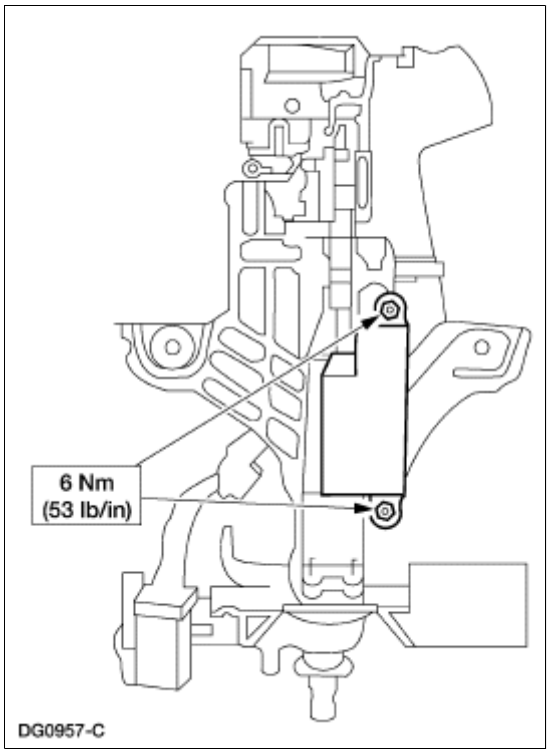
    NOTE: Install the steering column bearing and sleeve so that the inner race is visible when installed.

    Install the steering column bearing and sleeve.

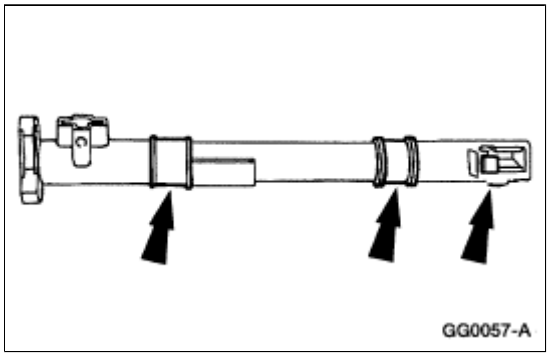


Item	Part Number	Description
1	—	Outer race
2	3517	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

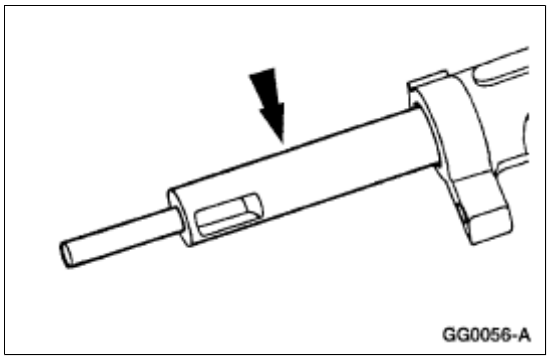
5. Install the ignition switch. Align the ignition switch with the slot and index mark on the steering column. Install the bolts.



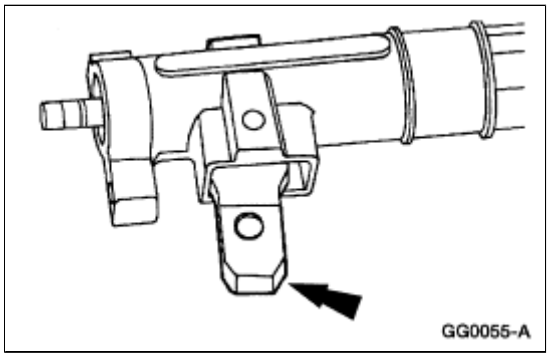
6. Install the transmission control selector lever spring clip and the gearshift lever socket bushings (7335) on the shift tube.
    - Coat the gearshift lever socket bushings with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.



7. Install the column shift selector lever plunger.
    - Coat the column shift selector plunger with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.

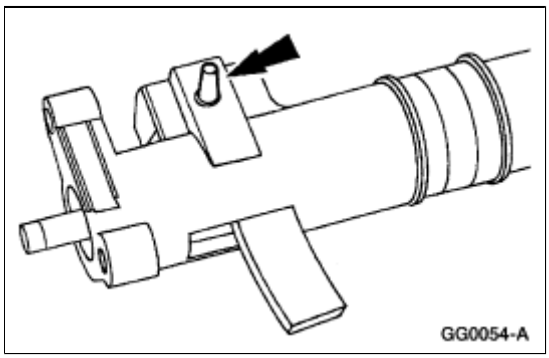


8. Position the gearshift lever in the shift tube.

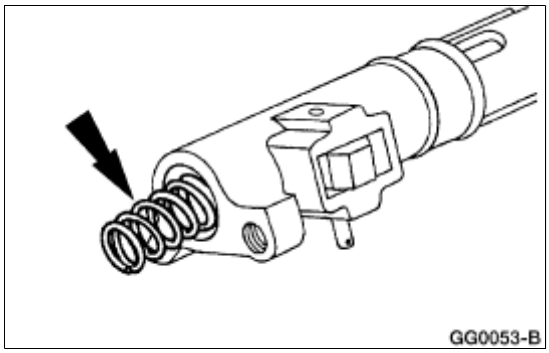


9. **CAUTION: Gearshift lever pin must be installed correctly or 1st gear position can be blocked.**

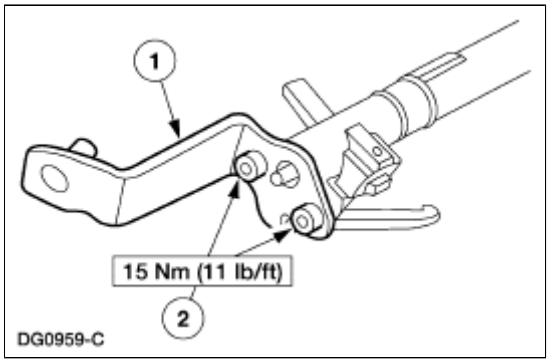
   Install the gearshift lever pin in the shift tube.



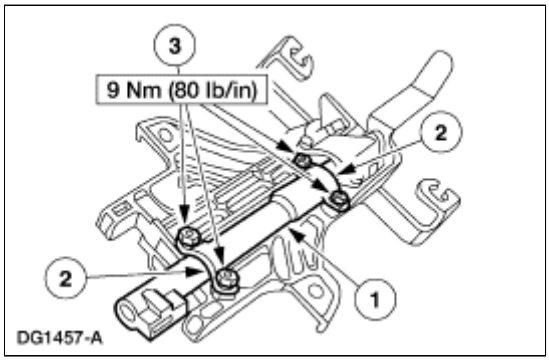
10. Install the gearshift selector tube spring in the shift tube.
    - Coat the end of the spring with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.



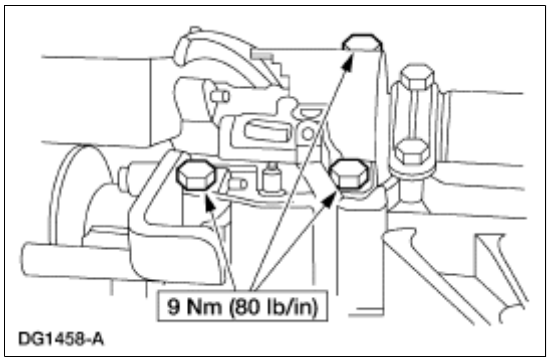
11. Install the transmission selector lever arm and support on the shift tube.
    1. Position the transmission selector lever arm and support.
    2. Install the bolts.



12. Install the shift tube.
    1. Position the shift tube.
    2. Position the shift tube clamps.
    3. Install the bolts.

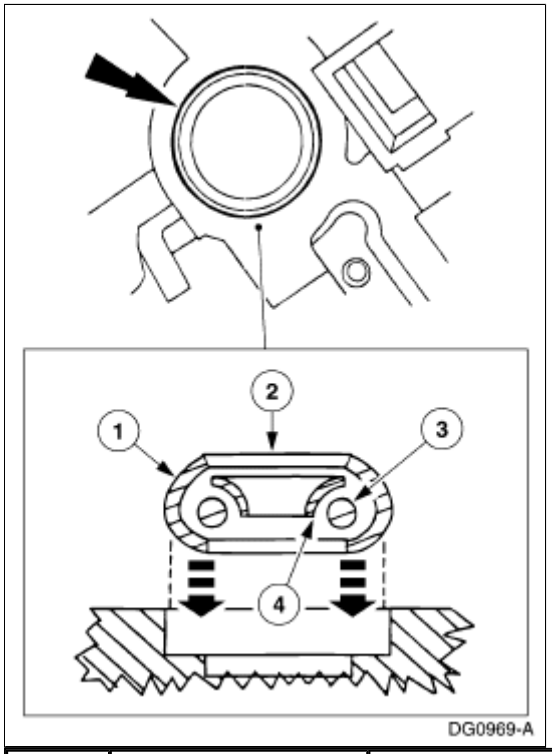


13. Position the brake shift interlock solenoid and install the bolts.

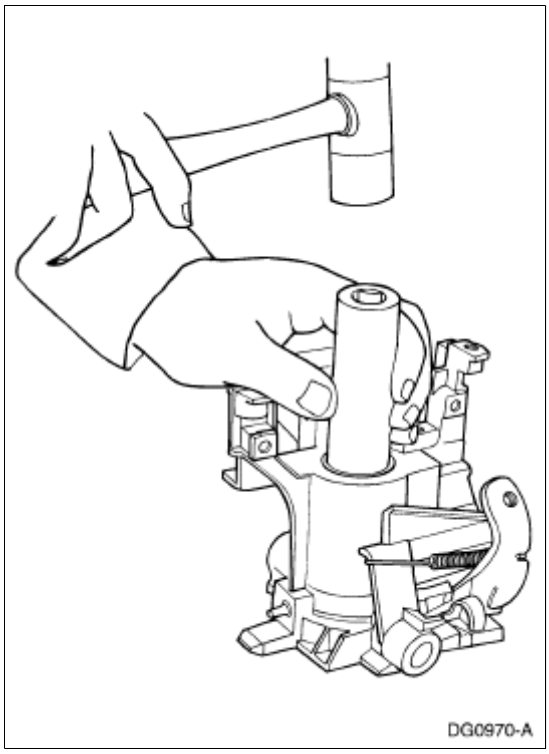


14. **CAUTION: Install the upper steering column bearing so that the inner race is visible when installed.**

Using an appropriate bearing installer or socket; install the upper steering column bearing on the steering column lock cylinder housing.



Item	Part Number	Description
1	—	Outer race
2	—	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

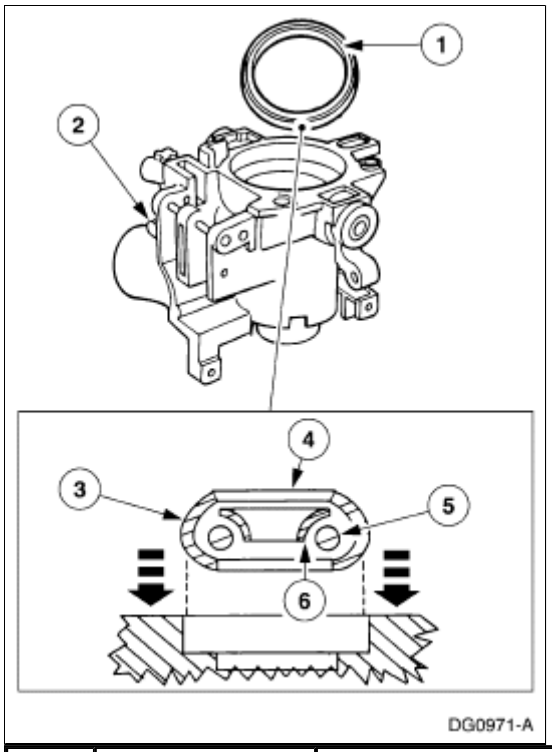


Vehicles with tilt steering columns

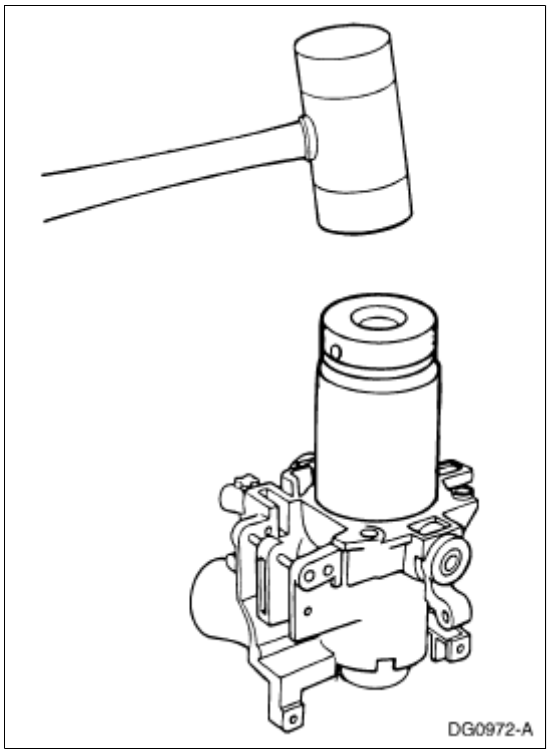
15. **CAUTION: Install the large steering column bearing so that the inner race is visible when installed.**

    NOTE: Use an appropriate bearing installer or socket.

    Install the large steering column bearing into the steering column lock cylinder housing.

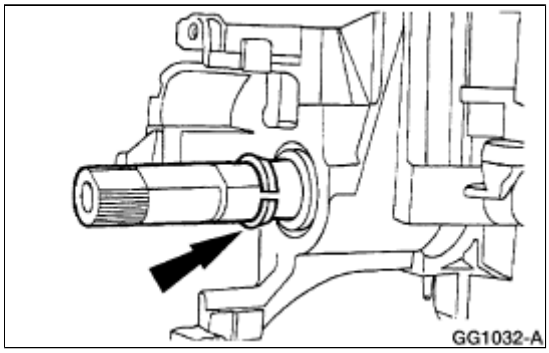


Item	Part Number	Description
1	—	Bearing slot
2	3511	Steering column lock cylinder housing
3	—	Outer race
4	—	Bearing (in the "UP" position)
5	—	Ball
6	—	Inner race

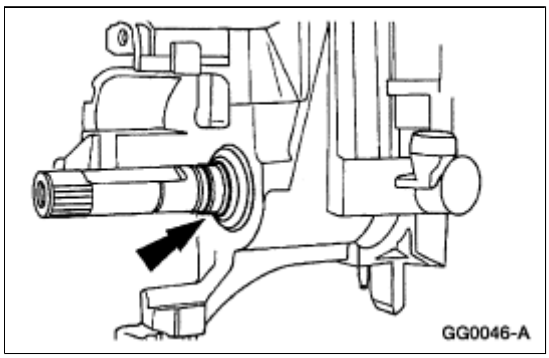


All vehicles

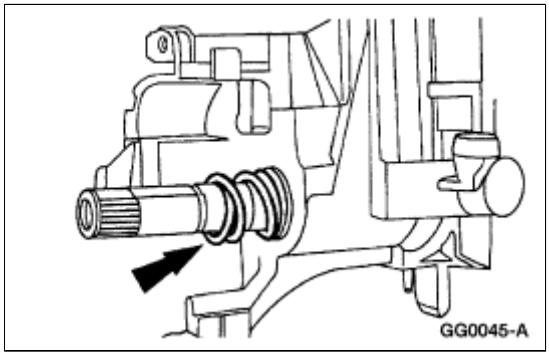
16. Position the steering column shaft in the steering column lock cylinder housing.
    - Install the steering column bearing tolerance ring on the steering column shaft.



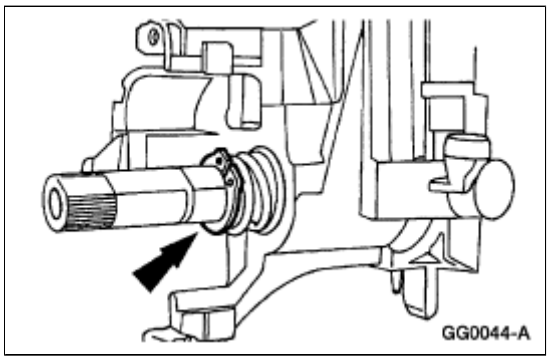
17. Install the steering column bearing sleeve.



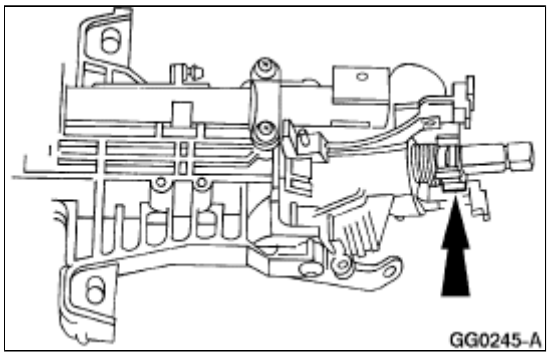
18. Install the steering column bearing spring (3C674).



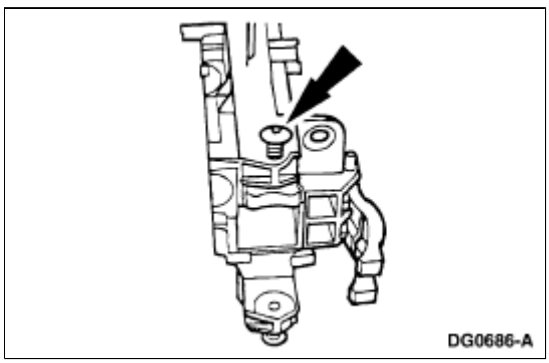
19. Install the snap ring.



20. Install the turn signal cancel cam.

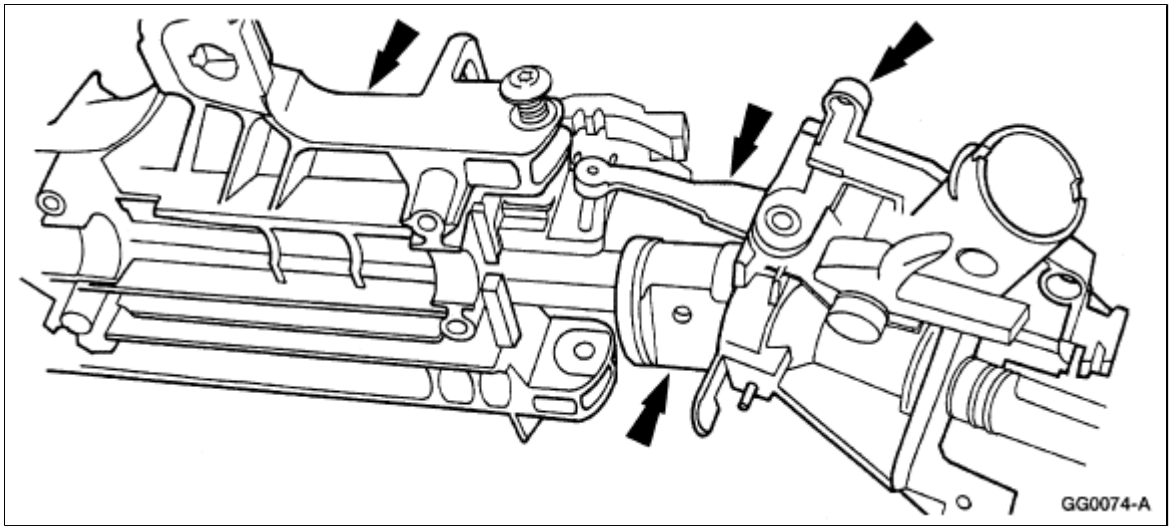


21. Install the lock cylinder housing screws loosely and position the steering actuator housing in a vise.

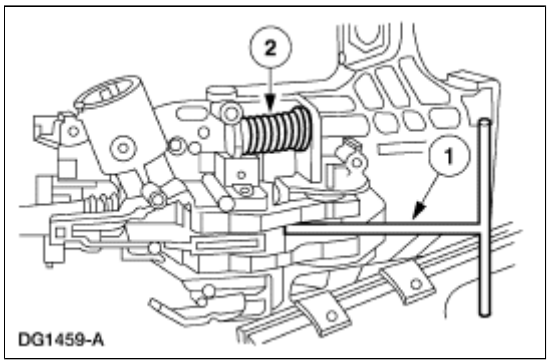


22. **NOTE:** Lubricate the lock cylinder housing bushings with Rust Penetrant and Inhibitor F2AZ-19A501-A or equivalent meeting Ford specification ESR-M99C56-A.

    Position the steering column lock cylinder housing and the steering column shaft on the steering actuator housing.
    - Make sure the upper and lower steering column lock actuators are aligned.

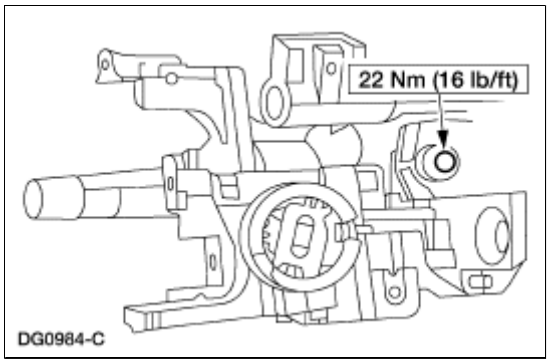


23. Position the steering column locking levers on the steering actuator housing.
    1. Use a shop fabricated tool.
    2. On tilt steering columns, install and compress the steering column position spring.



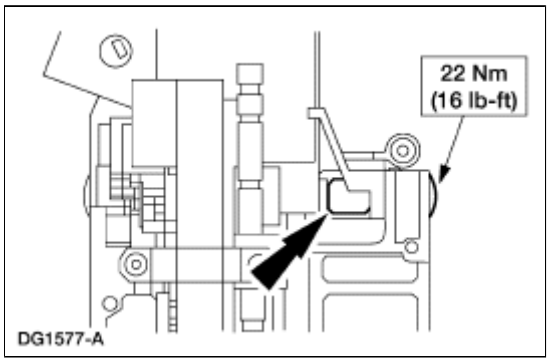
Vehicles with tilt steering columns

24. Position the lock cylinder housing and steering actuator housing, and tighten the lock cylinder housing screws.



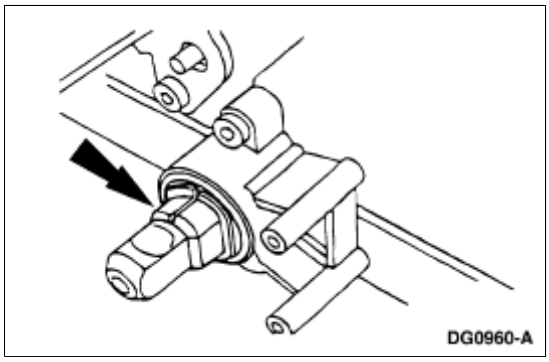
Vehicles with fixed steering columns

25. Install the steering column spacer (3C549). Tighten the two lock cylinder housing screws.
    - The steering column spacer is installed on the LH side of the steering column.



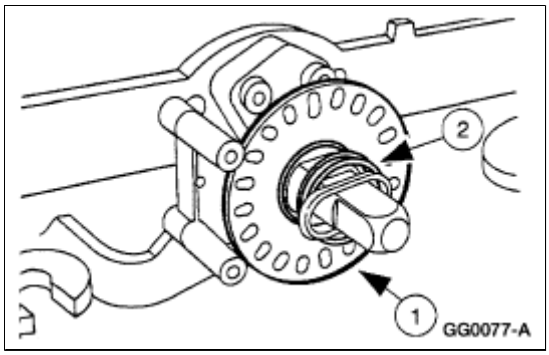
All vehicles

26. Install the steering column bearing tolerance ring.

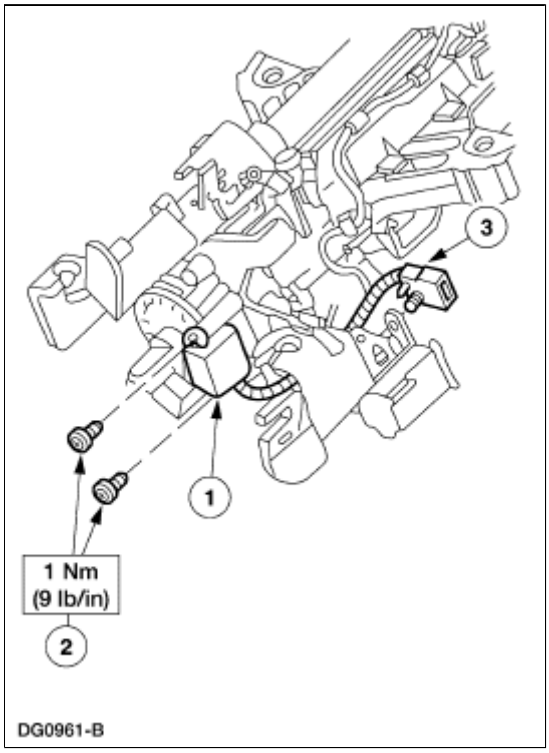


Vehicles with tilt steering columns

27. Install the sensor ring.
    1. Install the sensor ring.
    2. Install the steering column bearing spring.

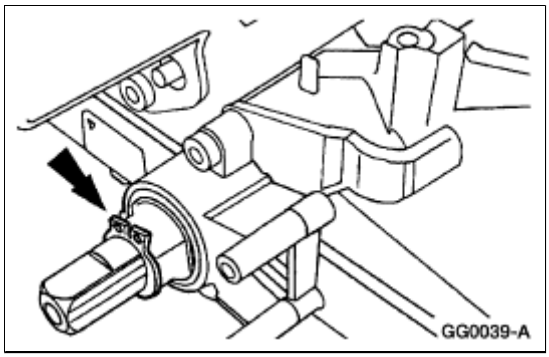


28. Install the shock absorber electronic steering sensor.
    1. Position the shock absorber electronic steering sensor.
    2. Install the screws.
    3. Connect the electrical connector.



Vehicles with fixed steering columns

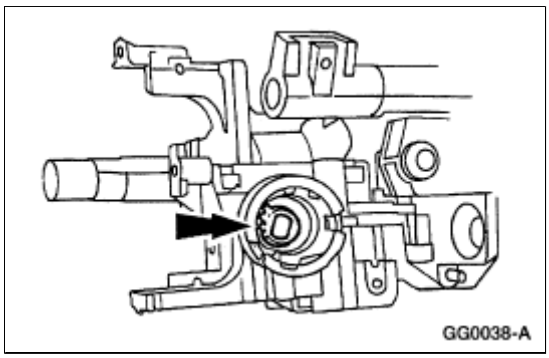
29. Install the snap ring.



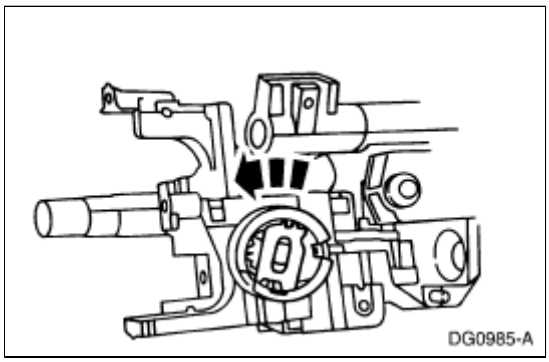
All vehicles

30. **NOTE:** The narrow section of the keyhole in the lock gear must be in the one o'clock position.

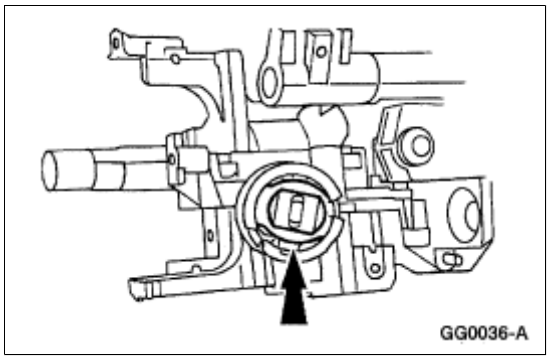
    Install the steering column lock gear.
    - Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to coat the steering column lock gear.



31. Install the steering column lock housing bearing.
    - The narrow section of the keyhole should be in the one o'clock position, with the tab inboard at the three o'clock position and rotate it counterclockwise.
    - Lubricate the steering column lock housing bearing with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.



32. Install the steering column upper bearing retainer firmly to engage the four retention tabs into the lock housing.



33. Install the steering column. For additional information, refer to Column in this section.

34. Install the air bag sliding contact. For additional information, refer to Section 501-20B .

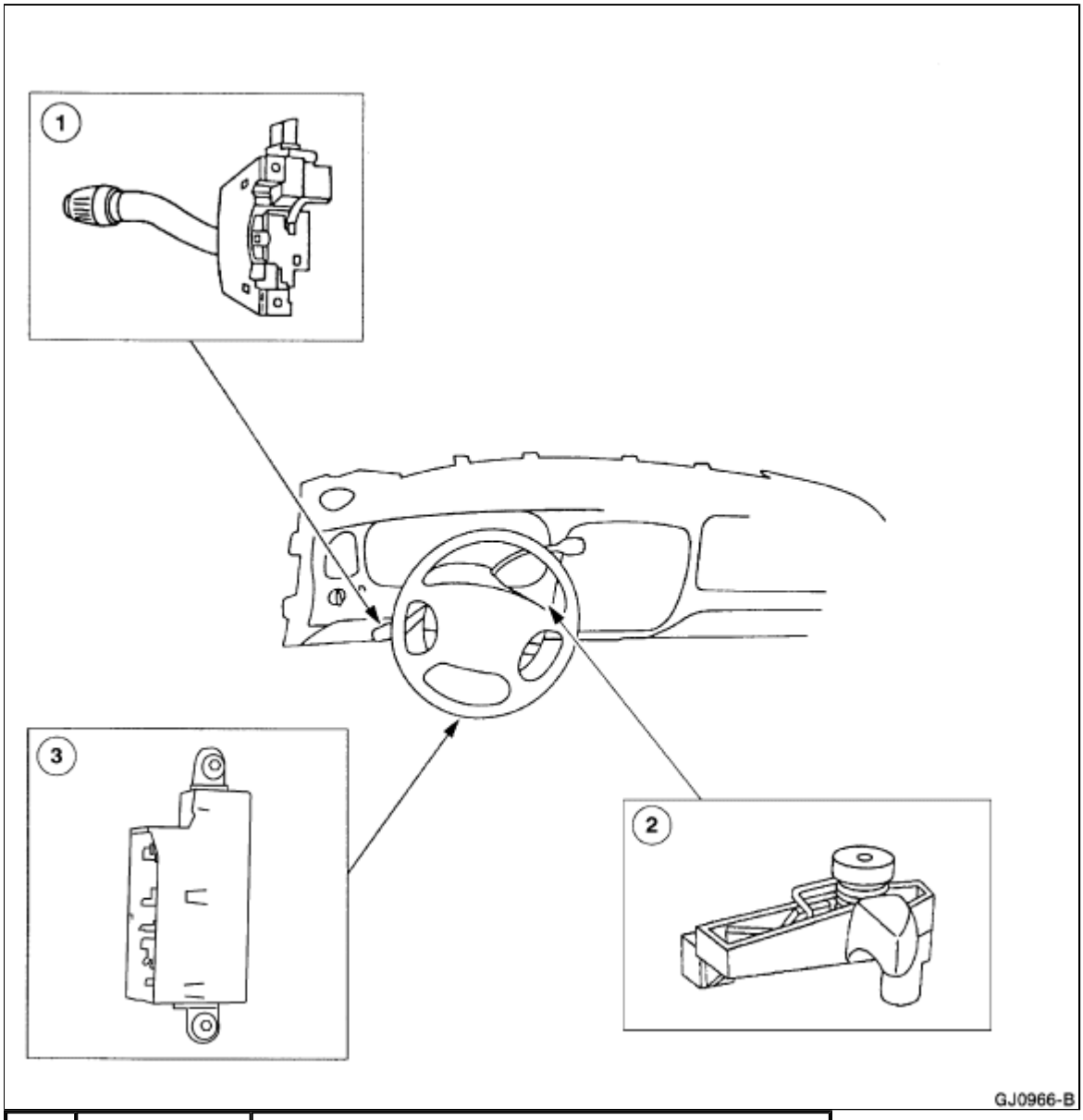
35. Install the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

Torque Specifications

Description	Nm	lb-in
Battery Ground Cable Bolt	7-10	62-89
Hood Latch Release Handle Screws	2.7-3.7	25-33
Ignition Switch Electrical Connector Bolt	0.8-1.2	7.1-10.6
Ignition Switch Screws	5.3-7.2	47-64
Instrument Panel Steering Column Opening Cover Reinforcement Screws	7.6-10.4	—
Key Release Lever Bolt	4-6	36-53
Lower Instrument Panel Steering Column Cover Screws	2.7-3.7	25-33
Multi-Function Switch Screws	2-3	18-26
Parking Brake Release Handle Screws	2.7-3.7	25-33

Steering Column Switches

Steering Column Switches Component Location



Item	Part Number	Description
1	13K359	Multi-Function Switch
2	3F527	Key Release Lever (Manual Transmission Only)
3	11572	Ignition Switch

The integrated multi-function switch is mounted to the LH side of the steering column and controls the turn signals, hazard flasher, windshield wiper/washer control, headlamp dimmer/flash-to-pass.

The ignition switch is mounted below the steering column and is activated by rotating the key lock cylinder on the steering column.

The ignition key warning switch terminal and wire are secured to the steering column by integral locking fingers.

Steering Column Switches

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Refer to Wiring Diagrams Cell 85 , Headlamps for schematic and connector information.

Refer to Wiring Diagrams Cell 90 , Turn/Stop/Hazard Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 81 , Interval Wiper/Washer for schematic and connector information.

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the multi-function switch or ignition switch.
2. Visually inspect for the following obvious signs of mechanical and electrical damage:

Visual Inspection Chart

Mechanical	Electrical
• Damaged multi-function switch • Damaged ignition switch	• Failed fuse(s) • Damaged wiring harness • Loose or corroded connections

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is properly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for GEM/CTM, go to Pinpoint Test E.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the GEM/CTM.

6. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is

			retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 .
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window LF One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window LF One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window LF Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	LF Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window LF Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select	GEM/CTM	REFER to Section 501-16 .

	Switch Input Short to Ground		
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delay Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit	GEM	REFER to Section 501-16 .

	Failure		
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size ratio. TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral InTow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral InTow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator	GEM	REFER to Section 308-07A .

	Short Circuit to Battery		
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD Low Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .

P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Left Front Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Right Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, OFFO-G, ON-B-
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED

BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	LF Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	LF Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage Low	GEM/CTM
B1322	Driver Door Ajar Circuit Short to Ground	GEM/CTM
B1330	Passenger Door Ajar Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Left Power Window Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM

B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Park Lamp Input Circuit Short to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM/CTM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Ignition Switch Is Inoperative	• Fuse(s). • Circuitry. • Ignition switch (11572).	• GO to Pinpoint Test A .
• No Power in ACC	• Ignition switch. • Circuitry.	• GO to Pinpoint Test B .
• No Power in RUN	• Ignition switch. • Circuitry.	• GO to Pinpoint Test C .
• No Power in START	• Ignition switch. • Circuitry.	• GO to Pinpoint Test D .
• No Communication With the Module — GEM/CTM	• Fuse. • Circuitry. • Module.	• GO to Pinpoint Test E .
• The Multi-Function Switch Hazard Switch Does Not Operate Properly	• Multi-function switch (13K359).	• GO to Component Test.
• High Key Efforts	• Ignition switch lock cylinder. • Steering column shrouds. • Casting/actuator binds, sticks, grabs with key rotation. • Ignition switch.	• GO to Component Test.

Pinpoint Tests

PINPOINT TEST A: THE IGNITION SWITCH IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE FUSE	
1	

2

Maxi-Fuse 1 (50A)

3 Check the power distribution box maxi-fuse 1 (50A).

- **Is the fuse OK?**

→ **Yes**
GO to A2 .

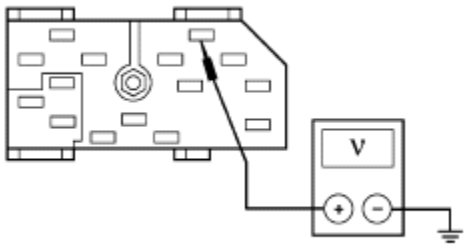
→ **No**
REPLACE maxi-fuse 1 (50A). TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary. TEST the system for normal operation.

A2 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH

1

Ignition Switch C233

2



GJ0469-A

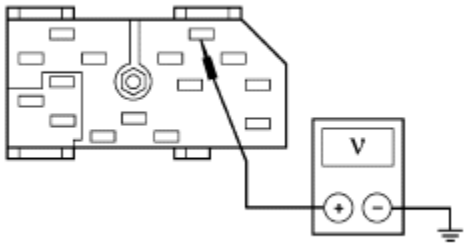
2 Measure the voltage between the ignition switch C233-B5, circuit 37 (Y), and ground.

- **Is the voltage greater than 10 volts?**

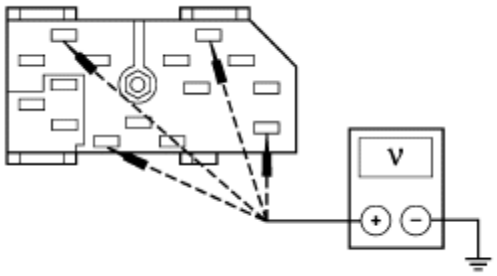
→ **Yes**
REPLACE the ignition switch. TEST the system for normal operation.

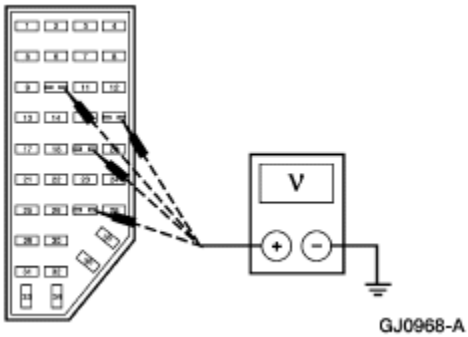
→ **No**
REPAIR circuit 37 (Y). TEST the system for normal operation.

PINPOINT TEST B: NO POWER IN ACC

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE RADIO OPERATION	
1 	2 Turn the radio on. • **Does the radio operate properly?** → **Yes** GO to B2 . → **No** GO to Pinpoint Test C .
B2 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1 Ignition Switch C233 2  GJ0469-A	2 Measure the voltage between the ignition switch C233 B-5, circuit 37 (Y), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the ignition switch. → **No** REPAIR circuit 37 (Y).

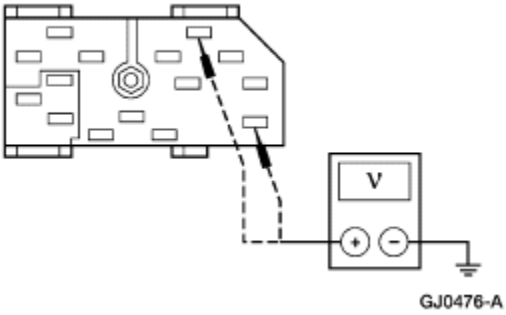
PINPOINT TEST C: NO POWER IN RUN

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1 2 Ignition Switch C233 3  GJ0967-A	3 Measure the voltage between ignition switch C233-B1, circuit 37 (Y), and ground; C233-B2, circuit 37 (Y), and ground; C233-B4, circuit 37 (Y), and ground; C233-B5, circuit 37 (Y), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to C2 . → **No** REPAIR the circuit in question. TEST the system for normal operation.
C2 CHECK THE IGNITION SWITCH	
	1 Perform the ignition switch continuity test; refer to EVTM CELL 149. • **Does the ignition switch test OK?** → **Yes** GO to C3 . → **No** REPLACE the ignition switch. TEST the system for normal operation.
C3 CHECK THE VOLTAGE SUPPLY TO THE FUSE JUNCTION PANEL	
1	

 Ignition Switch C233 2 3  GJ0968-A	3 Measure the voltage between fuse junction panel fuse 16 (30A) and ground, fuse 10 (7.5A) and ground, fuse 19 (25A) and ground, and fuse 27 (15A) and ground. • **Are the voltages greater than 10 volts?** → **Yes** Reverify the concern. → **No** If fuse location 16 (30A), REPAIR circuit 297 (BK/LG). If fuse location 10 (7.5A), REPAIR circuit 687 (GY/Y). If fuse location 19 (25A), REPAIR circuit 1050 (LG/P). If fuse location 27 (15A), REPAIR circuit 687 (GY/Y). TEST the system for normal operation.

PINPOINT TEST D: NO POWER IN START

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1 	

2 Ignition Switch C233 3  GJ0476-A	3 Measure the voltage between ignition switch C233-B4, circuit 37 (Y), C233-B5, circuit 37 (Y), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to D2 . → **No** REPAIR circuit 37 (Y). TEST the system for normal operation.
D2 CHECK THE IGNITION SWITCH	
	1 Perform the ignition switch continuity test; refer to EVTM CELL 149. • **Does the ignition switch test OK?** → **Yes** GO to D3 . → **No** REPLACE the ignition switch. TEST the system for normal operation.
D3 CHECK CIRCUIT 1050 (LG/P) AND CIRCUIT 32 (R/LB) FOR VOLTAGE	
1 Ignition Switch C233 2 	

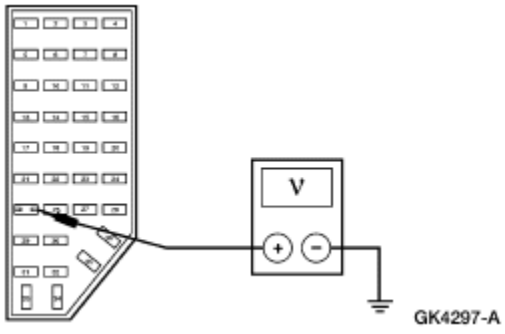
	3 Turn the key to the START position. • **Does the starter motor engage?** → **Yes** REPAIR circuit 1050 (LG/P). → **No** REPAIR circuit 32 (R/LB).

PINPOINT TEST E: NO COMMUNICATION WITH THE MODULE — GEM/CTM

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK POWER DISTRIBUTION BOX MAXI FUSE 5 (50A)	
1 Fuse 5 (50A)	• **Is the fuse OK?** → **Yes** GO to E2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
E2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to E3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.

E3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE

1



1 Measure the voltage between fuse junction panel fuse 25 (7.5A), pin 2, circuit 1052 (T/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E4 .

→ **No**
REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.

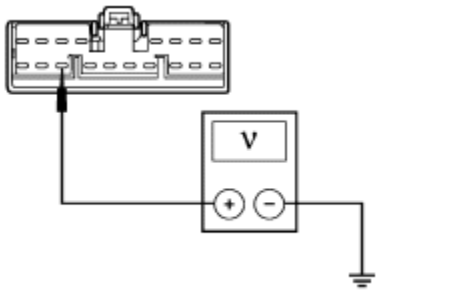
E4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (W/Y)

1

2

GEM/CTM C283

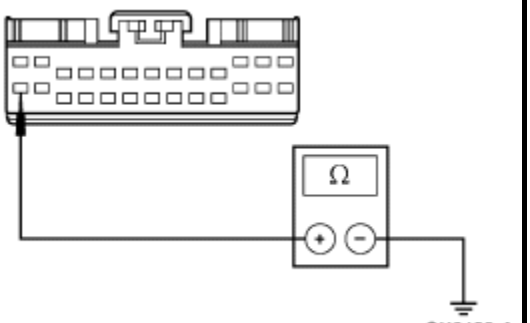
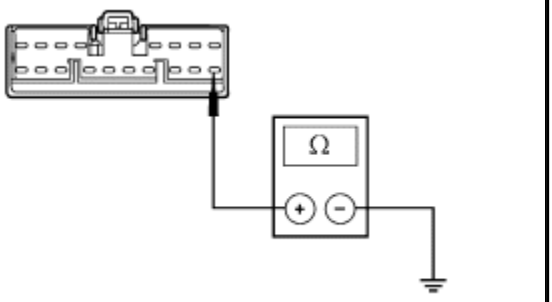
3



3 Measure the voltage between GEM/CTM C283-11, circuit 1001 (W/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E5 .

	→ **No** REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.
E5 CHECK CIRCUIT 570 (BK/W) FOR OPEN	
1 GEM/CTM C280 2  GK6422-A	2 Measure the resistance between GEM/CTM C280-14, circuit 570 (BK/W), and ground. • **Are the resistances less than 5 ohms?** → **Yes** GO to E6 . → **No** REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.
E6 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GK6044-A	1 Measure the resistance between GEM/CTM C283-18, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 57 (BK). CLEAR the DTCs.

	TEST the system for normal operation.

Component Test

Ignition Switch Mechanical Check

Test the mechanical operation of the ignition switch by rotating the lock cylinder through all switch positions. The movement should not stick or bind and should return from the START position back to the ON position without assistance (spring return). If sticking or binding is encountered, check for the following:

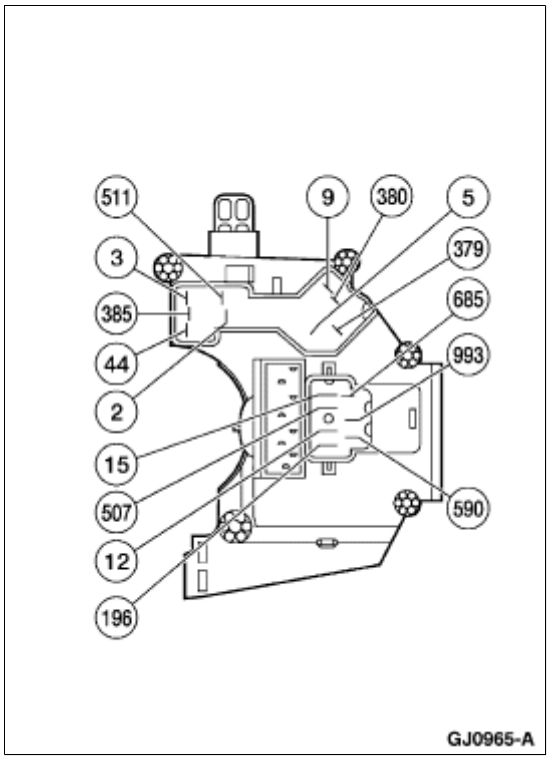
- Burrs on the lock cylinder key.
- Insufficient lube on lock cylinder.
- Bent or damaged ignition rod.
- Object rubbing against ignition rod.
- Excessive rubbing of actuator against transmission shift socket.
- Binding lock cylinder.
- Shroud rubbing against lock cylinder.
- Burrs or foreign material around the rack and pinion actuator in the lock cylinder housing.
- Insufficient lube on actuator. (Do not apply lubricant to the inside of the ignition switch.)
- Binding ignition switch.

If the steering wheel lock is engaged with the wheels loaded against a curb, there will be high effort required to turn the key from LOCK. Turn the steering wheel to either side of the lock to unload the system.

Ignition Switch Continuity Check

Refer to the Electrical Vacuum Troubleshooting Manual, Cell 149.

Multi-Function Switch



1. Measure the resistance between the multi-function switch terminals.
    1. If the resistances are as specified, multi-function switch is OK. RETURN the multi-function switch to the vehicle. TEST the system for normal operation.
    2. If the resistances are not as specified, REPLACE the multi-function switch. Refer to Multi-Function Switch. TEST the system for normal operation.

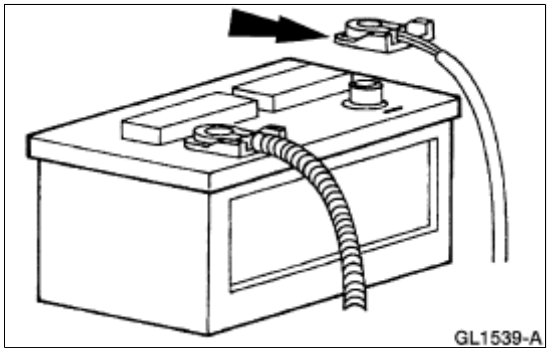
Function	Multi-Function Switch Position	Terminals	Resistance Values
Washer	ON	590 and 993	Less than 5 Ohms
	OFF	590 and 993	Greater than 10,000 Ohms
Wiper	OFF	685 and 993	Approximately 47,000 Ohms
	INT	685 and 993	Approximately 11,000 Ohms
	LO	685 and 993	Approximately 4,000 Ohms
	HI	685 and 993	Less than 5 ohms
Wiper	OFF	685 and 590	Approximately 150,000 Ohms
	INT	685 and 590	Between 14,000 Ohms and 11,000 Ohms
	LO	685 and 590	Approximately 7,200 Ohms
	HI	685 and 590	Approximately 3,200 Ohms

Wiper	OFF	590 and 993	Approximately 100,000 Ohms
	INT	590 and 993	Between 100,000 Ohms and 3,200 Ohms
	LO	590 and 993	Approximately 3,200 Ohms
	HI	590 and 993	Approximately 3,200 Ohms
Stoplamp Input	Center (no turn) Position	511 and 9, 511 and 5	Less Than 5 Ohms
Hazard	ON	385 and 5, 385 and 3, 385 and 9	Less than 5 Ohms
	OFF	385 and 5, 385 and 3, 385 and 9	Greater than 10,000 Ohms
Left Turn Signal	Place the Multi-Function Switch in the LEFT TURN Position	44 and 3, 44 and 9	Less than 5 Ohms
Right Turn Signal	Place the Multi-Function Switch in the RIGHT TURN Position	44 and 5, 44 and 2	Less than 5 Ohms
High Beam	Place the Multi-Function Switch in the HI BEAM Position	15 and 12	Less than 5 Ohms
Low Beam	Place the Multi-Function Switch in the LO BEAM Position	15 and 507	Less than 5 Ohms
Flash-To-Pass	Hold the Multi-Function Switch in the FLASH-TO-PASS Position	196 and 12, 15 and 507	Less than 5 Ohms

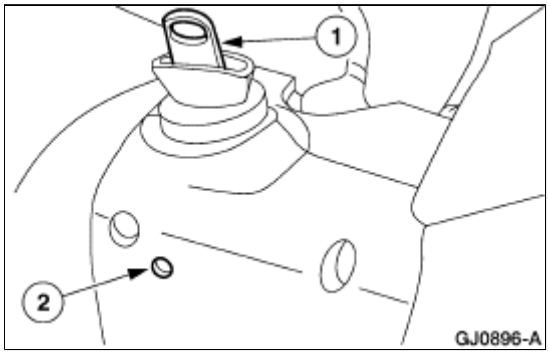
Multifunction Switch

Removal

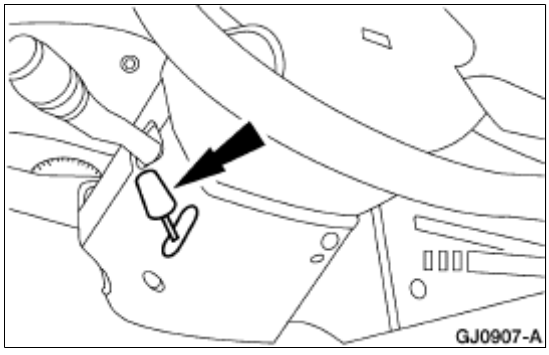
1. Disconnect the battery ground cable.



2. Remove the ignition switch lock cylinder.
    1. Insert the ignition key into the ignition switch lock cyliner and turn to RUN position.
    2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.

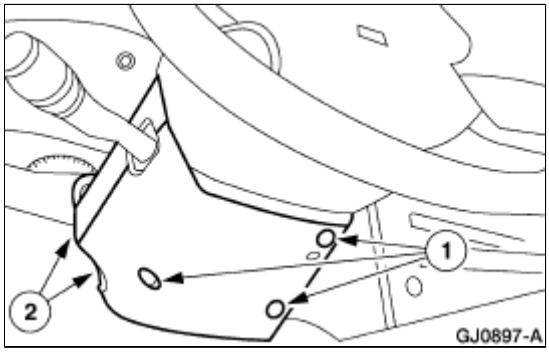


3. If equipped, twist the tilt wheel handle and shank counterclockwise and remove.

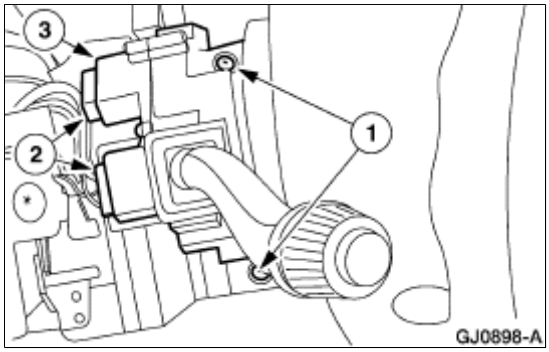


4. Remove the upper and lower steering column shrouds.
    1. Remove the screws.

2. Remove the upper and lower steering column shrouds.



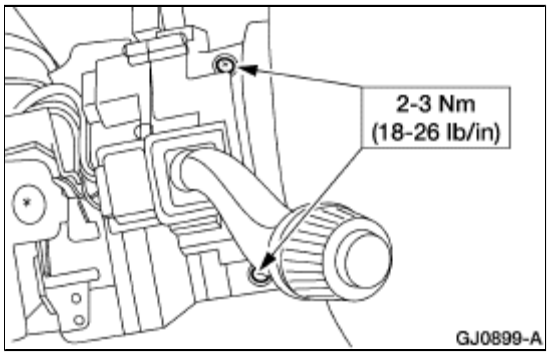
5. Remove the multi-function switch.
    1. Remove the screws.
    2. Disconnect the electrical connectors.
    3. Remove the multi-function switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

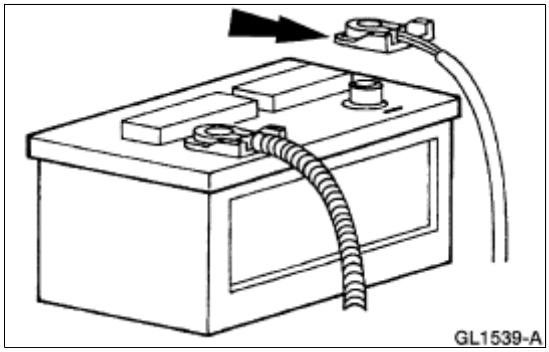
    To install, reverse the removal procedure.



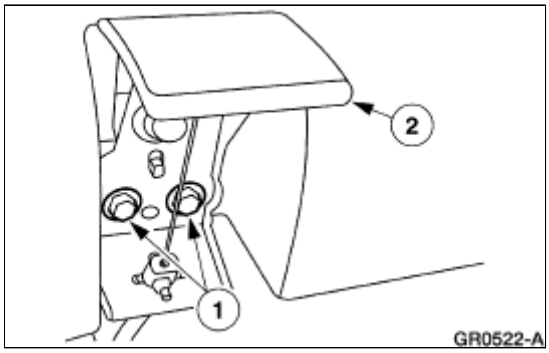
Ignition Switch

Removal

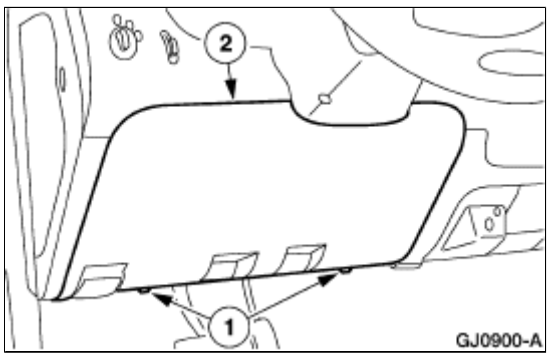
1. Disconnect the battery ground cable.



2. Detach the hood latch release handle and position aside.
    1. Remove the bolts.
    2. Position the hood latch release handle aside.

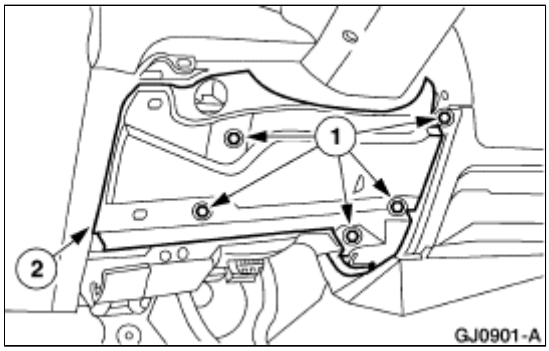


3. Remove the lower instrument panel steering column cover.
    1. Remove the screws.
    2. Remove the lower instrument panel steering column cover.

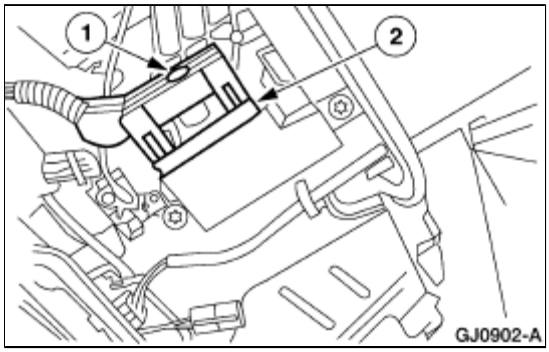


4. Remove the instrument panel steering column opening cover reinforcement.

1. Remove the bolts.
2. Remove the instrument panel steering column opening cover reinforcement.

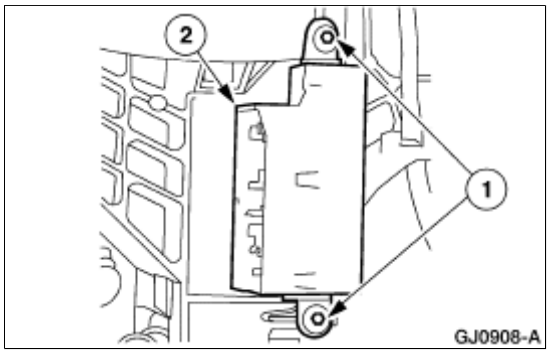


5. Disconnect the electrical connector.
   1. Loosen the bolt.
   2. Disconnect the electrical connector.



6. **NOTE:** The ignition key should be in the OFF position.

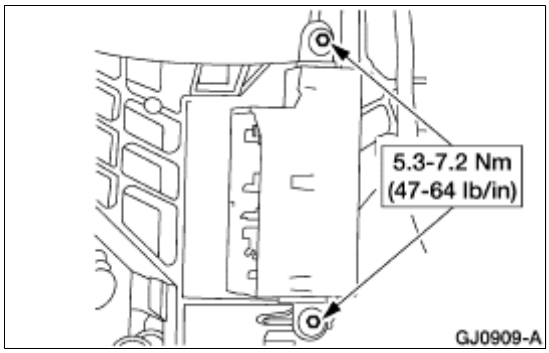
   Remove the ignition switch.
   1. Remove the screws.
   2. Remove the ignition switch.

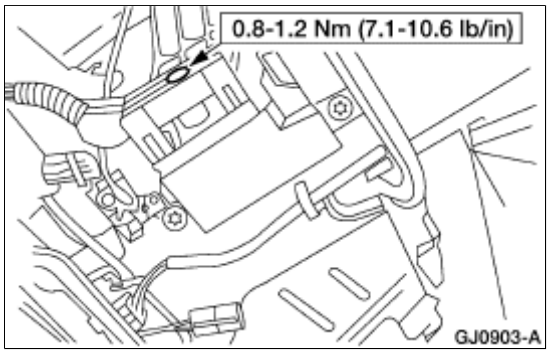


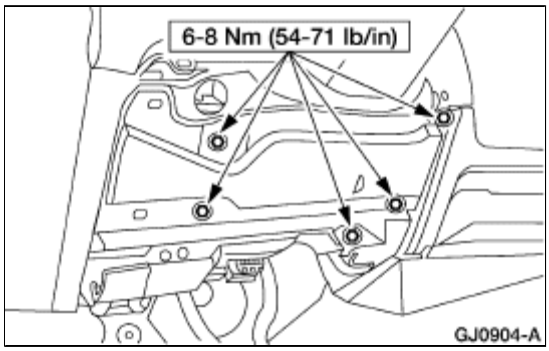
Installation

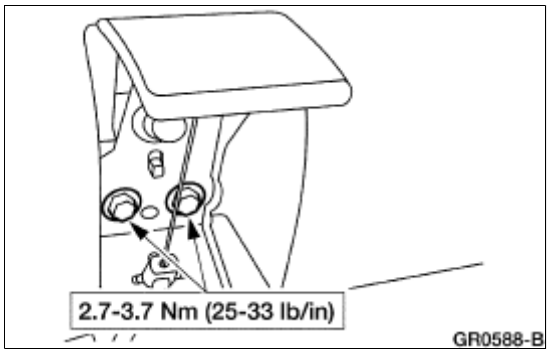
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn its strategy.

   To install, reverse the removal procedure.


5.3-7.2 Nm
(47-64 lb/in)
GJ0909-A


0.8-1.2 Nm (7.1-10.6 lb/in)
GJ0903-A


6-8 Nm (54-71 lb/in)
GJ0904-A


2.7-3.7 Nm (25-33 lb/in)
GR0588-B

Key Release Interlock Actuator

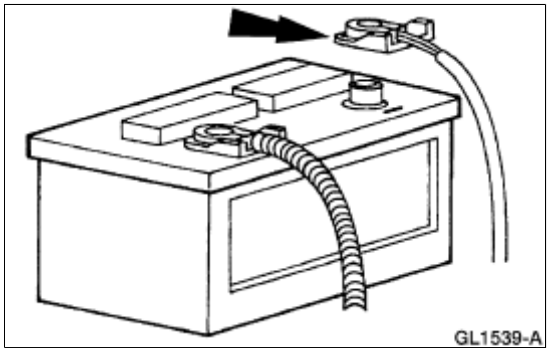
Removal and Installation

For additional information, refer to Section 211-04 .

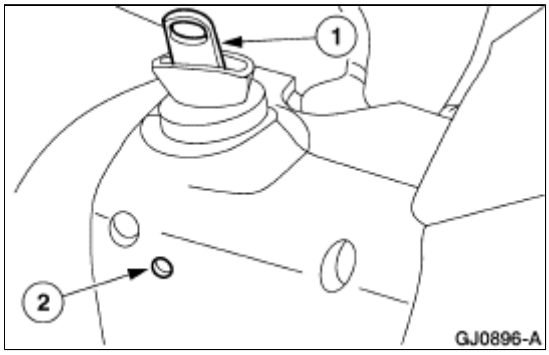
Key Release Button —Manual Transmission

Removal

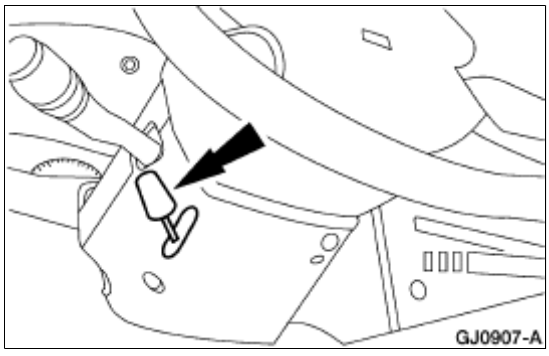
1. Disconnect the battery ground cable.



2. Remove the ignition switch lock cylinder (11582).
    1. Insert the ignition key into the ignition switch lock cylinder and turn to RUN position.
    2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.

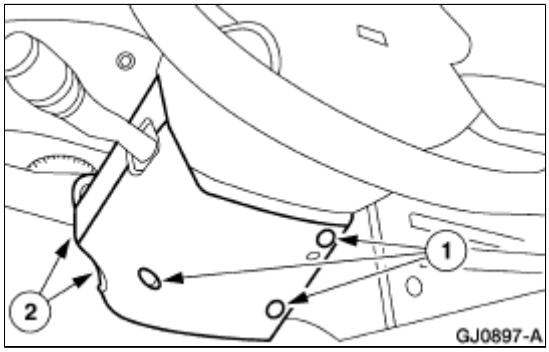


3. If equipped, remove the tilt wheel handle and shank.

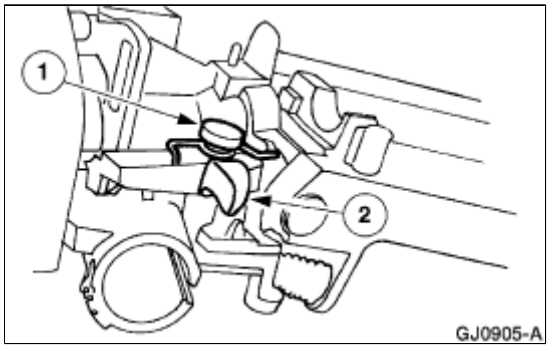


4. Remove the upper and lower steering column shrouds.
    1. Remove the screws.

2. Remove the upper and lower steering column shrouds.



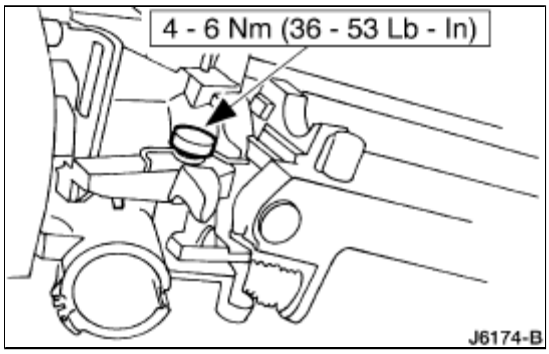
5. Remove the key release lever.
   1. Remove the key release lever bolt.
   2. Remove the release lever handle and the spring.



Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.



General Specifications

Item	Specification
Lubricants and Sealants	
Devcon Aluminum Liquid F2	M3D35-A (E)
Threadlock® 262 E2FZ-19554-B	WSK-M2G351-A6
Super Premium SAE Motor Oil	Refer to owner literature
Diesel engine oil	Refer to owner literature
Gasoline Engine Oil Dye 164-R3705	ESE-M99C103-B1

Engine

NOTE: This section contains information, steps and procedures that may not be specific to your engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis Manual.

The engine incorporates the following features:

- a closed positive crankcase ventilation (PCV) system. For additional information, refer to Section 303-08 .
- an exhaust emission control system. For additional information, refer to Section 303-08 .
- an evaporative emission control system. For additional information, refer to Section 303-13 .

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group 303 for the procedure.

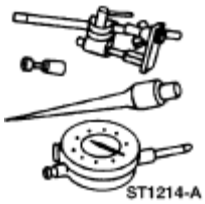
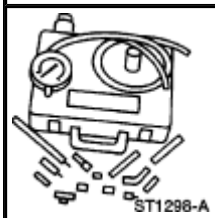
The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

Correct engine identification is required to order parts. Refer to the appropriate section in Group 303 for the procedure.

For complete vehicle and engine identification codes, refer to Section 100-01 .

Engine

Special Tool(s)

	Commercially Available Leakdown Tester
	Quick Disconnect Compression Tester 134-R0212 or equivalent
	Cup Shaped Adapter 303-007 (TOOL-6565-AB) or equivalent
	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent
	Engine Cylinder Leak Detection/Air Pressurization Kit 014-00708 or equivalent
	Oil Pressure Tester 303-088 (T73L-6600-A)
	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent (Leak Detector)

	Vacuum/Pressure Tester 164-R0253 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the engine to duplicate the condition.
2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
• Engine coolant leaks • Engine oil leaks • Fuel leaks • Damaged or severely worn parts • Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. If the concerns remain after the inspection, determine the symptoms and go to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Difficult starting	• Damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged starting system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged charging system/battery.	• REFER to Section 414-00 .
	• Burnt valve.	• INSTALL a new valve.
	• Worn piston.	• INSTALL a new piston and piston

		head.
	• Worn piston rings.	• INSTALL a new piston ring.
	• Worn cylinder.	• REPAIR or INSTALL a new cylinder block.
	• Damaged head gasket.	• INSTALL a new head gasket.
	• Damaged cooling system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Poor idling	• Vacuum leaks.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged valve tappet or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Damaged valve tappet guide or lash adjuster.	• INSTALL a new valve tappet guide or valve tappet.
	• Improper valve-to-valve seat contact.	• REPAIR or INSTALL a new valve or valve seat.
	• Damaged head gasket.	• INSTALL a new head gasket.
• Abnormal combustion	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged valve tappet or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Damaged valve tappet guide or valve tappet.	• INSTALL a new valve tappet guide or valve tappet.

	• Burnt or sticking valve.	• REPAIR or INSTALL a new valve.
	• Weak or broken valve spring.	• INSTALL a new valve spring.
	• Carbon accumulation in combustion chamber.	• ELIMINATE carbon buildup.
• Excessive oil consumption	• Leaking oil.	• REPAIR oil leakage.
	• Malfunctioning PCV system.	• REPAIR or INSTALL new necessary components.
	• Worn valve stem seal.	• INSTALL a new valve stem seal.
	• Worn valve stem or valve guide.	• INSTALL a new valve stem and valve guide.
	• Sticking piston rings.	• REPAIR or INSTALL new piston rings.
	• Worn piston ring groove.	• INSTALL a new piston and piston pin.
	• Worn piston or cylinder.	• REPAIR or INSTALL a new piston or cylinder block.
• Engine noise	• Leaking exhaust system.	• REPAIR exhaust leakage.
	• Incorrect drive belt tension.	• REFER to Section 303-05 .
	• Malfunctioning generator bearing.	• Refer to the appropriate section in Group 414 for the procedure.
	• Malfunctioning water pump bearing.	• REFER to Section 303-03 .
	• Malfunctioning or damaged cooling system.	• REFER to Section 303-03 .
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Loose timing chain/belt (6268).	• ADJUST or INSTALL a new timing chain/belt.
	• Damaged timing chain tensioner (6L266).	• INSTALL a new timing chain tensioner.
	• Excessive main bearing clearance.	• ADJUST clearance or INSTALL a new crankshaft main bearing (6333).
	• Seized or heat damaged crankshaft main bearing.	• INSTALL a new crankshaft main bearing.
	• Excessive crankshaft end play.	• INSTALL a new thrust bearing or crankshaft (6303).

	• Excessive connecting rod bearing clearance.	• INSTALL a new connecting rod bearing or connecting rod (6200).
	• Heat damaged connecting rod bearing (6211).	• INSTALL a new connecting rod bearing.
	• Damaged connecting rod bushing (6207).	• INSTALL a new connecting rod bushing.
	• Worn cylinder.	• REPAIR or INSTALL a new cylinder block (6010).
	• Worn piston (6108) or piston pin (6135).	• INSTALL a new piston or piston pin.
	• Damaged piston rings.	• INSTALL new piston rings.
	• Bent connecting rod.	• INSTALL a new connecting rod.
	• Malfunctioning valve tappet (6500) or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Excessive valve tappet or lash adjuster clearance.	• ADJUST clearance or INSTALL a new valve tappet guide or valve tappet.
	• Broken valve spring (6513).	• INSTALL a new valve spring.
	• Excessive valve guide clearance.	• ADJUST clearance or INSTALL a new valve guide (6510) and stem.
• Insufficient power	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged or plugged exhaust system.	• INSPECT exhaust system.
	• Incorrect tire size.	• REFER to Section 204-04 .
	• Dragging brakes.	• REFER to Section 206-00 .
	• Slipping transmission.	• Refer to the appropriate section in Group 307 for the procedure.
	• Malfunctioning valve tappet or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Damaged valve tappet guide or valve tappet.	• INSTALL a new valve tappet guide or valve tappet.
	• Compression leakage at valve	• REPAIR or INSTALL a new valve, valve seat or cylinder head (6049).

	seat.	
	• Seized valve stem.	• INSTALL a new valve stem.
	• Weak or broken valve spring.	• INSTALL a new valve spring.
	• Worn or damaged cam.	• INSTALL a new camshaft.
	• Damaged head gasket (6051).	• INSTALL a new head gasket.
	• Cracked or distorted cylinder head.	• INSTALL a new cylinder head.
	• Damaged, worn or sticking piston ring (s).	• REPAIR or INSTALL a new piston ring(s).
	• Worn or damaged piston.	• INSTALL a new piston and piston pin.

Component Tests

Engine Oil Leaks

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flywheel with a suitable solvent to remove all traces of oil.

Engine Oil Leaks—Fluorescent Oil Additive Method

Use the 12 Volt Master UV Diagnostic Inspection Kit to carry out the following procedure for oil leak diagnosis.

1. Clean the engine with a suitable solvent to remove all traces of oil.

2. Add Gasoline Engine Oil Dye 164-R3705 or equivalent meeting Ford specification ESE-M99C103-B1. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If the oil is not premixed, fluorescent additive must first be added to crankcase.

3. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the 12 Volt Master UV Diagnostic Inspection Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

Leakage Points—Underhood

Examine the following areas for oil leakage:

- valve cover gaskets
- intake manifold gaskets
- cylinder head gaskets
- oil bypass filter
- oil filter adapter
- engine front cover

- oil filter adapter and filter body
- oil level indicator tube connection
- oil pressure sensor

Leakage Points—Under Engine—With Vehicle on Hoist

- oil pan gaskets (6710)
- oil pan sealer
- oil pan rear seal (6723)
- engine front cover gasket
- crankshaft front seal (6700)
- crankshaft rear oil seal (6701)
- crankshaft main bearing cap side bolts
- oil filter adapter and filter body
- oil cooler, if equipped

Leakage Points—With Transmission and Flywheel Removed

- crankshaft rear oil seal
- rear main bearing cap parting line
- rear main bearing cap and seals
- flywheel mounting bolt holes (with flywheel [6375] installed)
- camshaft rear bearing covers (6266) or pipe plugs at the end of oil passages

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the dye method.

Compression Test—Compression Gauge Check

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery (10655) is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs (12405).

2. Set the throttle plates in the wide-open position.

3. Install a compression gauge such as the Compression Tester in the No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test—Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is within 75 percent of the highest reading. For additional information, refer to the Compression Pressure Limit Chart.

Compression Pressure Limit Chart

Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1131 kPa (164 psi)	848 kPa (123 psi)	1338 kPa (194 psi)	1000 kPa (146 psi)	1544 kPa (224 psi)	1158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1145 kPa (166 psi)	855 kPa (124 psi)	1351 kPa (196 psi)	1014 kPa (147 psi)	1558 kPa (226 psi)	1165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1158 kPa (168 psi)	869 kPa (126 psi)	1365 kPa (198 psi)	1020 kPa (148 psi)	1572 kPa (228 psi)	1179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (106 psi)	1172 kPa (170 psi)	876 kPa (127 psi)	1379 kPa (200 psi)	1034 kPa (150 psi)	1586 kPa (230 psi)	1186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1186 kPa (172 psi)	889 kPa (129 psi)	1303 kPa (202 psi)	1041 kPa (151 psi)	1600 kPa (232 psi)	1200 kPa (174 psi)
933 kPa (144 psi)	745 kPa (109 psi)	1200 kPa (174 psi)	903 kPa (131 psi)	1407 kPa (204 psi)	1055 kPa (153 psi)	1055 kPa (153 psi)	1207 kPa (175 psi)
1007 kPa (146 psi)	758 kPa (110 psi)	1214 kPa (176 psi)	910 kPa (132 psi)	1420 kPa (206 psi)	1062 kPa (154 psi)	1627 kPa (154 psi)	1220 kPa (177 psi)
1020 kPa (148 psi)	765 kPa (111 psi)	1227 kPa (178 psi)	917 kPa (133 psi)	1434 kPa (208 psi)	1075 kPa (156 psi)	1641 kPa (238 psi)	1227 kPa (178 psi)
1034 kPa (150 psi)	779 kPa (113 psi)	1241 kPa (180 psi)	931 kPa (135 psi)	1448 kPa (210 psi)	1083 kPa (157 psi)	1655 kPa (240 psi)	1241 kPa (180 psi)
1048 kPa (152 psi)	786 kPa (114 psi)	1255 kPa (182 psi)	936 kPa (136 psi)	1462 kPa (212 psi)	1089 kPa (158 psi)	1669 kPa (242 psi)	1248 kPa (181 psi)
1062 kPa (154 psi)	793 kPa (115 psi)	1269 kPa (184 psi)	952 kPa (138 psi)	1476 kPa (214 psi)	1103 kPa (160 psi)	1682 kPa (244 psi)	1262 kPa (183 psi)
1076 kPa (156 psi)	807 kPa (117 psi)	1282 kPa (186 psi)	965 kPa (140 psi)	1489 kPa (216 psi)	1117 kPa (162 psi)	1696 kPa (246 psi)	1269 kPa (184 psi)
1089 kPa (158 psi)	814 kPa (118 psi)	1296 kPa (188 psi)	972 kPa (141 psi)	1503 kPa (218 psi)	1124 kPa (163 psi)	1710 kPa (248 psi)	1202 kPa (186 psi)
1103 kPa (160 psi)	827 kPa (120 psi)	1310 kPa (190 psi)	979 kPa (142 psi)	1517 kPa (220 psi)	1138 kPa (165 psi)	1724 kPa (250 psi)	1289 kPa (187 psi)
1110 kPa (161 psi)	834 kPa (121 psi)	1324 kPa (192 psi)	993 kPa (144 psi)	1631 kPa (222 psi)	1145 kPa (166 psi)	—	—

If one or more cylinders reads low, squirt approximately one tablespoon of Super Premium SAE 5W-30 Motor Oil, XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G on top of the pistons in the low-reading cylin ders. Repeat the compression pressure check on these cylinders.

Compression Test—Interpreting Compression Readings

1. If compression improves considerably, piston rings are faulty.

2. If compression does not improve, valves are sticking or seating incorrectly.

3. If two adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.

Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest reading is within 75 percent of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of the Engine Cylinder Leak Detection/Air Pressurization Kit will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to dead center on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, a special gauge included in the kit will read the percentage of leakage. Leakage exceeding 20 percent is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve (6507) will be heard in the throttle body (9E926). A leak at the exhaust valve (6505) can be heard at the tail pipe. Leakage past the piston rings will be audible at the positive crankcase ventilation (PCV) connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator (8005).

Oil Consumption Test

The following diagnostic procedure is used to determine the source of excessive internal oil consumption.

1. **NOTE:** Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use generally decreases. Vehicles in normal service should get at least 1,450 km per liter (900 miles per quart) after 16,000 km (10,000 miles) of service. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

   Define excessive oil consumption, such as the number of miles driven per liter (quart) of oil used. Also determine customer's driving habits, such as sustained high speed operation, towing, extended idle and other considerations.

2. Verify that the engine has no external oil leak as described under Engine Oil Leaks in the Diagnosis and Testing portion of this section.

3. Verify that the engine has the correct oil level dipstick (6750).

4. Verify that the engine is not being run in an overfilled condition. Check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above MAX or the letter F in FULL. If significantly overfilled, carry out Steps 6a through 6d.

5. Verify the spark plugs are not oil saturated. If the spark plugs are oil saturated and compression is good it can be assumed the valve seals or valve guides are at fault.

6. Carry out an oil consumption test:

a. Drain the engine oil, remove the oil bypass filter (6714) and refill with one liter (quart) less than the recommended amount.
b. Run the engine for three minutes (10 minutes if cold), and allow the oil to drain back for at least five

minutes with the vehicle on a level surface.

c. Remove oil level dipstick and wipe clean. (Do not wipe with anything contaminated with silicone compounds.) Reinstall the oil level dipstick, being sure to seat it firmly in the oil level indicator tube (6754). Remove the oil level dipstick and draw a mark on the back (unmarked) surface at the indicated oil level. This level should be about the same as the MIN or ADD mark on the face of the oil level dipstick.
d. Add one liter (quart) of oil. Restart the engine and allow to idle for at least two minutes. Shut off the engine and allow the oil to drain back for at least five minutes. Mark the oil level dipstick, using the procedure above.
e. Record the vehicle mileage.
f. Instruct the customer to drive the vehicle as usual and perform the following:
    - Check the oil level regularly at intervals of 160 to 240 km (100-150 miles).
    - Return to the service point when the oil level drops below the lower (MIN or ADD) mark on the oil level dipstick.
    - Add only full liters (quarts) of the same oil in an emergency. Note the mileage at which the oil is added.
g. Check the oil level under the same conditions and at the same location as in Steps 6c and 6d.
    - Measure the distance from the oil level to the UPPER mark on the oil level dipstick and record.
    - Measure the distance between the two scribe marks and record.
    - Divide the first measurement by the second.
    - Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in kilometers per liter or in miles per quart.
h. If the oil consumption rate is unacceptable, go to Step 7.

7. Check the positive crankcase ventilation (PCV) system. Make sure the system is not plugged.

8. Check for plugged oil drain-back holes in the cylinder heads and cylinder block.

9. If the condition still exists after performing the above steps, go to Step 10.

10. Perform a cylinder compression test or perform a cylinder leak detection test with Engine Cylinder Leak Detection/Air Pressurization Kit. This can help determine the source of oil consumption such as valves, piston rings or other areas.

11. **NOTE:** After determining if new parts should be installed, make sure correct parts are used.

    Check valve guides for excessive guide clearance. Install new all valve stem seals (6571) after verifying valve guide clearance.

12. Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows:

    a. Remove the engine from the vehicle and place it on an engine work stand. Remove the intake manifolds (9424), cylinder heads, oil pan (6675) and oil pump (6600).
    b. Check piston ring clearance, ring gap and ring orientation. Repair as necessary.
    c. Check for excessive bearing clearance. Repair as necessary.

13. Repeat the oil consumption test (Step 6) to confirm the oil consumption concern has been resolved.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake

manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

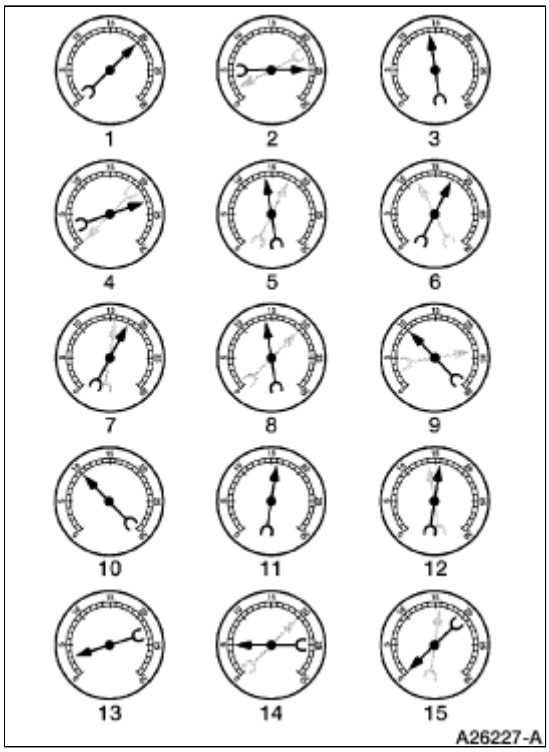
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test—Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).

5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

6. BURNED OR WARPED VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient hydraulic lash adjuster or hydraulic lash adjuster (HLA) clearance will also cause this reaction.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating.

8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but somewhat low reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body gasket leak.

14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler (5230), kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster (2005), the unit will not function correctly. Always fix vacuum leaks.

Excessive Engine Oil Consumption

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal engine components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- trailer towing applications
- severe loading applications
- sustained high speed operation

Engines need oil to lubricate the following internal components:

- cylinder block cylinder walls
- pistons and piston, pin and rings (6102)
- intake and exhaust valve stems
- intake and exhaust valve guides
- all internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following is a partial list of conditions that can affect oil consumption rates:

- engine duty cycle
- operator driving habits
- ambient temperature
- quality and viscosity of the oil

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the FULL or MAX on the oil level dipstick due to dilution (condensation and fuel) in the engine crankcase. The vehicle might then be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked, it may appear that a liter (quart) of oil was used in about 160 km (100 miles). This perceived 160 km (100 miles) per liter (quart) oil consumption rate causes customer concern even though the actual overall oil consumption rate is about 2,400 km (1,500 miles) per liter (quart).

Make sure the selected engine oil meets the current recommended API performance category with SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified. For additional information, refer to the vehicle Owner's Guide.

Oil Pressure Test

1. Disconnect and remove the oil pressure sensor (9278) from the engine.
2. Connect the Engine Oil Pressure Gauge to the oil pressure sender oil galley port.
3. Run the engine until normal operating temperature is reached.
4. Run the engine at the specified rpm and record the gauge reading.
5. The oil pressure should be within specifications; refer to the specification chart in the appropriate engine section.
6. If the pressure is not within specification, check the following possible sources:
    - insufficient oil
    - oil leakage
    - worn or damaged oil pump
    - oil pump screen cover and tube (6622)
    - excessive main bearing clearance
    - excessive connecting rod bearing clearance

Valve Train Analysis—Engine Off—Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis—Engine Off, Rocker Arm

- Check for loose mounting bolts, studs and nuts.
- Check for plugged oil feed in the rocker arms (6564) or cylinder head.

Valve Train Analysis—Engine Off, Camshaft Roller Followers and Hydraulic Lash Adjusters, Overhead Camshaft

- Check for loose mounting bolts on camshaft carriers.
- Check for plugged oil feed in the camshaft roller followers, lash adjusters or cylinder heads.

Valve Train Analysis—Engine Off, Camshaft—Engines

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Push Rods

- Check for bent push rods (6565) and restricted oil passage.

Valve Train Analysis—Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key (6518) on the valve stem and in valve spring retainer (6514).
- Check for correct seating on the valve stem.

Valve Train Analysis—Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check collapsed valve tappet gap.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis—Engine Running

- Start the engine and, while idling, check for correct operation of all parts. Check the following:

Valve Train Analysis—Engine Running, Positive Rotator and Valve Spring Retainer Keys

- Check for correct operation of positive rotator.

Valve Train Analysis—Engine Running, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for missing or damaged valve stem seals or guide mounted valve stem seals.
- Check for a plugged oil metering orifice in the cylinder head oil reservoir (4.6L engine only).

If insufficient oiling is suspected, check oil passages for blockage, then accelerate the engine to 1,200 rpm with the transmission in NEUTRAL and the engine at normal operating temperature. Oil should spurt from the rocker arm oil holes such that valve tips and camshaft roller followers are well oiled. With the valve covers (6582) off, some oil splash may overshoot camshaft roller followers.

Valve Train Analysis—Engine Running, Camshaft Lobe Lift—OHC Engines

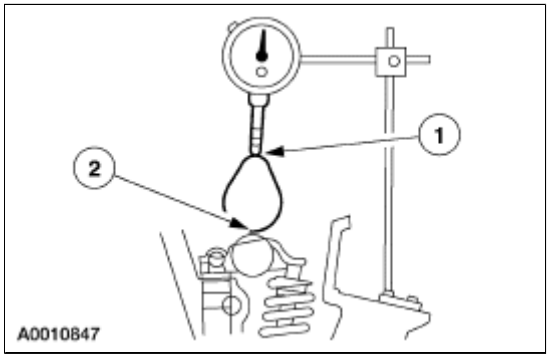
Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.

2. Remove the spark plugs.

3. Install the Dial Indicator with Bracketry so the rounded tip of indicator is on top of the camshaft lobe and on the same plane as the valve tappet.

4. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



5. Zero the dial indicator. Continue to rotate the crankshaft until the (1) high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

6. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the (2) base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.

7. **NOTE:** If the lift on any lobe is below specified service limits, the camshaft and camshaft roller followers operating on that camshaft (6250) must be replaced.

Remove the Dial Indicator with Bracketry.

8. Install the spark plugs.

9. Install the valve covers.

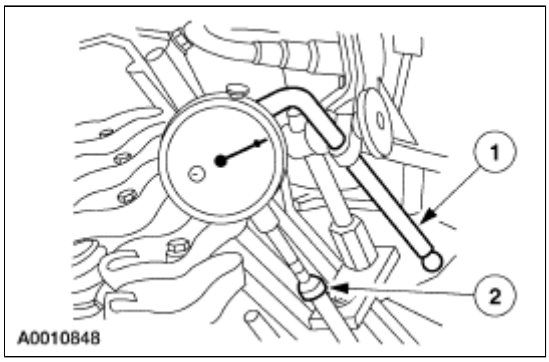
Valve Train Analysis—Engine Running, Camshaft Lobe Lift—Push Rod Engine

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.

2. Remove the rocker arm seat bolts, rocker arm seat (6A528) and rocker arms.

Typical Engine With Push Rods



3. Make sure the valve tappet is seated against camshaft (6250). Install (1) Dial Indicator with Bracketry so the ball socket adapter of the indicator is on top of the valve tappet or (2) Cup Shaped Adapter is on top of push rod and in same plane as valve tappet push rod movement.

4. Remove the spark plugs.

5. Connect an auxiliary starter switch in the starting circuit. Crank the engine with ignition switch in OFF position. Bump crankshaft over until valve tappet is on base circle of camshaft lobe. At this point, valve tappet will be in its lowest position. If checking during engine assembly, turn crankshaft using a socket or ratchet.

6. Zero the dial indicator. Continue to rotate crankshaft slowly until valve tappet is in fully-raised position (highest indicator reading).

7. **NOTE:** If lift on any lobe is below specified service limits, a new camshaft and valve tappet must be installed.

   Compare total lift recorded on dial indicator with specifications.

8. To check the accuracy of the original dial indicator reading, continue to rotate the crankshaft until indicator reads zero.

9. Remove the dial indicator, adapter and auxiliary starter switch.

10. **CAUTION: After installing rocker arms, do not rotate crankshaft until valve tappets have**

had sufficient time to bleed down. To do otherwise may cause serious valve damage. Manually bleeding-down valve tappets will reduce waiting time.

Install rocker arm seats, rocker arms and rocker arm seat bolts.

11. Install valve covers.

12. Install spark plugs.

Valve Train Analysis—Engine Running, Valve Tappet

Valve tappet noise can be caused by any of the following:

- excessive valve tappet gap (collapsed)
- sticking valve tappet plunger
- valve tappet check valve not functioning correctly
- air in lubrication system
- leakdown rate too rapid
- excessive valve guide wear

Excessive collapsed valve tappet gap can be caused by loose rocker arm seat bolts/nuts, incorrect initial adjustment or wear of valve tappet face, or worn roller valve tappets, push rod (6565), rocker arm (6564), rocker arm seat or valve tip. With valve tappet collapsed, check gap between the valve tip and the rocker arm to determine if any other valve train parts are damaged, worn or out of adjustment.

A sticking valve tappet plunger can be caused by contaminants or varnish inside the valve tappet.

A valve tappet check valve that is not functioning can be caused by an obstruction such as dirt or chips that prevent it from closing when the camshaft lobe is lifting the valve tappet. It may also be caused by a broken check valve spring.

Air bubbles in the lubrication system will prevent the valve tappet from supporting the valve spring load. This can be caused by too high or too low an oil level in the oil pan or by air being drawn into the system through a hole, crack or leaking gasket on the oil pump screen cover and tube.

If the leakdown time is below the specified time for used valve tappets, noisy operation can result. If no other cause for noisy valve tappets can be found, the leakdown rate should be checked and new valve tappets installed for any valve tappets outside the specification.

Assembled valve tappets can be tested with Hydraulic Tappet Leakdown Tester to check the leakdown rate. The leakdown rate specification is the time in seconds for the plunger to move a specified distance while under a 22.7 kg (50 lb) load. Test the valve tappets as outlined in this section.

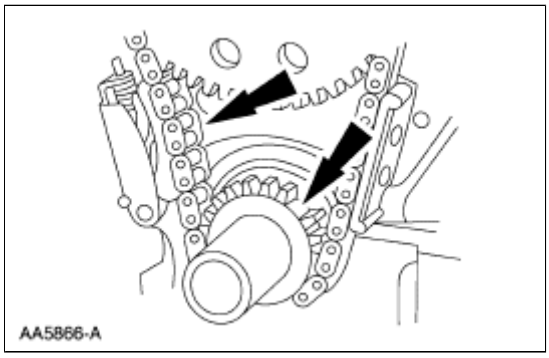
Sprockets

1. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation.**

   NOTE: Specifications show the expected minimum or maximum condition. Refer to the appropriate section in Group 303 for the procedure.

   NOTE: If a component fails to meet the specifications, it is necessary to install a new component or refinish. If the component can be refinished, wear limits are provided as an aid to making a decision. A new component must be installed for any component that fails to meet specifications and cannot be refinished.

   Inspect the timing chain/belt and the sprockets.
   - Install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



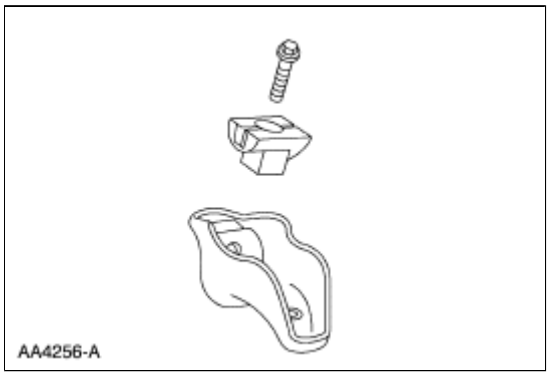
Rocker Arms —Cleaning

1. Clean all parts thoroughly. Make sure all oil passages are open.
2. Make sure oil passage in the push rod/valve tappet end of the rocker arm (6564) is open.

Rocker Arms —Inspection

CAUTION: Do not attempt to true surfaces by grinding. Check the rocker arm pad, side rails and seat for excessive wear, cracks, nicks or burrs. Check the rocker arm seat bolt for stripped or broken threads. Install new components as ncessary or possible damage may occur.

1. Inspect the rocker arm push rod bore for nicks, scratches, scores or scuffs. Install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



2. Inspect the pad at the valve end of the rocker arm for indications of scuffing or abnormal wear. If the pad is grooved, install a new rocker arm. Refer to the appropriate section in Group 303 for the procedure.

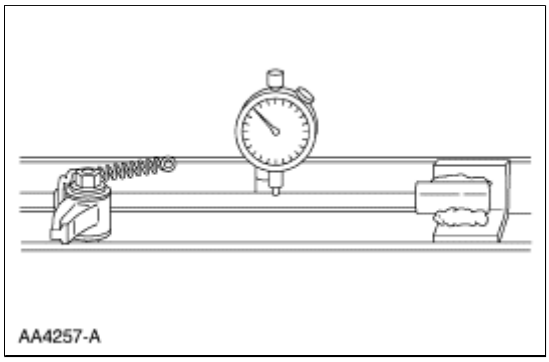
Push Rods —Cleaning

1. Clean the push rods (6565) in a suitable solvent. Blow out the oil passage in the push rods with compressed air.

Push Rods —Inspection

1. **CAUTION: Do not attempt to straighten push rods.**

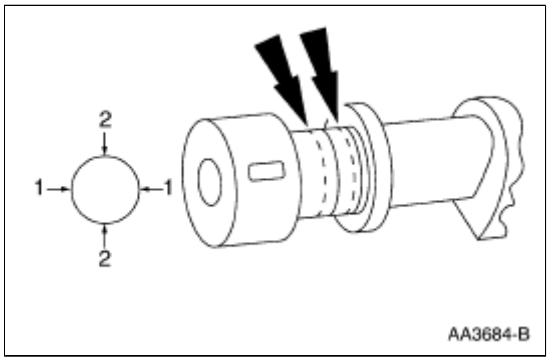
   Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Install new push rods as necessary. Refer to the appropriate section in Group 303 for the procedure.
   - The push rods can be checked for straightness while they are installed in the engine by rotating them with the valve closed.
   - They also can be checked using a Dial Indicator with Bracketry.



2. If the push rod is bent beyond specifications, install a new push rod. Refer to the appropriate section in Group 303 for the procedure.

Camshaft Journal —Diameter

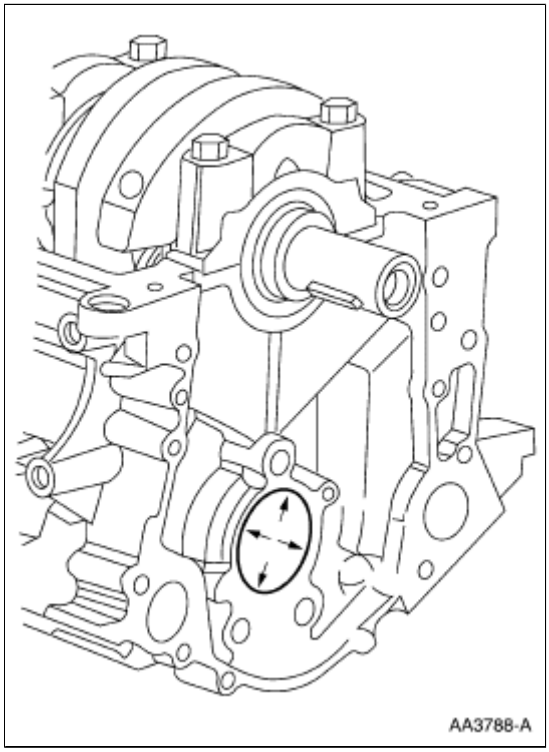
1. Measure each camshaft journal diameter in two directions.
    - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Camshaft Journal —Clearance, Push Rod Engine, Micrometer Method

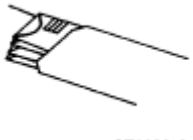
1. **NOTE:** The camshaft journals must meet specifications before checking camshaft journal clearance.

   Measure each camshaft bearing (6261) in two directions.
   - Subtract the camshaft journal diameter from the camshaft bearing diameter.



Camshaft Journal —Clearance, Plastigage Method

Special Tool(s)

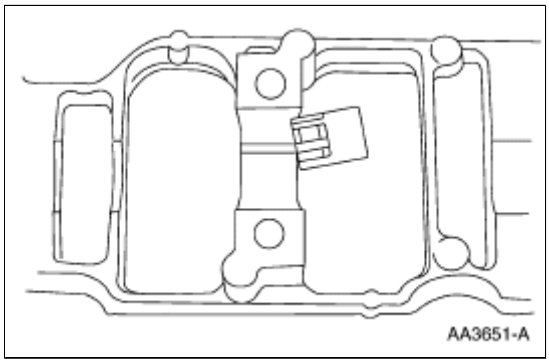
 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: The camshaft journals must meet specifications before checking camshaft journal clearance.

1. Remove the camshaft bearing cap and lay Plastigage across the surface. Refer to the appropriate section in Group 303 for the procedure.

2. **NOTE:** Do not turn the camshaft while carrying out this procedure.

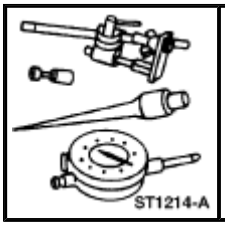
   Position the camshaft bearing cap and install the bolts. Refer to the appropriate section in Group 303 for the procedure.

   
   AA3651-A

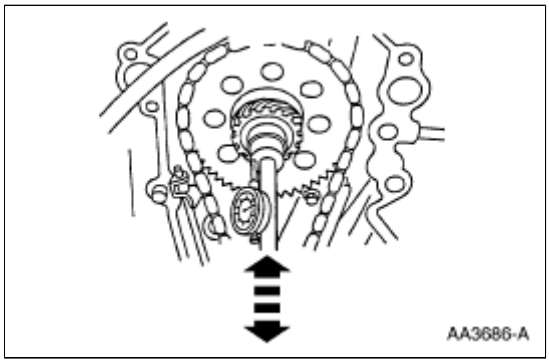
3. Use Plastigage to verify the camshaft journal clearance.
   - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

Camshaft —End Play, Push Rod Engines

Special Tool(s)

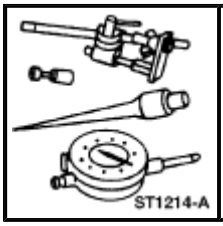
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

1. Remove the valve tappets. Refer to the appropriate section in Group 303 for the procedure.
2. Use a Dial Indicator with Bracketry to measure camshaft end play.
3. Position the camshaft to the rear of the cylinder block.
4. Zero the indicator.
5. Move the camshaft to the front of the cylinder block. Note and record the camshaft end play.
    - If camshaft end play exceeds specifications, install a new camshaft thrust plate (6269).

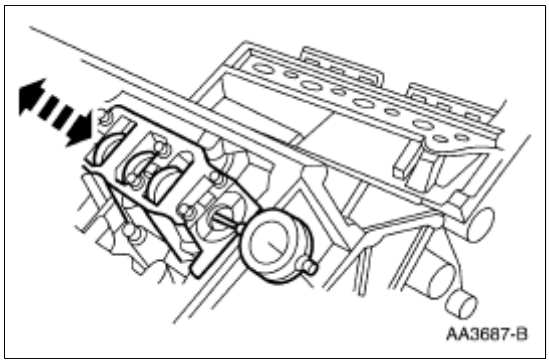


Camshaft —End Play, OHC Engines

Special Tool(s)

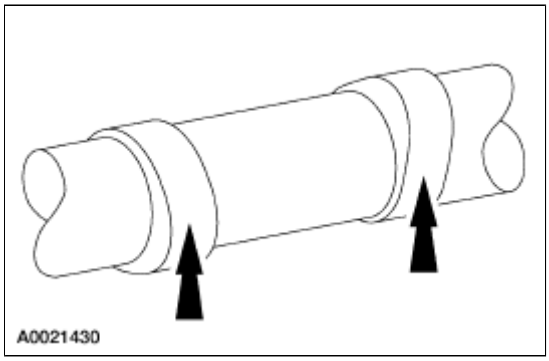
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

1. Remove the roller followers. Refer to the appropriate section in Group 303 for the procedure.
2. Use a Dial Indicator with Bracketry to measure camshaft end play.
3. Position the camshaft to the rear of the cylinder head.
4. Zero the indicator.
5. Move the camshaft to the front of the cylinder head. Note and record the camshaft end play.
   - If camshaft end play exceeds specifications, install new camshaft and recheck end play. Refer to the appropriate section in Group 303 for the procedure.
   - If camshaft end play exceeds specification after camshaft installation, install a new cylinder head. Refer to the appropriate section in Group 303 for the procedure.



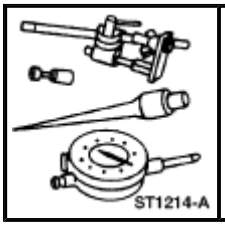
Camshaft —Lobe Surface

1. Inspect camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.
    - If excessive pitting or damage is present, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

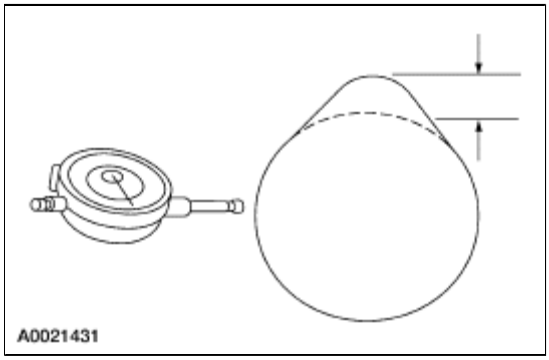


Camshaft —Lobe Lift

Special Tool(s)

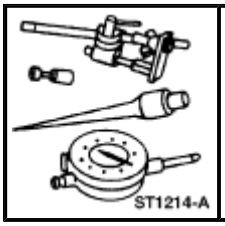
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

1. Use a Dial Indicator with Bracketry to measure camshaft intake/exhaust lobe lift.
    - Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading to figure the camshaft lobe lift.
    - For additional information, refer to Specifications in the appropriate section in Group 303.



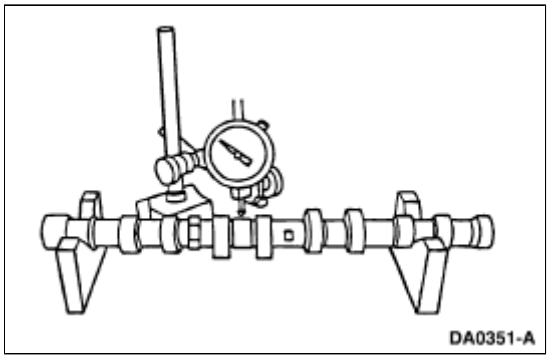
Camshaft —Runout

Special Tool(s)

 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

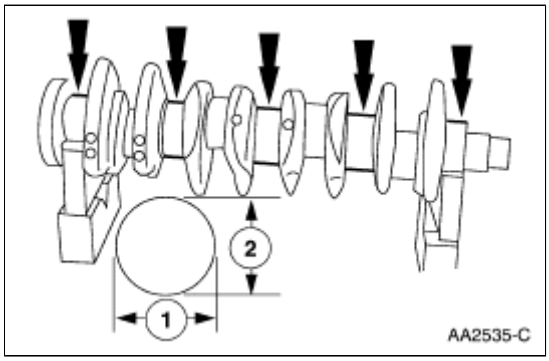
1. **NOTE:** Camshaft journals must be within specifications before checking runout.

   Use a Dial Indicator with Bracketry to measure the camshaft runout.
   - Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading.
   - For additional information, refer to the specification chart in the appropriate engine section.
   - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



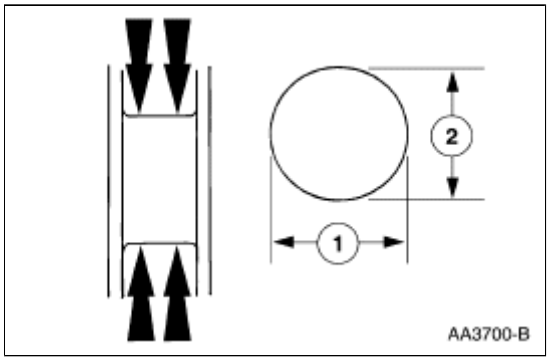
Crankshaft Main Bearing Journal —Diameter

1. Measure each of the crankshaft main bearing journal diameters in at least two directions.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



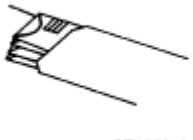
Crankshaft Main Bearing Journal —Taper

1. Measure each of the crankshaft main bearing journal diameters in at least two directions at each end of the main bearing journal.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - If it out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



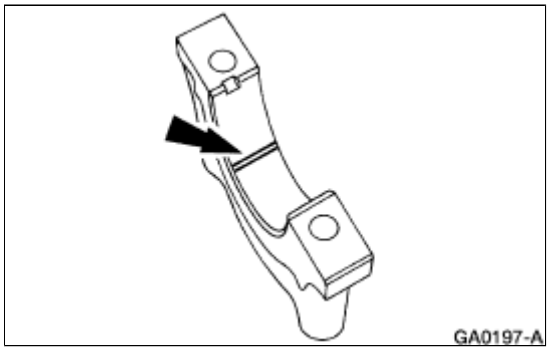
Crankshaft Main Bearing Journal —Clearance

Special Tool(s)

 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: Crankshaft main bearing journals must be within specifications before checking journal clearance.

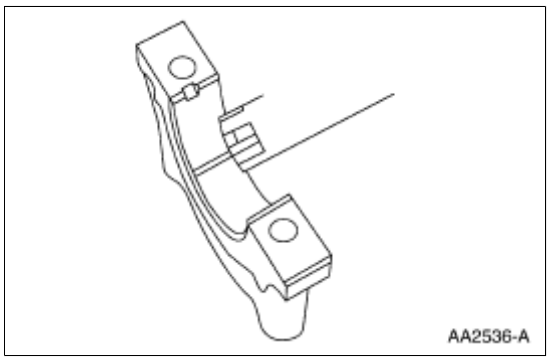
1. Remove the crankshaft main bearing caps and crankshaft main bearing.
2. Lay a piece of Plastigage across the face of each crankshaft main bearing surface.



3. **NOTE:** Do not turn the crankshaft while carrying out this procedure.

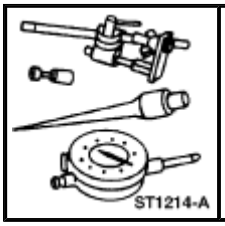
   Install and remove the crankshaft main bearing cap.

4. Verify the crankshaft journal clearance.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

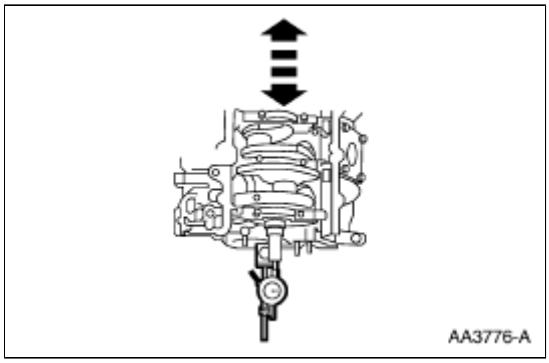


Crankshaft —End Play

Special Tool(s)

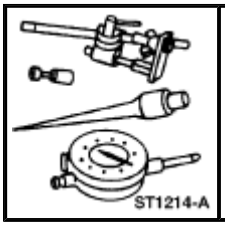
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

1. Measure the crankshaft end play. Use a Dial Indicator with Bracketry to measure crankshaft end play.
2. Position the crankshaft to the rear of the cylinder block.
3. Zero the indicator.
4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
   - If crankshaft end play exceeds specifications, install a new crankshaft thrust washer (6334) or crankshaft thrust main bearing (6337). Refer to the appropriate section in Group 303 for the procedure.



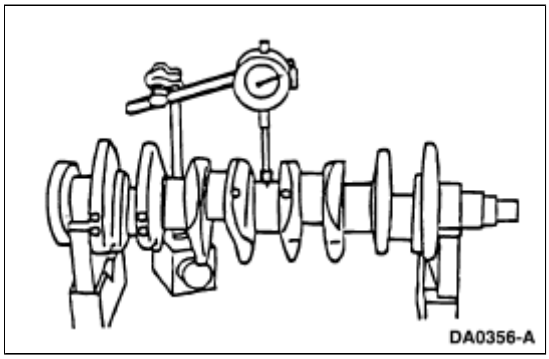
Crankshaft —Runout

Special Tool(s)

 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent

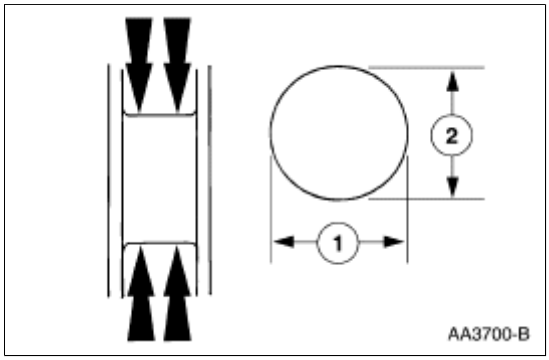
1. **NOTE:** Crankshaft main bearing journals must be within specifications before checking runout.

   Use the Dial Indicator with Bracketry to measure the crankshaft runout.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - Rotate the crankshaft and subtract the lowest dial indicator reading from the highest dial indicator reading to figure the crankshaft runout. If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



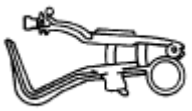
Crankshaft —Connecting Rod Journal Taper, Out of Round

1. Measure the crankshaft connecting rod journal diameters in two directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify measurement is within the wear limit.
    - For additional information, refer to Specifications in the appropriate section in Group 303.
    - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



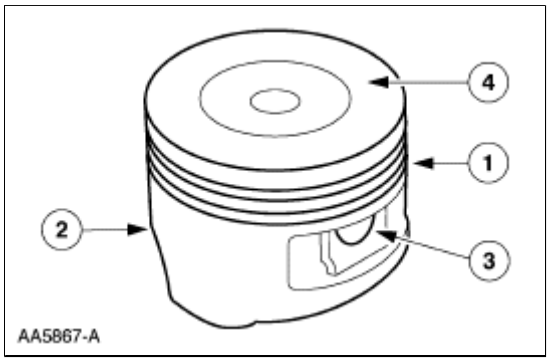
Piston —Inspection

Special Tool(s)

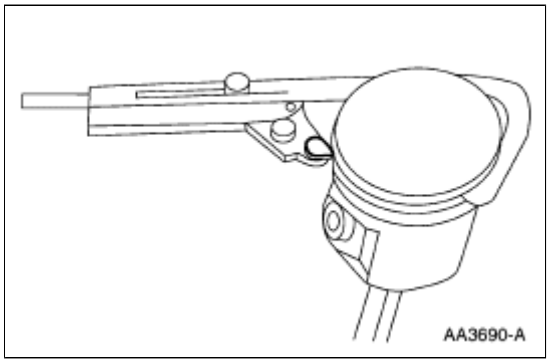
 ST1279-A	Piston Ring Groove Cleaner 303-D033 (D81L-6002-D) or equivalent

CAUTION: Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage can occur.

1. Clean and inspect the (1) ring lands, (2) skirts, (3) pin bosses, and the (4) tops of the pistons. If wear marks, scores or glazing is found on the piston skirt, check for a bent or twisted connecting rod.



2. Use the Piston Ring Groove Cleaner to clean the piston ring grooves.
   - Make sure the oil ring holes are clean.

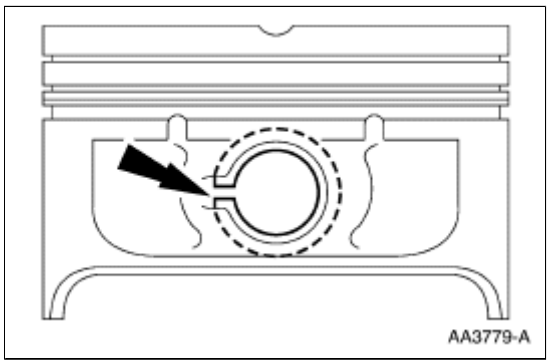


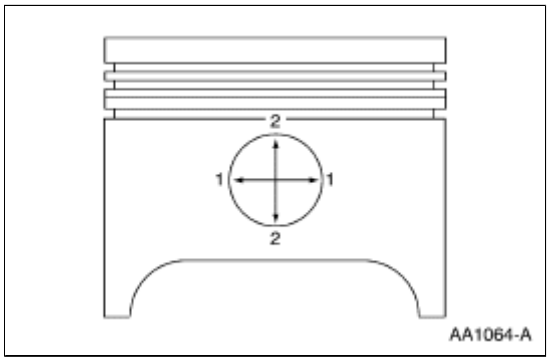
Piston —Pin to Bore Diameter

1. **WARNING: Cover the end of the pin bore with a hand or shop rag when removing the retainer ring, since it has a tendency to spring out. Wear eye protection.**

   NOTE: Piston and piston pins are a matched set and should not be interchanged.

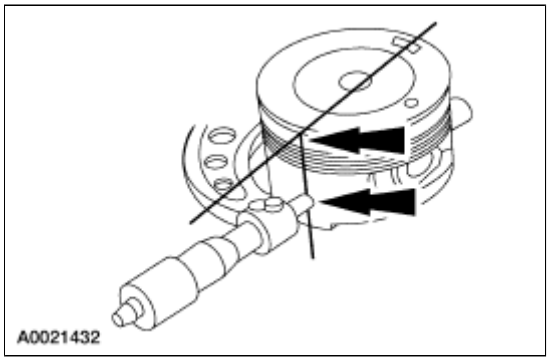
   Measure the piston pin bore diameter in two directions on each side. Verify the diameter is within specification.
   - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.





Piston —Diameter

1. Measure the piston dome and skirt diameter 90 degrees from the piston pin at the points indicated. For additional information, refer to Specifications in the appropriate section in Group 303.
    - If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



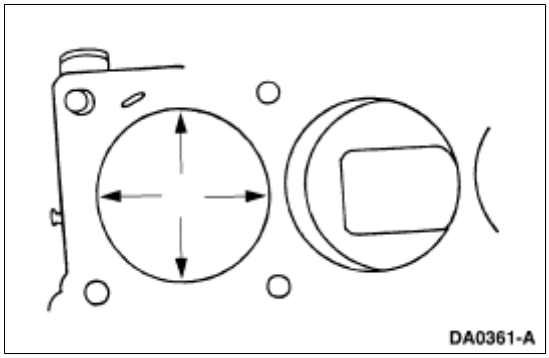
Piston —to Cylinder Bore Clearance

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.

Piston —Selection

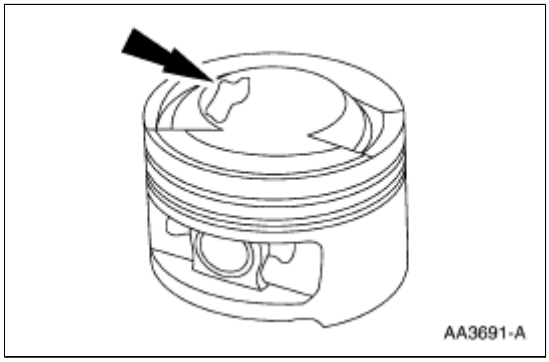
NOTE: The cylinder bore must be within the specifications for taper and out-of-round before fitting a piston.

1. Select a piston size based on the cylinder bore.



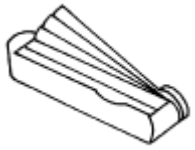
2. **NOTE:** For precision fit, new pistons are divided into three categories within each size range based on their relative position within the range. A paint spot on the new pistons indicates the position within the size range.

   Choose the piston with the correct paint color.
   - For additional information, refer to the appropriate section in Group 303 for piston grading.



Piston —Ring End Gap

Special Tool(s)

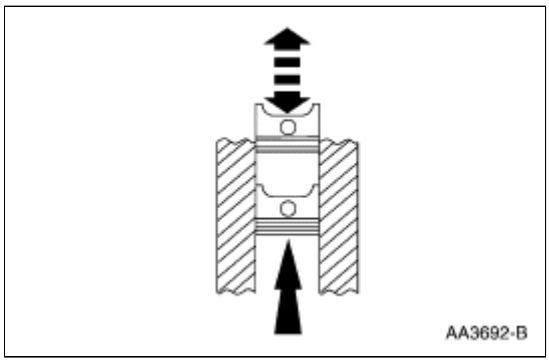
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

CAUTION: Use care when fitting piston rings to avoid possible damage to the piston ring or the cylinder bore.

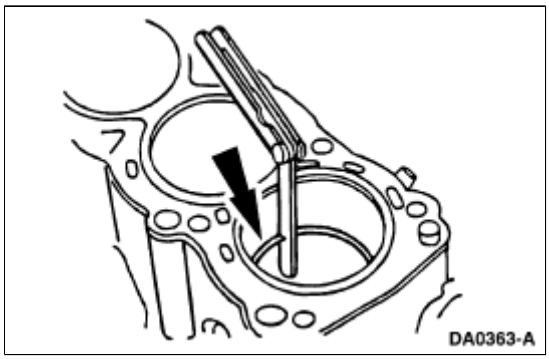
CAUTION: Piston rings should not be transferred from one piston to another.

NOTE: Cylinder bore must be within specification for taper and out-of-round.

1. Use a piston without rings to push a piston ring in a cylinder to the bottom of ring travel.

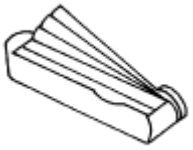


2. Use a feeler gauge to measure the top piston ring end gap and the second piston ring end gap.
   - For additional information, refer to Specifications in the appropriate section in Group 303.

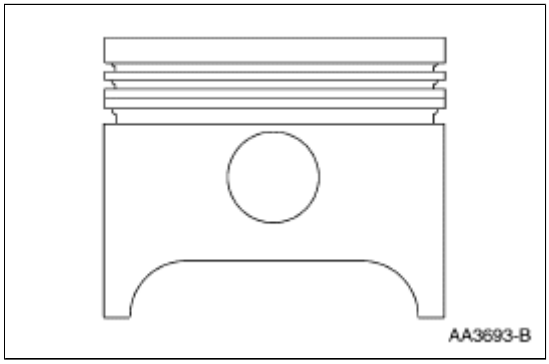


Piston —Ring-to-Groove Clearance

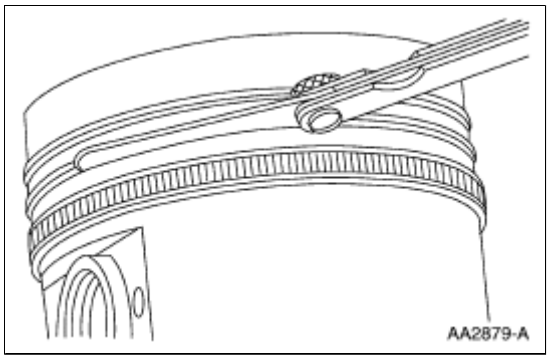
Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

1. Inspect for a step in the grooves.

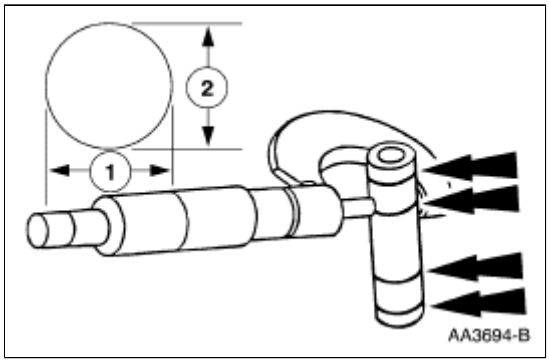


2. Measure the piston ring-to-groove clearance.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Piston —Pin Diameter

1. Measure the piston pin diameter in two directions at the points shown. Verify the diameter is within specification.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

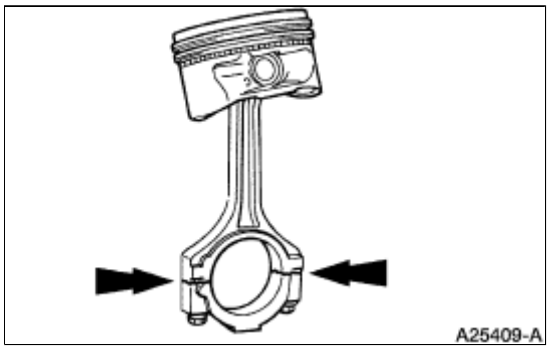


Connecting Rod —Cleaning

1. **CAUTION: Do not use a caustic cleaning solution or damage to connecting rods can occur.**

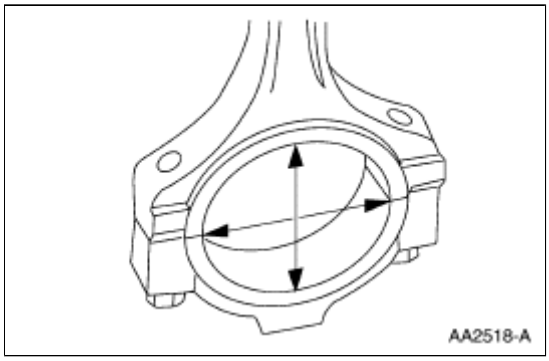
   NOTE: If the connecting rod large end is mechanically split or cracked to produce a unique parting face, a locking joint is produced. Parts are not interchangeable.

   Mark and separate the parts and clean with solvent. Clean the oil passages.



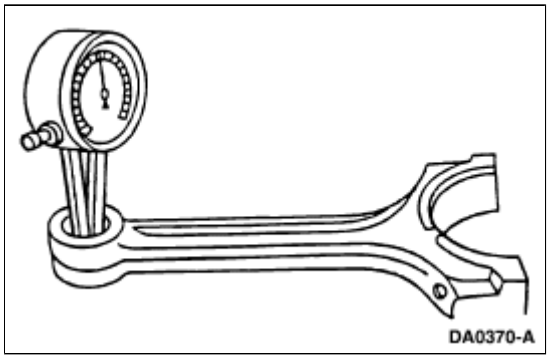
Connecting Rod —Large End Bore

1. Measure the bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.
    - For additional information, refer to Specifications in the appropriate section in Group 303.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



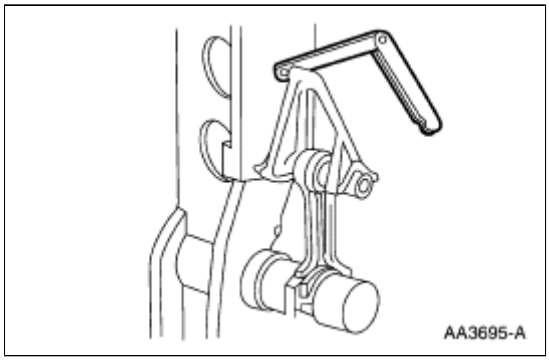
Connecting Rod —Bushing Diameter

1. Measure the inner diameter of the connecting rod bushing, if equipped. Verify the diameter is within specification.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



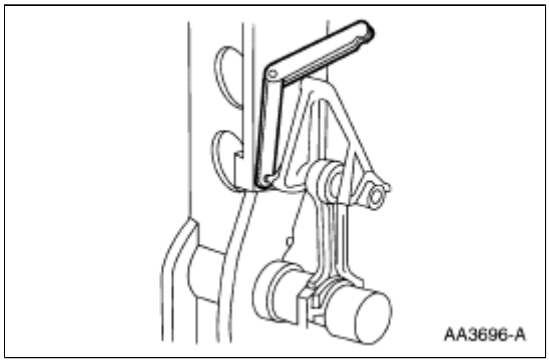
Connecting Rod —Bend

1. Measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



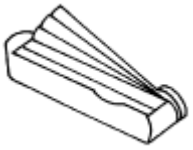
Connecting Rod —Twist

1. Measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

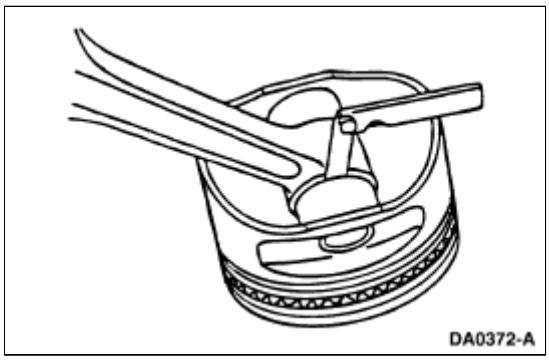


Connecting Rod —Piston Pin Side Clearance

Special Tool(s)

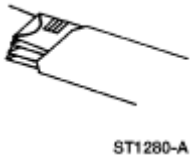
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

1. Measure the clearance between the connecting rod and the piston. Verify the measurement is within specification.
   - For additional information, refer to Specifications in the appropriate section in Group 303.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Connecting Rod —Bearing Journal Clearance

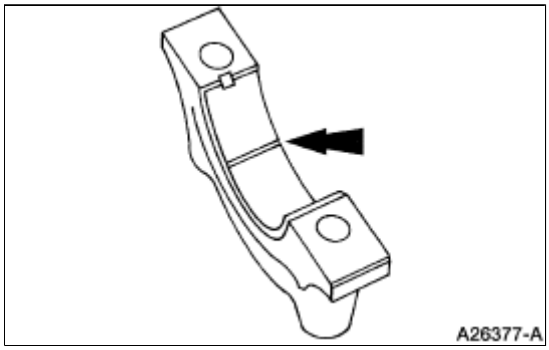
Special Tool(s)

 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: The crankshaft connecting rod journals must be within specifications to check the connecting rod bearing journal clearance.

1. Remove the connecting rod bearing cap.

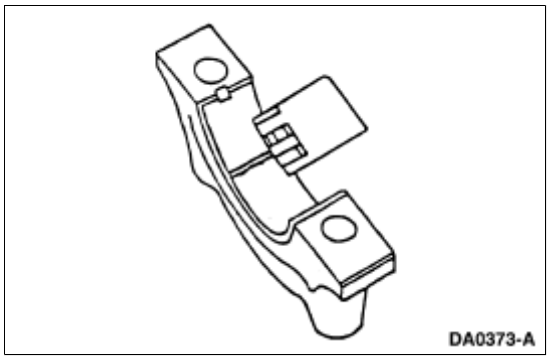
2. Position a piece of Plastigage across the bearing surface.



3. **NOTE:** Do not turn the crankshaft during this step.

   Install and tighten to specifications, then remove the connecting rod bearing cap.

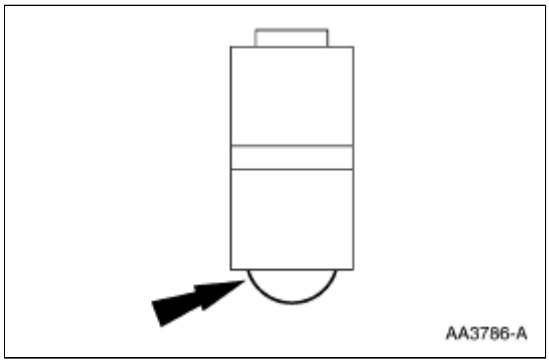
4. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged connecting rod or connecting rod bearing.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.


DA0373-A

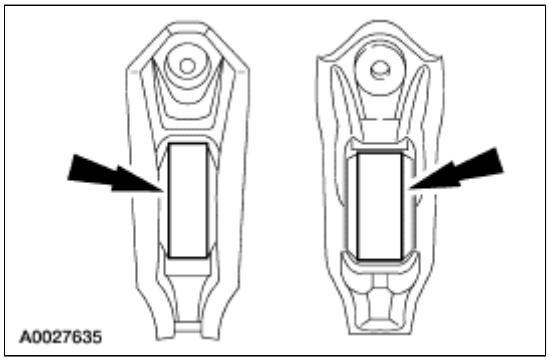
Roller Follower —Inspection

Push rod engines

1. Inspect the roller for flat spots or scoring. If any damage is found, inspect the camshaft lobes and valve tappet for damage.



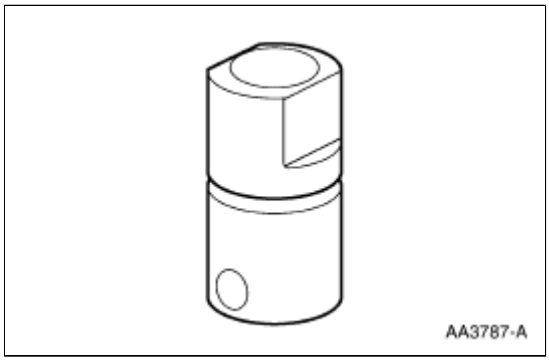
OHC engines



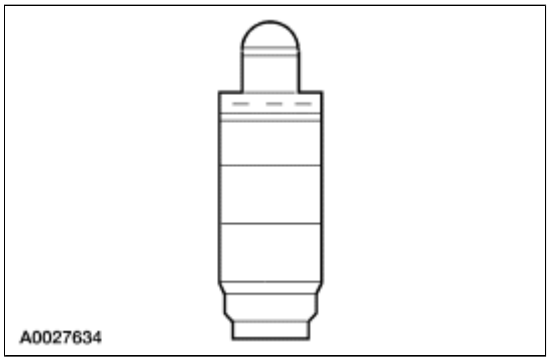
Valve Tappet —Inspection

Push rod engines

1. Inspect the hydraulic valve tappet and roller for damage. If any damage is found, inspect the camshaft lobes and valves for damage.



OHC engines

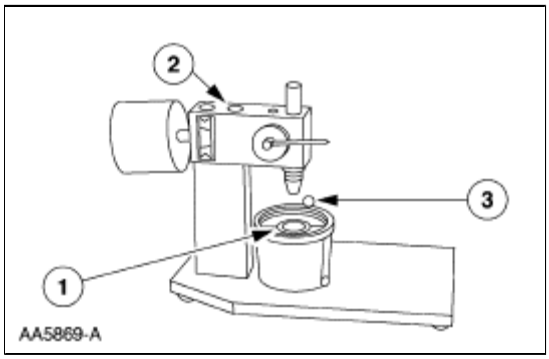


Valve Tappet —Leakdown Test, Hydraulic

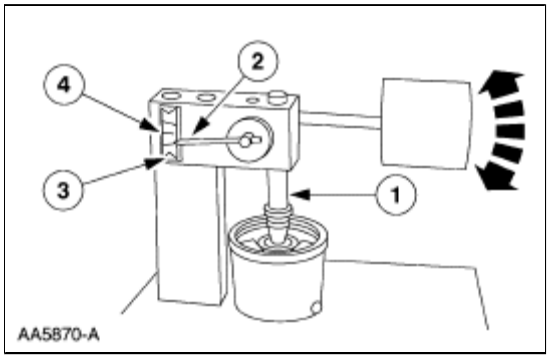
1. **NOTE:** The leakdown test will not be accurate if it is done with engine oil in the hydraulic valve tappet. Use testing fluid. New hydraulic valve tappets are already filled with testing fluid.

   Compress the hydraulic valve tappet to remove the engine oil if necessary.

2. Place the (1) hydraulic valve tappet in a (2) commercially available hydraulic tappet leakdown tester. Position the (3) steel ball provided in the plunger cap. Add testing fluid to cover the hydraulic valve tappet and compress hydraulic tappet leakdown tester until the hydraulic valve tappet is filled with testing fluid.

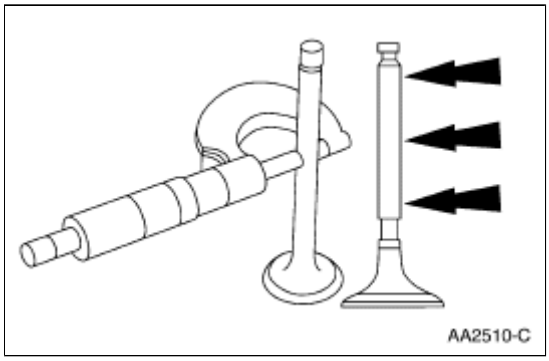


3. Adjust the length of the (1) ram so the (2) pointer is just below the (3) Start Timing mark when the ram contacts the hydraulic valve tappet. Start timing as the pointer passes the (3) Start Timing mark and end timing as the pointer reaches the (4) center mark. For additional information, refer to the appropriate engine section in Group 303 for specifications on time parameters.



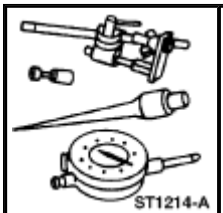
Valve —Stem Diameter

1. Measure the diameter of each intake and exhaust valve stem at the points shown. Verify the diameter is within specification.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Valve —Stem to Valve Guide Clearance

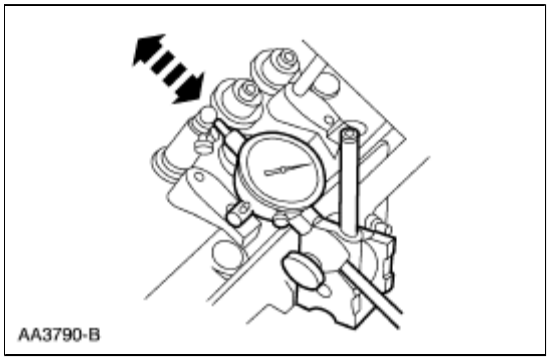
Special Tool(s)

 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent
ST1251-A	Valve Stem Checking Tool 303-004 (TOOL-6505-E) or equivalent

NOTE: Valve stem diameter must be within specifications before checking valve stem to valve guide clearance.

1. **NOTE:** If necessary, use a magnetic base.

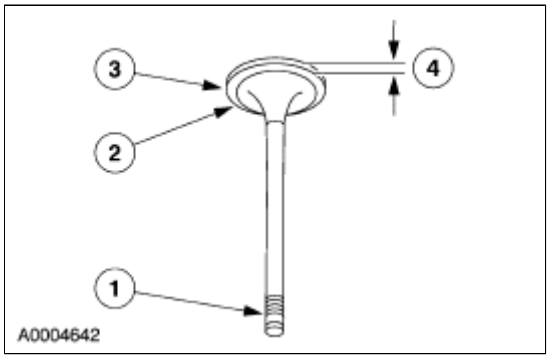
   Install a Valve Stem Clearance Tool on the valve stem and install a Dial Indicator with Bracketry. Lower the valve until the Valve Stem Clearance Tool contacts the upper surface of the valve guide.

   
   AA3790-B

2. Move the Valve Stem Clearance Tool toward the indicator and zero the indicator. Move the Valve Stem Clearance Tool away from the indicator and note the reading. The reading will be DOUBLE the valve stem-to-valve guide clearance. Valves with oversize stems will need to be installed if out of specification.

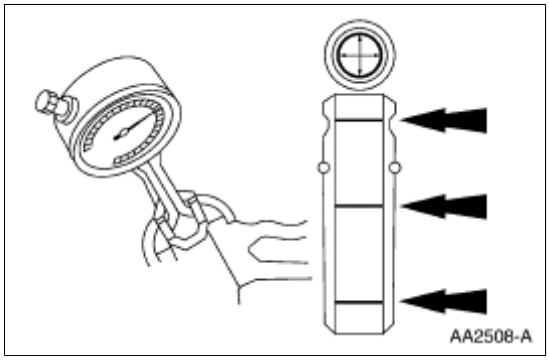
Valve —Inspection

1. Inspect the following valve areas:
    1. the end of the stem for grooves or scoring
    2. the valve face and the edge for pits, grooves or scores
    3. the valve head for signs of burning, erosion, warpage and cracking
    4. the valve margin for wear



Valve —Guide Inner Diameter

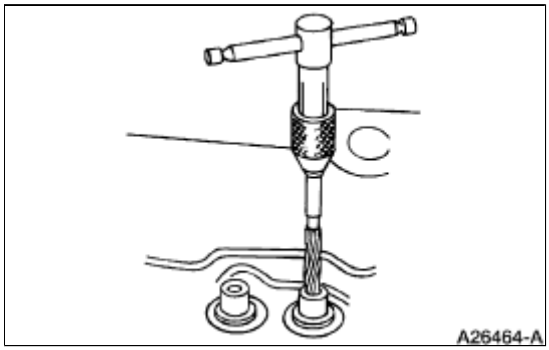
1. Measure the inner diameter of the valve guides in two directions where indicated.
   - For additional information, refer to Specifications in the appropriate section in Group 303.



2. If the valve guide is not within specifications, ream the valve guide and install a valve with an oversize stem or remove the valve guide and install a new valve guide.

Valve —Guide Reaming

1. Use a hand-reaming kit to ream the valve guide.

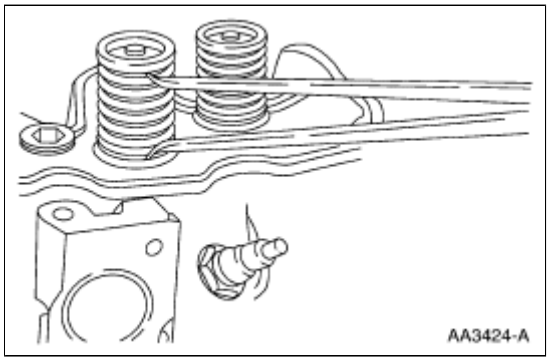


2. Reface the valve seat.

3. Clean the sharp edges left by reaming.

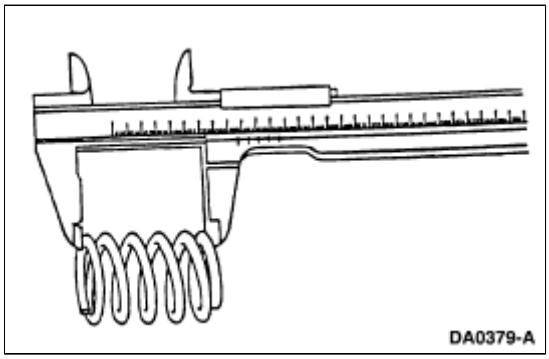
Valve —Spring Installed Length

1. Measure the installed length of each valve spring.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components. Refer to the appropriate section in Group 303 for the procedure.



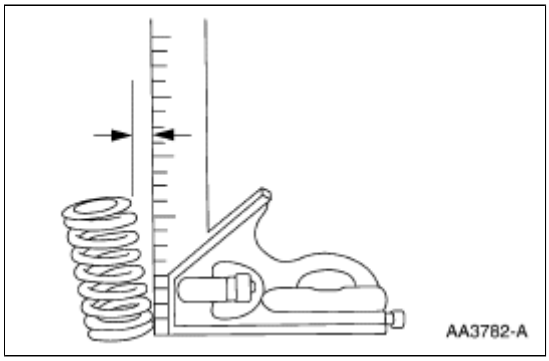
Valve —Spring Free Length

1. Measure the free length of each valve spring.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



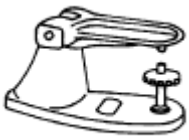
Valve —Spring Squareness

1. Measure the out-of-square on each valve spring.
    - Turn the valve spring and observe the space between the top of the valve spring and the square. Install a new valve spring if out of square. Refer to the appropriate section in Group 303 for the procedure.

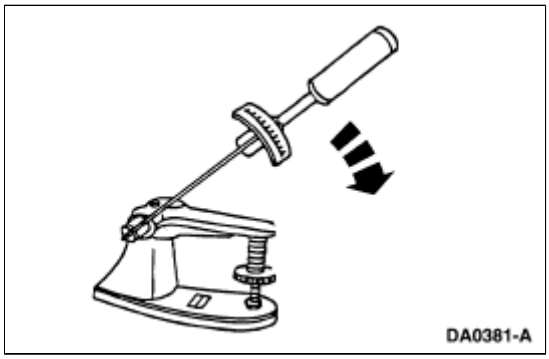


Valve —Spring Strength

Special Tool(s)

 ST1278-A	Valve/Clutch Spring Tester 303-006 (TOOL-6513-DD) or equivalent

1. Use a Valve/Clutch Spring Tester to check the valve spring for correct strength at the specified valve spring length.
    - For additional information, refer to Specifications in the appropriate section in Group 303.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

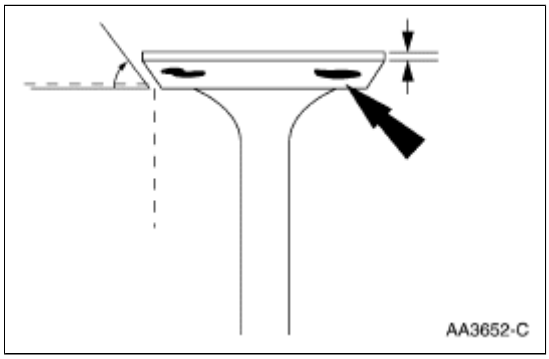


Valve —Seat Inspection

Valve and Seat Refacing Measurements

CAUTION: After grinding valves or valve seats, check valve clearance.

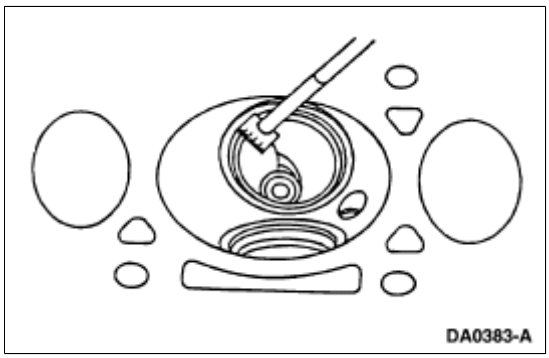
1. Check the valve head and seat.
   - Check valve angles.
   - Check margin width.
   - Refer to the appropriate section in Group 303 for the procedure.
   - Be sure margin width is within specification.



2. Inspect for abnormalities on the valve face and seat.

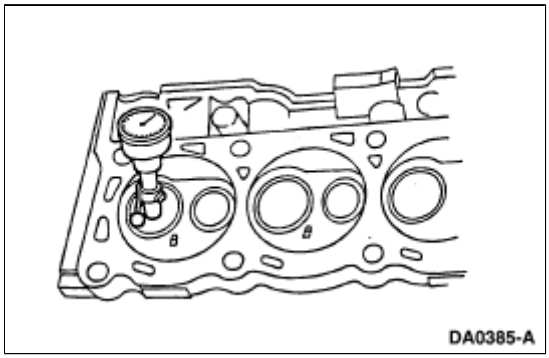
Valve —Seat Width

1. Measure the valve seat width. If necessary, grind the valve seat to specification.
   - Measure the intake valve seat width.
   - Measure the exhaust valve seat width.
   - Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
   - Refer to the appropriate section in Group 303 for the procedure.



Valve —Seat Runout

1. Use the Valve Seat Runout Gauge to check valve seat runout.

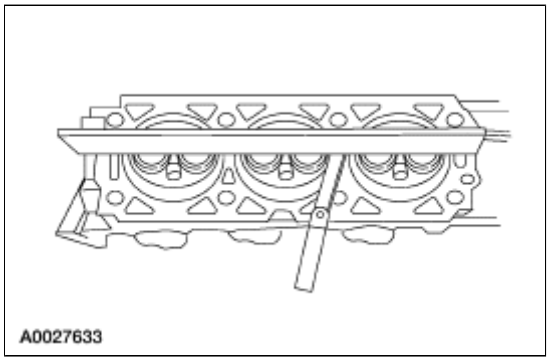


Cylinder Head —Distortion

Special Tool(s)

ST1246-A	Straight Edge 303-D039 (D83L-4201-A) or equivalent

1. Use a straight edge and a feeler gauge to inspect the cylinder head for flatness. If the cylinder head is distorted, install a new cylinder head.

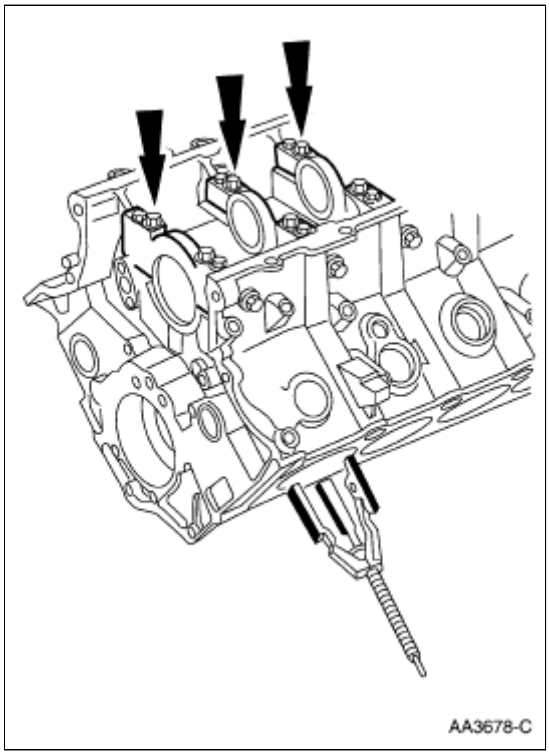

A0027633

Cylinder Bore —Honing

Special Tool(s)

ST1275-A	Engine Cylinder Hone Set 303-S084 (T73L-6011-A) or equivalent

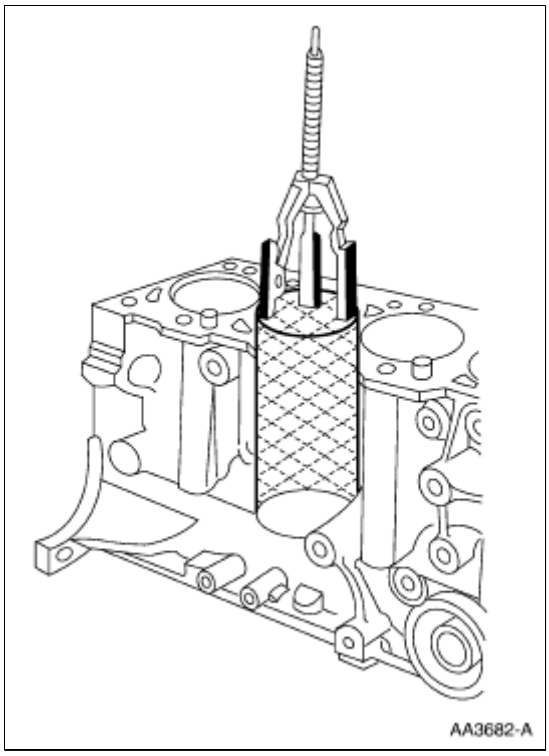
1. Install and tighten all main bearing caps to specification. For additional information, refer to Specifications in the appropriate section in Group 303.


AA3678-C

2. **NOTE:** To correct taper or out-of-round, bore the cylinder block.

   NOTE: Honing should be done when fitting new piston rings and to remove glazed surface finish.

   Hone with the Engine Cylinder Hone Set, at a speed of 300-500 rpm and a hone grit of 180-220 to provide the desired cylinder bore surface finish of 18-38AA.
   - For additional information, refer to the appropriate section in Group 303 for base strokes per minute specification.


AA3682-A

Cylinder Bore —Cleaning

1. **CAUTION: If these procedures are not followed, rusting of the cylinder bores may occur.**

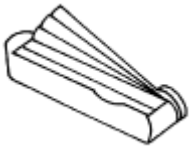
   Clean the cylinder bores with soap or detergent and water.

2. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.

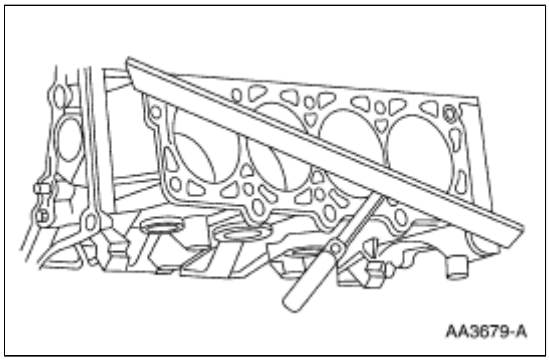
3. Use a clean, lint-free cloth and lubricate the cylinder bores.
   - Use Super Premium SAE Motor Oil meeting Ford specification.

Cylinder Block —Distortion

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent
ST1246-A	Straightedge 303-D039 (D83L-4201-A) or equivalent

1. Use a straightedge and a feeler gauge to inspect the cylinder block for flatness. If the cylinder block is distorted, resurface the cylinder block within specification.

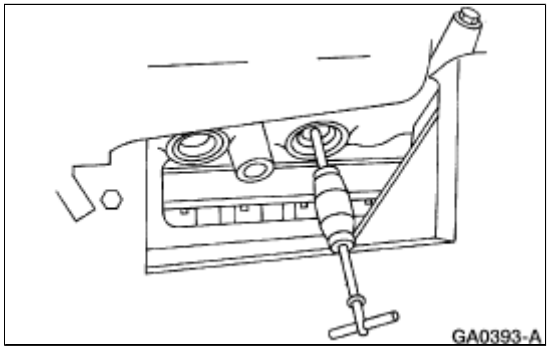

AA3679-A

Cylinder Block —Core Plug Replacement

Special Tool(s)

ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)

1. Use a slide hammer or tools suitable to remove the cylinder block core plug.


GA0393-A

2. Inspect the cylinder block plug bore for any damage that would interfere with the correct sealing of the plug. If the cylinder block plug bore is damaged, bore for the next oversize plug.

3. **NOTE:** Oversize plugs are identified by the OS stamped in the flat located on the cup side of the plug.

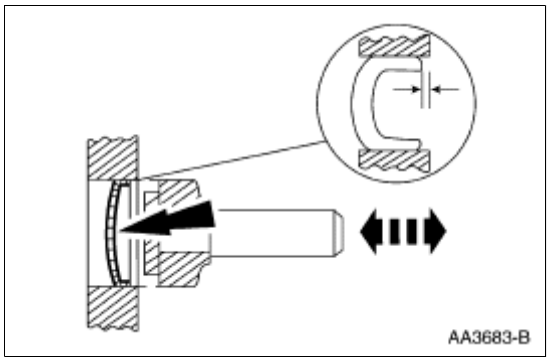
   Coat the cylinder block core plug and bore lightly with Threadlock 262 E2FZ-19554-B or equivalent meeting Ford specification WSK-M2G351-A6 and install the cylinder block core plug.

Cup-Type

4. **CAUTION: Use care during this procedure so as not to disturb or distort the cup sealing surface.**

   CAUTION: When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.

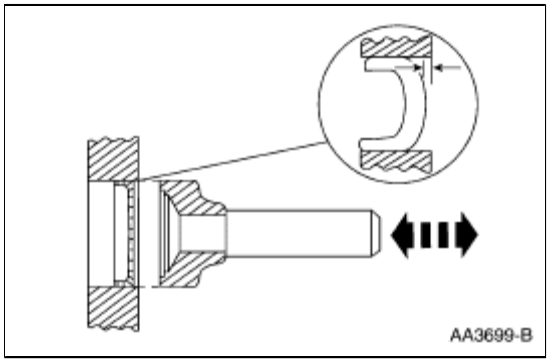
   Use a tool suitable to seat the cup-type cylinder block core plug.



Expansion-Type

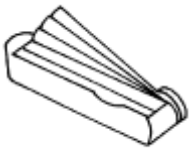
1. **CAUTION: Do not contact the crown when installing an expansion-type cylinder block core plug. This could expand the plug before seating and result in leakage.**

   Use tool suitable to seat the expansion-type cylinder block core plug.



Spark Plug —Thread Repair

Special Tool(s)

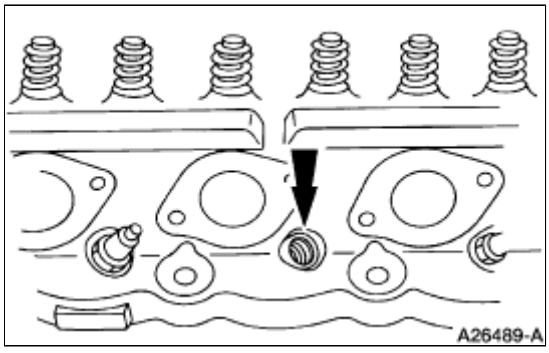
ST1281-A	Sav-A-Thread Master Kit 107-R0921 or equivalent
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

CAUTION: The cylinder head must be removed from the engine before installing a tapersert. If this procedure is done with the cylinder head on the engine, the cylinder walls can be damaged by metal chips produced by the thread cutting process.

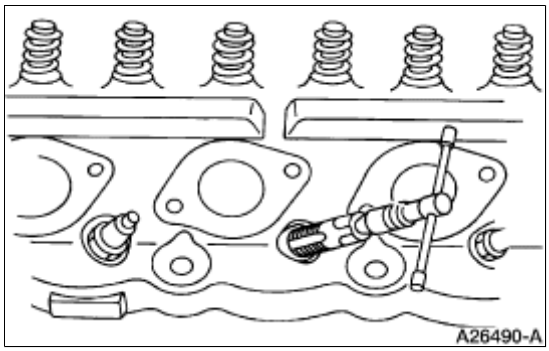
CAUTION: Do not use power or air-driven tools for installing taperserts.

NOTE: This repair is permanent and will have no effect on cylinder head or spark plug life.

1. Clean the spark plug seat and threads.



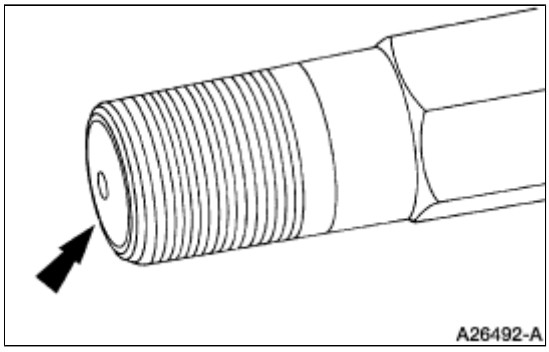
2. Start the tap into the spark plug hole, being careful to keep it correctly aligned. As the tap begins to cut new threads, apply aluminum cutting oil.



3. Continue cutting the threads and applying oil until the stop ring bottoms against the spark plug seat.

4. Remove the tap and metal chips.

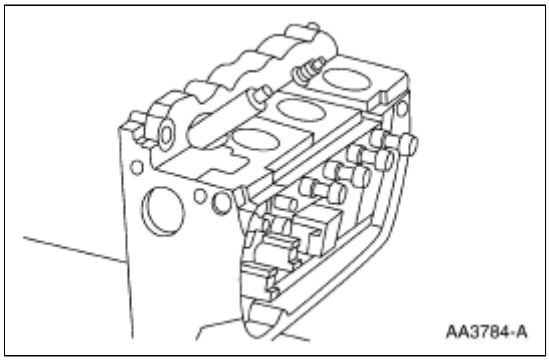
5. Coat the threads of the mandrel with cutting oil.



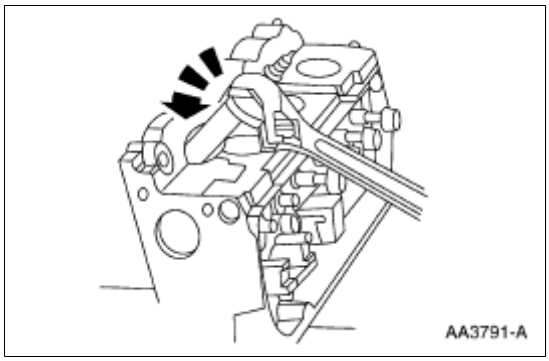
6. Thread the tapersert onto the mandrel until one thread of the mandrel extends beyond the tapersert.

7. **NOTE:** A correctly installed tapersert will be either flush with or 1.0 mm (0.039 inch) below the spark plug gasket seat.

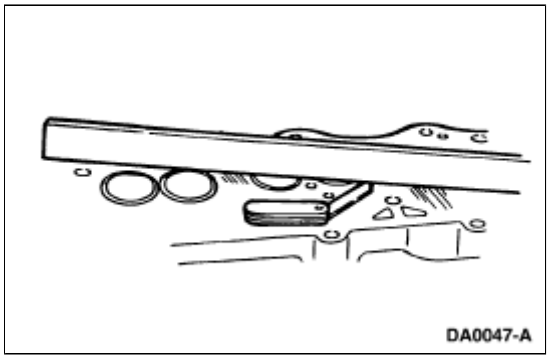
   Tighten the tapersert into the spark plug hole.



8. Turn the mandrel body approximately one-half turn counterclockwise and remove.

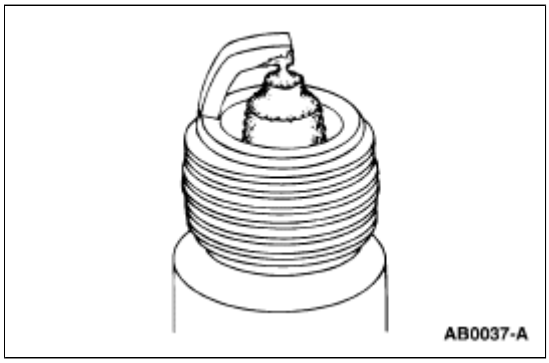


9. Use the Feeler Gauge and a suitable straightedge to check for cylinder head flatness.
    - Refer to the appropriate section in Group 303 for the procedure.

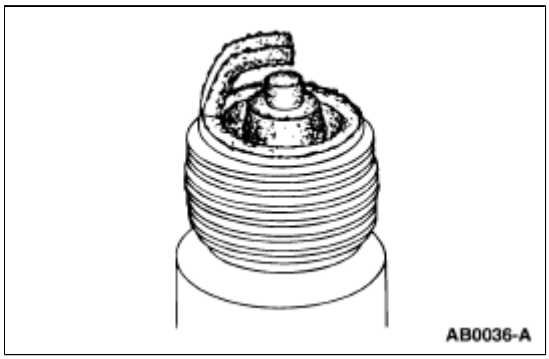


Spark Plug —Inspection

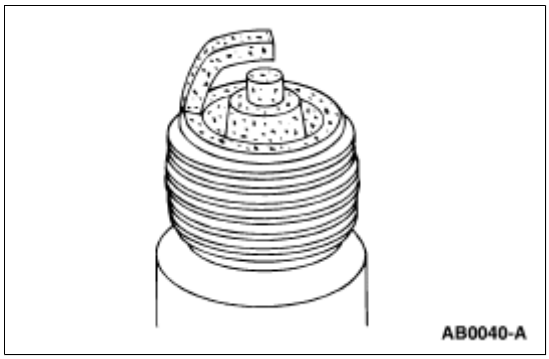
1. Inspect the spark plug for a bridged gap.
    - Check for deposit build-up closing the gap between the electrodes. Deposits are caused by oil or carbon fouling.
    - Clean the spark plug.



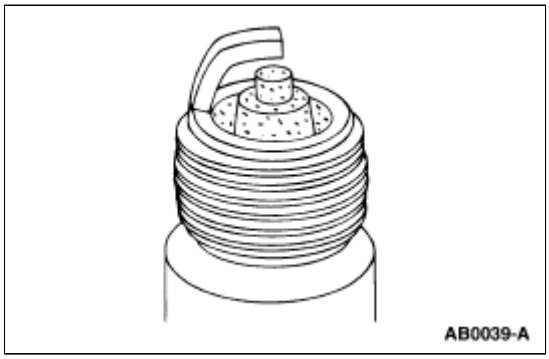
2. Check for oil fouling.
    - Check for wet, black deposits on the insulator shell bore electrodes, caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
    - Correct the oil leak concern.
    - Install a new spark plug.



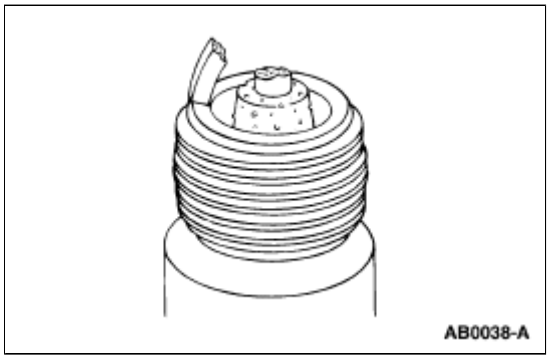
3. Inspect for carbon fouling. Look for black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes, caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling.
    - Clean the spark plug.



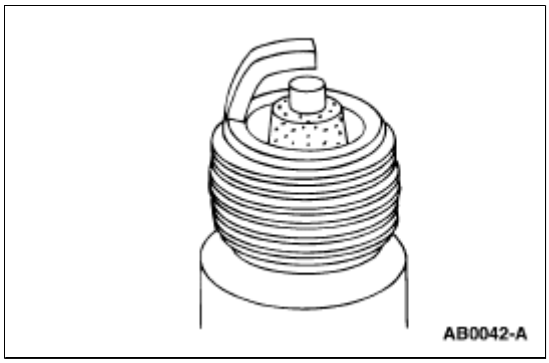
4. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.



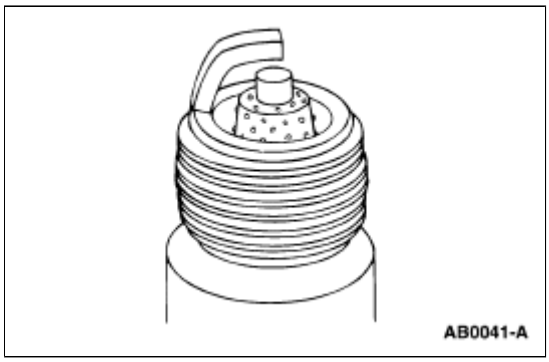
5. Inspect for pre-ignition, identified by melted electrodes and a possibly damaged insulator. Metallic deposits on the insulator indicate engine damage. This may be caused by incorrect ignition timing, wrong type of fuel or the installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.



6. Inspect for overheating, identified by a white or light gray spots and with bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.



7. Inspect for fused deposits, identified by melted or spotty deposits resembling bubbles or blisters. These are caused by sudden acceleration.
    - Clean the spark plug.

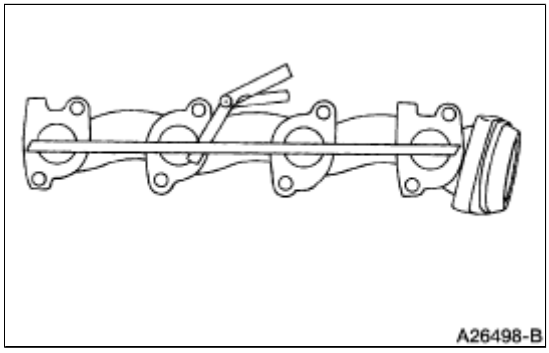


Exhaust Manifold —Inspection

Special Tool(s)

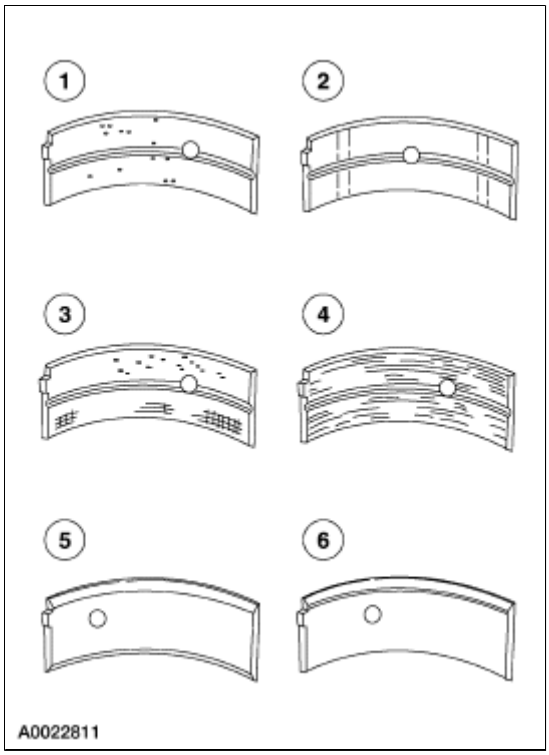
ST1246-A	Straight Edge 303-D039 (D83L-4201-A) or equivalent

1. Place a Straight edge across the exhaust manifold flanges and check for warping with a feeler gauge.


A26498-B

Bearing —Inspection

1. Inspect bearings for the following defects. Possible causes are shown:
    1. cratering—fatigue failure
    2. spot glazing—improper seating
    3. scratching—dirty
    4. base exposed—poor lubrication
    5. both edges worn—journal damaged
    6. one edge worn—journal tapered or bearing not seated



General Specifications

Item	Specification
4.0L (push rod)	
Displacement L (CID)	4.0L (244)
Number of cylinders	6
Bore mm (inch)	100.4 (3.9527)
Stroke mm (inch)	84.4 (3.31)
Firing order	1-4-2-5-3-6
Minimum oil pressure at 2,000 rpm (engine at normal operating temperature) kPa (psi)	103 (15)
Cylinder Head and Valve Train	
Combustion chamber volume (cc)	46.34-48.34
Valve guide bore diameter mm (inch)	8.062-8.087 (0.317-0.318)
Valve arrangement front to rear	LH=I-E-I-E-I-E RH=E-I-E-I-E-I
Head gasket surface flatness mm (inch)	a
Head gasket surface finish rms	60-150
Valve Seat	
Width mm (inch)	1.697-2.263 (0.067-0.089)
Angle degrees	45
Runout TIR maximum mm (inch)	0.038 (0.0014)
Valves	
Intake exhaust mm (inch)	8.025-8.043 (0.3159-0.3167) 7.999-8.017 (0.3149-0.3156
Valve stem to guide clearance exhaust mm (inch)	0.021-0.064 (0.0008-0.0025)
Valve stem to guide clearance intake mm (inch)	0.046-0.089 (0.0018-0.0035)
Head diameter intake mm (in)	4.35 (1.71)
Head diameter exhaust mm (in)	34.5 (1.36)
Valve face angle degrees	44
Valve face runout limit mm (inch)	0.051 (0.002)
Valve Rocker Arm Shaft, Push Rods and Tappets	
Push rod runout TIR maximum mm (inch)	0.508 (0.020)

Tappet diameter mm (inch)	22.205-22.238 (0.8742-0.8755)
Tappet to bore clearance mm (inch)	0.013-0.056 (0.0005-0.0022)
Repair limit mm (inch)	0.127 (0.005)
Hydraulic lifter leakdown rate for 1/16 inch travel	10-50 seconds
Valve Springs	
Intake valve spring free length mm (inch)	48.514 (1.91)
Exhaust valve spring free length mm (inch)	48.514 (1.91)
Intake valve spring assembled height mm (inch)	40.08-40.87 (1.578-1.609)
Exhaust valve spring assembled height mm (inch)	40.08-40.87 (1.578-1.609)
Valve spring out of square mm (inch)	1.98 (0.078)
Intake valve spring compression pressure at specified height (lbs)	347-383 Nm 39.86-40.4 mm 256-282 lb-ft at 1.56-1.59 in
Camshaft	
Intake lobe lift mm (inch)	6.92 (0.272)
Exhaust lobe lift mm (inch)	6.92 (0.272)
Maximum allowable lobe lift loss mm (inch)	0.127 (0.005)
End play mm (inch)	0.065-0.165 (0.0025 - 0.0064)
Journal to bearing clearance mm (inch)	0.025-0.076 (0.001-0.003)
Repair limit mm (inch)	0.152 (0.006)
Camshaft Drive	
No. 1 journal diameter mm (inch)	49.57-49-59 (1.951-1.952)
No. 2 journal diameter mm (inch)	49.21-49.23 (1.937-1.938)
No. 3 journal diameter mm (inch)	48.83-48.84 (1.9224-1.9228)
No. 4 journal diameter mm (inch)	48.44- 48.46 (1.907-1.9078)
Maximum camshaft journal runout mm (inch)	0.127 (0.005)
No. 1 bearing inside diameter mm (inch)	49.635-49.655 (1.954-1.955)
No. 2 bearing inside diameter mm (inch)	49.225-49.275 (1.939-1.940)
No. 3 bearing inside diameter mm (inch)	48.750-48.768 (1,919-9.920)
No. 4 bearing inside diameter mm (inch)	48.875-48.895 (1.924-1.925)
Front bearing location depth [b] mm (inch)	0.51-0.89 (0.020-0.035)
Cylinder Block	

Cylinder bore diameter mm (inch)	100.38-100.43 (3.9527-3.9543)
Maximum cylinder out-of-round mm (inch)	0.025 (0.0009)
Maximum cylinder taper mm (inch)	0.025 (0.0009)
Main bearing bore diameter mm (inch)	60.62-60.64 (2.3866-2.3874)
Crankshaft to rear face of block runout TIR maximum mm (inch)	0.127 (0.005)
Crankshaft and Flywheel	
Main bearing journal diameter mm (inch)	56.980-57.0 (2.2433-2.2441)
Main bearing journal out-of-round mm (inch)	0.015 (0.0006)
Main bearing journal runout TIR maximum mm (inch)	0.0508 (0.002)
Main bearing journal runout limit mm (inch)	0.127 (0.005)
Main bearing thrust face runout TIR maximum mm (inch)	0.0254 (0.001)
Main bearing journal taper maximum per inch mm (inch)	0.008 (0.0003 per inch)
Thrust bearing journal length mm (inch)	26.39-26.44 (1.039-1.041)
Main and rod bearing journal finish rms maximum	12 and 8.8
Main bearing thrust face finish rms maximum	20
Connecting rod journal diameter mm (inch)	53.98-54.0 (2.1252-2.1260)
Connecting rod journal maximum out-of-round mm (inch)	0.008 (0.0003)
Connecting rod journal taper per inch maximum mm (inch)	0.008 (0.0003 per inch)
Crankshaft free end play mm (inch)	0.05-0.32 (0.002-0.01250)
Connecting Rod Bearings	
Clearance to crankshaft mm (inch)	0.020-0.053 (0.0008-0.0020)
Bearing wall thickness mm (inch)	1.399-1.406 (0.055-0.0554)
Main Bearings	
Clearance to crankshaft (inch)	0.013-0.056 (0.0005-0.0022)
Bearing wall thickness mm (inch)	1.799-1.806 (0.0708-0.0711)
Connecting Rod, Piston and Rings	
Piston pin bore or bushing i.d. mm (inch	23.958-23.976 (0.943-0.944)
Rod bearing bore i.d. mm (inch)	56.82-56.84 (2.237-2.238)
Rod bearing bore out-of-round mm (inch)	0.01 (0.0004)
Rod length center to center mm (inch)	145.965-146.035 (5.746-5.749)
Alignment (bore-to-bore max. diff.) twist mm (inch)	0.038 (0.0015) per 25.4 mm (1.000)
Alignment (bore-to-bore max. diff.) bend mm (inch)	0.0125 (0.0049) per 25.4 mm (1.000)
Side clearance (assembled to crank) mm (inch)	0.092-0.268 (0.0032-0.0106)
Piston Pin	

Length mm (inch)	72.0-72.80 (2.835-2.866)
Red Blue	23.992-23.997 (0.9446-0.9448) 23.997-24 (0.9448-0.9449)
Pin to piston clearance mm (inch)	0.008-0.0152 (0.0003-0.0006)
Pin to connecting rod clearance mm (inch)	Interference Fit
Piston	
Diameter - mm (inch) [c]	100.380-100.400 (3.952-3.953)
Piston to bore clearance mm (inch)	0.021-0.048 (0.0008-0.0019)
Pin bore diameter mm (inch)	24.007-24.013 (0.9452-0.9453)
Top ring grove width mm (inch)	1.976-1.989 (0.0778-0.0783)
Bottom ring grove width mm (inch)	2.977-2.99 (0.1172-0.1177)
Diameter—coded blue mm (inch)	100.880-100.900 (3.972)
Diameter—coded yellow mm (inch)	101.350-101.370 (3.99)
Piston Rings	
Top compression ring gap mm (inch)	0.381-0.584 (0.015-0.023)
Bottom compression ring gap mm (inch)	0.381-1.397 (0.015-0.055)
Oil ring gap mm (inch)	0.381-1.397 (0.015-0.055)
Top compression ring width mm (inch)	1.578-1.59 (0.062)
Bottom compression ring width mm (inch)	1.728-1.74 (0.068-0.069)
Top compression side clearance mm (inch)	0.050-0.082 (0.001-0.003)
Bottom compression side clearance mm (inch)	0.050-0.082 (0.001-0.003)
Lubrication System	
Relief valve spring pressure lbs. at 35.3 lbs. (1.39 inch)	61.3-66.3 Nm (45.100-48.730 lb/ft)
Driveshaft to housing clearance mm (inch)	0.002-0.0031 (0.001)
Relief valve to housing clearance mm (inch)	0.0015-0.003 (0.0001)
Rotor assembly end clearance max. mm (inch)	0.0014-0.0044 (0.00015)
Outer race to end clearance mm (inch)	0.006-0.012 (0.0002-0.005)
Engine oil capacity liters (quarts) with oil filter	4.7 (5)
Lubricant	
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or DSP	WSS-M2C153-G
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A
Sealer	

Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Pipe Sealant With Teflon® D8AZ-19554-A	WSK-M2G350-A2 and ESR-M18P7-A
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

[a] 0.079 mm (in) (0.003 inch) in any 6 inches—0.16 mm (in) (0.06 inch) overall
[b] distance in inches that the front edge of the bearing is installed below the front face of the cylinder block
[c] Measured 56 mm (2.205 inch) from the piston dome at 90 degrees to the pin

Torque Specifications

Description	Nm	lb-ft	lb-in
Oil filter adapter bolt	57	42	—
Water pump to front cover bolts and studs	8.5-12	6-9	—
Engine front cover bolts and studs	17-21	13-15	—
Timing chain guide bolts	13	10	—
Timing chain tensioner bolts	10	—	89
Camshaft sprocket bolt	64	47	—
Rocker arm shaft bolts [a]	a	a	a
Valve cover bolts [a]	a	a	a
Ignition coil nuts	6	—	53
Oil filter	13	10	—
Upper intake manifold nuts	23	17	—
Wiring harness retainer nuts	15	11	—
EGR valve to exhaust manifold tube nut	40	30	—
EGR outlet tube bracket nut	47	35	—
EGR valve bolts	25	18	—
Camshaft thrust plate bolts	11	8	—
Oil pan bolts and nuts	8	—	71
Oil pump screen cover bolts	11	8	—
Oil pump bolts	18	13	—
Connecting rod bearing cap nuts [a]	a	a	a
Crankshaft main bearing cap bolts [a]	a	a	a
Crankshaft oil baffle nuts	19	15	—
Cylinder head bolts [a]	a	a	a
Lower intake manifold bolts [a]	a	a	a
Flywheel bolt [a]	a	a	a
Crankshaft pulley bolt [a]	a	a	a

Crankshaft position sensor	9-12	—	80-106
Exhaust manifold to cylinder head bolts	20-25	15-18	—
Water pump pulley bolts	22-28	17-20	—
Thermostat housing bolts	25	18	—
Generator mounting bracket bolts	40-55	30-40	—
A/C compressor mounting bracket brace bolts	47	35	—
A/C manifold tube bolt	20	15	—
Spark plugs	20	15	—
Transmission cooler line bracket bolts.	13-17	10-12	—
Engine insulator mount nuts (lower)	90	66	—
Fuel injection supply manifold studs	15	11	—
Oil level indicator tube nut	25	18	—
Engine wire harness bulkhead connector bolt	10-12	—	89-106
Bell housing bolts	40-55	30-40	—
Battery cable bracket bolt	15	11	—
Bulkhead connector bolt	6	—	53
Engine ground wire bolt	10	—	89
PCM connector bolt	6	—	53
Engine harness ground	10	—	89
Oil pressure sensor	20	15	—
Engine insulator mount nuts (upper)	88-132	65-97	—
Cylinder identification sensor screws	2.5-3.5	—	23-30
Exhaust manifold-to-exhaust inlet crossover pipe bolts	40	30	—
Oil pan drain plug	26	19	—
Oil filter adapter bolt	55-60	41-44	—
Torque converter mounting nuts	35	26	—
Front driveshaft CV joint bolts	30	22	—
Axle-to-frame bolts	70	52	—

[a] Refer to the procedure.

Engine

The compact Ford 60 degree 4.0L V-6 engine:

- is of lightweight, cast iron construction.
- has a precision-molded cast iron crankshaft.
- has replaceable aluminum/tin alloy crankshaft main bearing.
- has replaceable copper alloy camshaft bearing and connecting rod bearing.
- has forged-steel connecting rods.
- uses a distributorless ignition system.

Engine Identification

For quick identification, refer to the vehicle control information decal mounted under the hood:

- The decal lists information needed for repairing. For additional information, refer to Section 100-01 .

An engine identification label is attached to the engine:

- It identifies each engine for determining parts usage.
- It identifies the engine displacement.
- It identifies the model year. For additional information, refer to Section 100-01 .

Emission Calibration Label

NOTE: It is critical that the engine codes and the calibration number are known when ordering parts or making inquiries.

The emission calibration label is located on the radiator support:

- It identifies the engine calibration number.
- It identifies the engine code number and the revision level.

Exhaust Emission Control System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

1. The air/fuel mixture needed by the engine is provided by the sequential electronic fuel injection system.

2. Fuel:
   - is supplied from the fuel tank by a fuel pump.
   - is filtered into the fuel injection supply manifold.
   - is delivered by the fuel injectors. A fuel damper is in place to prevent fluctuations in pressure caused by injector pulsation.

Crankshaft

1. The crankshaft:
    - is supported on four steel-backed, aluminum crankshaft main bearings.

2. To provide smooth engine operation, the piston crankpins are positioned to provide a power impulse every 120 degrees of crankshaft rotation. This spacing provides quiet, smooth operation.

3. The crankshaft is connected to the camshaft by two sprockets and a timing chain, providing a 2:1 drive ratio.

Camshaft

The camshaft:

- is supported by four camshaft bearings.
- thrust loads and end play are limited by the camshaft thrust plate.
- has a synchronizer drive gear located at the rear of the camshaft and part of the casting.

The camshaft synchronizer:

- drives the oil pump through the oil pump intermediate shaft.
- has a camshaft position (CMP) sensor is mounted on top of the camshaft synchronizer. For additional information, refer to Section 303-14 .

Valve Train

The roller valve tappets:

- provide automatic lash adjustment.
- transfer up-and-down motion to the rocker arms through the push rods then the motion is delivered to the exhaust valves and the intake valves.

Positive Crankcase Ventilation System

The engine is equipped with a positive closed type ventilation system recycling the crankcase vapors to the upper intake manifold. For additional information, refer to Section 303-08 .

Engine Cooling System

The 4.0L engine is liquid cooled by:

- a centrifugal water pump driven by the crankshaft.
- a water thermostat which prevents coolant flow to the radiator until the engine is at normal operating temperature. For additional information, refer to Section 303-03 .

Drive Belt System

Vehicles equipped with the 4.0L engine use a poly-v design drive belt with a self-adjusting drive belt tensioner. For additional information, refer to Section 303-05 .

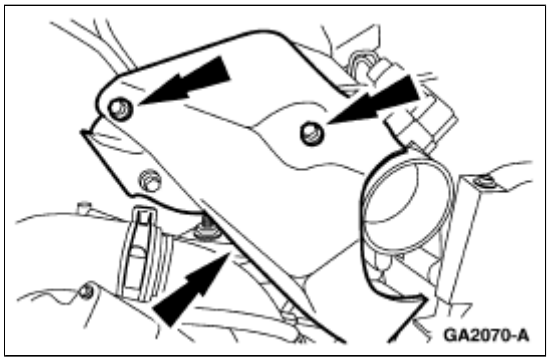
Engine

Refer to Section 303-00 for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

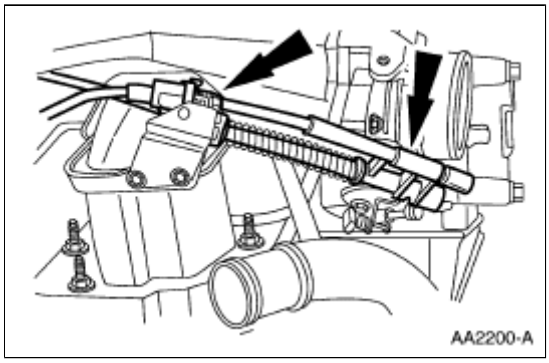
Intake Manifold —Upper

Removal

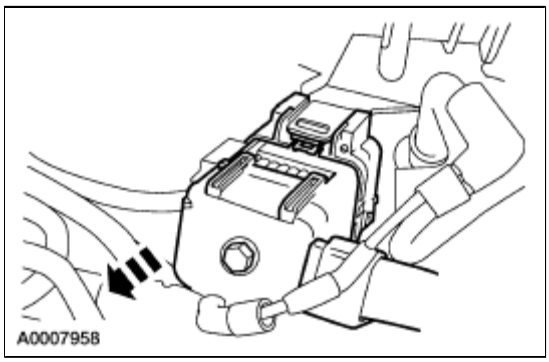
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the accelerator cable snow shield.



4. Disconnect the accelerator cable from the speed control actuator cable (if equipped) and position aside.

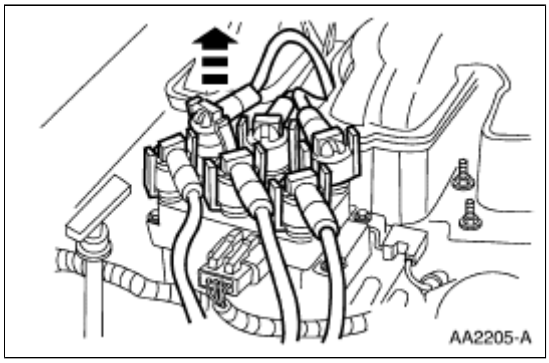


5. Loosen the bolt and slide the engine control wiring connector off the bracket.

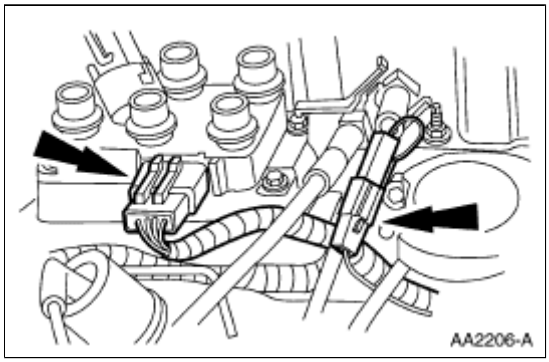


6. **NOTE:** Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wires before removing them.

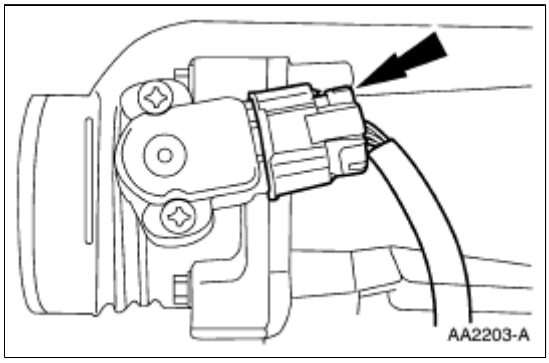
   Disconnect the spark plug wires from the ignition coil.



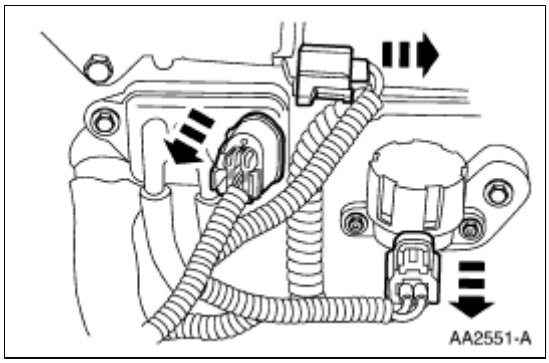
7. Disconnect the ignition coil and the radio ignition interference capacitor electrical connectors.



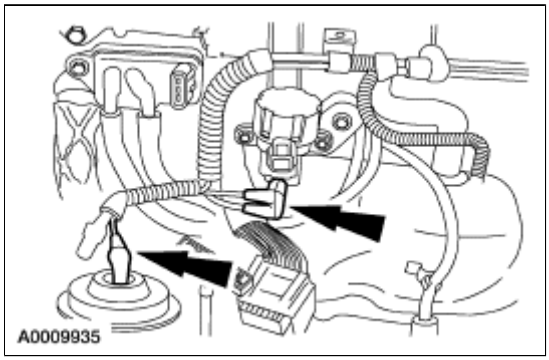
8. Disconnect the throttle position (TP) sensor electrical connector.



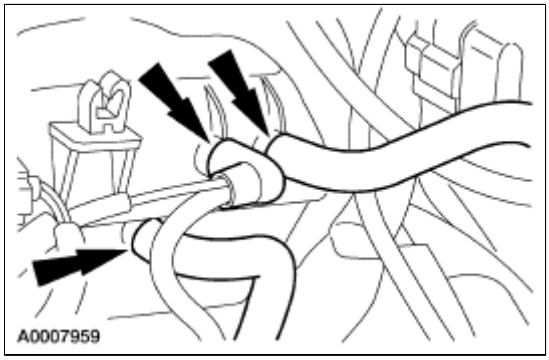
9. Disconnect the electrical connectors:
   - idle air control (IAC) solenoid
   - EGR transducer
   - EGR solenoid



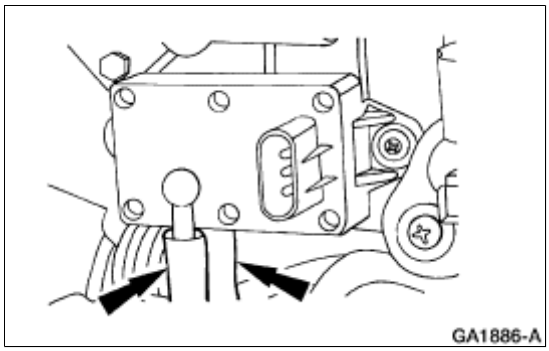
10. Disconnect the vacuum connections:
    - EGR solenoid
    - EGR valve



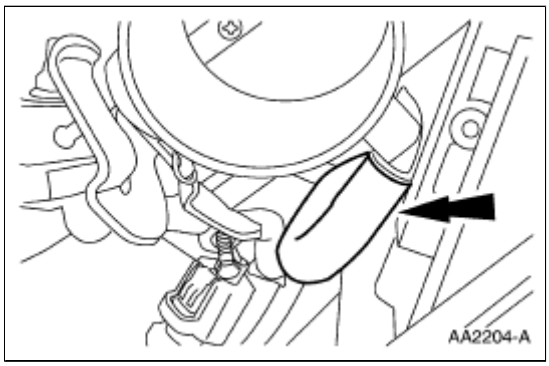
11. Disconnect the brake booster vacuum hose, the positive crankcase ventilation (PCV) hose, and the vacuum hose.



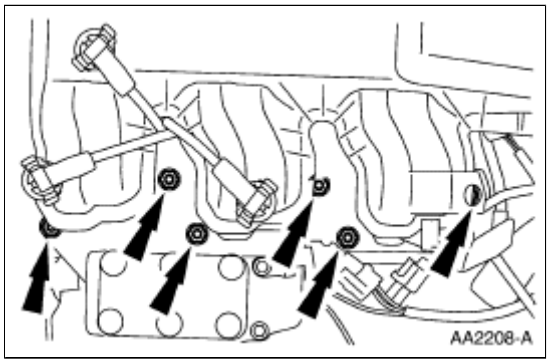
12. Disconnect the hoses from the EGR backpressure transducer.



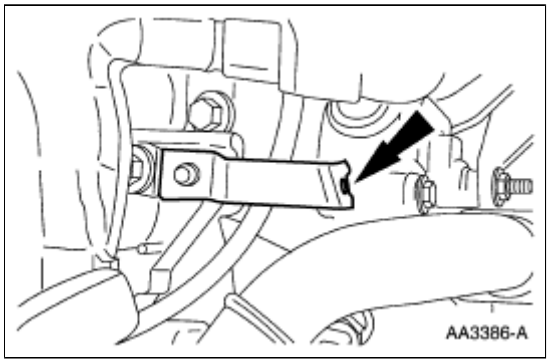
13. Disconnect the canister purge line from the throttle body.



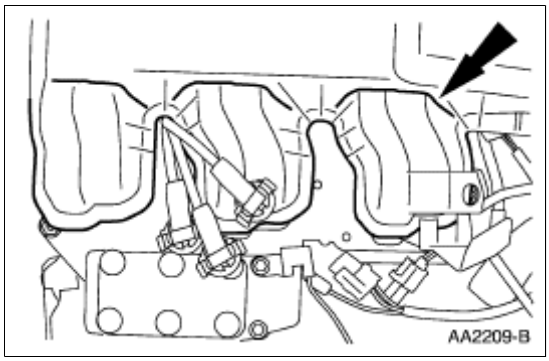
14. Remove the nuts.



15. Remove the fuel line bracket.



16. Remove the upper intake manifold and the gasket.

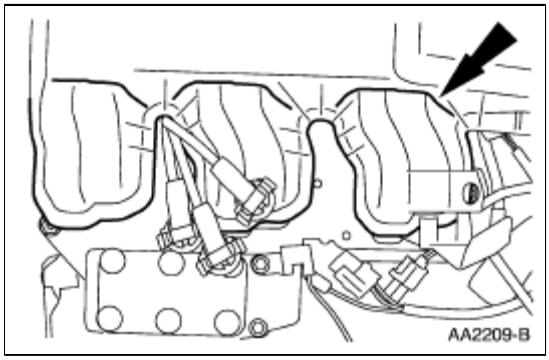


17. Inspect and install new gaskets, if necessary.

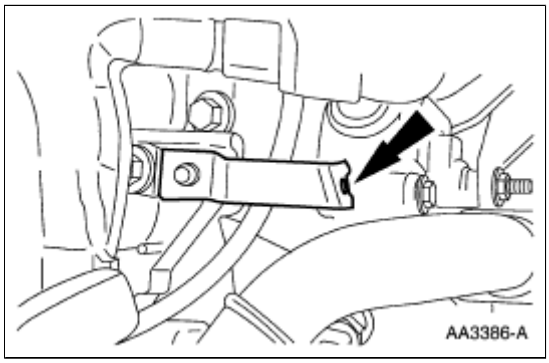
Installation

1. **NOTE:** Before installing the upper intake manifold, the EGR port must be clean and free of obstruction. Remove carbon buildup from the EGR passages. Inspect and install new seals.

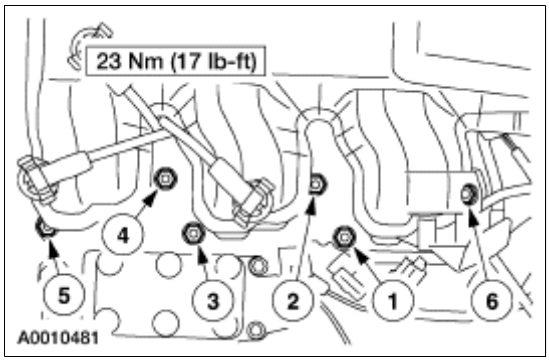
   Position the upper intake manifold.



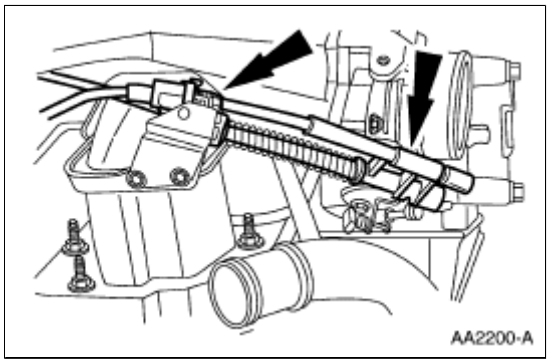
2. Position the fuel line bracket.



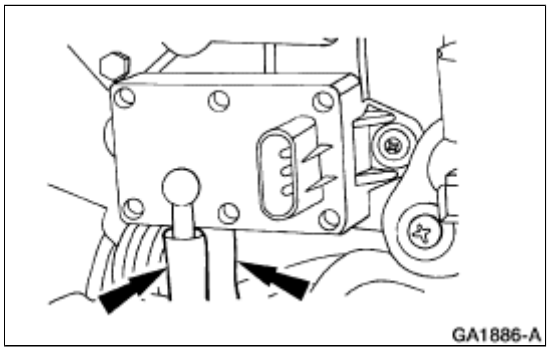
3. Install the nuts.
   - Tighten the nuts in the sequence shown.



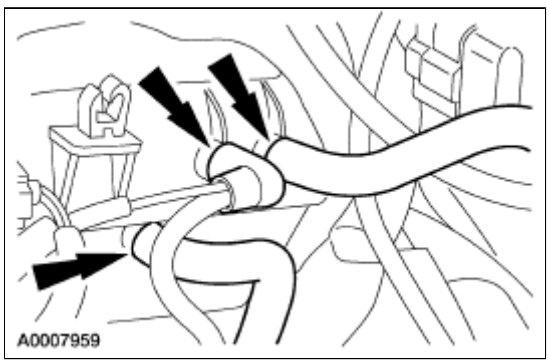
4. Connect the canister purge line from the throttle body.



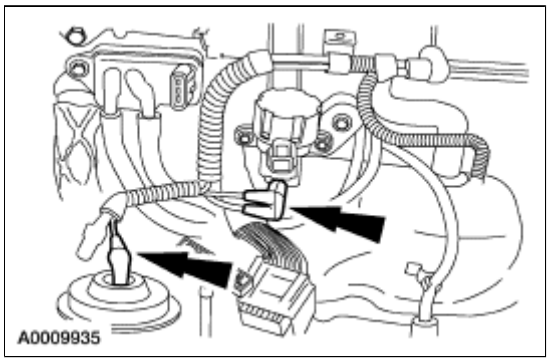
5. Connect the hoses to the EGR backpressure transducer.



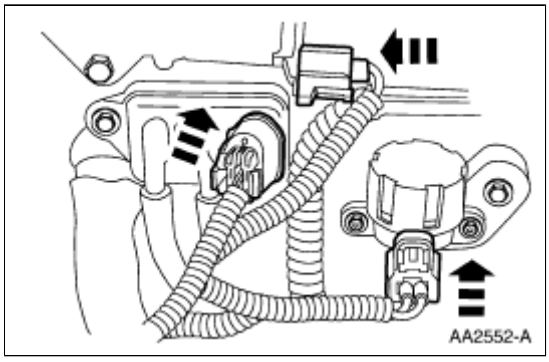
6. Connect the brake vacuum booster hose, the positive crankcase ventilation (PCV) hose and the vacuum hose.



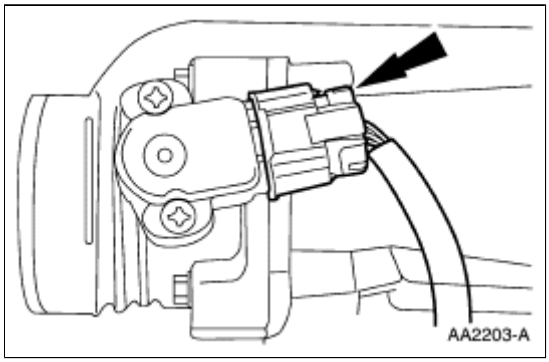
7. Connect the vacuum connections:
    - EGR valve
    - EGR solenoid



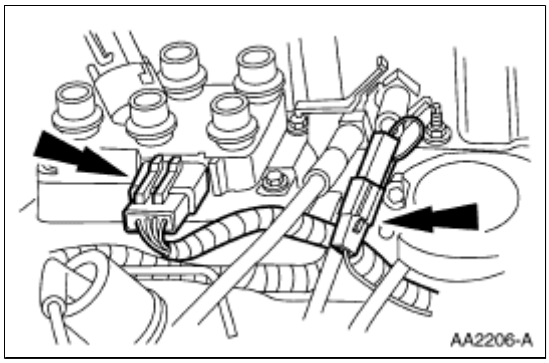
8. Connect the electrical connectors:
    - EGR solenoid
    - EGR transducer
    - idle air control (IAC) solenoid



9. Connect the throttle position (TP) sensor electrical connector.



10. Connect the ignition coil and the radio ignition interference capacitor electrical connectors.

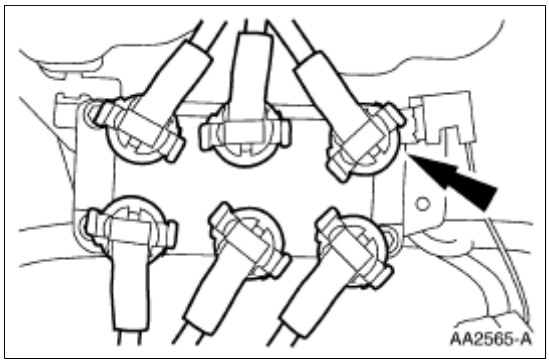


11. **CAUTION: Correct installation of the spark plug wires is critical to vehicle operation. If one spark plug wire is not correctly installed on the spark plug or ignition coil, both spark plugs connected to that segment of the ignition coil may not fire under load.**

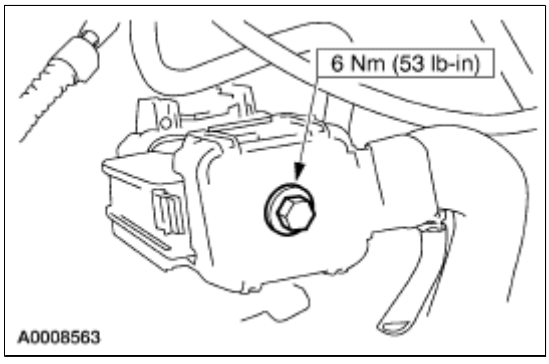
    NOTE: Wipe the spark plug wires with a clean, damp cloth prior to inspection.

    NOTE: When a spark plug wire is removed for any reason from a spark plug or ignition coil, or a new spark plug wire is installed, Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A must be applied to the spark plug wire boot prior to installation.

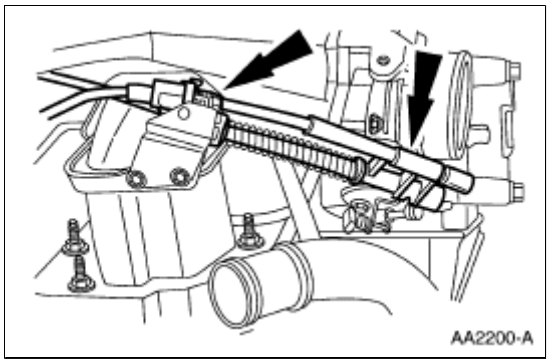
    Connect the spark plug wires to the ignition coil.



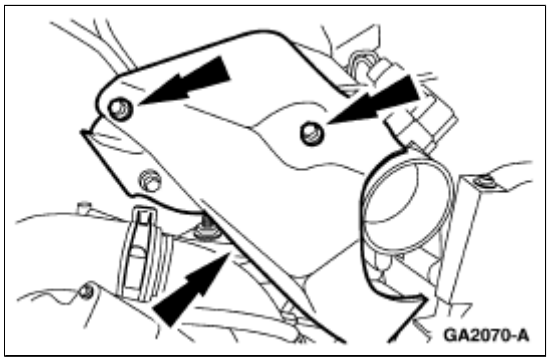
12. Slide the engine sensor control wiring connector on the bracket and tighten the bolt.



13. Connect the accelerator cable to the speed control actuator cable (if equipped).



14. Install the accelerator cable snow shield.



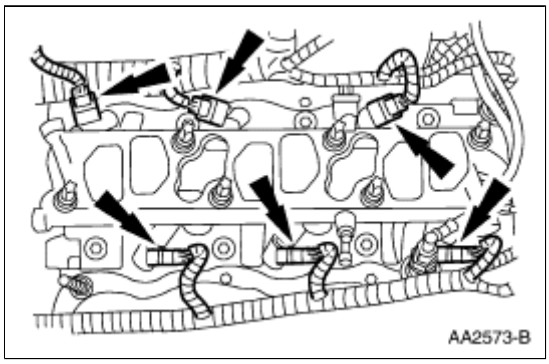
15. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

16. Connect the battery ground cable. For additional information, refer to Section 414-01 .

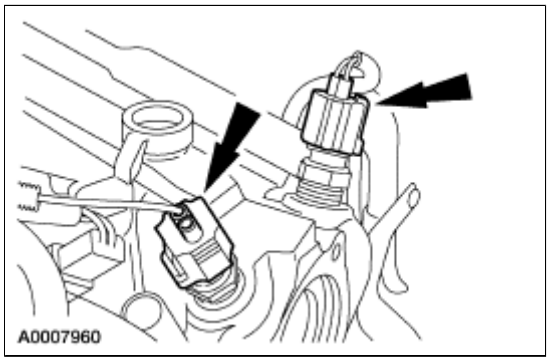
Intake Manifold —Lower

Removal

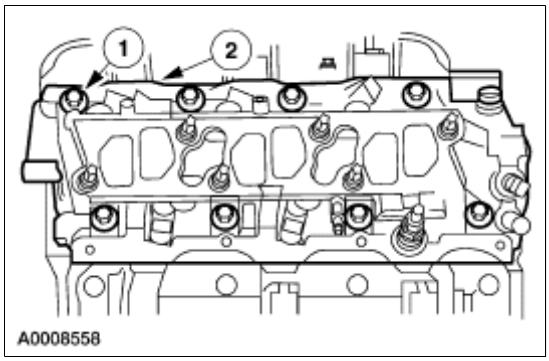
1. Remove the valve covers. For additional information, refer to Valve Cover—RH , Valve Cover—LH in this section.
2. Disconnect the fuel line. For additional information, refer to Section 310-01 .
3. Remove the water thermostat. For additional information, refer to Section 303-03 .
4. Disconnect the fuel injector electrical connectors.



5. Disconnect the engine coolant temperature (ECT) sensor, and the water temperature sender electrical connectors.



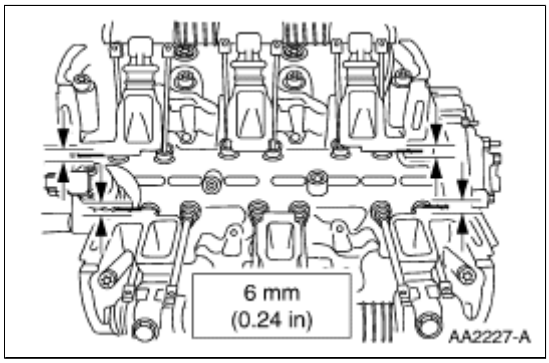
6. Remove the intake manifold.
    1. Remove the bolts.
    2. Remove the intake manifold and gasket.



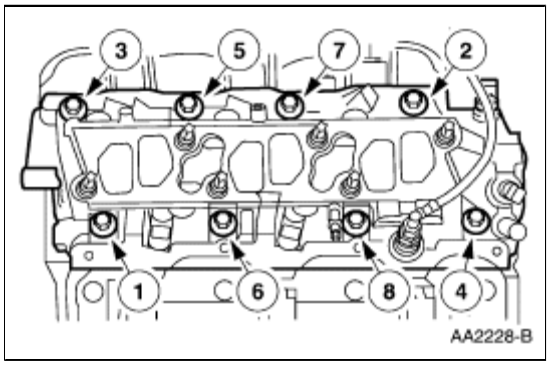
Installation

1. Clean and inspect the sealing surfaces.

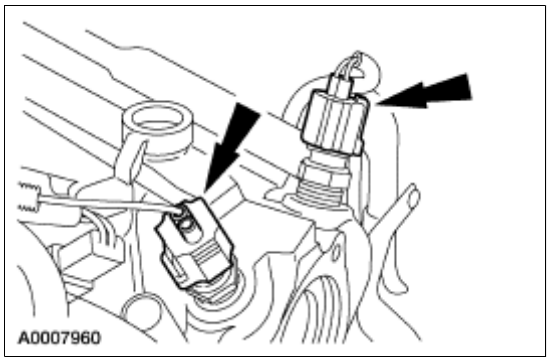
2. Apply a bead of silicone rubber in four places.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



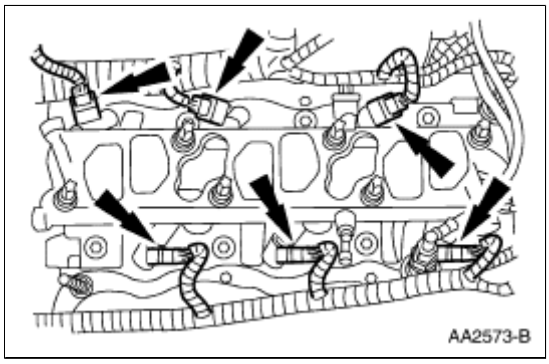
3. Install the gasket, the intake manifold and tighten the bolts in sequence in four steps:
   1. Tighten to 3 Nm (27 lb-in).
   2. Tighten to 10 Nm (89 lb-in).
   3. Tighten to 13 Nm (10 lb-ft).
   4. Tighten to 16 Nm (12 lb-ft).



4. Connect the engine coolant temperature (ECT) sensor, and the water temperature sender electrical connectors.



5. Connect the fuel injector electrical connectors.

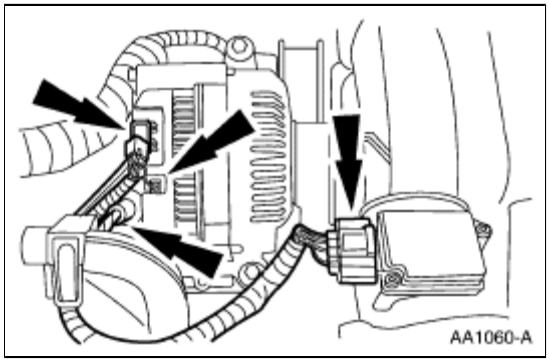


6. Install the water thermostat. For additional information, refer to Section 303-03 .
7. Connect the fuel line. For additional information, refer to Section 310-01 .
8. Install the valve covers. For additional information, refer to Valve Cover—RH or Valve Cover—LH in this section.

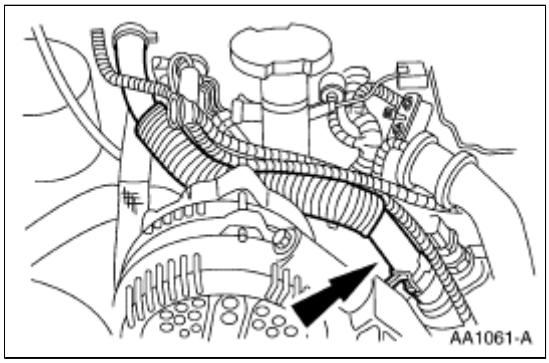
Valve Cover —RH

Removal

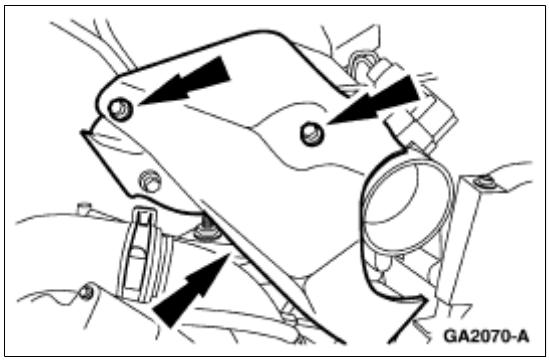
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the spark plug wires. For additional information, refer to Section 303-07A .
3. Drain the cooling system. For additional information, refer to Section 303-03 .
4. Disconnect the crankcase ventilation tube from the valve cover.
5. Disconnect the upper radiator hose from the intake manifold.
6. Disconnect the mass air flow (MAF) sensor and the generator electrical connectors.



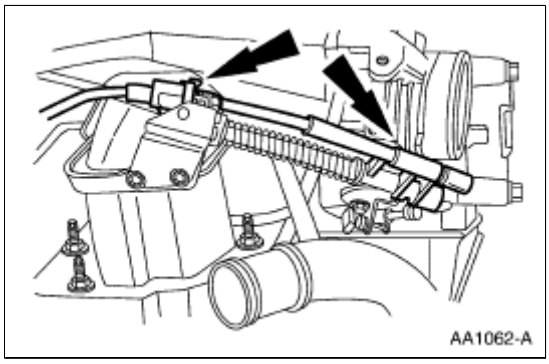
7. Disconnect the heater water hose.



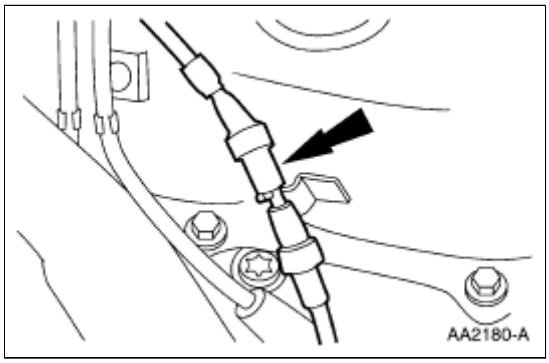
8. Remove the accelerator cable control snow shield.



9. Disconnect the speed control cable (if equipped) and position aside.



10. Disconnect the vacuum line.

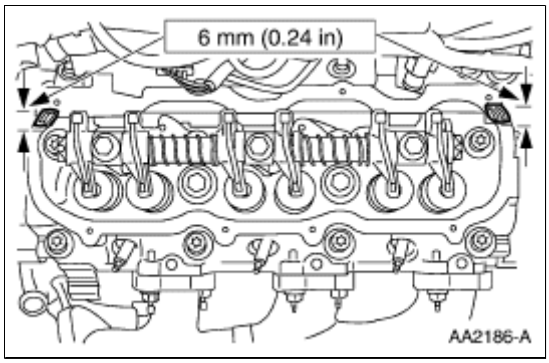


11. Remove the valve cover and the gasket.

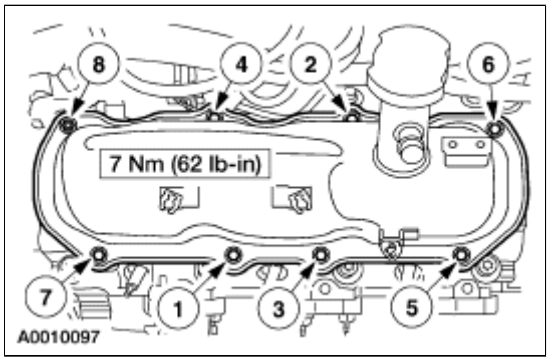
Installation

1. **NOTE:** Clean and inspect the sealing surfaces.

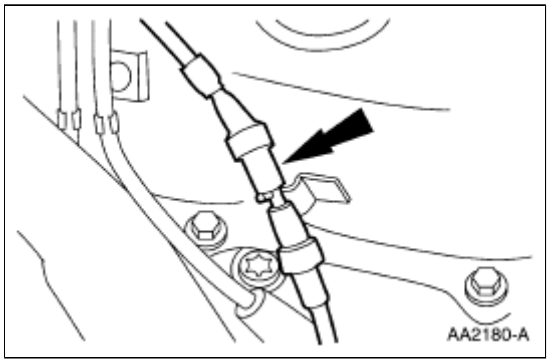
   Apply a bead of silicone rubber in two places.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



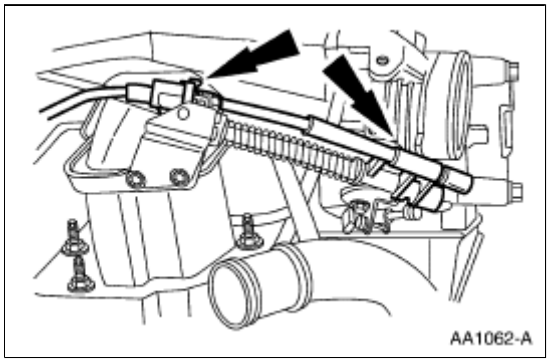
2. Install the valve cover gasket and the valve cover.
    - Tighten the bolts in the sequence shown.



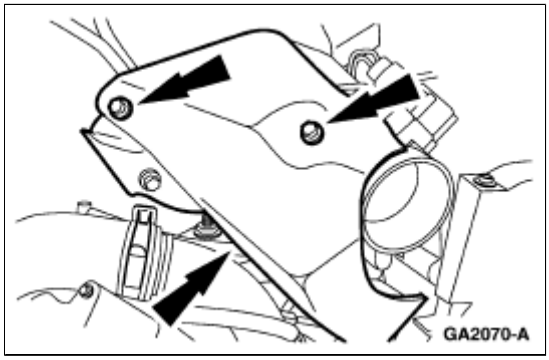
3. Connect the vacuum line.



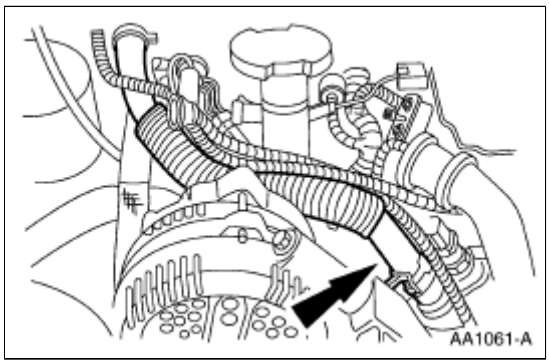
4. Connect the speed control cable (if equipped).



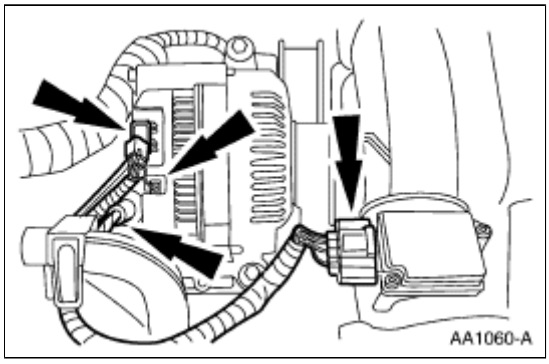
5. Install the accelerator cable snow shield.



6. Connect the heater water hose.



7. Connect the mass air flow (MAF) sensor and the generator electrical connectors.

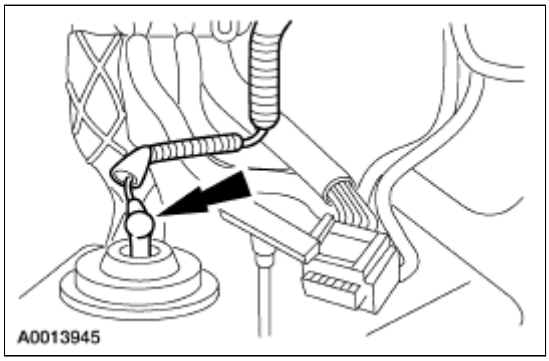


8. Connect the upper radiator hose to the intake manifold.
9. Connect the crankcase ventilation tube to the valve cover.
10. Connect the spark plug wires. For additional information, refer to Section 303-07A .
11. Connect the battery ground cable. For additional information, refer to Section 414-01 .
12. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .

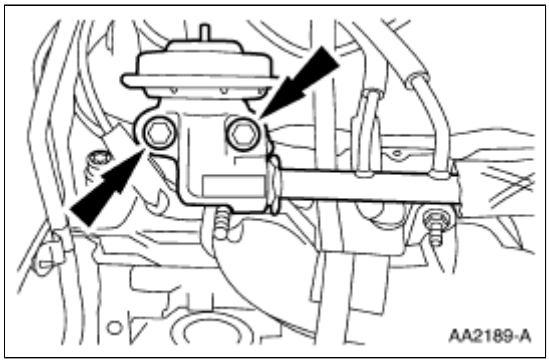
Valve Cover —LH

Removal

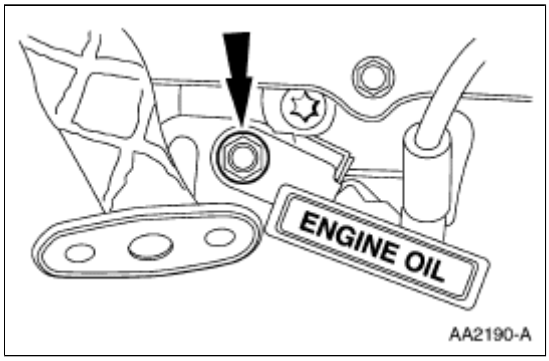
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.
2. Disconnect the EGR valve vacuum line.



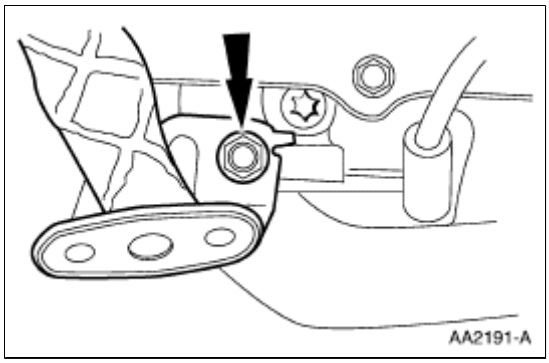
3. Remove the bolts.



4. Remove the oil level indicator tube.



5. Remove the EGR tube and the bracket.

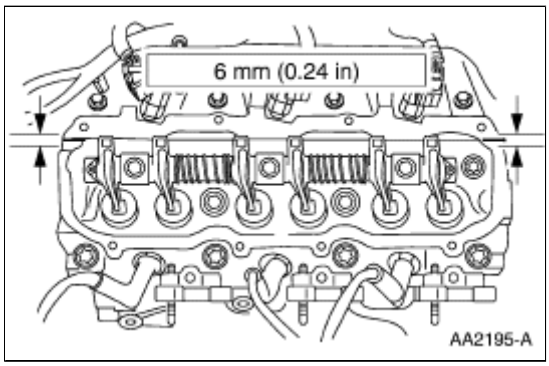


6. Remove the valve cover and the gasket.

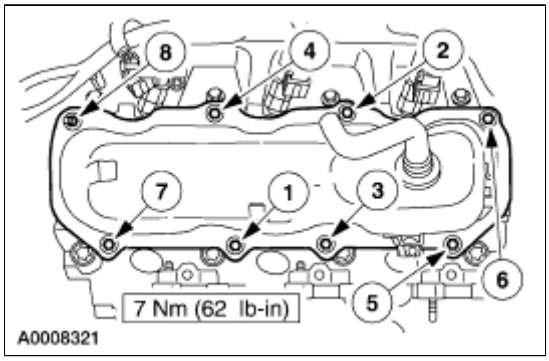
Installation

1. **NOTE:** Clean and inspect the sealing surfaces.

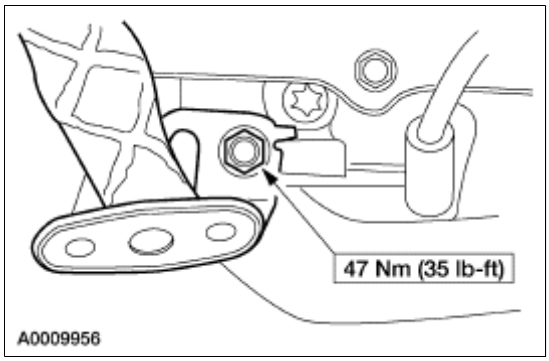
   Apply a bead of silicone rubber in two places.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



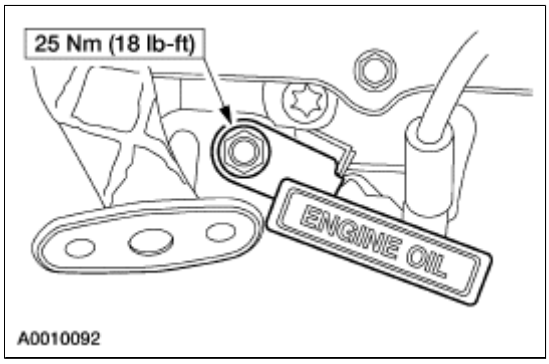
2. Install the valve cover gasket, valve cover and the bolts.
   - Tighten the bolts in the sequence shown.



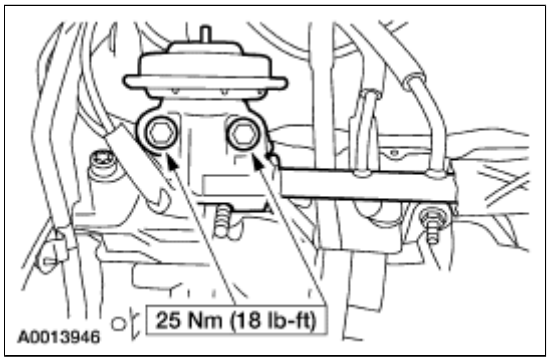
3. Install the EGR tube and the bracket.



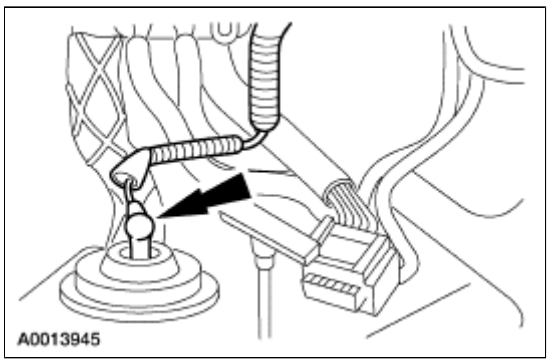
4. Install the oil level indicator tube.



5. Install a new gasket and the EGR valve.



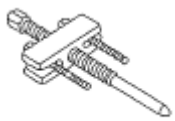
6. Connect the EGR valve vacuum line.



7. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

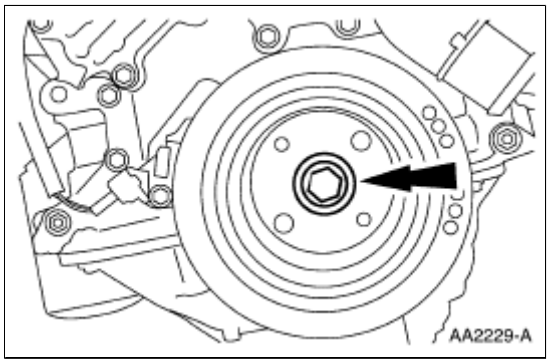
Crankshaft Pulley

Special Tool(s)

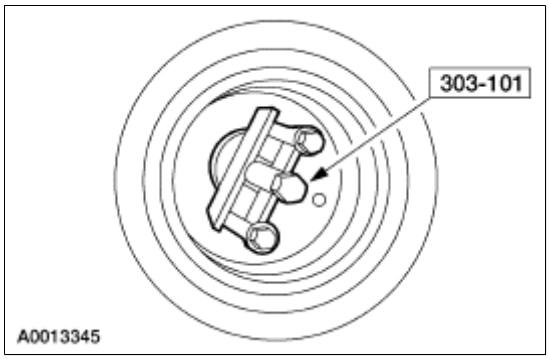
 ST1829-A	Crankshaft Damper Remover 303-101 (T74P-6316-A)
ST2428-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)

Removal

1. Remove the fan and fan shroud. For additional information, refer to Section 303-03 .
2. Remove the drive belt. For additional information, refer to Section 303-05 .
3. Remove the bolt.
   - Discard the bolt.



4. Using the special tool, remove the crankshaft pulley.

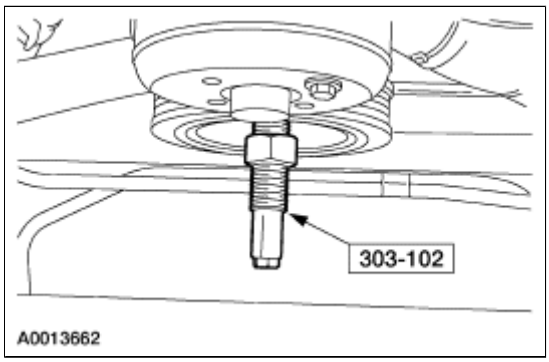


5. If necessary, remove the crankshaft key.

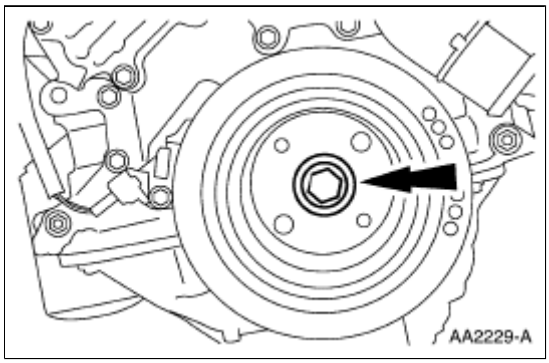
Installation

1. If necessary, install the crankshaft key.

2. Using the special tool, install the crankshaft pulley.
   - Coat the sealing surfaces of the crankshaft damper with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M4G323-G.
   - Coat the crankshaft damper keyway with silicone rubber.
     - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.
   - Install the crankshaft pulley.



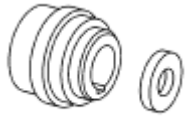
3. Install a new bolt and tighten in two steps.
   1. Tighten to 45 Nm (33 lb-ft).
   2. Tighten an additional 90 degrees.



4. Install the drive belt. For additional information, refer to Section 303-05 .
5. Install the fan and shroud. For additional information, refer to Section 303-03 .

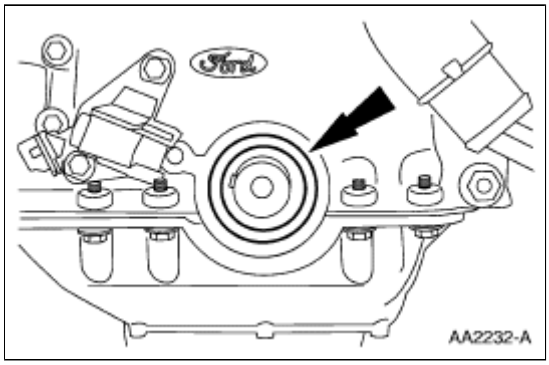
Crankshaft Oil Seal —Front

Special Tool(s)

ST1288-A	Front Cover Seal Remover 303-107 (T74P-6700-A)
ST2428-A	Crankshaft Damper Replacer 303–102 (T74P-6316-B)
 ST2439-A	Front Cover Aligner Replacer 303–093 (T74P-6019-A)

Removal

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
2. Use the Front Cover Seal Remover to remove the seal.



Installation

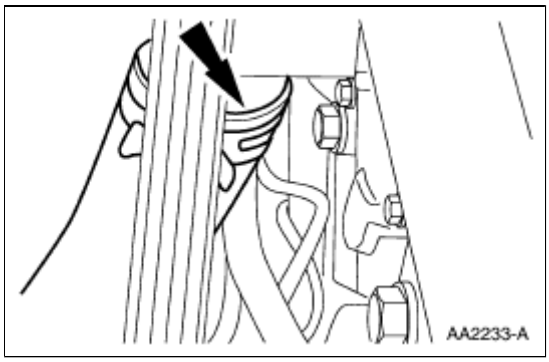
1. Install the front seal.
   - Lubricate the seal lip with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M4G323-G.
   - Using the Crankshaft Damper and Seal Replacer, install the front seal.

2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

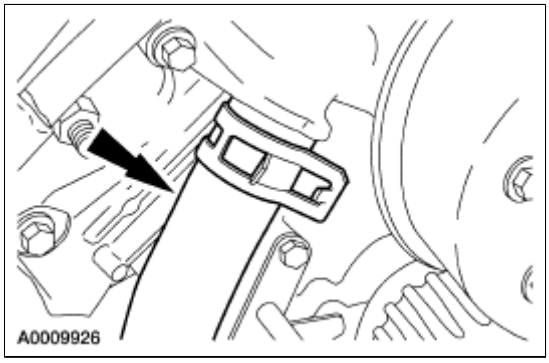
Engine Front Cover

Removal

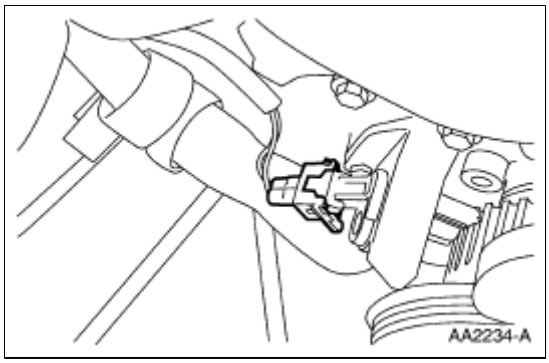
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Drain the engine coolant. For additional information, refer to Section 303-03 .
3. Remove the oil pan. For additional information, refer to Oil Pan in this section.
4. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
5. Disconnect the lower radiator hose.



6. Disconnect the heater water hose from the water pump.

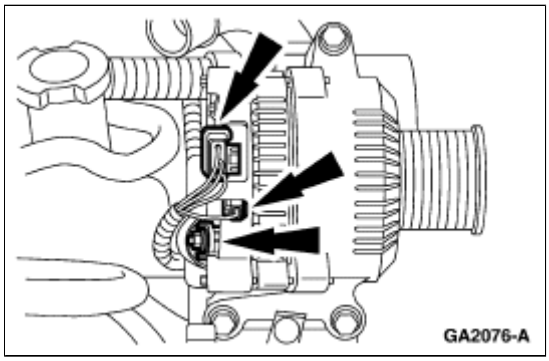


7. Disconnect the crankshaft position (CKP) sensor electrical connector.

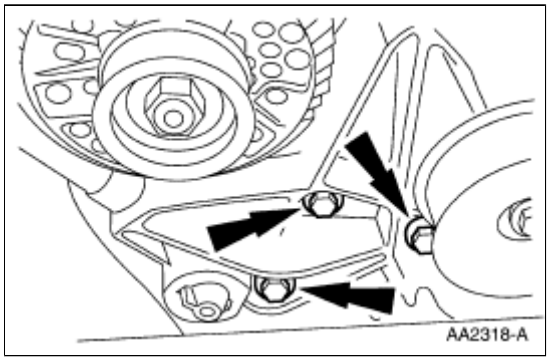


8. Remove the drive belt tensioner. For additional information, refer to Section 303-05 .

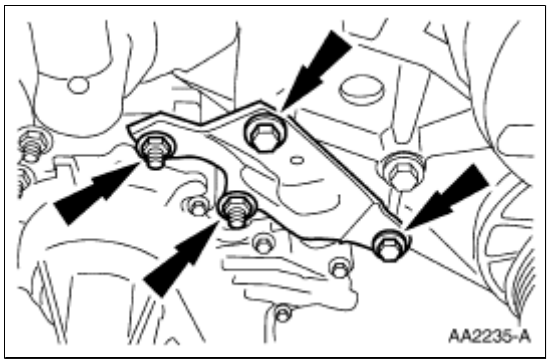
9. Disconnect the generator electrical connectors.



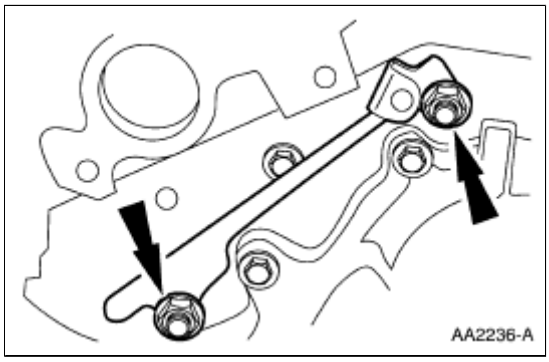
10. Remove the generator mounting bracket.



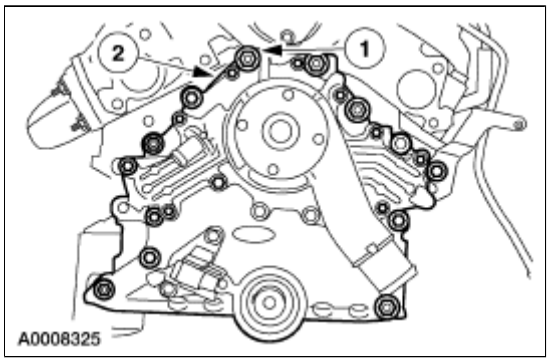
11. Remove the A/C bracket-to-water pump brace.



12. Remove the wire harness retainer.



13. Remove the engine front cover.
    1. Remove the bolts and the nuts.
    2. Remove the front cover and the gasket.

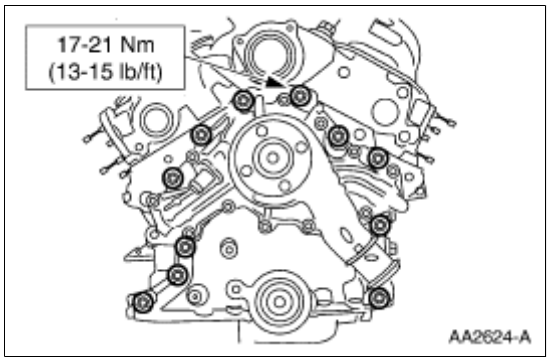


Installation

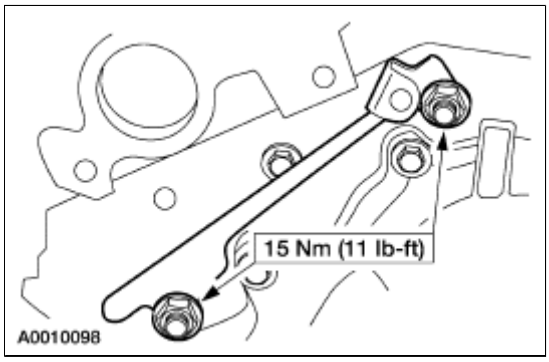
1. Clean and inspect all the sealing surfaces.

2. **NOTE:** Use a straightedge to align the engine front cover and the cylinder block at the oil pan mating surface.

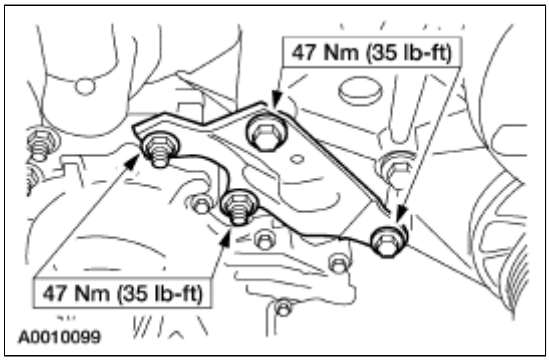
   Install the engine front cover gasket and the front cover.



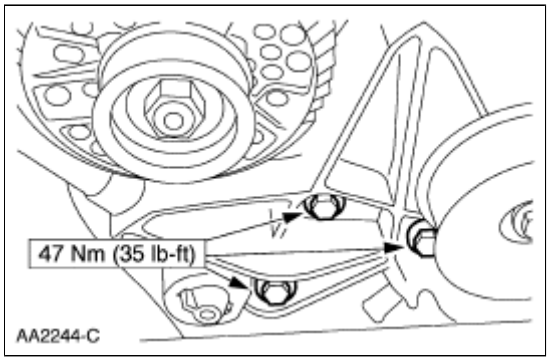
3. Install the wire harness retainer.



4. Install the A/C bracket-to-water pump brace.

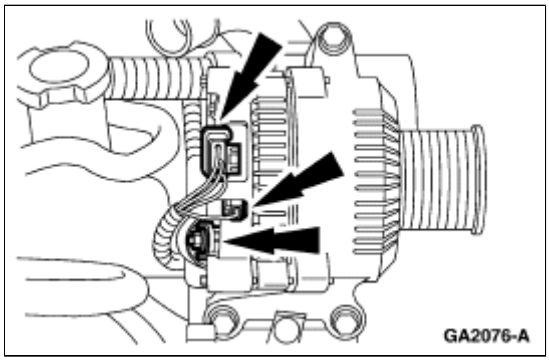


5. Install the generator mounting bracket.

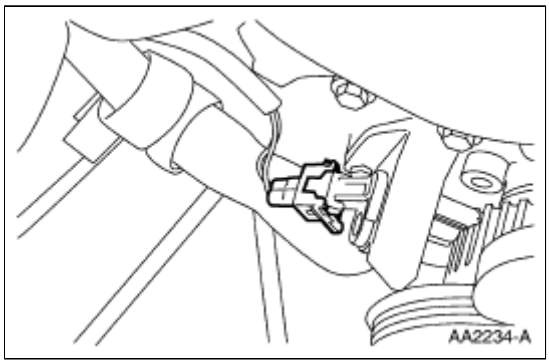


6. Install the drive belt tensioner. For additional information, refer to Section 303-05 .

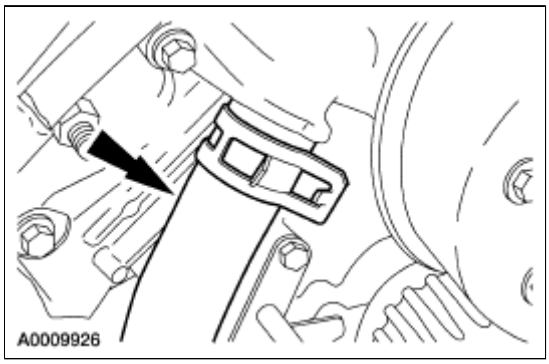
7. Connect the generator electrical connectors.



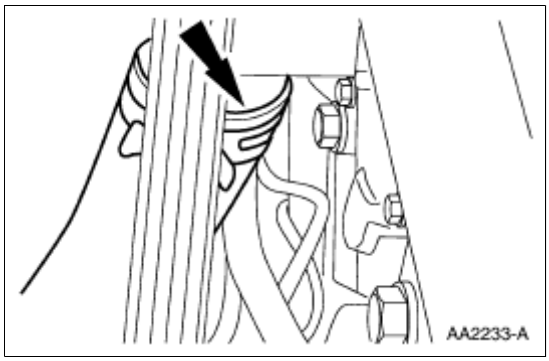
8. Connect the crankshaft position (CKP) sensor electrical connector.



9. Connect the heater water hose to the water pump.



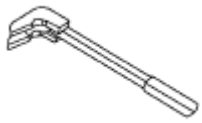
10. Connect the lower radiator hose.



11. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
12. Install the oil pan. For additional information, refer to Oil Pan in this section.
13. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .
14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Valve Spring

Special Tool(s)

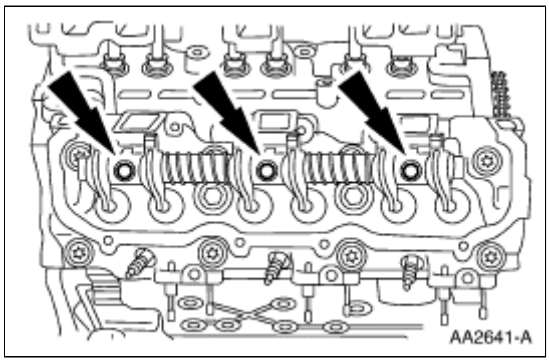
 ST1794-A	Valve Spring Compressor 303-104 (T74P-6565-A)
ST1795-A	Valve Spring Compressor Bar 303-105 (T74P-6565-B)

Removal

1. Remove the valve covers. For additional information, refer to Intake Manifold—Upper and Intake Manifold—Lower in this section.

2. **CAUTION: If the rocker arm shaft is not loosened gradually, the shaft may become bent during removal.**

   Remove the rocker arm shaft assembly.

   
   AA2641-A

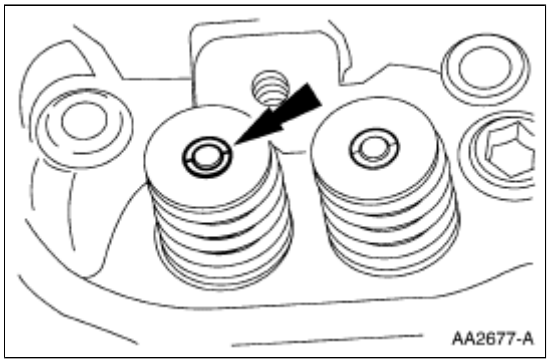
3. Remove the spark plugs. For additional information, refer to Section 303-07A .

4. Position the piston at top dead center.

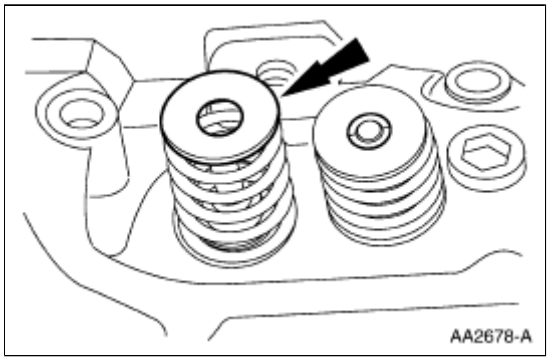
5. **CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this from happening and still allow enough travel to check the valve for binds and excessive guide-to-valve stem clearance.**

Use a suitable tool to apply air pressure to the cylinder.

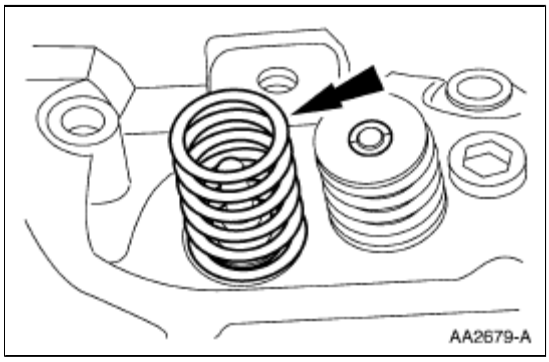
6. Using the Valve Spring Compressor Bar and the Valve Spring Compressor, remove the valve spring retainer key.



7. Remove the valve spring retainer.



8. Remove the valve spring.



9. Inspect the valve spring. For additional information, refer to Section 303-00 .

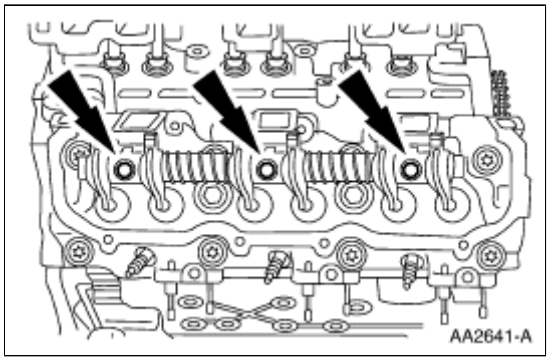
Installation

1. To install, reverse the removal procedure.

2. **NOTE:** If the rocker arm shaft is not tightened gradually, the shaft may become bent during installation.

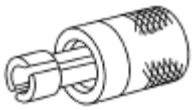
Install the rocker arm shaft assembly and tighten in two steps:

1. Tighten to 32 Nm (24 lb-ft).
2. Tighten an additional 90 degrees.



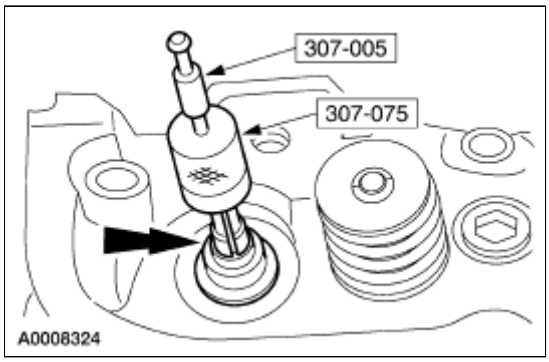
Valve Seal

Special Tool(s)

ST1824-A	Valve Stem Seal Replacer 303-370 (T90T-6571-A)
ST1187-A	Impact Hammer 307-005 (T59L-100-B)
 ST2114-A	Valve Seal Remover 303-075 (T72J-6571)

Removal

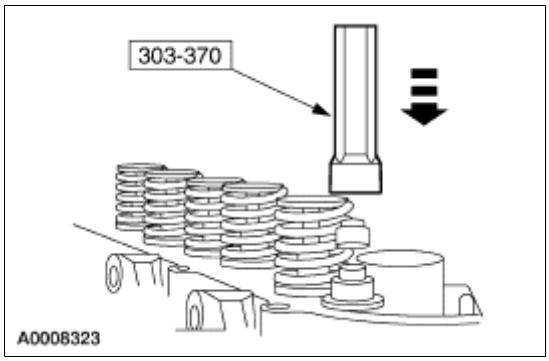
1. Remove the valve spring. For additional information, refer to Valve Spring in this section.
2. Using the special tools, remove the valve stem seal.



Installation

1. **NOTE:** Lubricate the valve stem with Super Premium SAE 5W-30 Motor Oil X0-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   Use the special tool to install the valve stem seal.



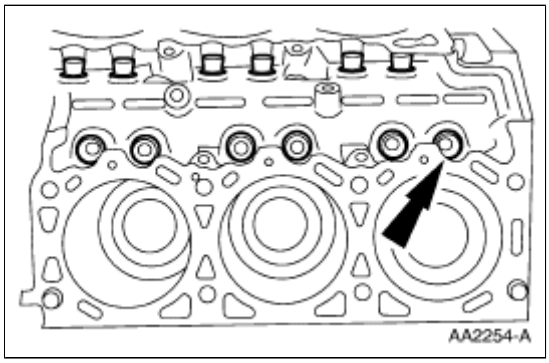
2. Install the valve spring. For additional information, refer to Valve Spring in this section.

Valve Tappet

Removal and Installation

1. Remove the cylinder heads. For additional information, refer to Cylinder Head in this section.
2. **NOTE:** Mark the valve tappets to make sure they are reinstalled in their original location.

   Remove the valve tappets.



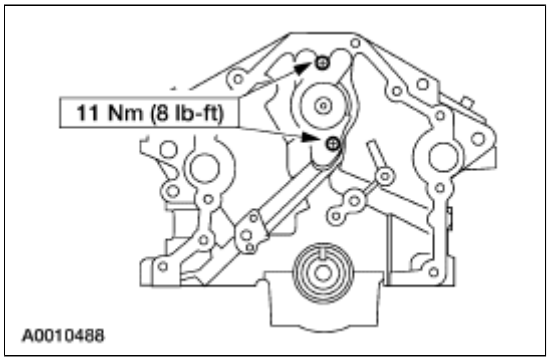
3. Inspect the valve tappets. For additional information, refer to Section 303-00 .
4. **NOTE:** Lubricate the valve tappets and bore with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   To install, reverse the removal procedure.

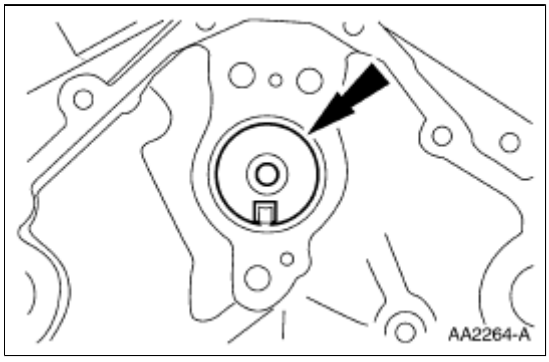
Camshaft

Removal and Installation

1. Remove the valve tappets. For additional information, refer to Valve Tappet in this section.
2. Remove the timing chain. For additional information, refer to Timing Chain in this section.
3. Remove the camshaft synchronizer. For additional information, refer to Section 303-14 .
4. Remove the camshaft thrust plate.



5. Remove the camshaft.

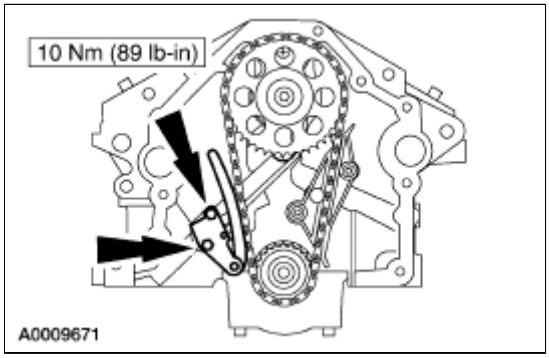


6. To install, reverse the removal procedure.

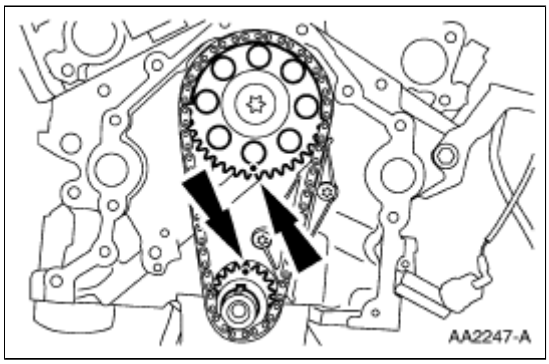
Timing Chain

Removal and Installation

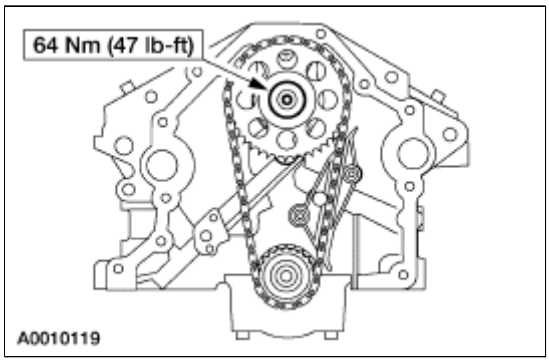
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Remove the timing chain tensioner.



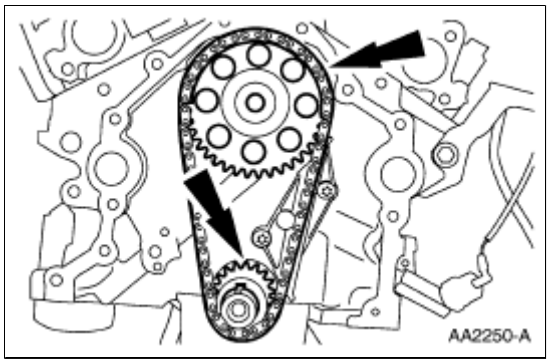
3. Align the timing marks.



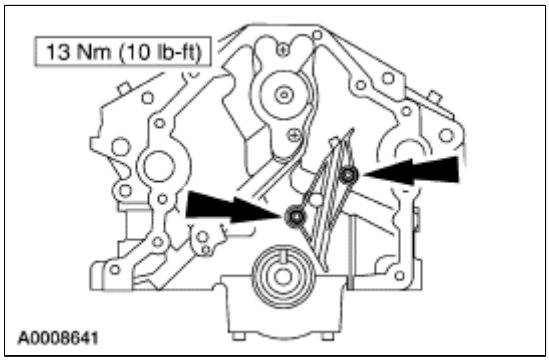
4. Remove the bolt.



5. Remove the timing chain and the timing gears as an assembly.



6. Remove the timing chain guide.

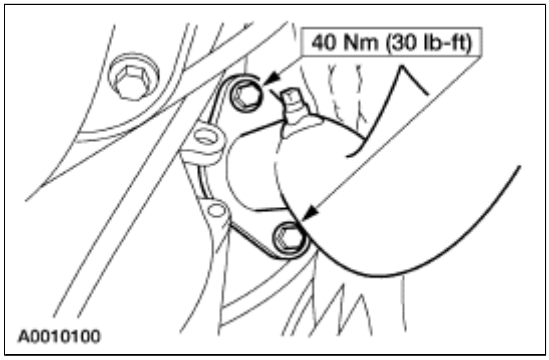


7. To install, reverse the removal procedure.

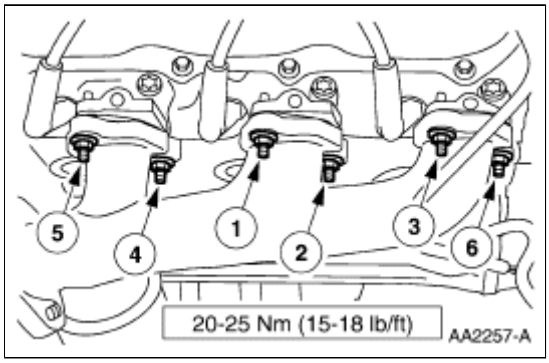
Exhaust Manifold —RH

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts.



3. Lower the vehicle.
4. Remove the exhaust manifold and the gasket.

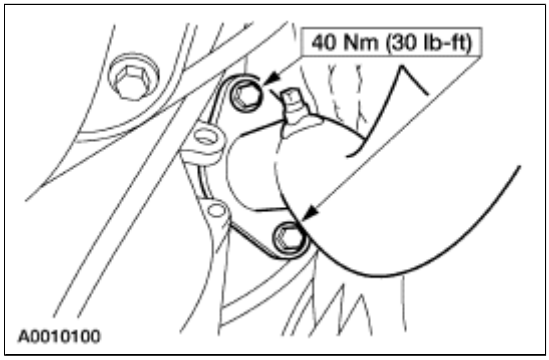


5. To install, reverse the removal procedure.

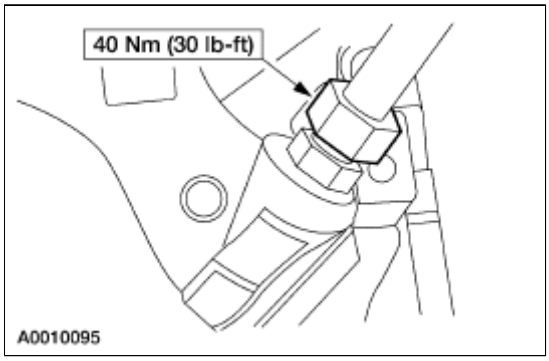
Exhaust Manifold —LH

Removal and Installation

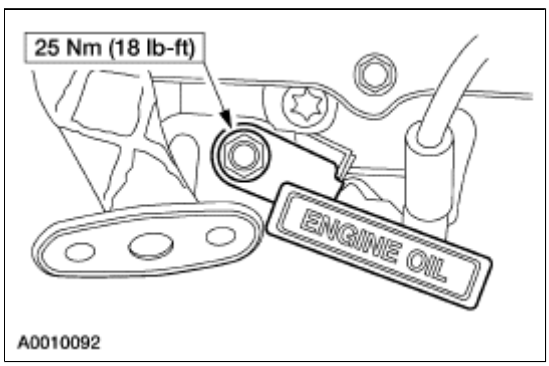
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts.



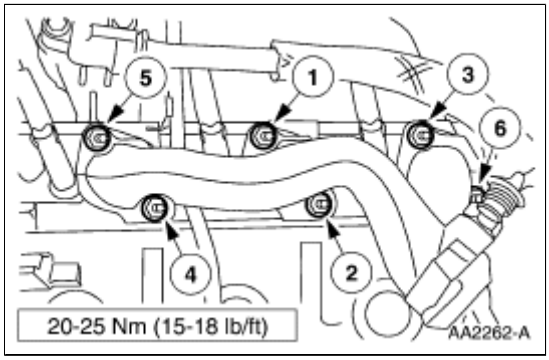
3. Lower the vehicle.
4. Disconnect the EGR valve to exhaust manifold tube.



5. Remove the oil level indicator tube.



6. Remove the exhaust manifold and the gasket.

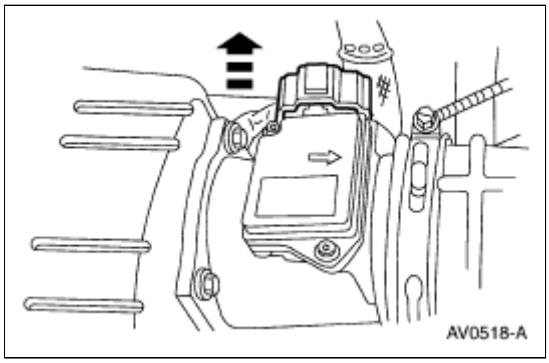


7. To install, reverse the removal procedure.

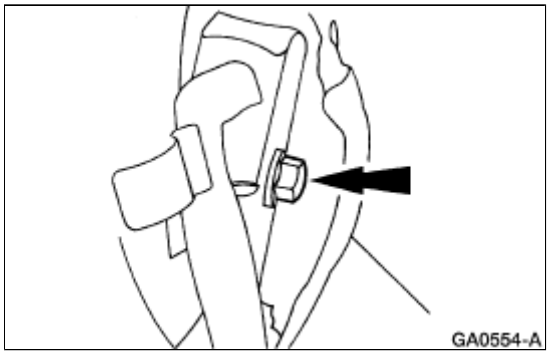
Cylinder Head

Removal

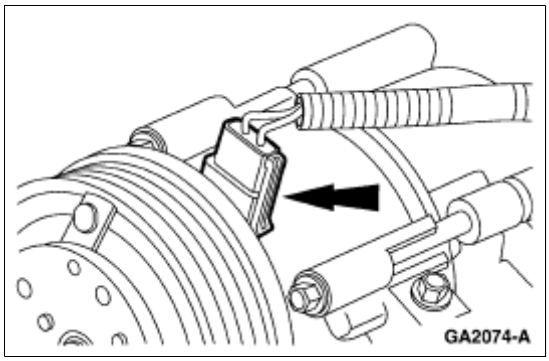
1. Remove the accelerator control splash shield.
2. Remove the drive belt tensioner. For additional information, refer to Section 303-05 .
3. Disconnect the mass air flow sensor electrical connector.



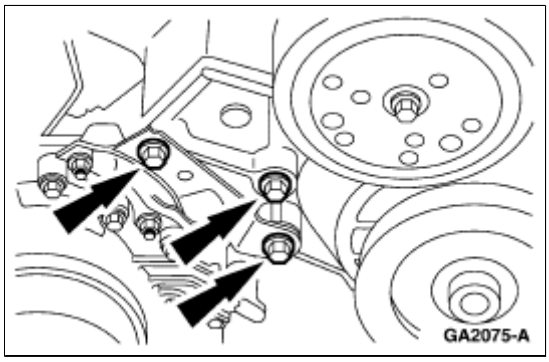
4. Recover the A/C system. For additional information, refer to Section 412-03 .
5. Loosen the bolt and separate the A/C manifold tube from the A/C compressor.



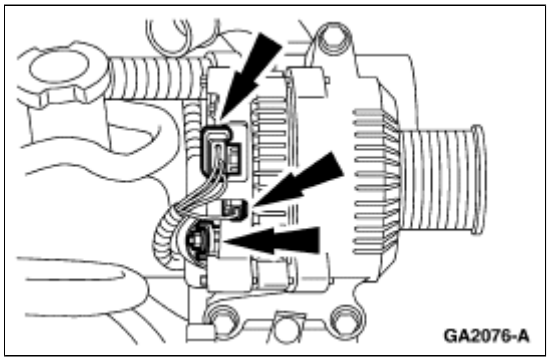
6. Disconnect the A/C compressor electrical connector.



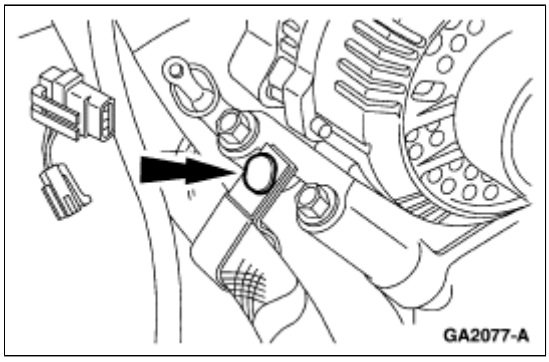
7. Position the A/C compressor mounting bracket aside.



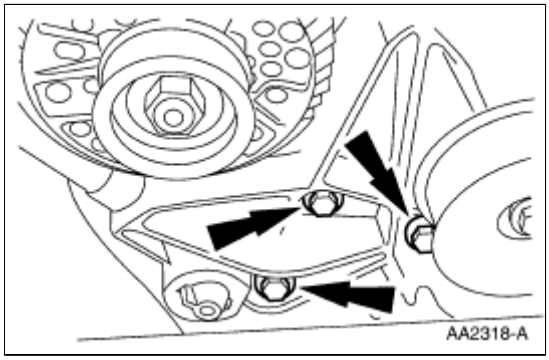
8. Disconnect the generator electrical connectors.



9. Disconnect the heater hose retaining clip and position the heater water hose aside.



10. Remove the generator mounting bracket.



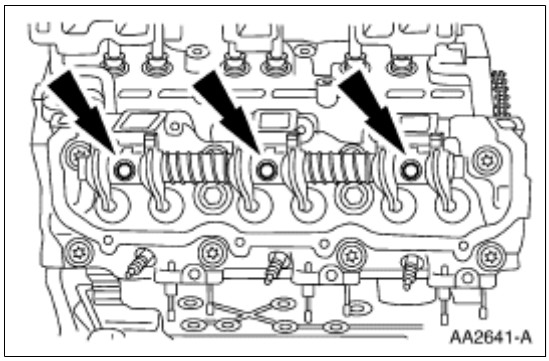
11. Remove the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.

12. Remove the LH and RH exhaust manifolds. For additional information, refer to Exhaust Manifold—LH and Exhaust Manifold—RH in this section.

13. Remove the cylinder head-to-bulkhead ground strap.

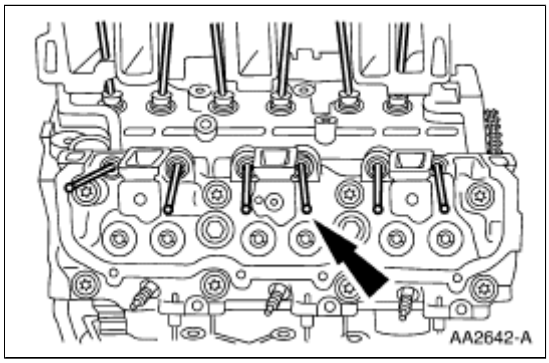
14. **CAUTION: If the rocker arm shaft is not loosened gradually, the shaft may become bent during removal.**

    Remove the RH and LH rocker arm shafts.



15. **NOTE:** Mark the position of the push rods so they can be reinstalled in their original position.

    Remove the push rods.



16. Remove the cylinder heads and the gaskets.

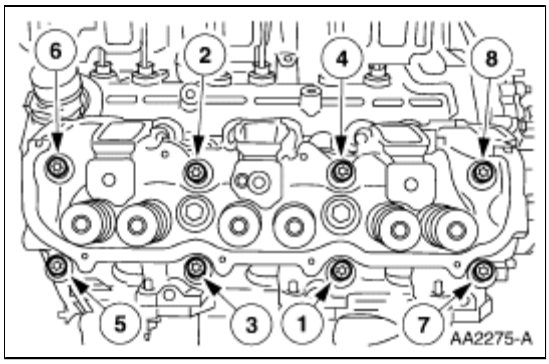
Installation

1. Clean and inspect all sealing surfaces.

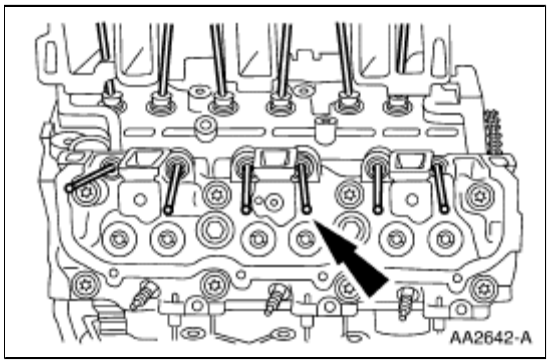
2. **NOTE:** New bolts must be used.

   NOTE: The head gaskets are not interchangeable and are marked for either right or left side use.

   Position the cylinder head and gasket and install the new bolts in three steps:
   1. Tighten to 34 Nm (25 lb-ft).
   2. Tighten to 72 Nm (53 lb-ft).
   3. Tighten an additional 90 degrees.

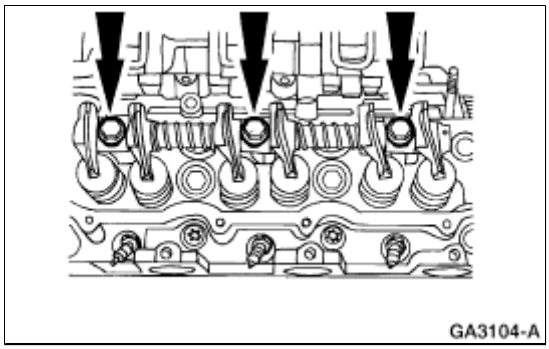


3. Install the push rods.



4. **CAUTION: Tighten the rocker arm shaft gradually or it may become bent during installation.**

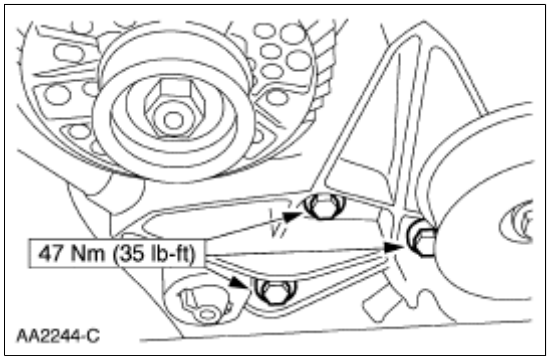
   Install the rocker arm and shaft assembly and tighten the bolts in two steps:
   1. Tighten to 33 Nm (24 lb-ft).
   2. Tighten an additional 90 degrees.



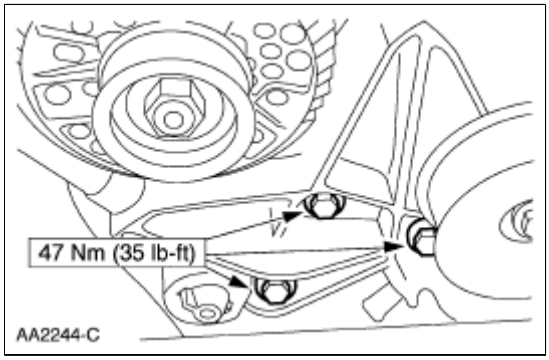
5. Install the cylinder head-to-bulkhead ground strap.

6. Install the LH and RH exhaust manifolds. For additional information, refer to Exhaust Manifold—LH and Exhaust Manifold—RH in this section.

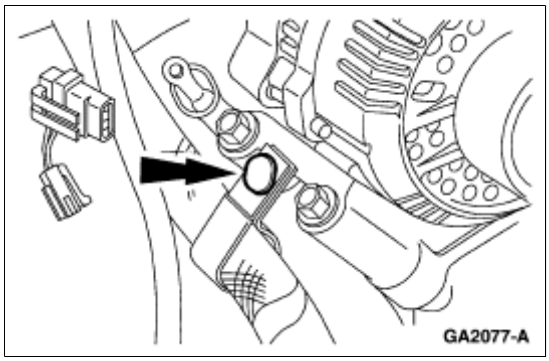
7. Install the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.



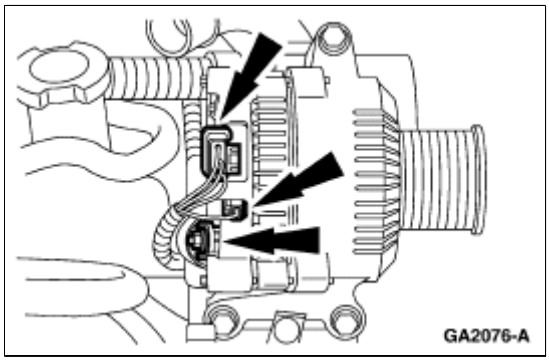
8. Install the generator mounting bracket.



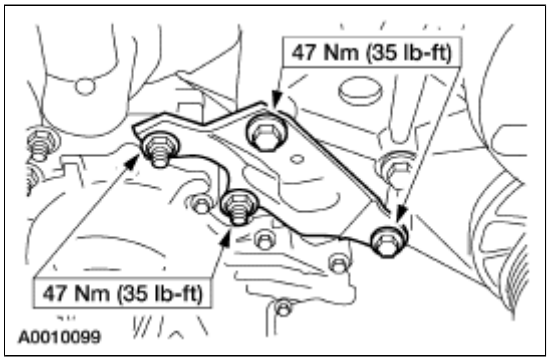
9. Connect the heater hose retaining clip.



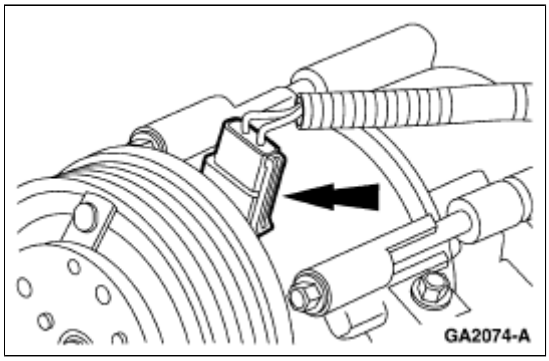
10. Connect the generator electrical connectors.



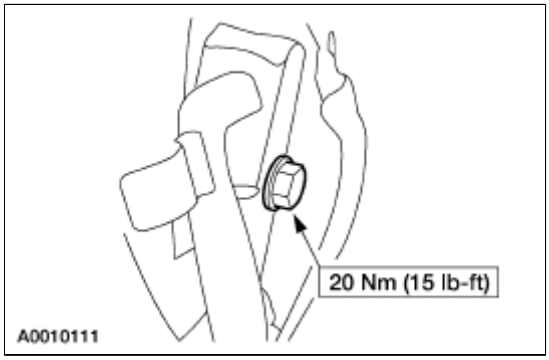
11. Install the A/C compressor mounting bracket.



12. Connect the A/C compressor electrical connector.



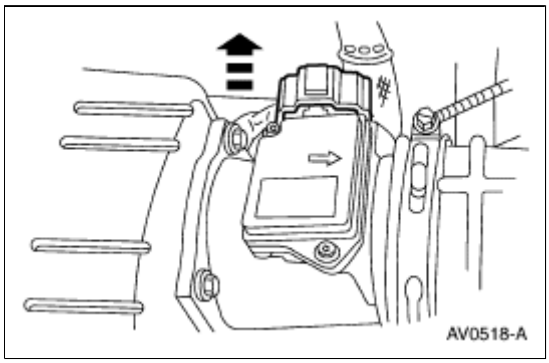
13. Install the A/C manifold tube to the A/C compressor.



14. Recharge the A/C system. For additional information, refer to Section 412-00 .

15. Install the drive belt tensioner. For additional information, refer to Section 303-05 .

16. Connect the mass air flow sensor electrical connector.

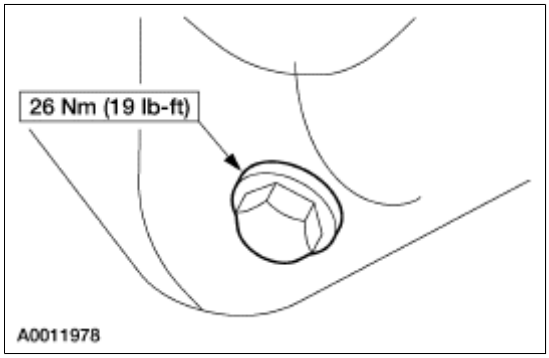


17. Install the accelerator control splash shield.

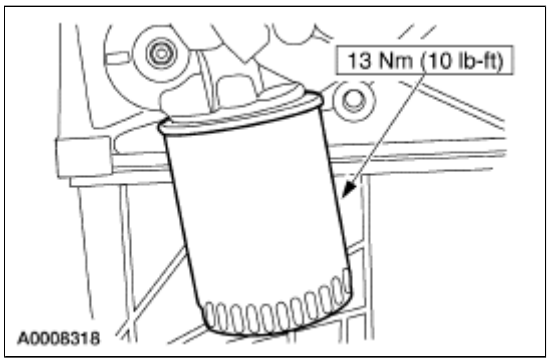
Oil Filter Adapter

Removal and Installation

1. Drain the engine oil.

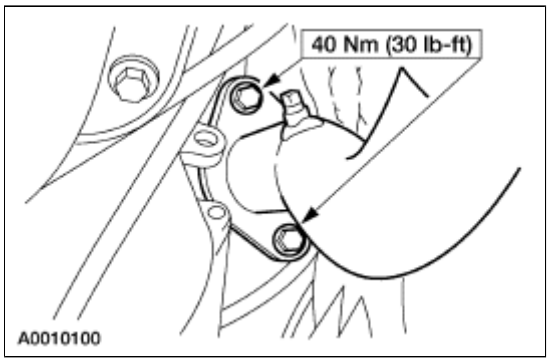


2. Remove the oil bypass filter.

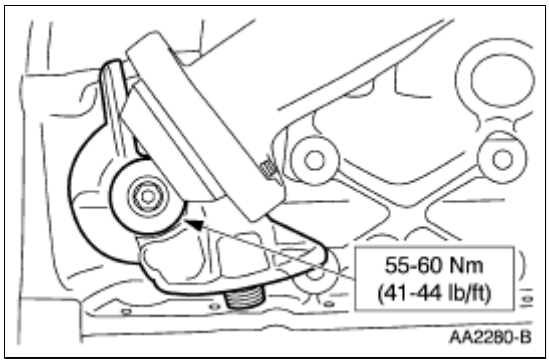


NOTE: RH side is shown, LH side is similar.

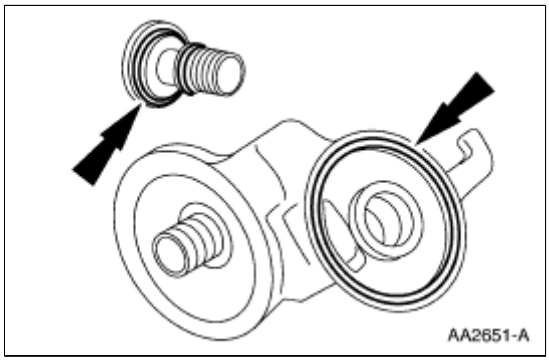
3. Disconnect the exhaust pipe from the exhaust manifolds.



4. Remove the oil filter adapter.



5. Inspect and install new O-ring seals if necessary.

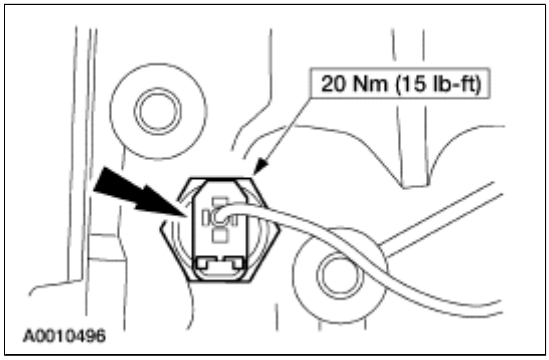


6. To install, reverse the removal procedure.

Oil Pressure Switch

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the oil pressure sensor electrical connector and remove the sensor.



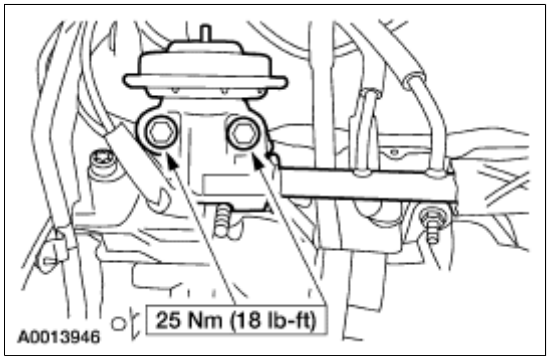
3. **NOTE:** Coat the threads of the oil pressure sensor with Pipe Sealant with Teflon®D8AZ-19554-A or equivalent meeting Ford specifications WSK-M2G350-A2 and ESR-M18P7-A.

   To install, reverse the removal procedure.

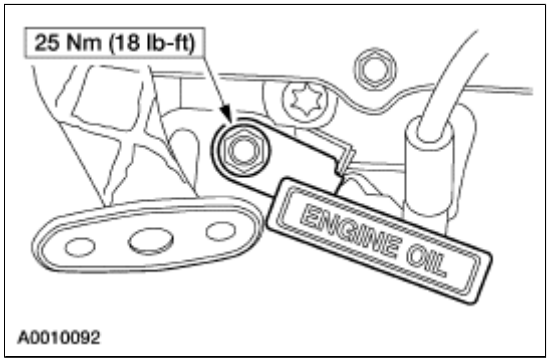
Oil Level Indicator and Tube

Removal and Installation

1. Remove the EGR valve.



2. Remove the oil level indicator tube.



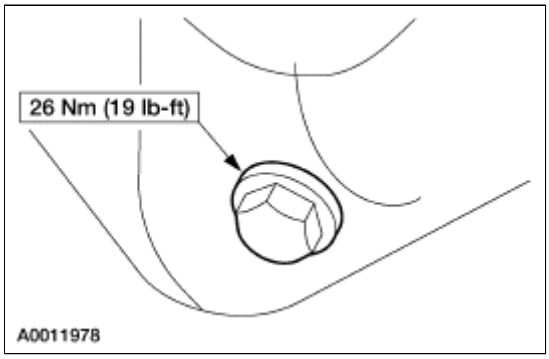
3. To install, reverse the removal procedure.

Oil Pan

Removal

On All Vehicles

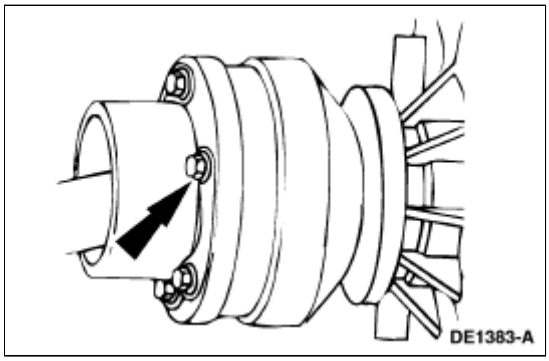
1. Check vehicle ride height. For additional information, refer to Section 204-05 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Drain the engine oil and reinstall the drain plug.



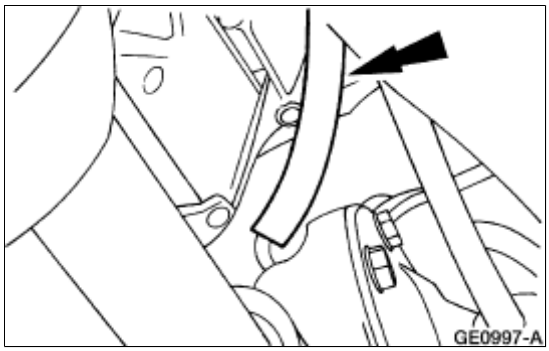
4. Remove both front torsion bars. For additional information, refer to Section 204-01A (Front Suspension—4x2) or Section 204-01B (Front Suspension—4x4).

For 4WD Vehicles

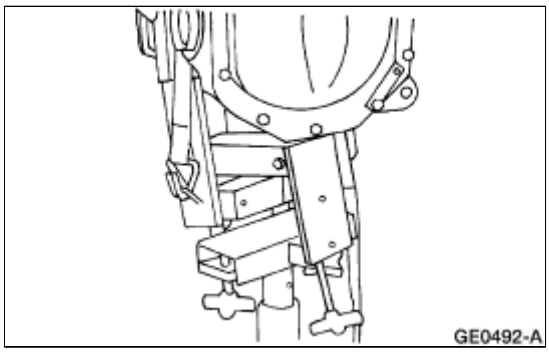
5. Disconnect the front driveshaft CV joint and position aside.



6. Disconnect the axle vent tube.

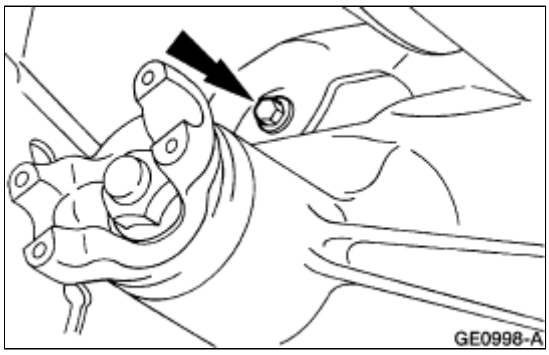


7. Support the axle with a suitable jack.



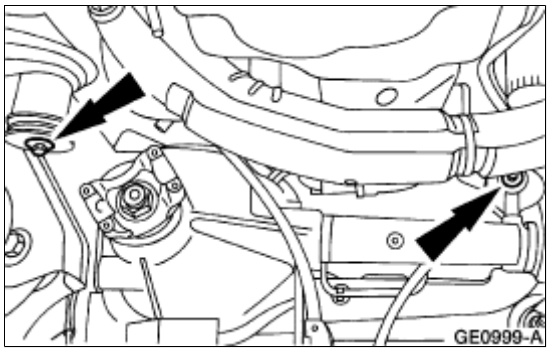
8. **NOTE:** Front driveshaft removed for clarity.

   Remove the left front axle-to-frame bolt.



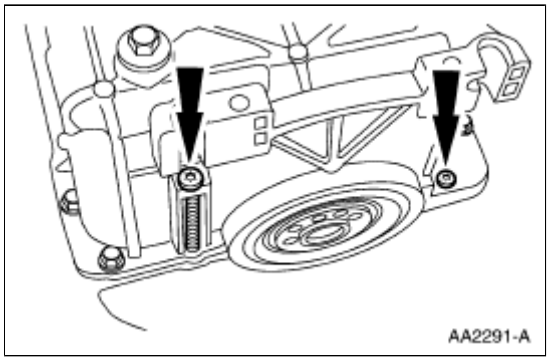
9. **NOTE:** Front driveshaft removed for clarity.

   Remove the two axle-to-frame bolts. Lower the axle to just rest on the lower control arms.

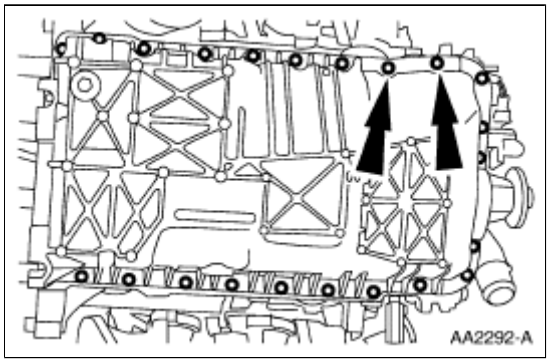


On All Vehicles

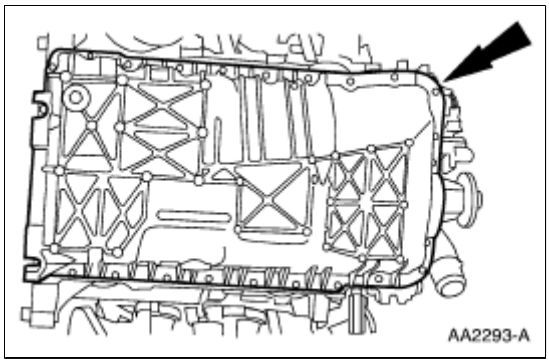
10. Remove the starter motor. For additional information, refer to Section 303-06 .
11. Remove the bolts.



12. Remove the bolts and the nuts.



13. Remove the oil pan and the gasket.

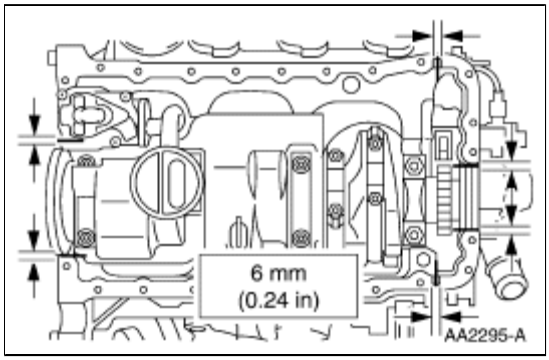


Installation

On All Vehicles

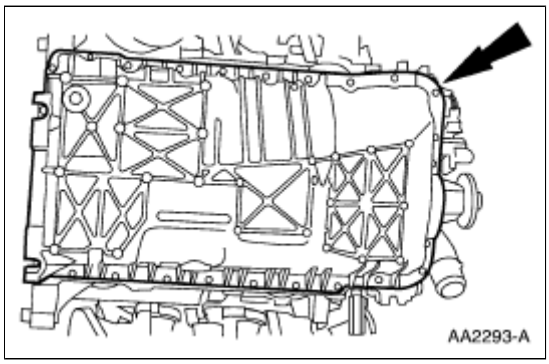
1. Clean and inspect the sealing surfaces.

2. Apply a bead of silicone rubber in six places. Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.

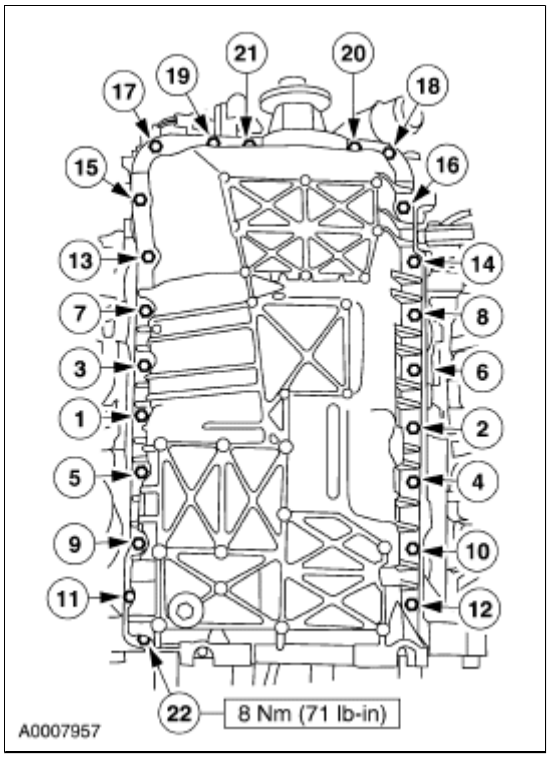


3. **NOTE:** Use a straightedge to maintain the rear oil pan edge-to-rear cylinder block edge alignment.

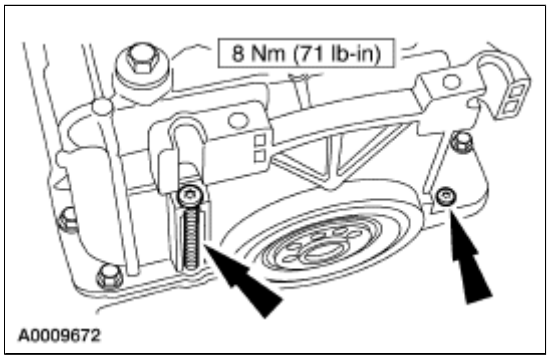
   Position the gasket and the oil pan.



4. Install the bolts and nuts and tighten in the sequence shown.



5. Install the bolts.

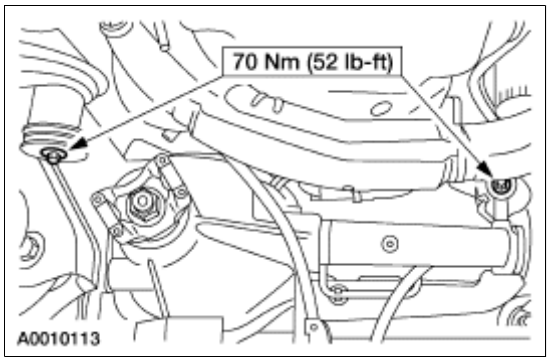


6. Install the starter motor. For additional information, refer to Section 303-06 .

For 4WD Vehicles

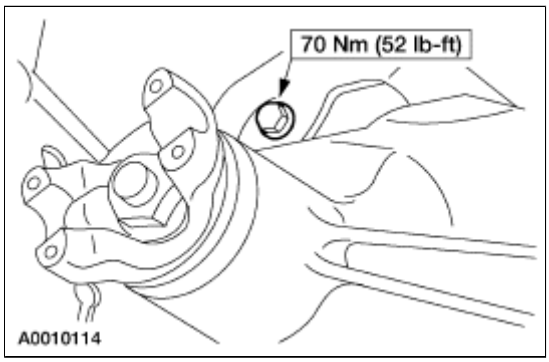
7. **NOTE:** Front driveshaft removed for clarity.

   Raise the axle and install the two axle-to-frame bolts and nuts.

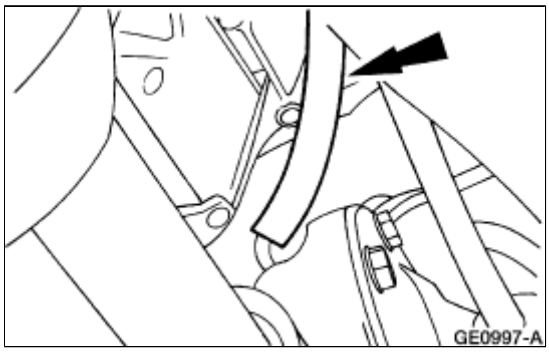


8. **NOTE:** Front driveshaft removed for clarity.

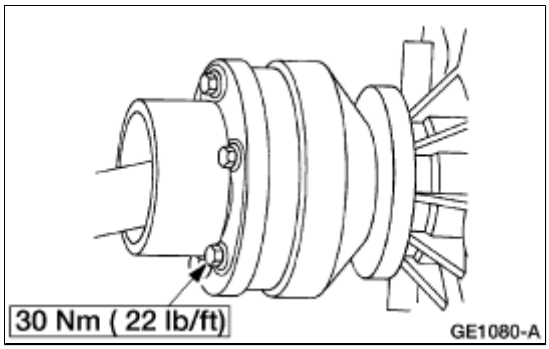
   Install the left front axle-to-frame bolt and nut.



9. Remove the jack from the axle.
10. Connect the axle vent tube.



11. Connect the front driveshaft CV joint.



On All Vehicles

12. Install the front torsion bars. For additional information, refer to Section 204-01A (Front Suspension—4x2) or Section 204-01B (Front Suspension—4x4).

13. Lower the vehicle.

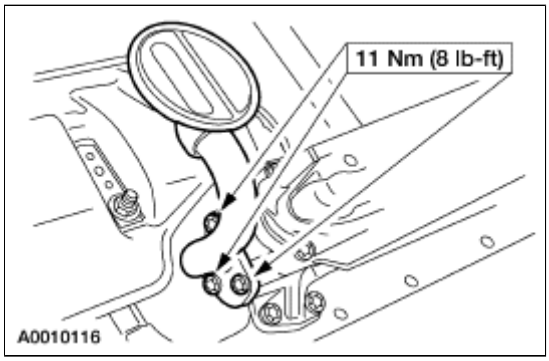
14. Fill the engine with Super Premium SAE 5W-30 Motor Oil X0-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

15. Check vehicle ride height. For additional information, refer to Section 204-05 .

Oil Pump Screen and Pickup Tube

Removal and Installation

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the oil pump screen cover and tube.
   - Discard the gasket.

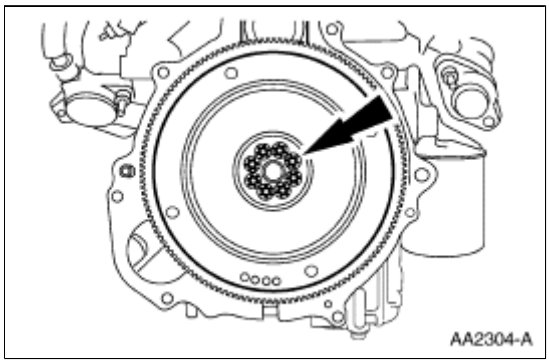


3. Clean and inspect the sealing surfaces.
4. To install, reverse the removal procedure.

Flywheel

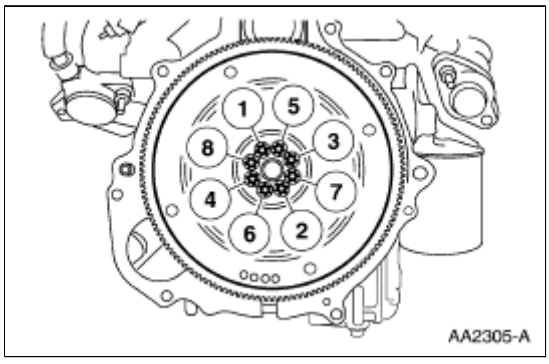
Removal

1. Remove the transmission. For additional information, refer to Section 307-01A (5R55E) for automatic transmissions or Section 308-03 for manual transmissions.
2. On manual transmission-equipped vehicles, remove the clutch. For additional information, refer to Section 308-02 .
3. Remove the flywheel.



Installation

1. Inspect the flywheel. For additional information, refer to Section 308-00 .
2. Install the spacer, flywheel, and tighten the bolts in sequence in two steps:
    1. Tighten to 13 Nm (10 lb-ft).
    2. Tighten to 71 Nm (52 lb-ft).



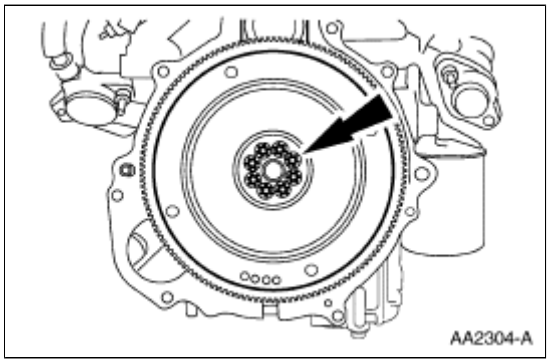
3. On manual transmission-equipped vehicles, install the clutch. For additional information, refer to Section 308-02 .
4. Install the transmission. For additional information, refer to Section 307-01A (5R55E) for automatic transmissions or Section 308-02 for manual transmissions.

Flexplate

Removal

1. Remove the transmission. For additional information, refer to Section 307-01A (4R44E) or Section 307-01B (5R55E).

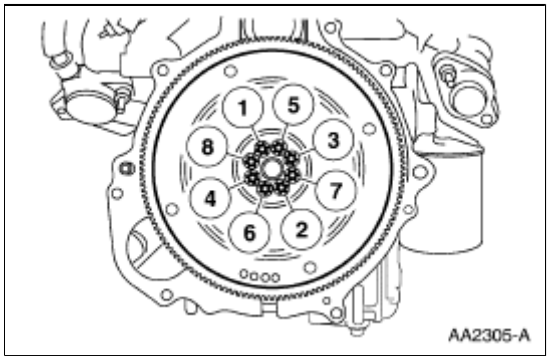
2. Remove the bolts and the flexplate.



Installation

1. Position the spacer and the flexplate and install the bolts. Tighten the bolts in the sequence shown in two stages.
   - Stage 1: Tighten to 13 Nm (10 lb-ft).
   - Stage 2: Tighten to 71 Nm (52 lb-ft).

2. Install the transmission. For additional information, refer to Section 307-01A (4R44E) or Section 307-01B (5R55E).



Crankshaft Rear Oil Seal

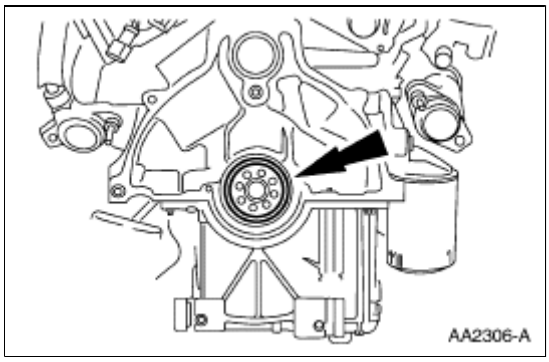
Special Tool(s)

ST1785-A	Rear Oil Seal Replacer 303-S524 (T95T-6701-AR)
ST2132-A	Rear Crank Seal Replacer 303-579 (T97T-6701-A)

Removal

1. Remove the flexplate or flywheel. For additional information, refer to Flexplate or Flywheel in this section.

2. Remove the crankshaft rear oil seal using a punch and a jet plug remover.

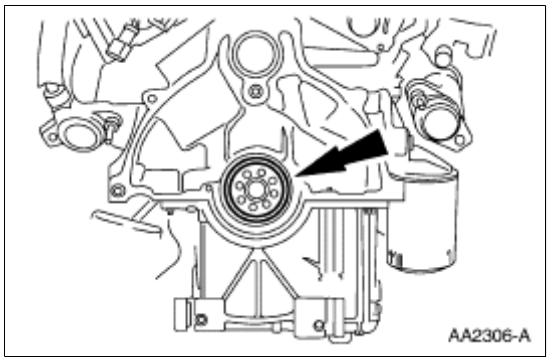


Installation

1. **NOTE:** Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   Lubricate the inner seal lip on the crankshaft rear oil seal.

2. Install the crankshaft rear oil seal using the Rear Oil Seal Replacer.

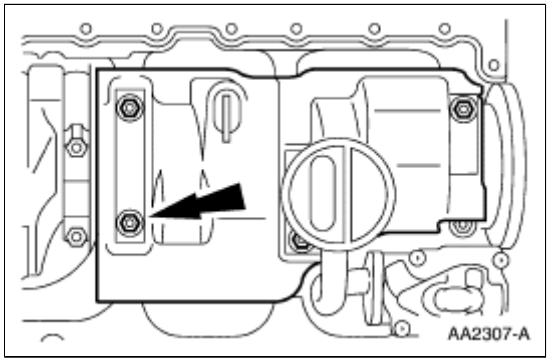


3. Install the flexplate or flywheel. For additional information, refer to Flexplate or Flywheel in this section.

Crankshaft Main Bearing

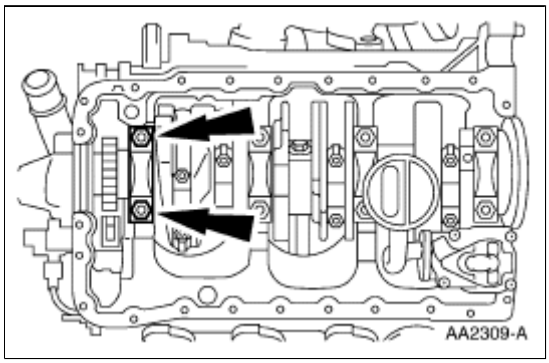
Removal

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the oil pan baffle.

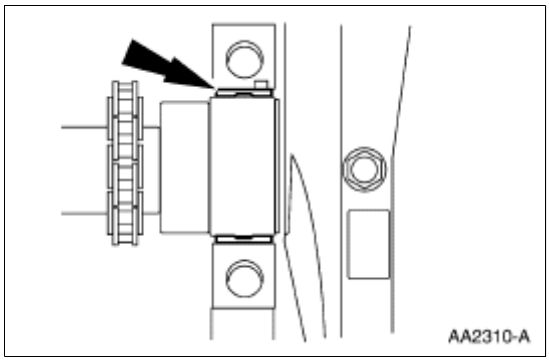


3. **CAUTION: The crankshaft main bearings must be inspected and new bearings installed one set at a time or damage to the engine may occur.**

   Remove one crankshaft main bearing cap.



4. Remove the crankshaft main bearing.



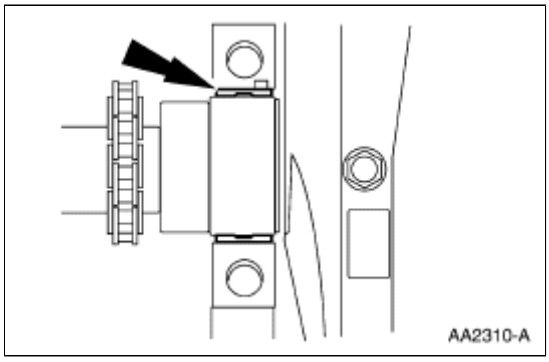
5. Repeat the procedure until all the crankshaft main bearings are removed.

Installation

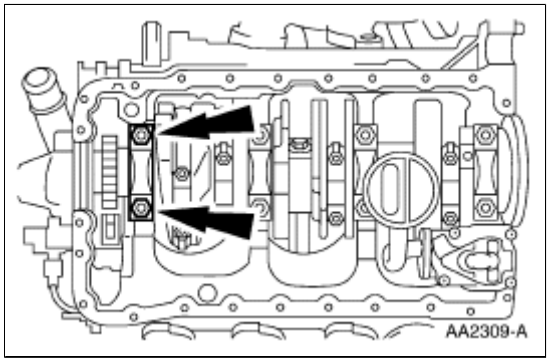
1. The crankshaft main bearings are precision fit; refer to Section 303-00 for checking clearances or bearing selection.

2. **NOTE:** Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   Install the crankshaft main bearing.

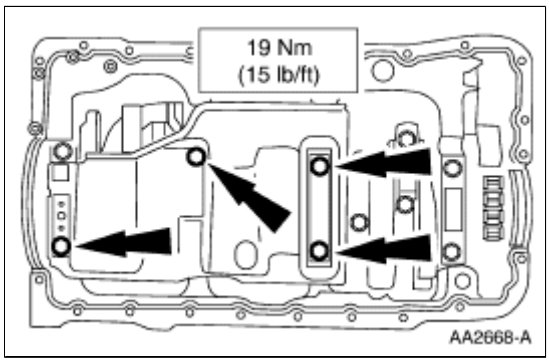


3. Install the crankshaft main bearing cap. Tighten the bolts in pairs in two steps:
   1. Tighten to 35 Nm (26 lb-ft).
   2. Tighten to 97 Nm (72 lb-ft).



4. Repeat the procedure until all the crankshaft main bearings are installed.

5. Install the oil pan baffle.

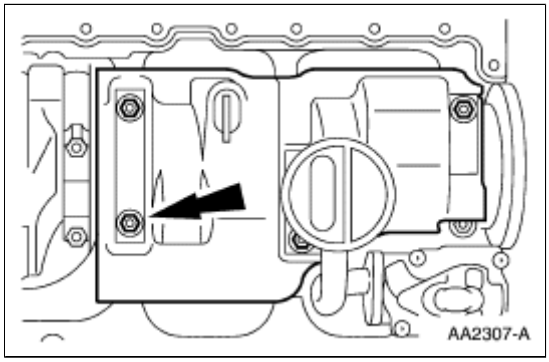


6. Install the oil pan. For additional information, refer to Oil Pan in this section.

Connecting Rod Bearings

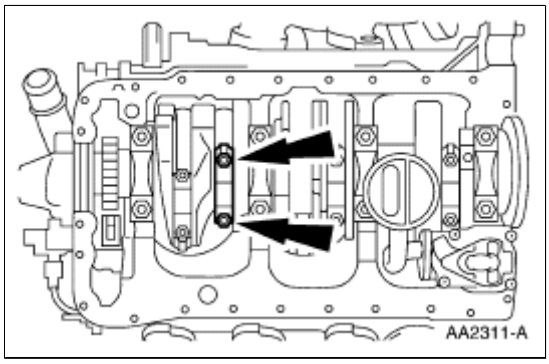
Removal

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the oil pan baffle.

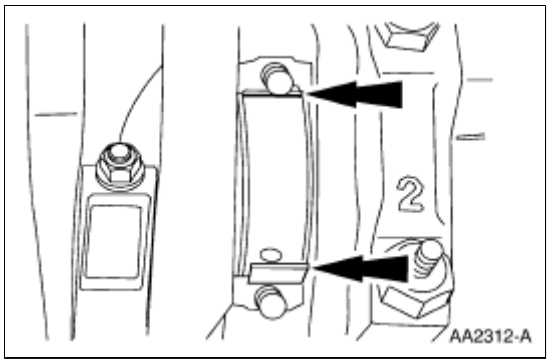


3. **CAUTION: The connecting rod bearing caps and the connecting rods are a matched set. Installing the incorrect connecting rod bearing cap on a connecting rod may result in engine damage.**

   Remove the connecting rod bearing cap.



4. Remove the connecting rod bearing.



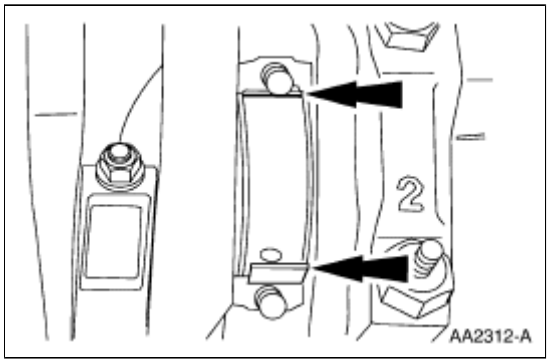
5. Repeat the procedure until all the crankshaft main bearings are removed.

Installation

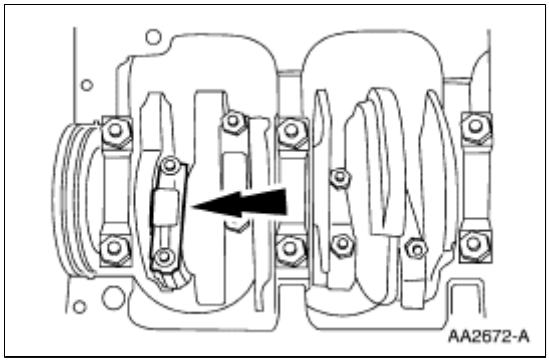
1. The connecting rod bearings are precision fit. For additional information, refer to Section 303-00 for checking clearances or bearing selection.

2. **CAUTION: The connecting rod bearings must be lubricated with Super Premium SAE 5W-30 Motor Oil XO–5W30–QSP or equivalent meeting Ford specification WSS-M2C153–G.**

   Install the connecting rod bearing.

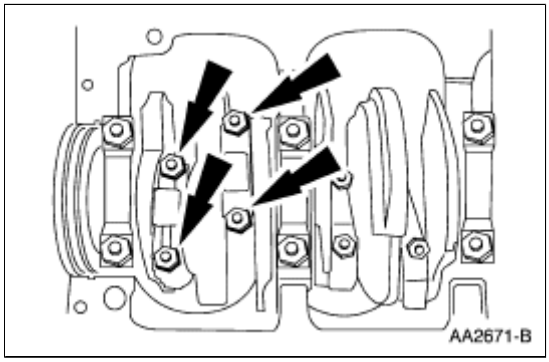


3. Install the connecting rod caps.
   - For connecting rod component tests, refer to Section 303-00 .

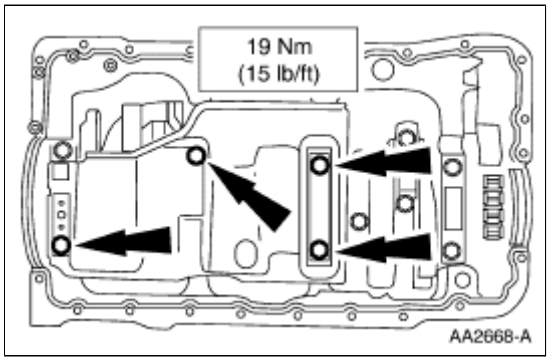


4. Install the nuts and tighten in two steps.
   1. Tighten to 20 Nm (15 lb-ft).

2. Tighten an additional 90 degrees.



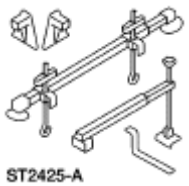
5. Repeat the procedure until all the connecting rod bearings are installed.
6. Install the oil pan baffle.



7. Install the oil pan. For additional information, refer to Oil Pan in this section.

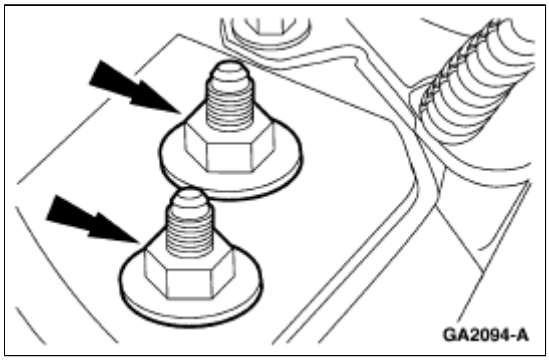
Engine Support Insulators

Special Tool(s)

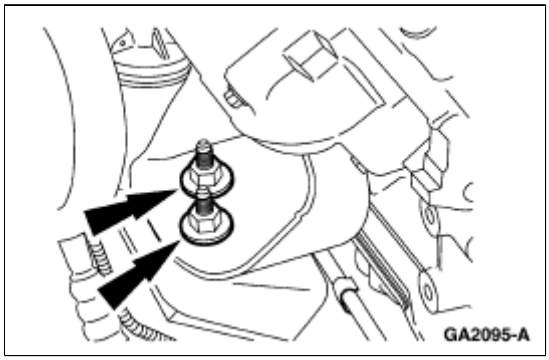
ST1831-A	Lifting Eyes 303–D030 (D81L-6001-D)
 ST2425-A	3-Bar Engine Support Kit 303-F072

Removal

1. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
2. Remove the LH engine support insulator nuts.


GA2094-A

3. Remove the RH engine support insulator nuts.


GA2095-A

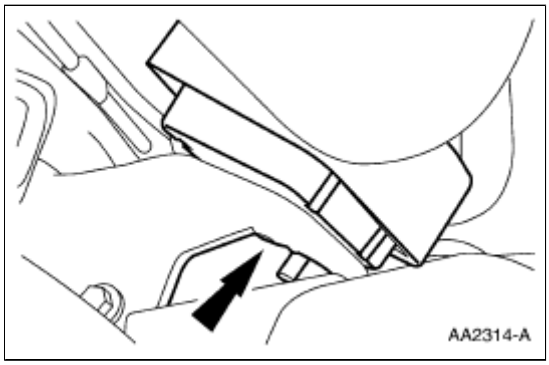
4. **NOTE:** The Lifting Eyes should be installed on the exhaust manifold studs for number one and number six cylinders.

   Install the lifting eyes.

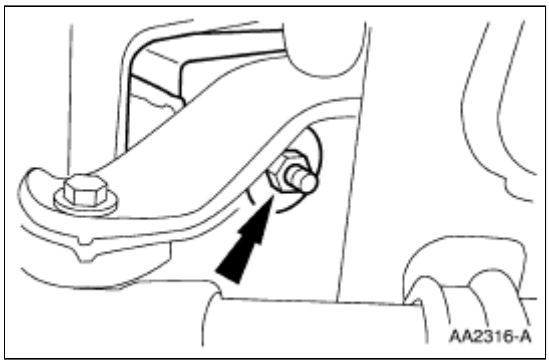
5. Raise the engine with the three bar engine support.

6. Raise and support the vehicle. For additional information, refer to Section 100-02 .

7. Remove the LH engine support insulator.

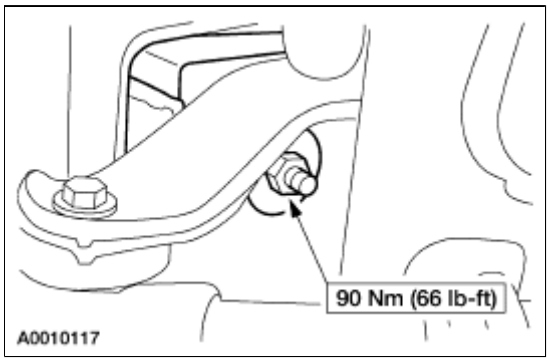


8. Remove the RH engine support insulator.

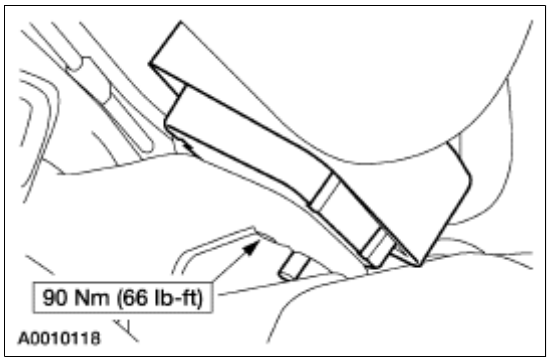


Installation

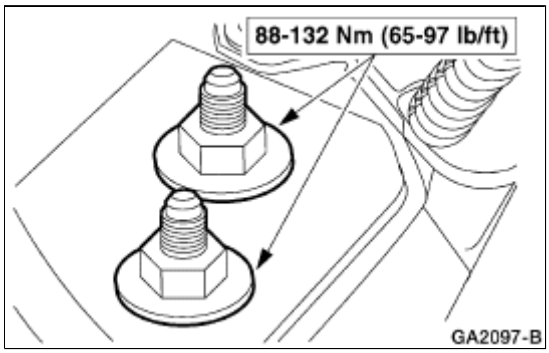
1. Install the RH engine support insulator.



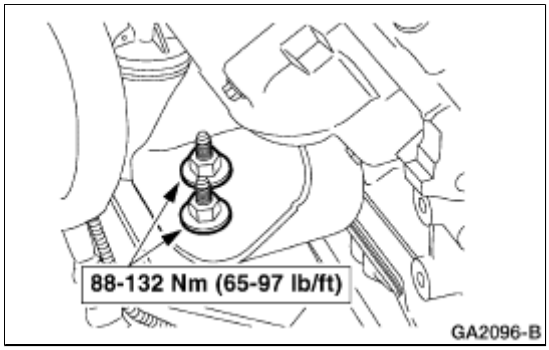
2. Install the LH engine support insulator.



3. Lower the vehicle.
4. Lower the engine and remove the three bar engine support.
5. Remove the lifting eyes from the exhaust manifold studs
6. Install the LH engine support insulator nuts.



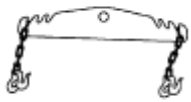
7. Install the RH engine support insulator nuts.



8. Install the engine cooling fan. For additional information, refer to Section 303-03 .

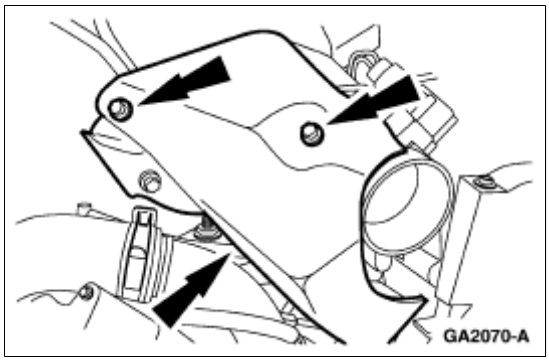
Engine

Special Tool(s)

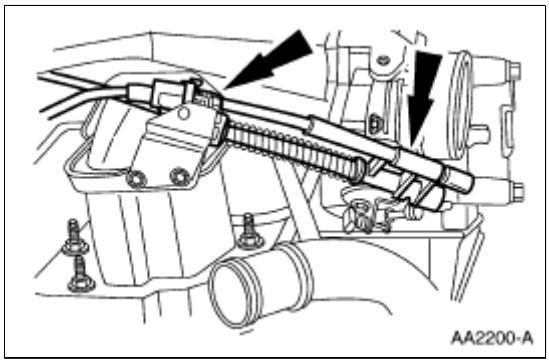
ST1831-A	Lifting Eyes 303-D030 (D81L-6001-D) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

Removal

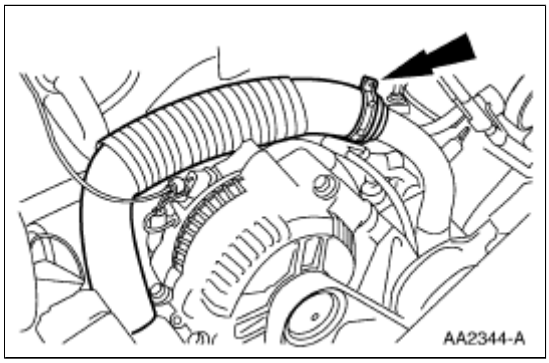
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Drain the engine cooling system. For additional information, refer to Section 303-03 .
3. Recover the A/C system. For additional information, refer to Section 412-00 .
4. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
5. Remove the radiator. For additional information, refer to Section 303-03 .
6. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
7. Remove the hood.
8. Disconnect the power steering pressure hose.
9. Disconnect the power steering return hose.
10. Remove the accelerator cable snow shield.



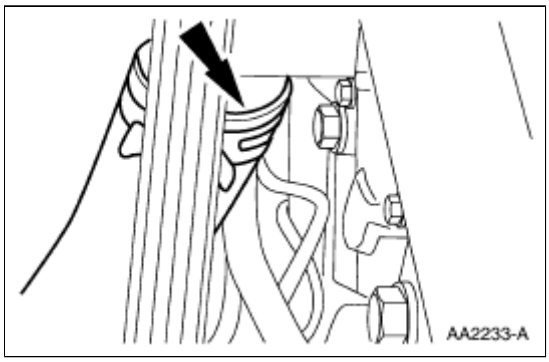
11. Disconnect the accelerator cable and the speed control cable (if equipped).



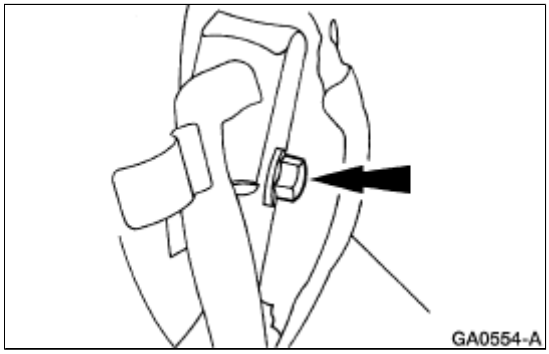
12. Remove the upper radiator hose.



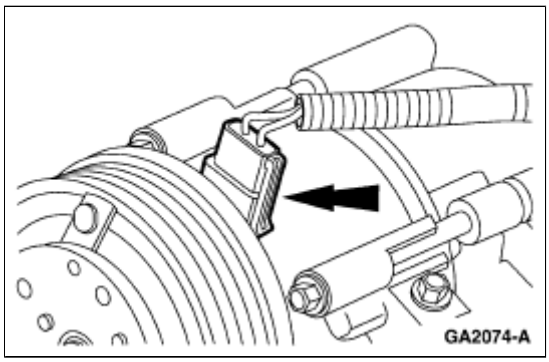
13. Remove the lower radiator hose.



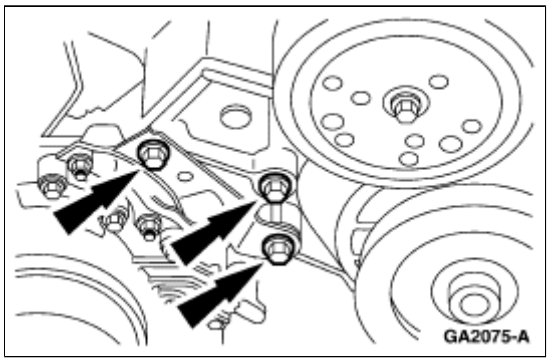
14. Loosen the bolt and remove the A/C manifold tube from the A/C compressor.



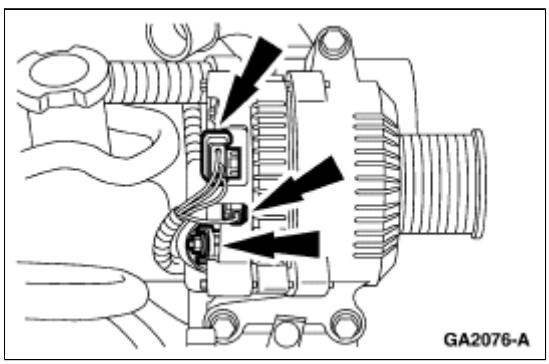
15. Disconnect the A/C compressor electrical connector.



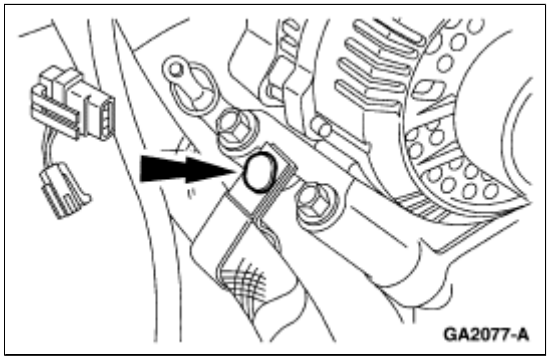
16. Remove the A/C compressor mounting bracket and position aside.



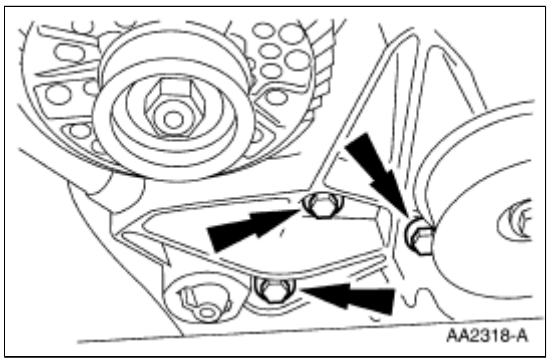
17. Disconnect the generator electrical connectors.



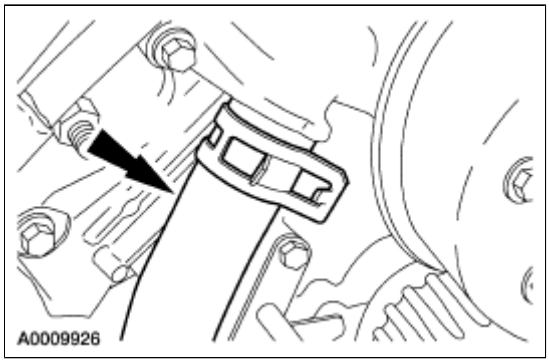
18. Disconnect the heater hose retaining clip.



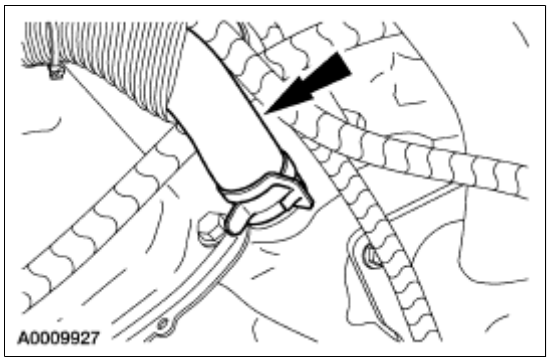
19. Remove the generator mounting bracket.



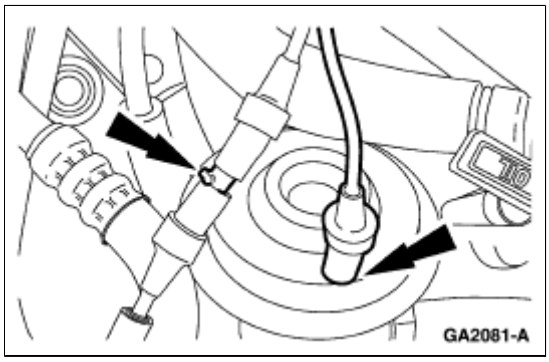
20. Disconnect the heater water hose from the water pump.



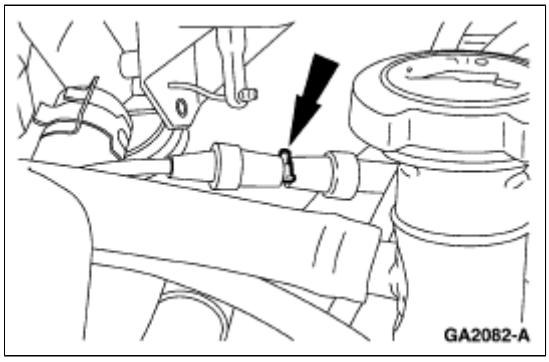
21. Disconnect the heater water hose from the lower intake manifold.



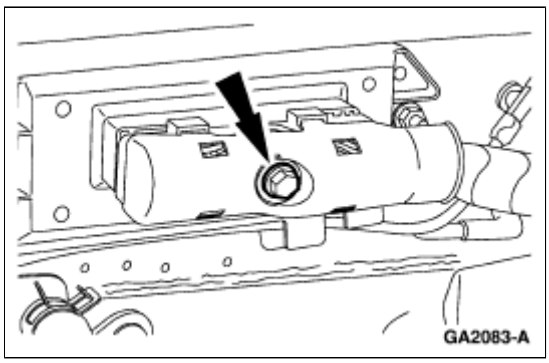
22. Disconnect the EGR valve vacuum connector and the LH vacuum connector.



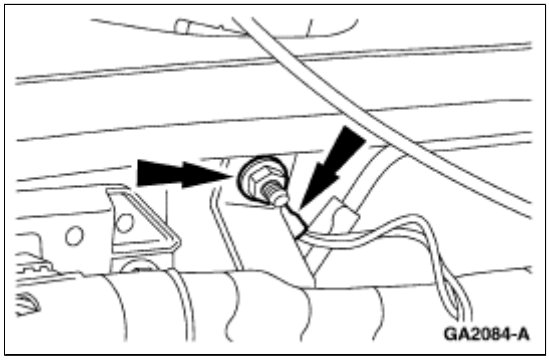
23. Disconnect the RH vacuum connector.



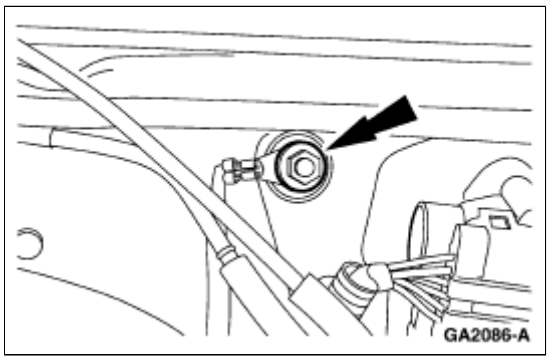
24. Disconnect the powertrain control module (PCM) electrical connector.



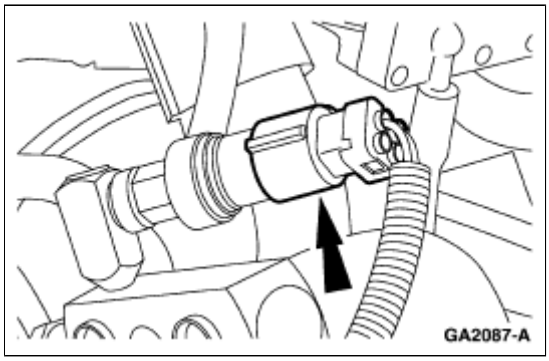
25. Remove the engine harness ground wire.



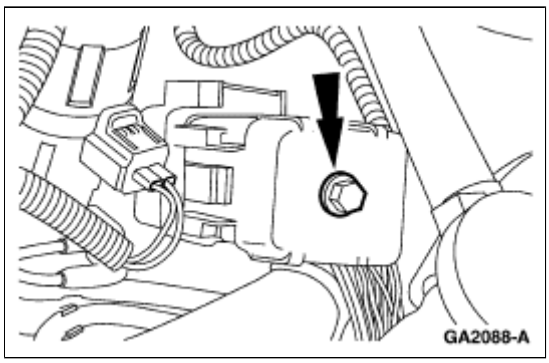
26. Remove the engine-to-body ground wire.



27. Disconnect the A/C high pressure switch electrical connector.

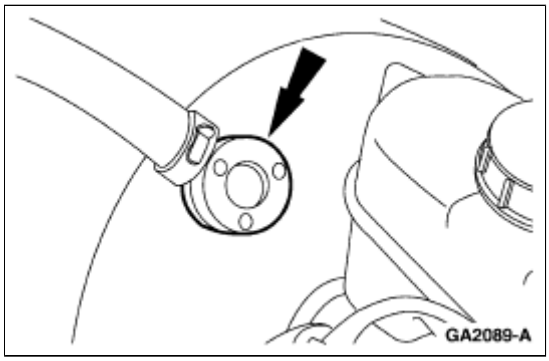


28. Disconnect the bulkhead connector.

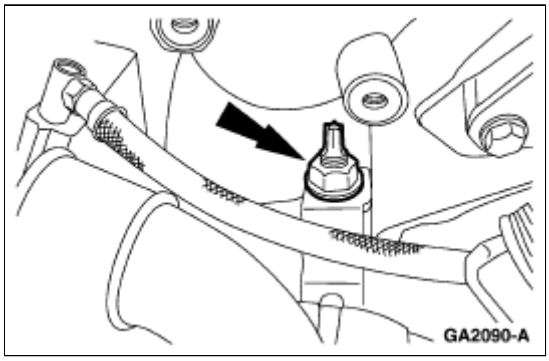


29. Disconnect the fuel line. For additional information, refer to Section 310-00 .

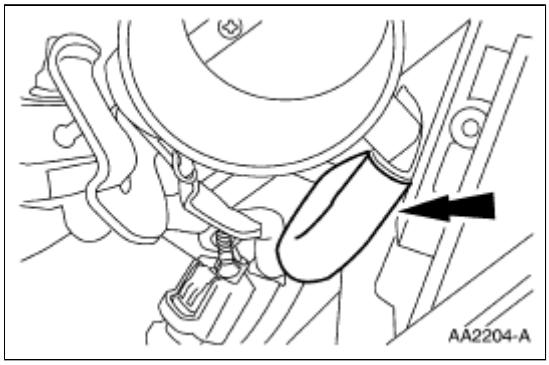
30. Disconnect the vacuum connector from the brake booster.



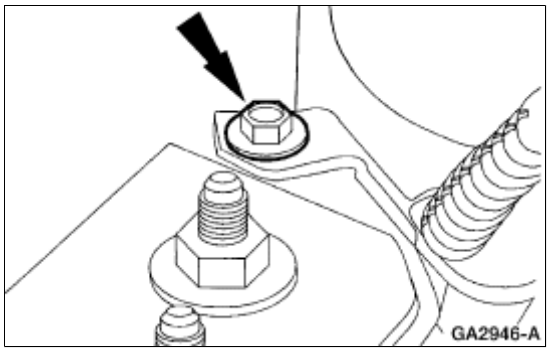
31. Disconnect the generator harness clip and position the harness aside.



32. Disconnect the canister purge line.

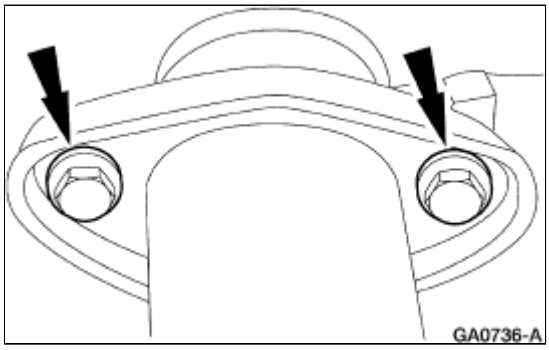


33. Position the battery cable bracket aside.



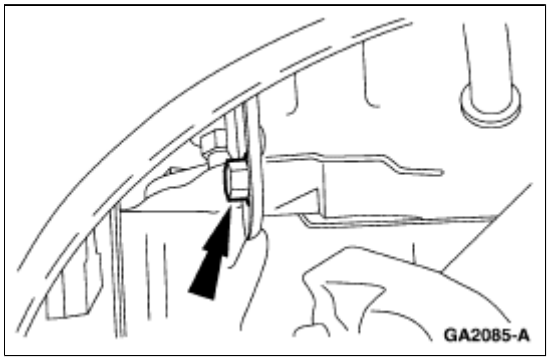
34. Raise and support the vehicle. For additional information, refer to Section 100-02 .

35. Remove the four RH and LH exhaust manifold bolts.



36. Disconnect the heated oxygen sensors.

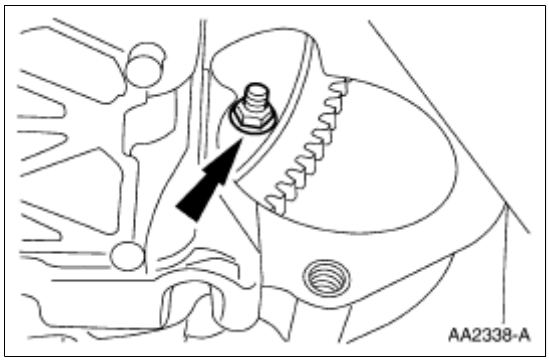
37. Access the A/C manifold tube bracket through the RH wheel well and remove the bolt.



38. Remove the starter motor. For additional information, refer to Section 303-06 .

39. **NOTE:** For automatic transmission only.

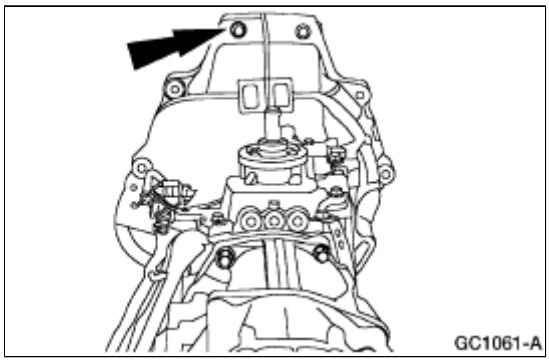
    Remove the four nuts.



40. Disconnect the transmission harness electrical connectors.

41. **NOTE:** Manual transmission is shown; automatic transmission is similar.

    Remove the nine engine to transmission bolts.



42. Drain the engine oil.

43. Lower the vehicle.

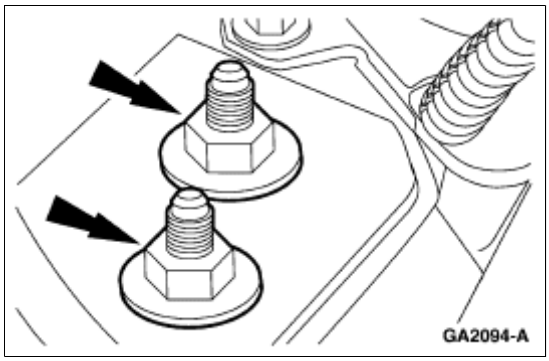
44. **NOTE:** The Lifting Eyes should be installed on the exhaust manifold studs for number one and number six cylinders.

    Install the lifting eyes.

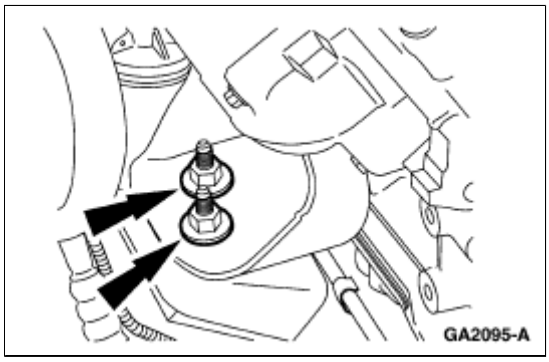
45. Support the engine with a floor crane.

46. Support the transmission with a suitable floor jack.

47. Remove the LH engine support insulator nuts.



48. Remove the RH engine support insulator nuts.



49. Remove the engine from the vehicle.

50. **NOTE:** For manual transmissions.

    Remove the clutch. For additional information, refer to Section 308-01 .

51. **NOTE:** For automatic transmissions.

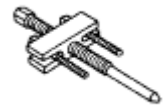
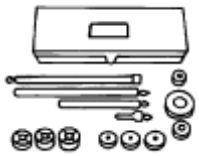
    Remove the flywheel.

52. Remove the spacer plate.

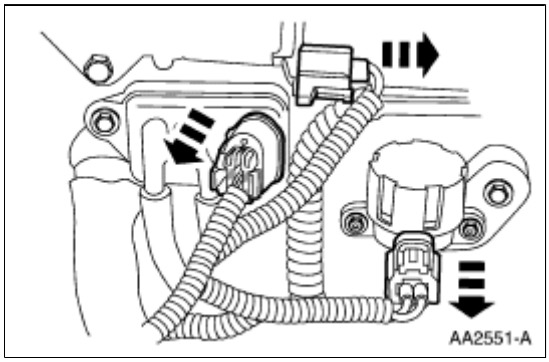
53. Install the engine on a workstand.

Engine

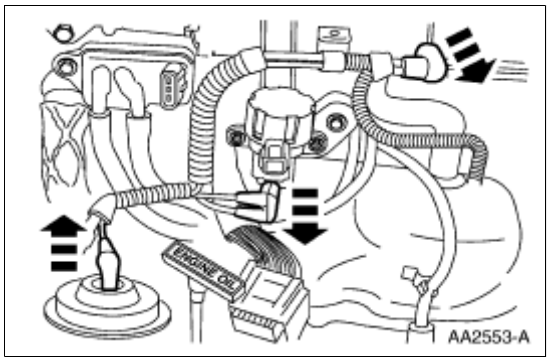
Special Tool(s)

 ST1784-A	Crankshaft Damper Remover 303-101 (T74P-6316-A)
 ST1381-A	Camshaft Bearing Service Set 303–017 (T65L-6250-A)

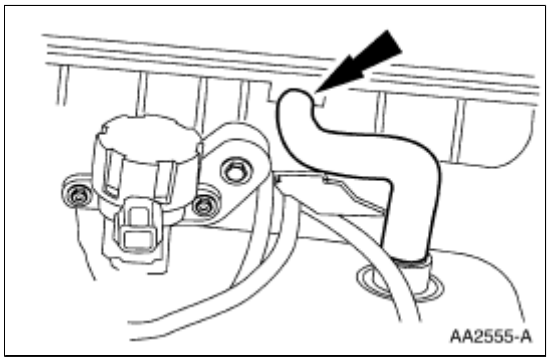
1. Disconnect the electrical connectors:
   - idle air control (IAC) valve
   - EGR transducer
   - EGR solenoid



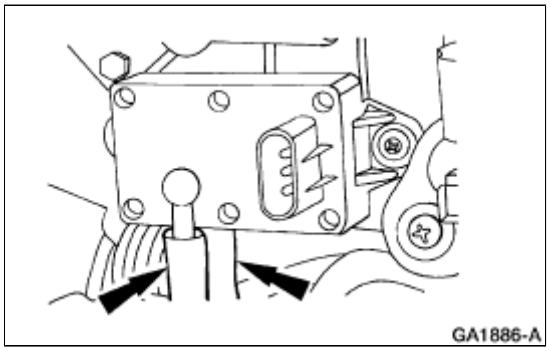
2. Disconnect the vacuum line connections:
   - EGR solenoid
   - upper intake manifold
   - EGR valve



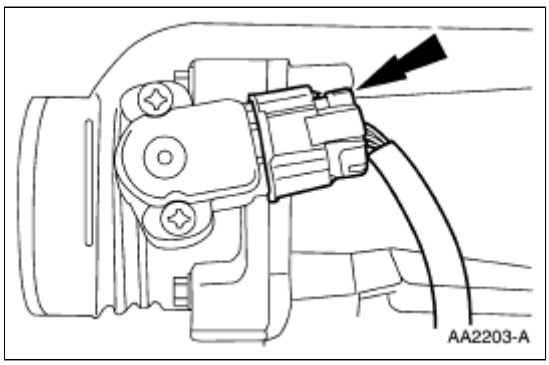
3. Disconnect the crankcase ventilation tube.



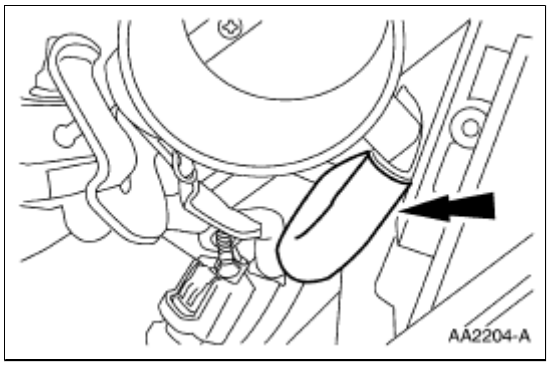
4. Disconnect the EGR sensor hoses.



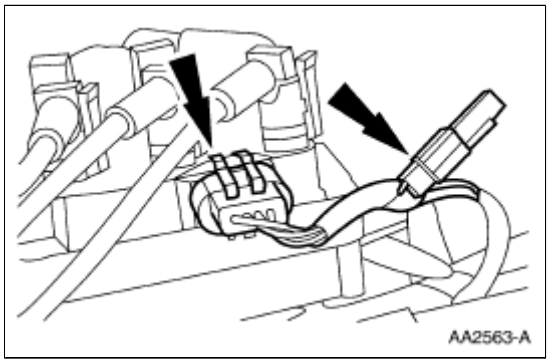
5. Disconnect the throttle position (TP) sensor electrical connector.



6. Disconnect the canister purge line from the throttle body.



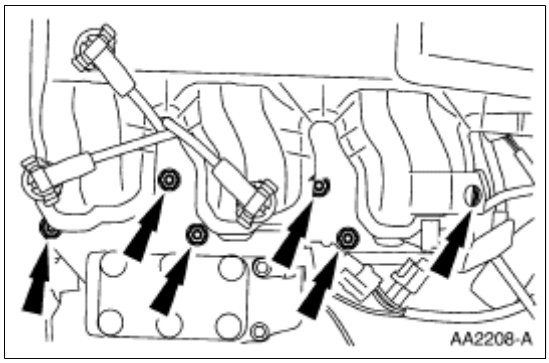
7. Disconnect the ignition coil and the radio ignition interference capacitor electrical connectors.



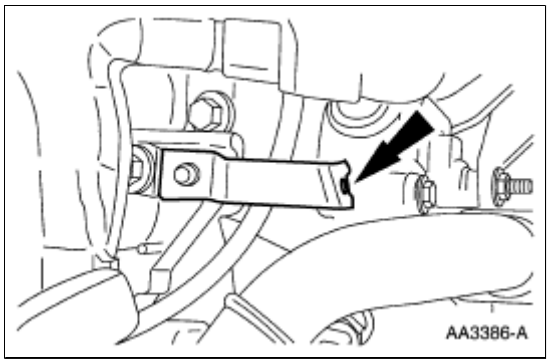
8. **NOTE:** Spark plug wires must be connected to the correct ignition coil terminals and spark plugs. Mark spark plug wires before removing them.

   Disconnect the spark plug wires from the spark plugs and the ignition coils.

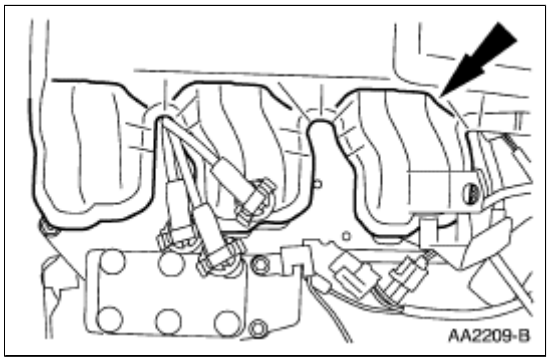
9. Remove the nuts.



10. Detach the fuel line bracket.

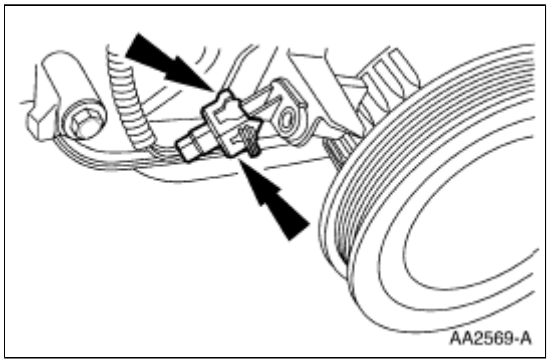


11. Remove the upper intake manifold.

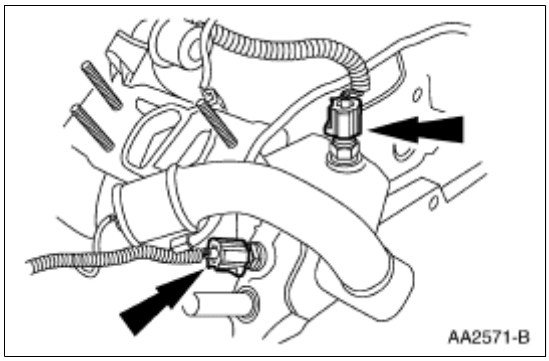


12. Inspect and install a new gasket if necessary.

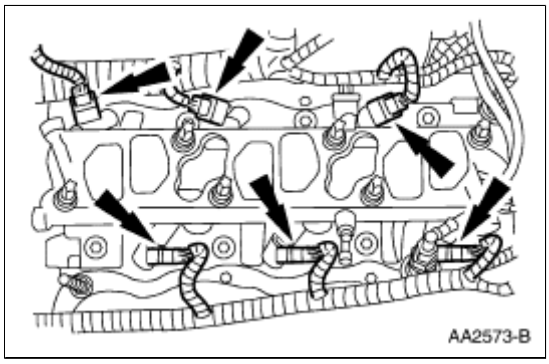
13. Disconnect the crankshaft position (CKP) sensor electrical connector.



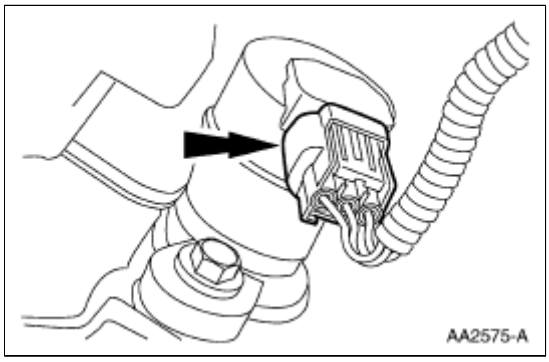
14. Disconnect the electrical connectors:
    - engine coolant temperature (ECT) sensor
    - water temperature sender unit



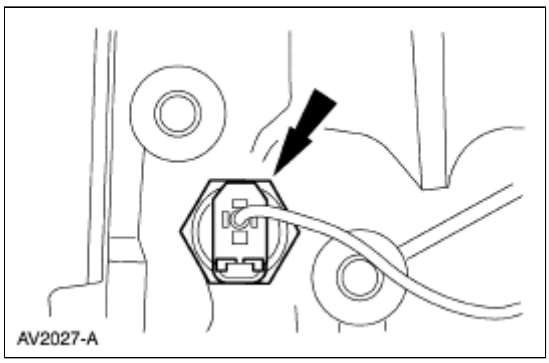
15. Disconnect the fuel injector electrical connectors.



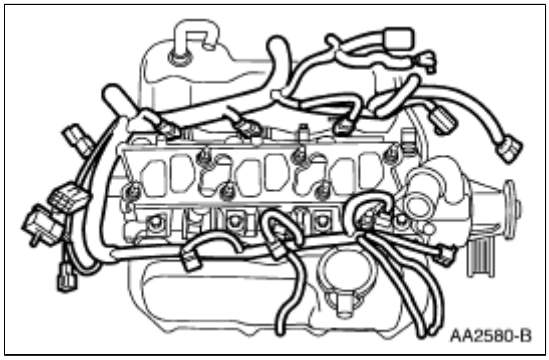
16. Disconnect the camshaft position (CMP) sensor electrical connector.



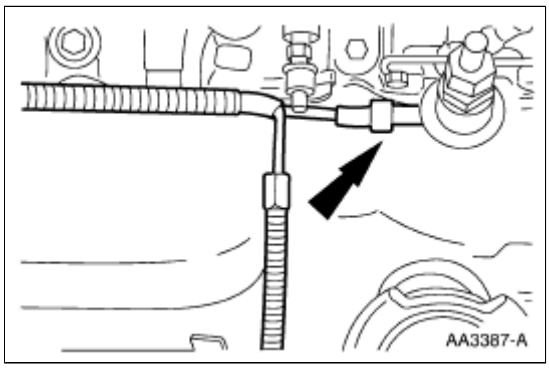
17. Disconnect the oil pressure sensor electrical connector and remove the sensor.



18. Remove the engine control sensor wiring.

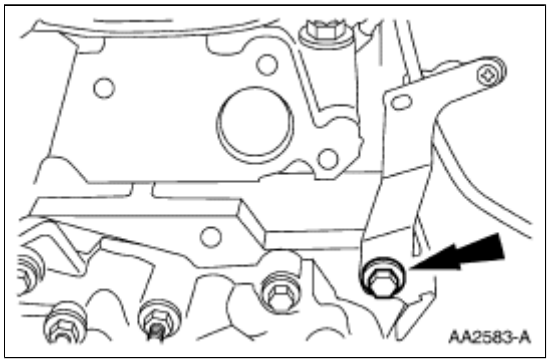


19. Disconnect the vacuum line and remove the vacuum line harness.

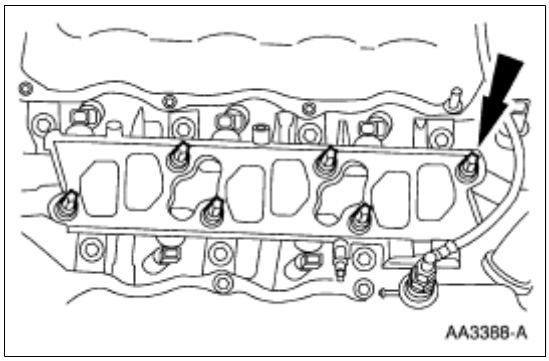


20. Remove the fan clutch and fan blade assembly. For additional information, refer to Section 303-03 .

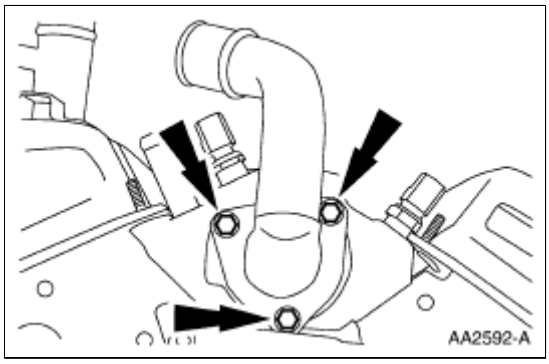
21. Remove the bolt.



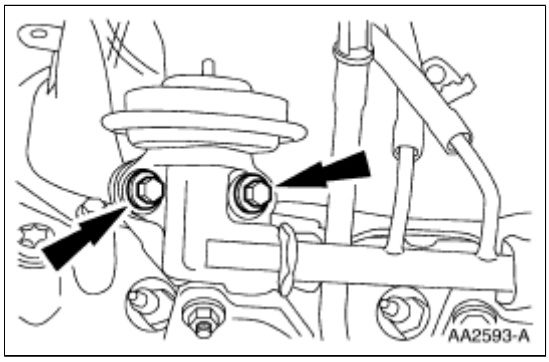
22. Remove the fuel injection supply manifold, the fuel injectors and discard the gasket.



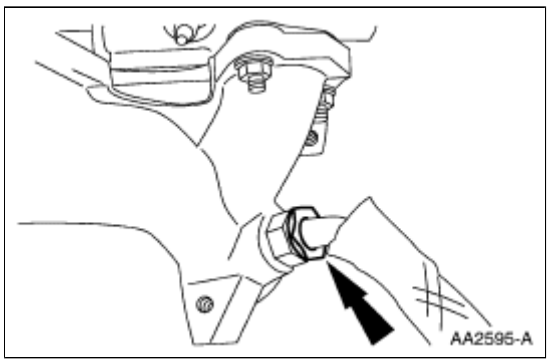
23. Remove the water hose connection and the water thermostat.



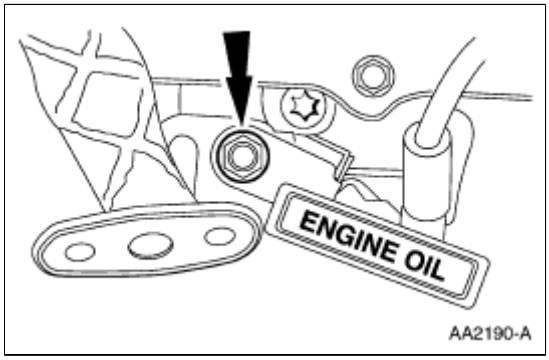
24. Remove the bolts.



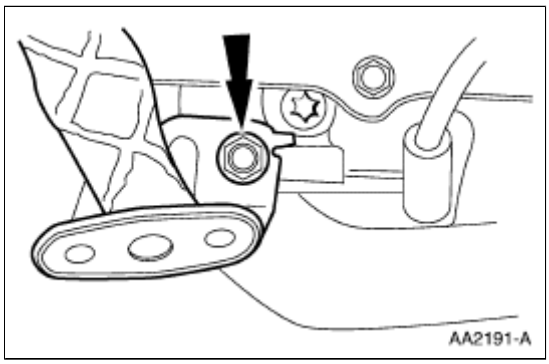
25. Disconnect the EGR valve to exhaust manifold tube.



26. Remove the oil level indicator tube.

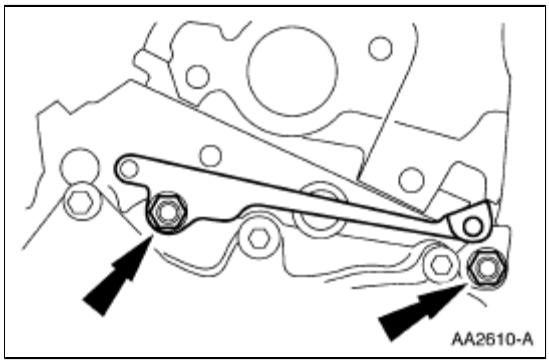


27. Remove the EGR outlet tube and the bracket.



28. Remove the RH and LH exhaust manifolds and gaskets. For additional information, refer to Exhaust Manifold—RH and Exhaust Manifold—LH in this section.

29. Remove the wiring harness retainer bracket.



30. Remove the engine mount brackets. For additional information, refer to Engine Support Insulators in this section.

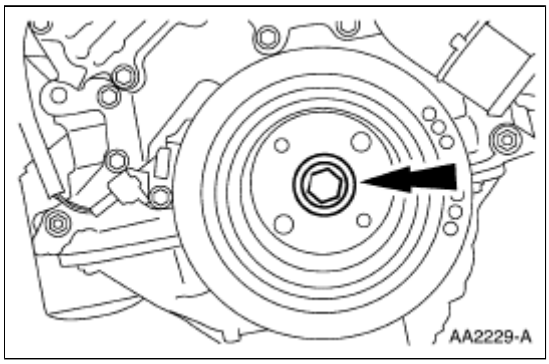
31. Remove the drive belt. For additional information, refer to Section 303-05 .

32. Remove the belt tensioner. For additional information, refer to Section 303-05 .

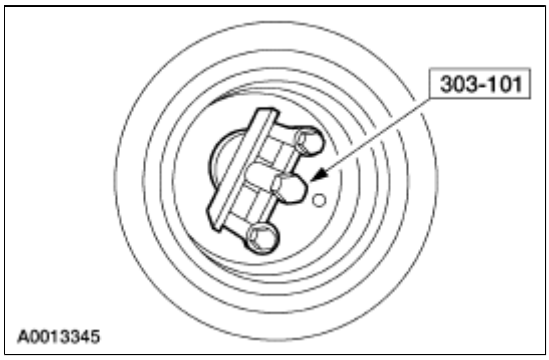
33. Remove the alternator and bracket. For additional information, refer to Section 414-02 .

34. Remove the power steering and A/C bracket. For additional information, refer to Section 211-02 .

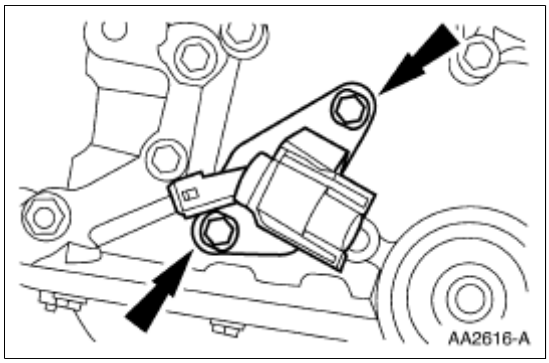
35. Remove the bolt.
    - Discard the bolt.



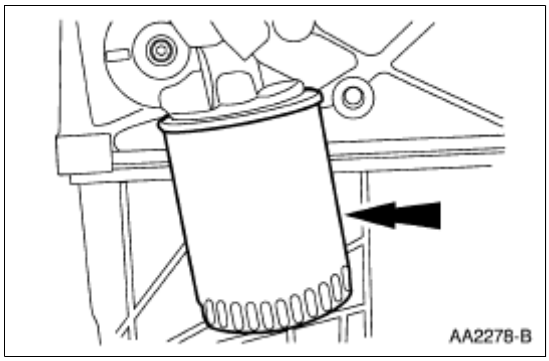
36. Using the special tool, remove the crankshaft pulley.



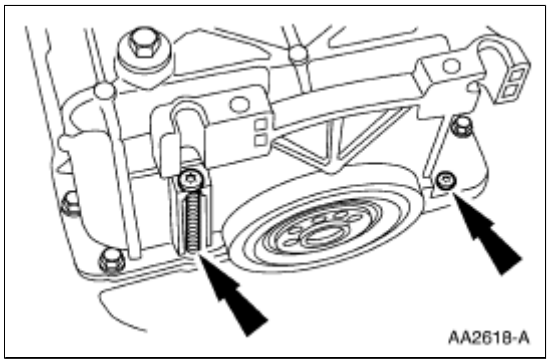
37. Remove the crankshaft position (CKP) sensor.



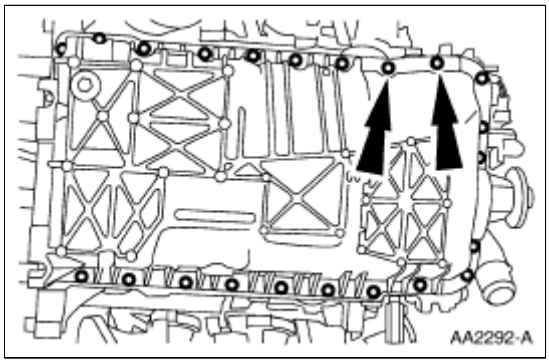
38. Remove the oil filter.



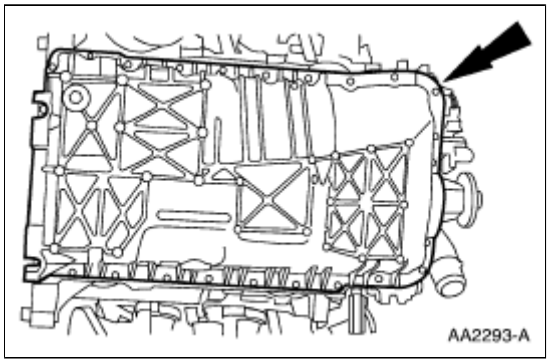
39. Remove the bolts.



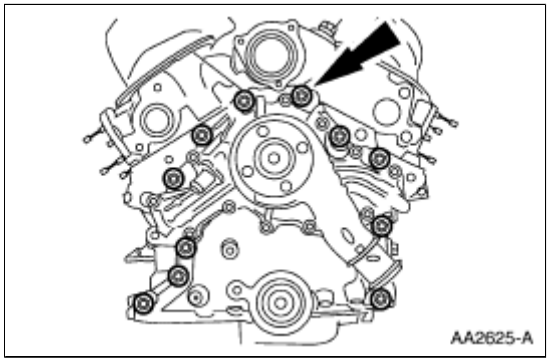
40. Remove the bolts and the nuts.



41. Remove the oil pan and the gasket.

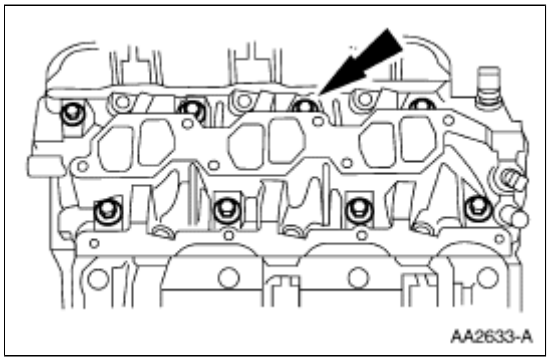


42. Remove the front cover and the gasket.

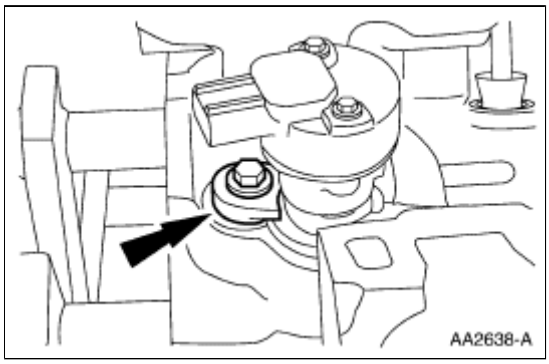


43. Remove the RH and the LH valve covers and the gaskets.

44. Remove the lower intake manifold and the gasket.

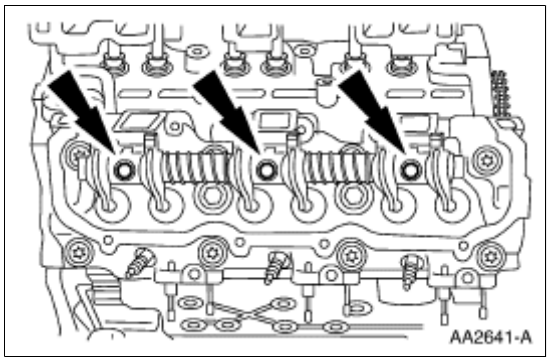


45. Remove the camshaft synchronizer.



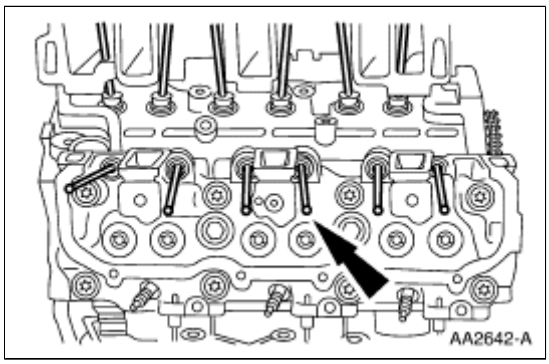
46. **CAUTION: If the rocker arm shaft is not loosened gradually, the shaft may become bent during removal.**

Remove the RH and the LH rocker arm shafts.

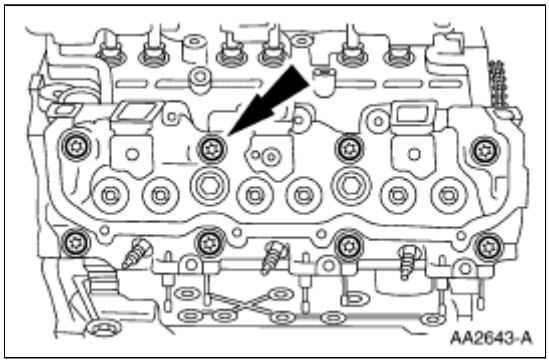


47. **NOTE:** Mark the push rods to make sure they are reinstalled in their correct location.

    Remove the push rods.

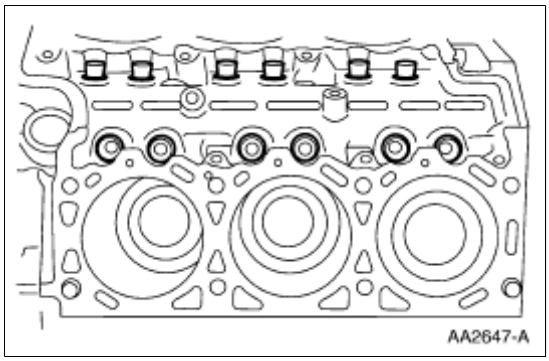


48. Remove the cylinder heads and the gaskets.

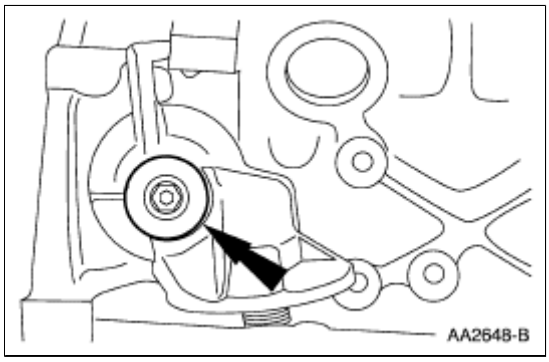


49. **NOTE:** Mark the valve tappets to make sure they are reinstalled in their original location.

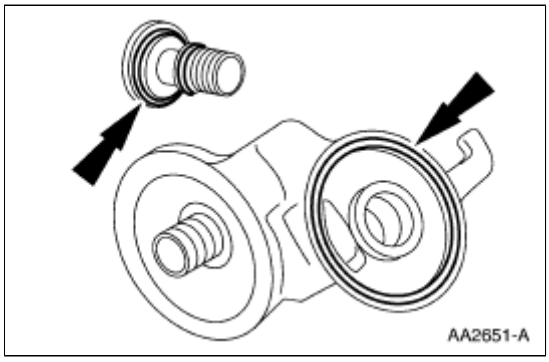
    Remove the valve tappets.



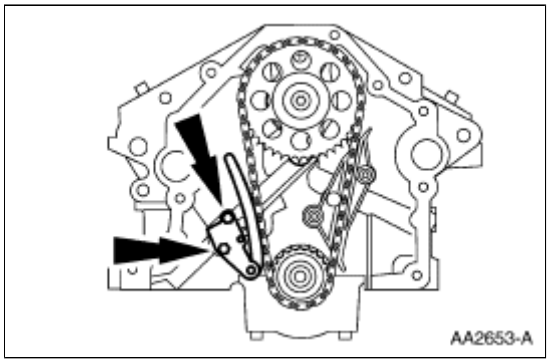
50. Remove the oil filter adapter.



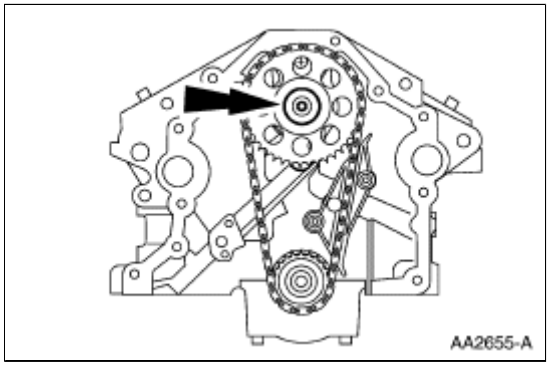
51. Inspect and install new O-ring seals if necessary.



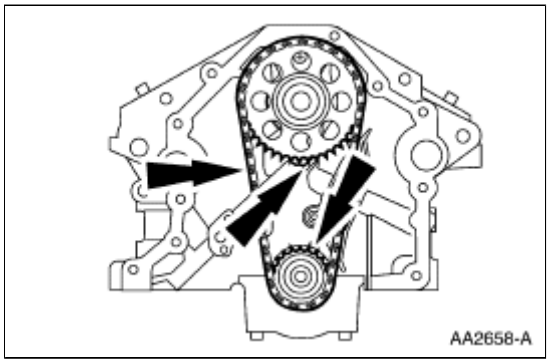
52. Remove the timing chain tensioner.



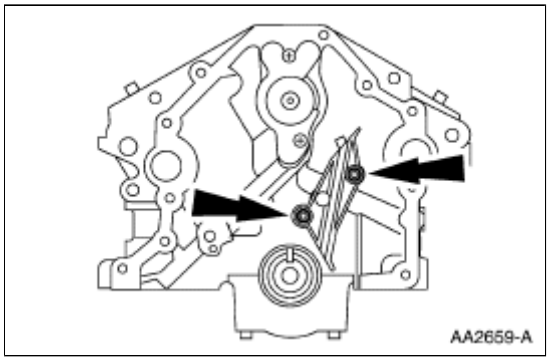
53. Remove the bolt.



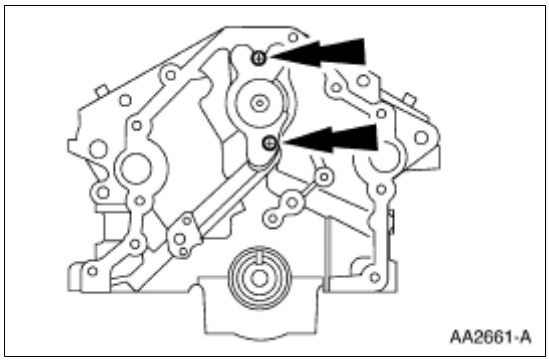
54. Remove the camshaft sprocket and the crankshaft sprocket with the timing chain.



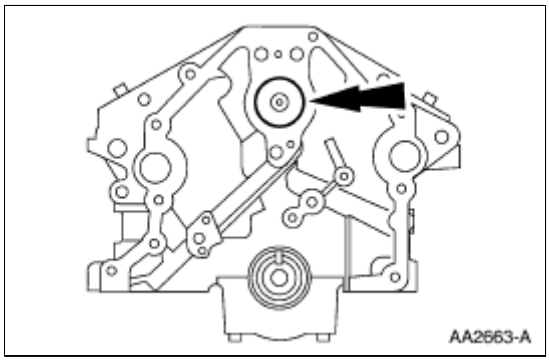
55. Remove the timing chain guide.



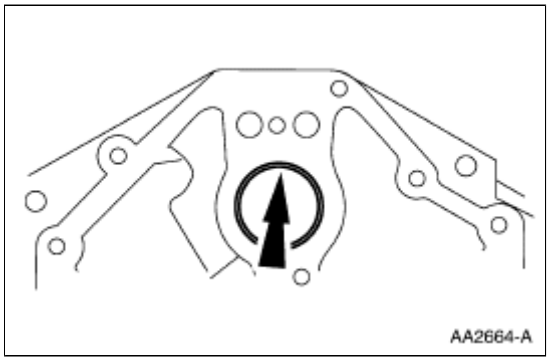
56. Remove the camshaft thrust plate.



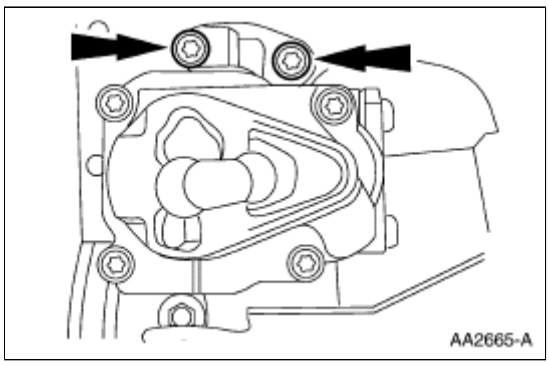
57. Remove the camshaft.



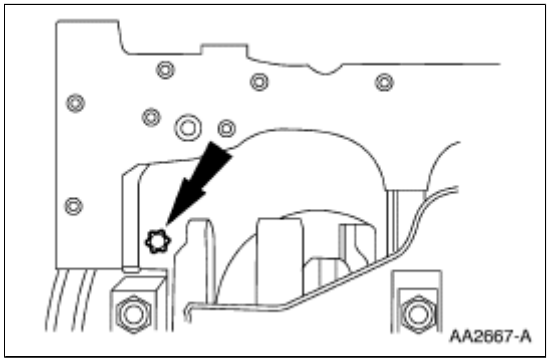
58. Use the Camshaft Bearing Remover to remove the camshaft bearings.



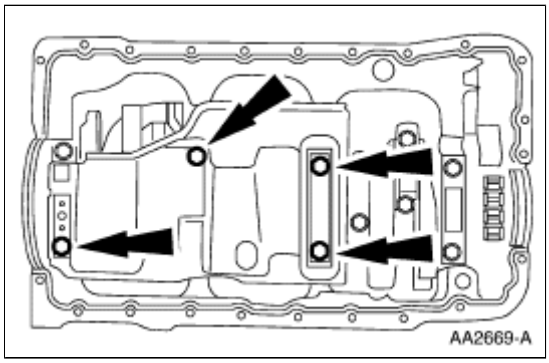
59. Remove the oil pump.



60. Remove the oil pump shaft.

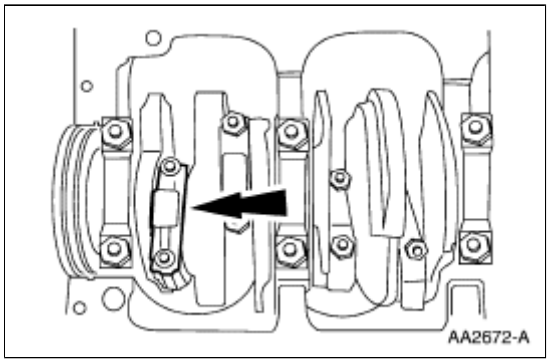


61. Remove the oil baffle assembly.

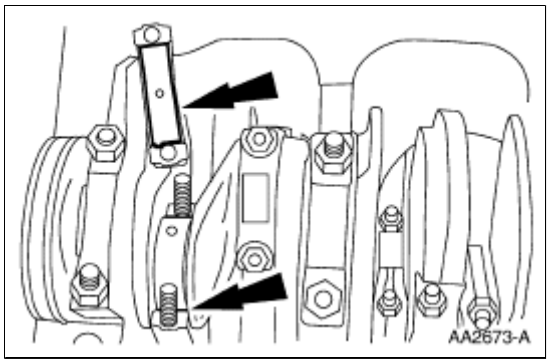


62. **NOTE:** Mark the connecting rod caps so they can be reinstalled in their original position.

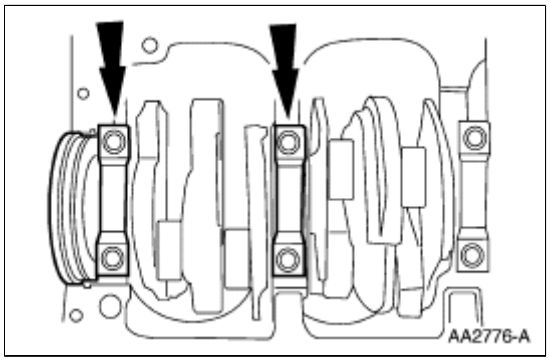
    Remove the connecting rod caps.



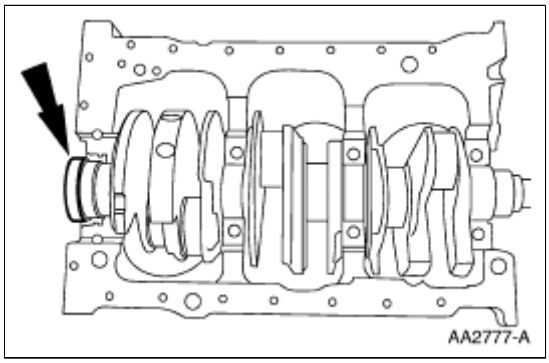
63. Remove the connecting rod bearings.



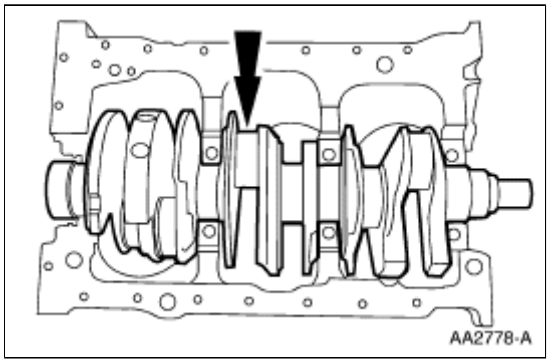
64. Remove the crankshaft main bearing caps.



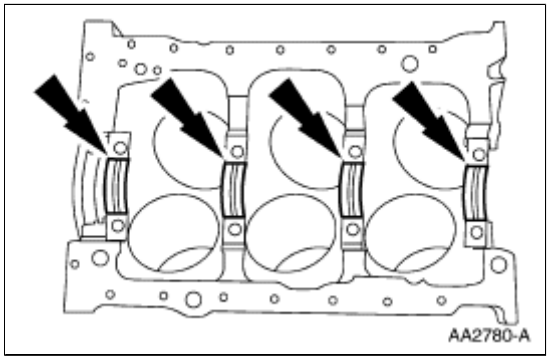
65. Remove the crankshaft rear oil seal.



66. Remove the crankshaft.

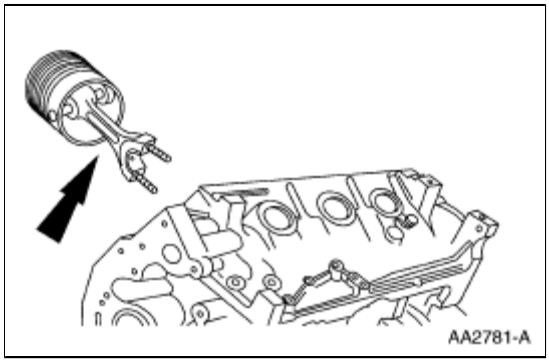


67. Remove the crankshaft main bearings and the crankshaft thrust main bearing.



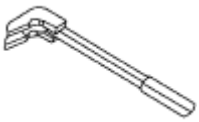
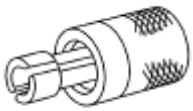
68. **CAUTION: Place a rubber hose over the connecting rod studs to protect the crankshaft journals and the cylinder walls from being damaged.**

Remove the piston connecting rod assembly.



Cylinder Head

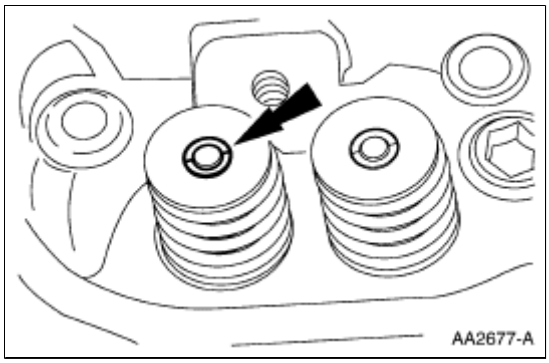
Special Tool(s)

ST1824-A	Valve Stem Seal Replacer 303-370 (T90T-6571-A)
ST1795-A	Spring Compressor Bar 303-105 (T74P-6565-B)
 ST1794-A	Valve Spring Compressor 303-104 (T74P-6565-A)
ST1187-A	Impact Hammer 307-005 (T59L-100-B)
 ST2114-A	Valve Seal Remover 303-075 (T72J-6571)

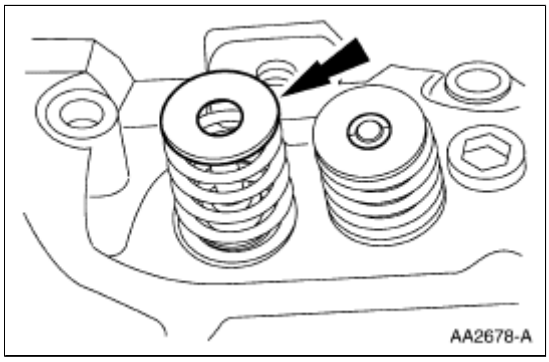
Disassembly

NOTE: All of the valve components must be marked and reinstalled in their original location.

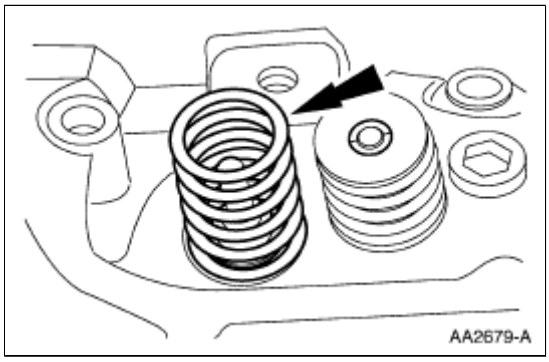
1. Using the Valve Spring Compressor Bar and the Valve Spring Compressor, remove the valve spring retainer key.



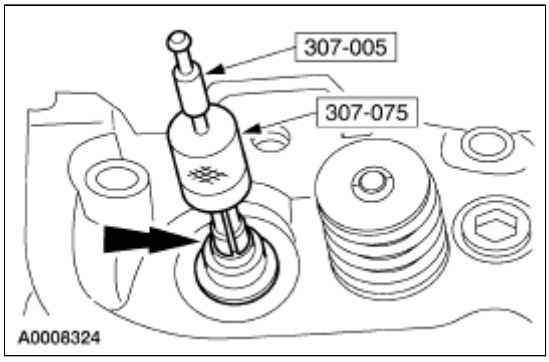
2. Remove the valve spring retainer.



3. Remove the valve spring.

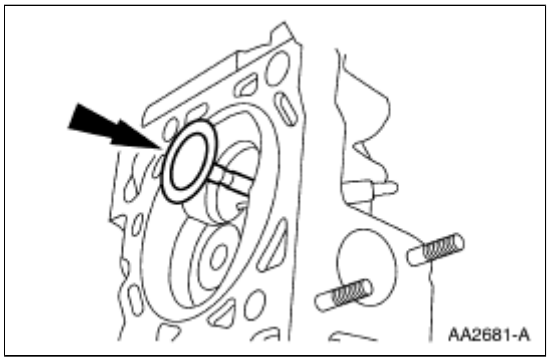


4. Using the special tools, remove the valve stem seal.



5. **NOTE:** Repeat the above procedure for each valve.

   Remove the valve.



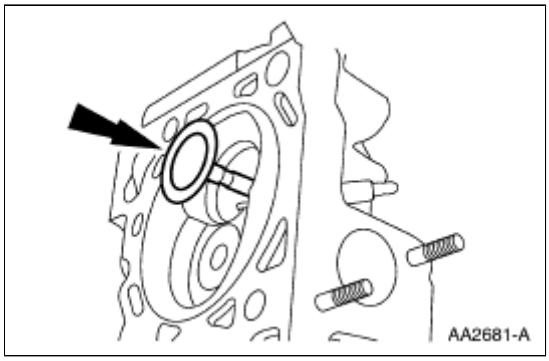
6. Inspect the valves and the valve spring; refer to Section 303-00 .

7. Inspect the valve guide and the valve seat; refer to Section 303-00 .

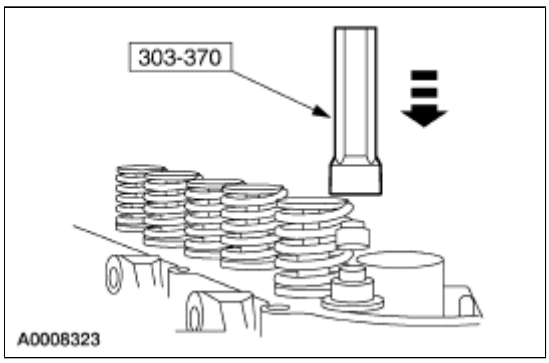
Assembly

1. **NOTE:** The valve stem must be lubricated before installation. Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

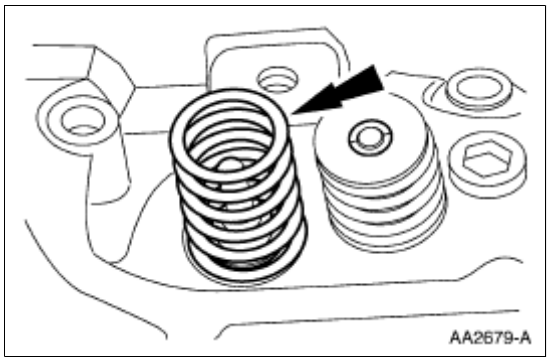
   Install the valve.



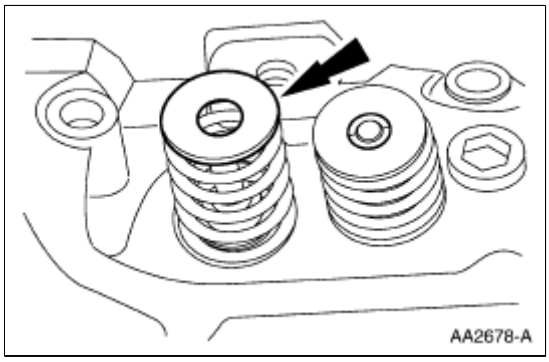
2. Using the special tool, install the valve stem seal.



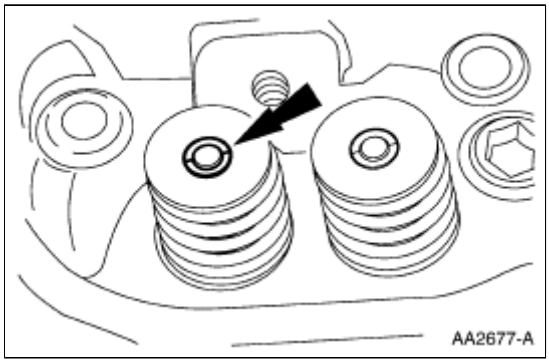
3. Install the valve spring.



4. Install the valve spring retainer.



5. Using the Valve Spring Compressor Bar and the Valve Spring Compressor, install the valve spring retainer key.



6. **NOTE:** Repeat the above procedure for each valve.

   Inspect the valve spring installed length. For additional information, refer to Section 303-00 .

Piston —Piston Pin Connecting Rod, Press Fit

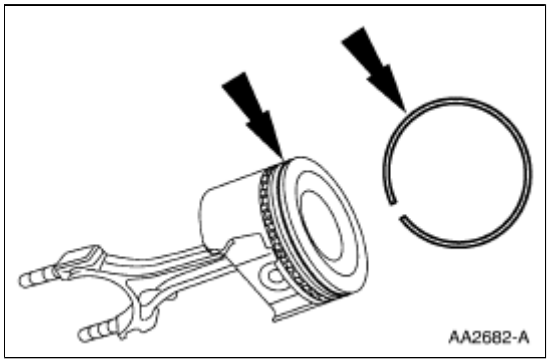
Special Tool(s)

ST1336-A	Pin Remover/Replacer 303-S024 (T68P-6135-A)

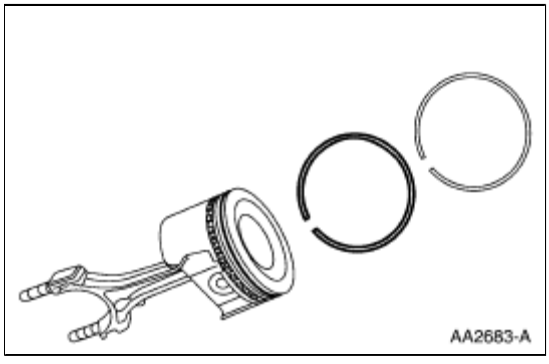
Disassembly

1. **CAUTION: Use a suitable ring expander to remove piston rings to prevent damage.**

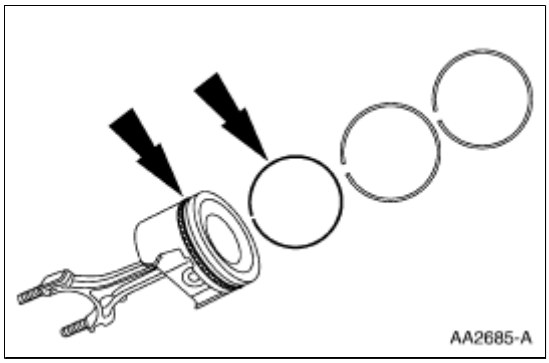
   Remove the top compression ring.


AA2682-A

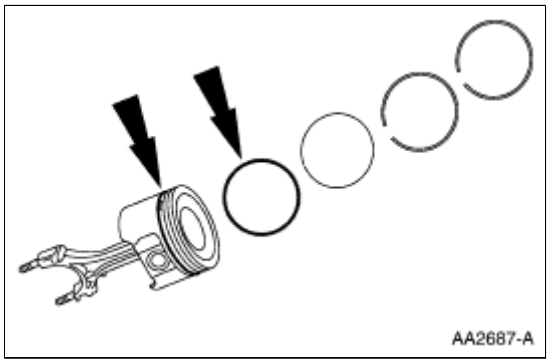
2. Remove the second compression ring.


AA2683-A

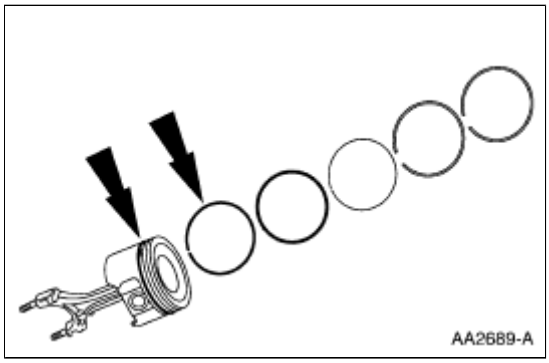
3. Remove the first oil control ring.



4. Remove the oil control spacer ring.



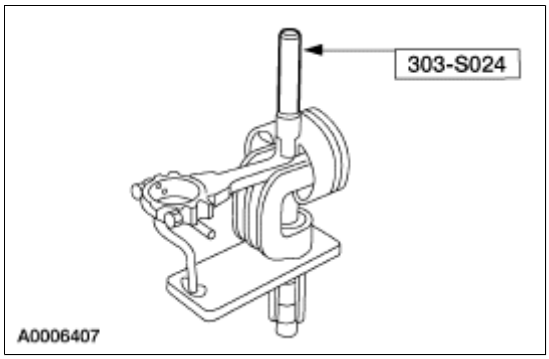
5. Remove the second oil control ring.



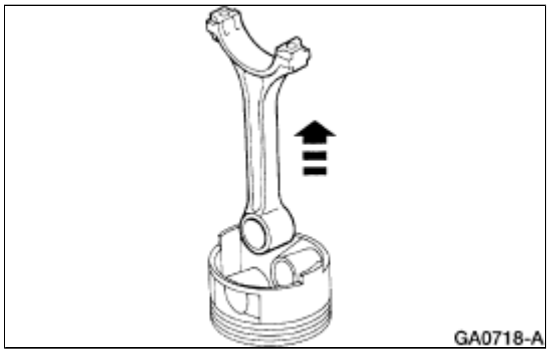
6. **CAUTION: Do not re-use the piston or pin if removed or damage to the engine may occur.**

   NOTE: Take note of piston connecting rod assembly and mark the connecting rod and piston to make sure of correct orientation during reassembly.

   Using the special tool, press the piston pin out of the piston connecting rod assembly.



7. Remove the connecting rod from the piston.



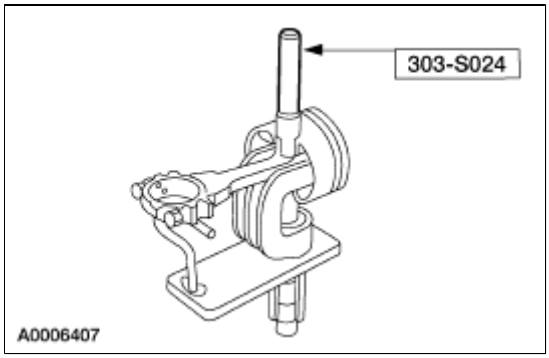
8. Clean and inspect the connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. Lubricate the new piston pin and new piston's pin bore.
   - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

2. **NOTE:** During assembly the small end of the connecting rod must be heated to 232°-316°C (450°-600°F).

   Using the special tool, press the piston pin into the piston and the connecting rod.

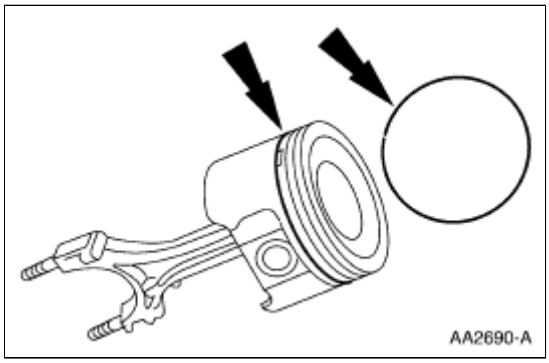


3. **NOTE:** Lubricate the piston and the piston rings with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

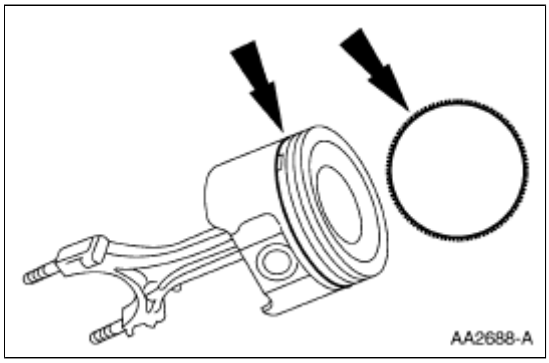
   NOTE: Use a suitable ring expander to install the piston rings. Make sure ring end gaps are equally

spaced around the circumference of the piston for all piston rings.

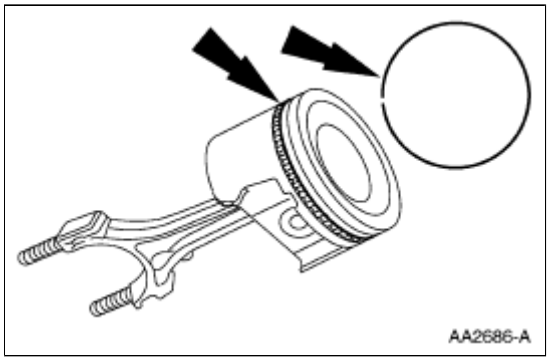
Install the second oil control ring.



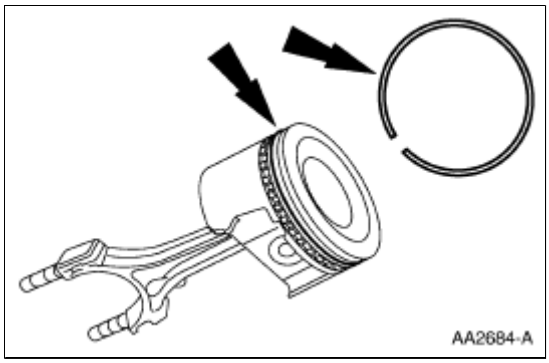
4. Install the oil control spacer ring.



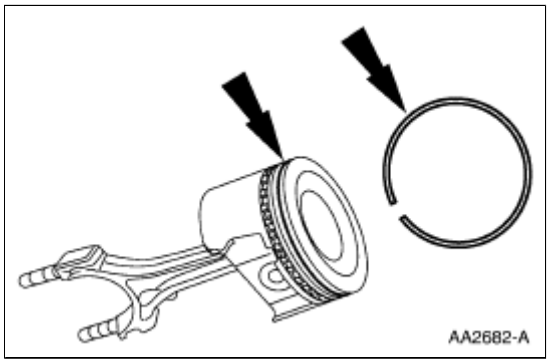
5. Install the first oil control ring.



6. Install the second compression ring.



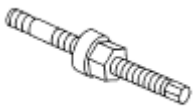
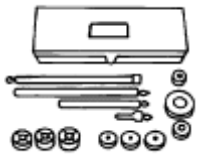
7. Install the top compression ring.



8. Check piston ring end gap and ring-to-groove side clearance. For additional information, refer to Section 303-00 .

Engine

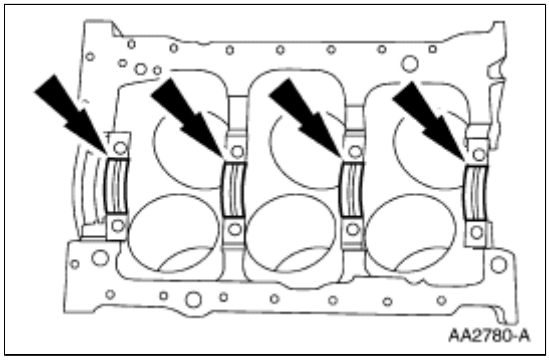
Special Tool(s)

 ST1287-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)
 ST1381-A	Camshaft Bearing Service Set 303–017 (T65L-6250-A)

NOTE: Before engine assembly use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A and a suitable plastic or wooden scraper to clean sealing surfaces. All sealing surfaces must be clean. Make sure coolant and oil passages are clear.

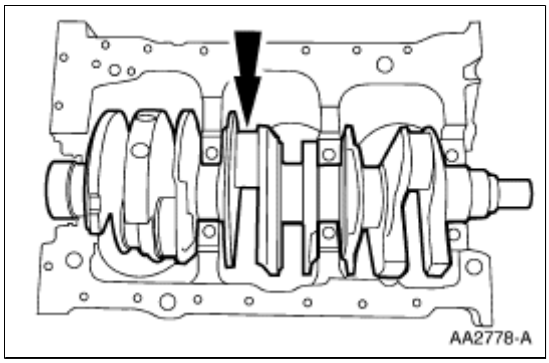
1. **NOTE:** All crankshaft components must be lubricated before installation.

   Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G. Install the crankshaft main bearings and the crankshaft thrust main bearing.

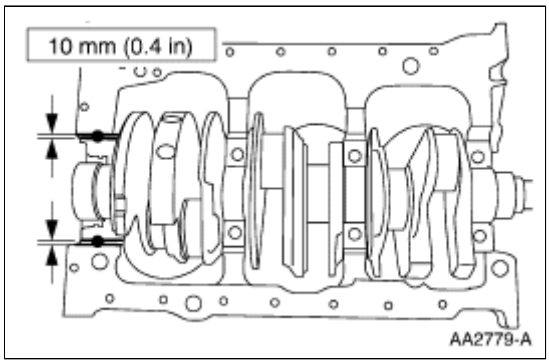
   
   AA2780-A

2. **NOTE:** The crankshaft main bearings are precise selective fit. Inspect bearing clearance. For additional information, refer to Section 303-00 .

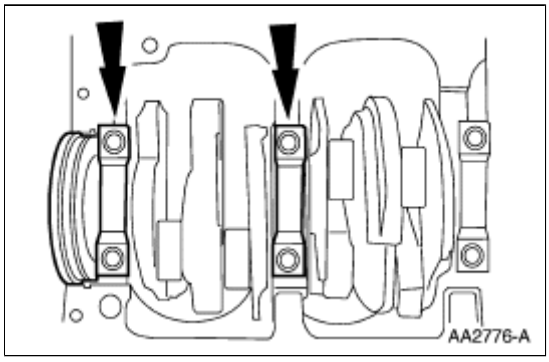
   Install the crankshaft.



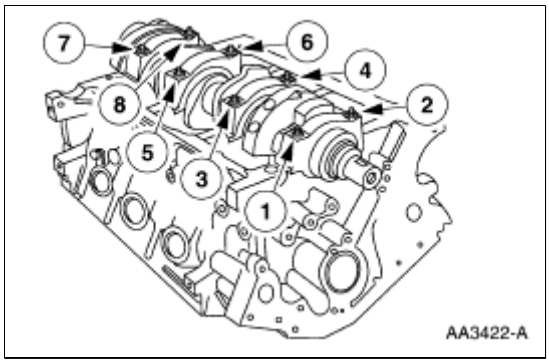
3. Apply silicone rubber in two places.
    - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



4. Install the crankshaft main bearing caps.



5. Tighten the four bolts and the four studs in pairs in two steps:
    1. Tighten to 35 Nm (25 lb-ft).
    2. Tighten to 97 Nm (72 lb-ft).

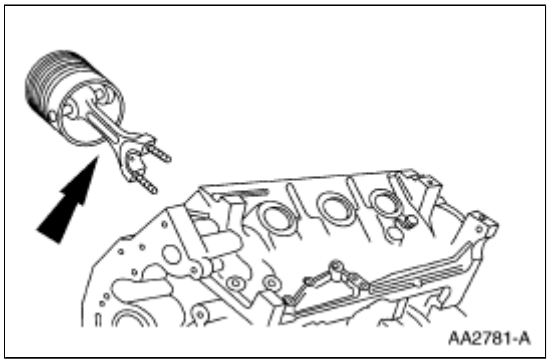


6. **CAUTION: Place a rubber hose over the connecting rod studs to protect the crankshaft journals and cylinder walls from being damaged.**

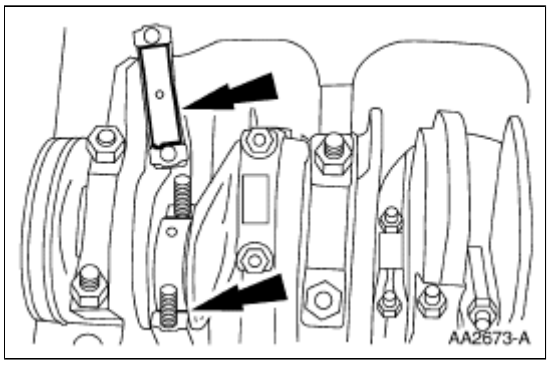
   NOTE: Cylinder walls and piston must be lubricated. Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   NOTE: Position the piston with the notch in the piston head toward the front of the engine.

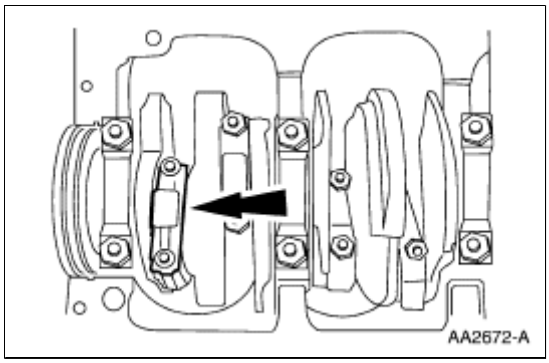
   Install the piston connecting rod assembly using a suitable piston ring compressor.



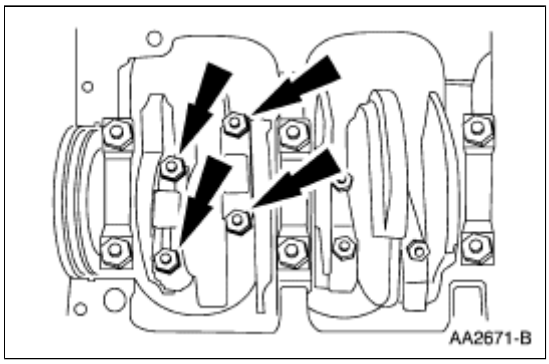
7. Install the connecting rod bearings.



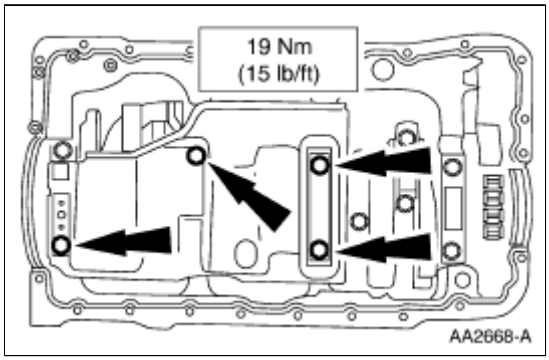
8. Install the connecting rod caps.
   - For connecting rod component tests, refer to Section 303-00 .



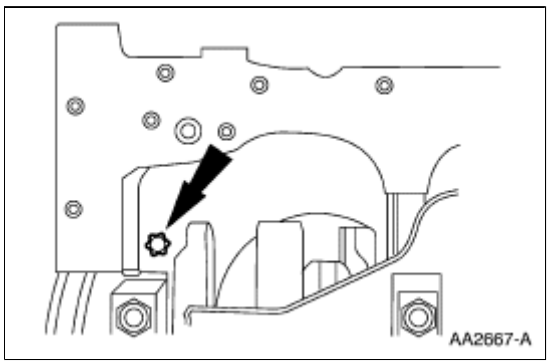
9. Install the nuts and tighten in two steps.
    1. Tighten to 20 Nm (15 lb-ft).
    2. Tighten an additional 90 degrees.



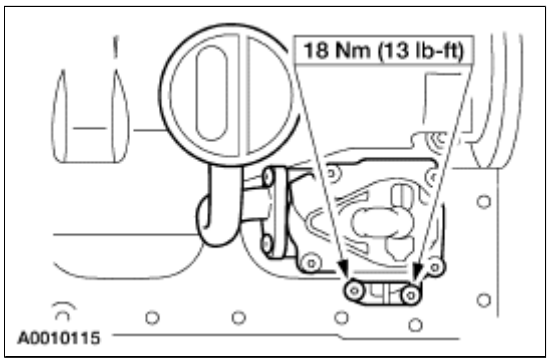
10. Install the oil baffle assembly.



11. Install the oil pump shaft.

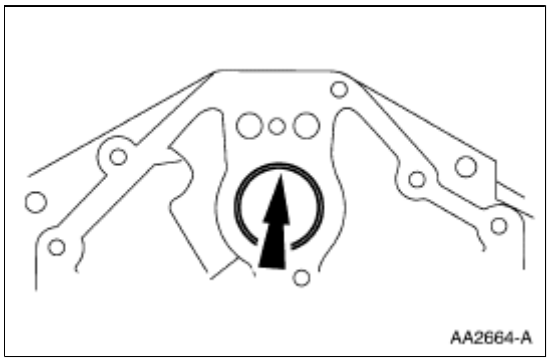


12. Install the oil pump.

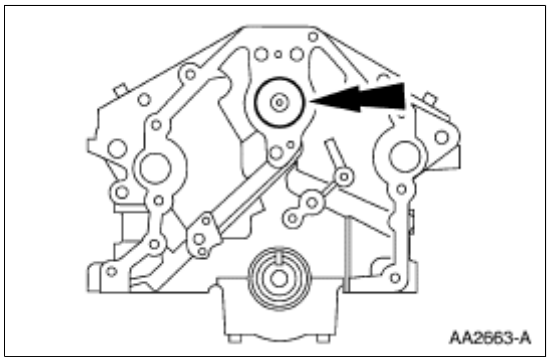


13. **NOTE:** All camshaft components must be lubricated before installation; use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

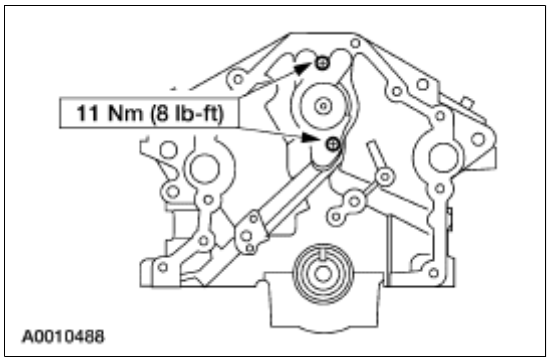
    If removed, use the Camshaft Bearing Service Set and install the camshaft bearings.



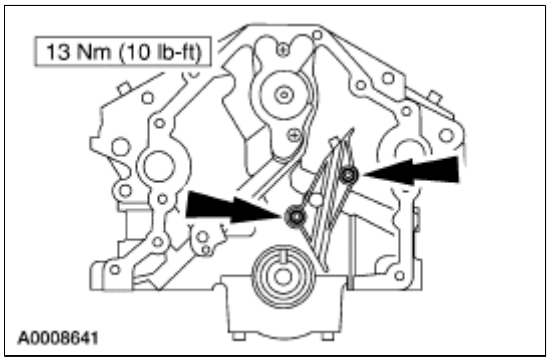
14. Install the camshaft.



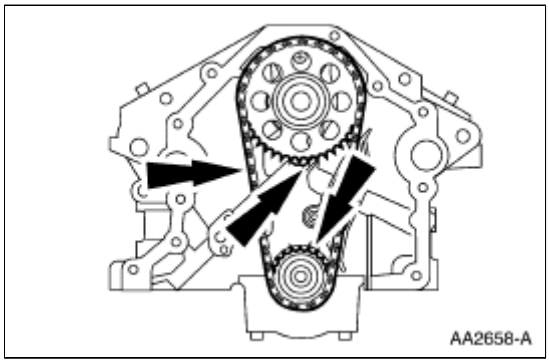
15. Install the camshaft thrust plate.



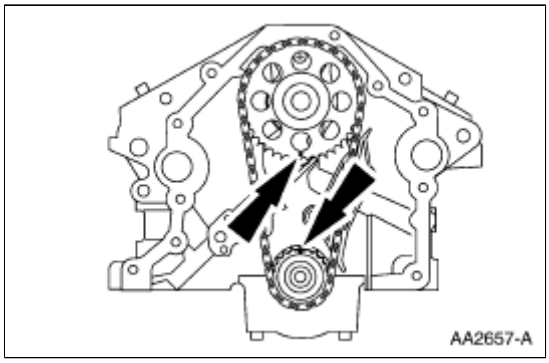
16. Install the timing chain guide.



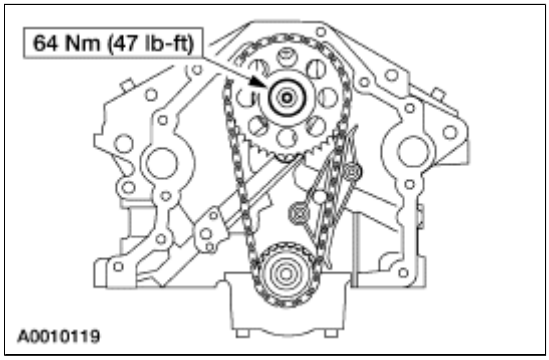
17. Install the camshaft sprocket and the crankshaft sprocket with the timing chain.



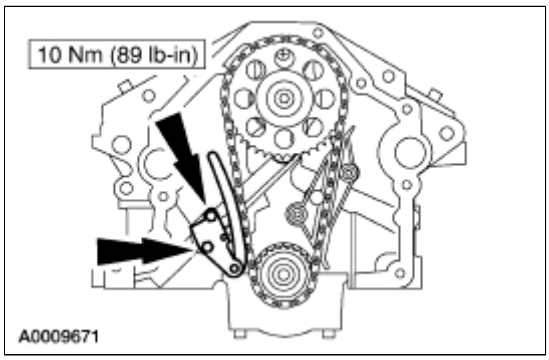
18. Verify the timing mark alignment.



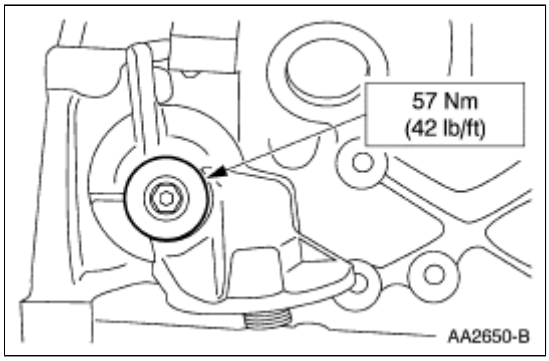
19. Install the bolt.



20. Install the timing chain tensioner.

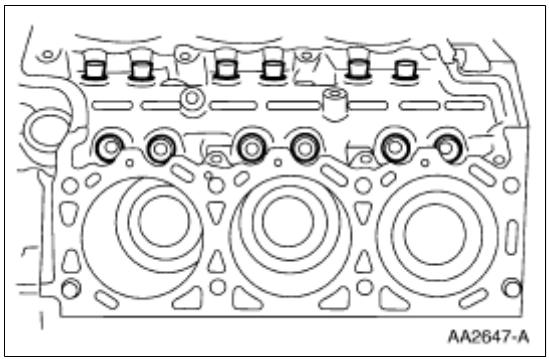


21. Install the oil filter adapter.



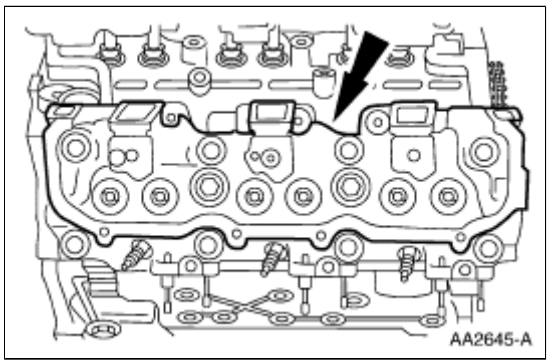
22. **NOTE:** Lubricate the valve tappets and bore with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

    Install the valve tappets.



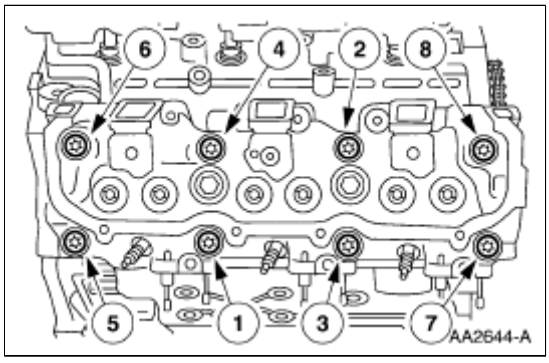
23. Install new cylinder head gaskets.

24. Install the cylinder heads.

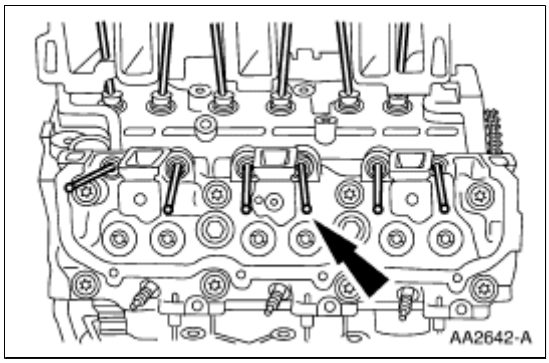


25. **NOTE:** The RH side is shown; the LH side is similar.

    Install bolts and tighten in sequence shown in three steps:
    1. Tighten to 32 Nm (24 lb-ft).
    2. Tighten to 72 Nm (53 lb-ft).
    3. Tighten an additional 90 degrees.

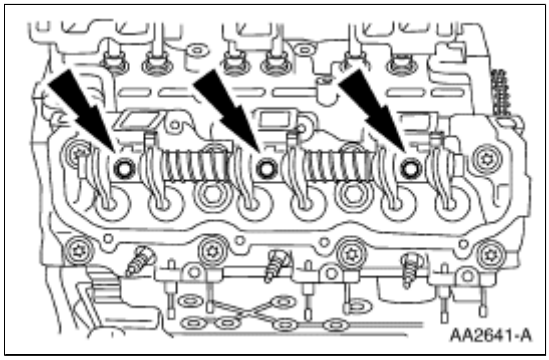


26. Install the push rods.



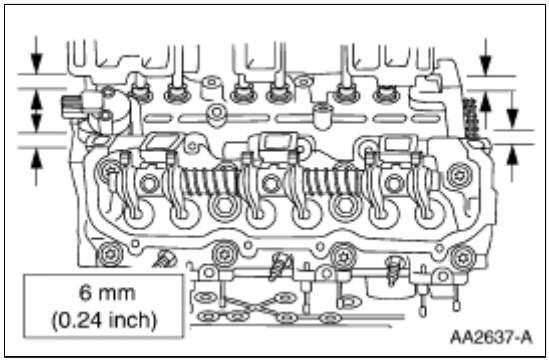
27. **CAUTION: If the rocker arm shaft is not tightened gradually, the shaft may become bent during installation.**

    Install the RH and LH rocker arm shaft assembly and tighten in two steps:
    1. Tighten to 32 Nm (24 lb-ft).
    2. Tighten an additional 90 degrees.



28. Install the camshaft synchronizer. For additional information, refer to Section 303-14 .

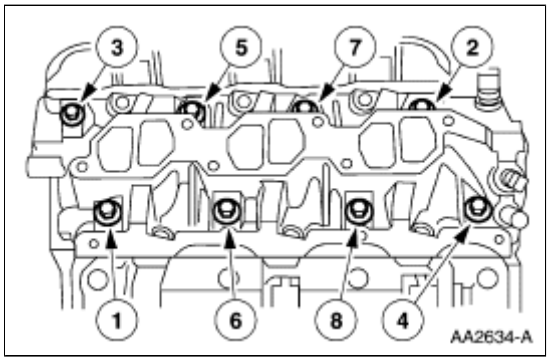
29. Apply silicone rubber in four places.
    - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



30. Install a new lower intake manifold gasket.

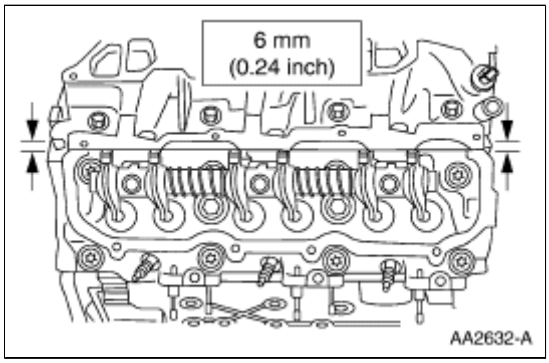
31. Install the lower intake manifold and tighten the bolts in sequence in four steps:
    1. Tighten to 2 Nm (18 lb-in).
    2. Tighten to 10 Nm (89 lb-in).

3. Tighten to 13 Nm (10 lb-ft).
4. Tighten to 12 Nm (12 lb-ft).



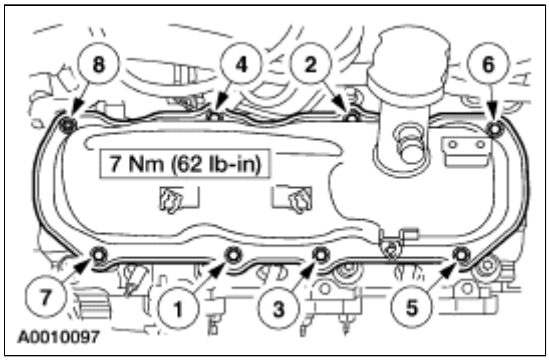
32. **NOTE:** The RH side is shown; the LH side is similar.

    Apply sealer in two places.
    - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.

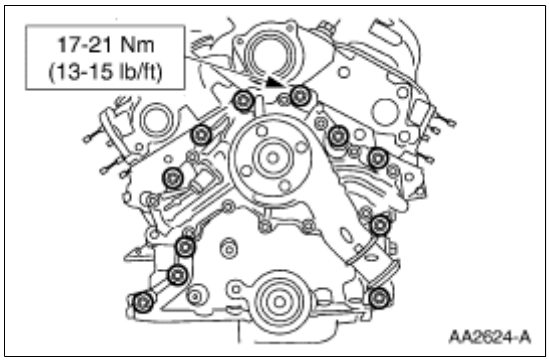


33. **NOTE:** The RH side is shown; the LH side is similar.

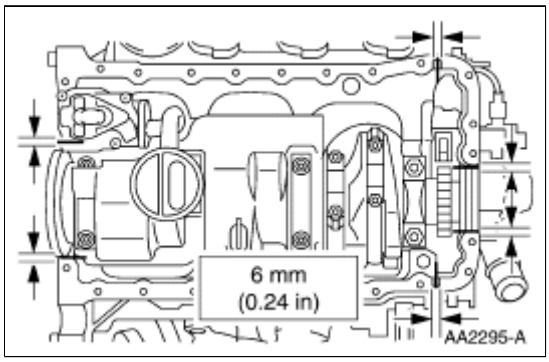
    Install the RH and LH valve covers and new gaskets. Tighten the bolts in the sequence shown.



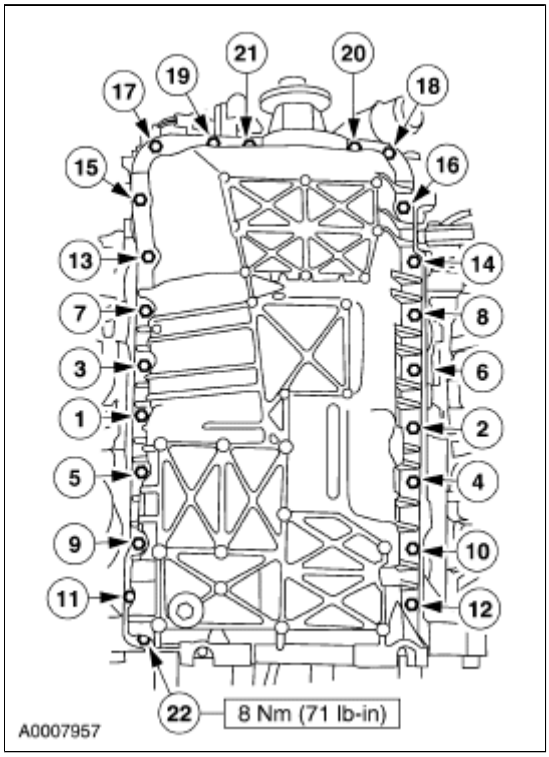
34. Install a new gasket and the front cover.



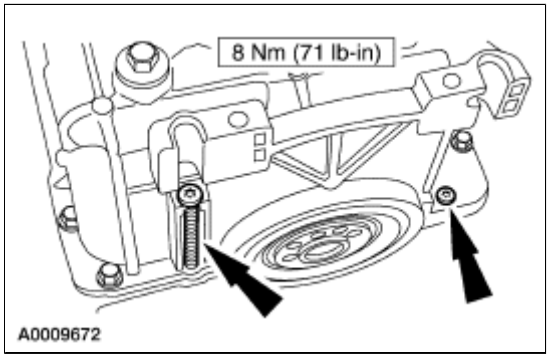
35. Apply silicone rubber in six places.
    - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



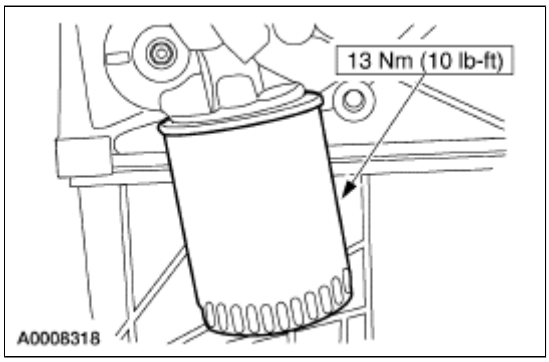
36. Install a new gasket, the oil pan and tighten the bolts and the nuts in the sequence shown.



37. Install the bolts.

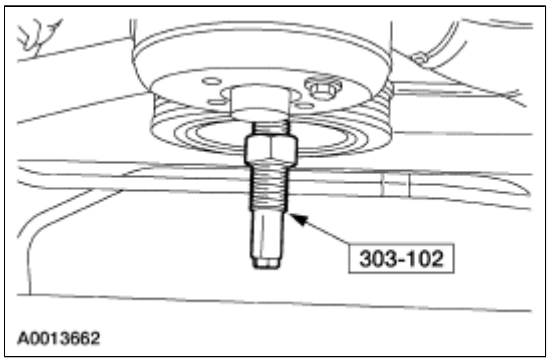


38. Install a new oil filter.



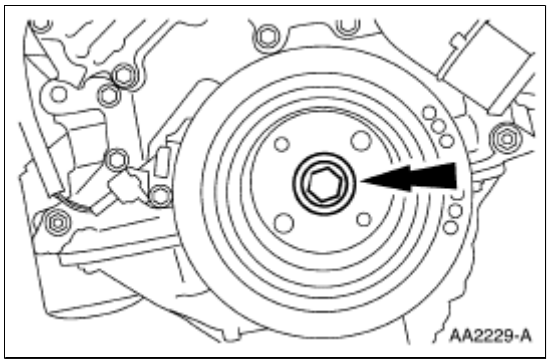
39. Install the crankshaft position (CKP) sensor. For additional information, refer to Section 303-07A .

40. Using the special tool, install the crankshaft pulley.

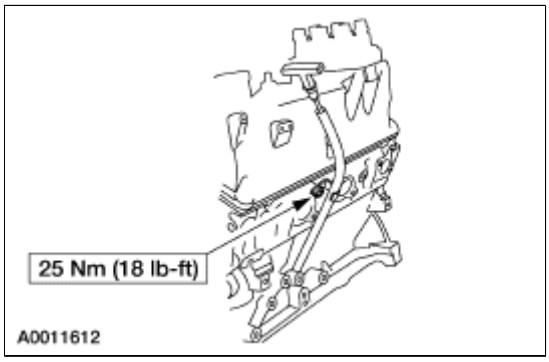


41. **NOTE:** This bolt is torque-to-yield and a new bolt must be installed.

    Install a new bolt and tighten in two steps:
    1. Tighten to 45 Nm (33 lb-ft).
    2. Tighten an additional 90 degrees.



42. Install the oil level indicator tube.



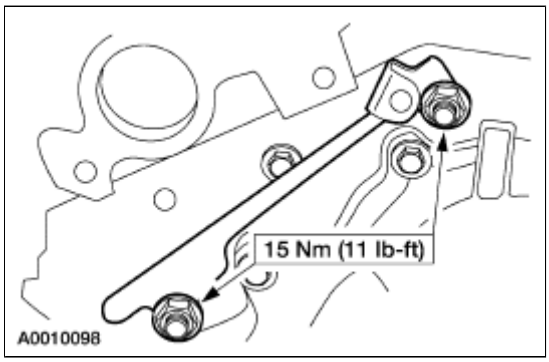
43. Install the power steering and A/C bracket. For additional information, refer to Section 211-02 .

44. Install the alternator and mounting bracket. For additional information, refer to Section 414-02 .

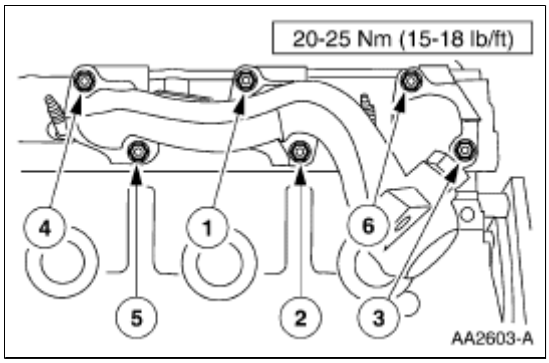
45. Install the accessory drive belt tensioner. For additional information, refer to Section 303-05 .

46. Install the engine mount brackets. For additional information, refer to Engine Support Insulators in this section.

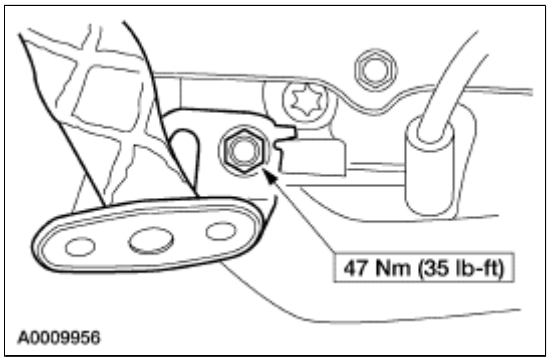
47. Install the wiring harness retainer bracket.



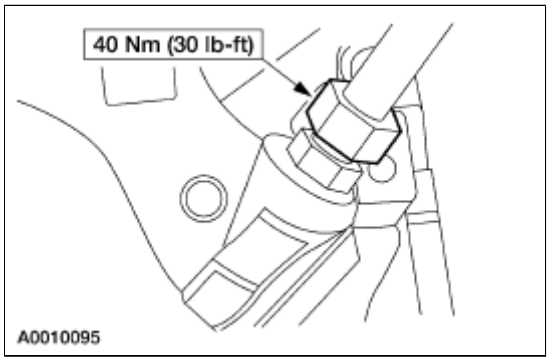
48. Install the RH and LH exhaust manifold gaskets, exhaust manifolds and tighten in the sequence shown.



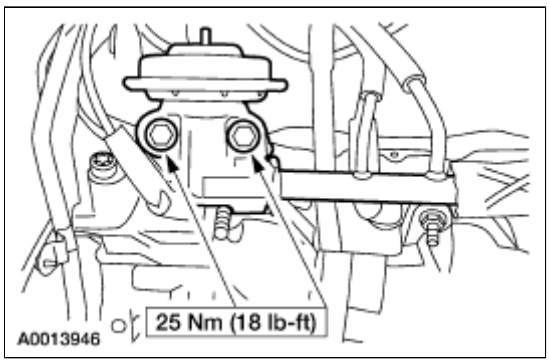
49. Install the EGR outlet tube and bracket.



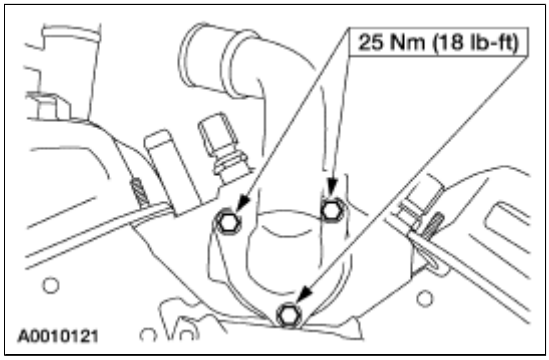
50. Connect the EGR valve tube to the exhaust manifold.



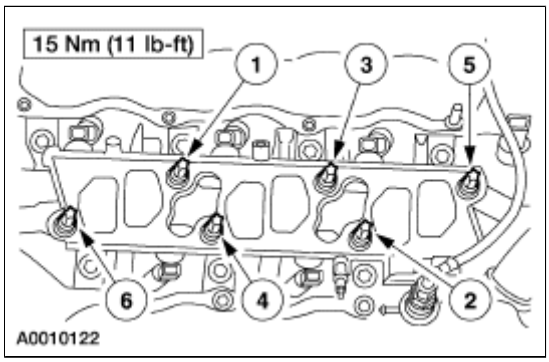
51. Install a new gasket and the EGR valve.



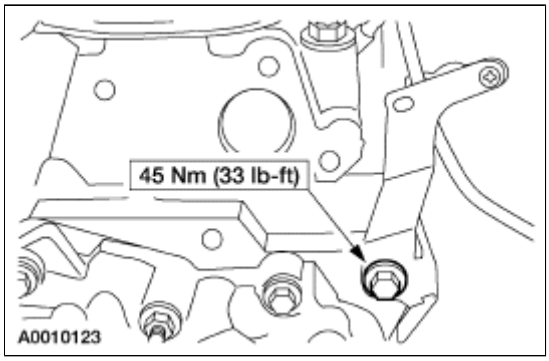
52. Install the water thermostat and the water hose connection.



53. Install a new gasket, the fuel injection supply manifold and tighten the studs in the sequence shown.

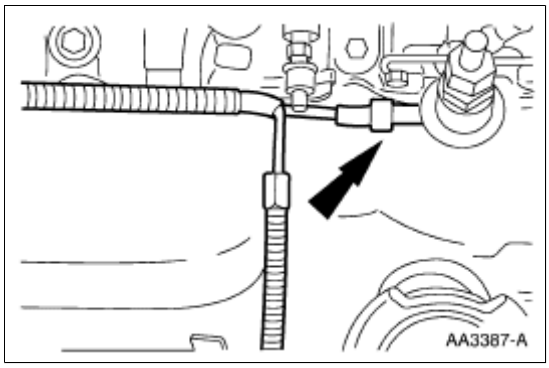


54. Install the bolt.

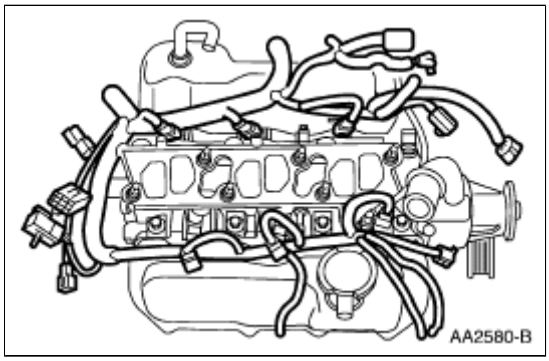


55. Install the fan blade clutch and fan blade assembly. For additional information, refer to Section 303-03 .

56. Position the vacuum harness and connect the line.

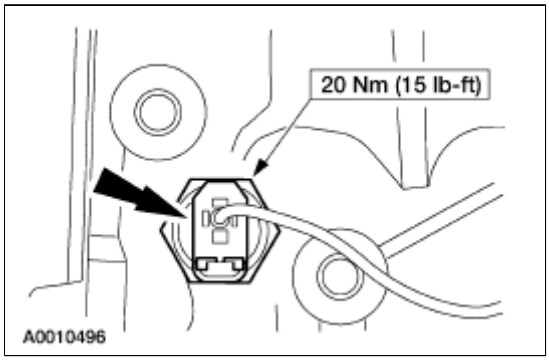


57. Position the engine control sensor wiring.

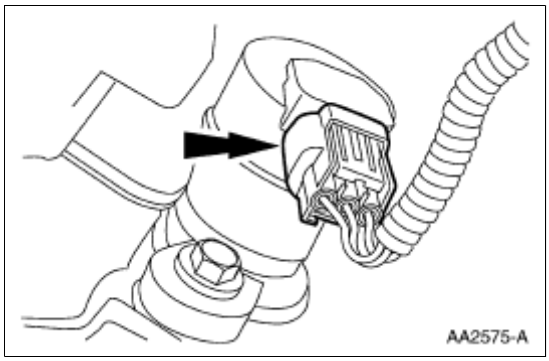


58. **NOTE:** Use Pipe Sealant with Teflon® D8AZ-19554-A or equivalent meeting Ford specifications WSK-M2G350-A2 and ESR-M18P7-A on the threads.

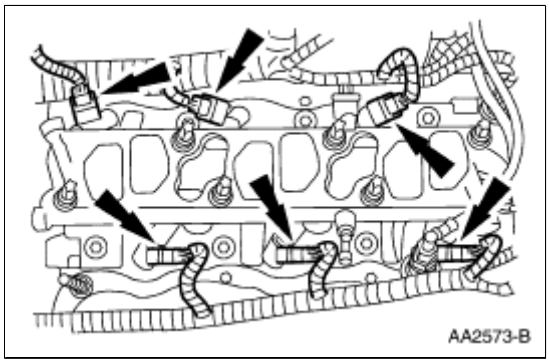
    Install the oil pressure sensor and connect the electrical connector.



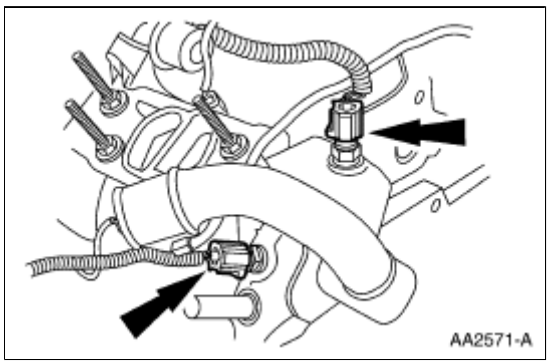
59. Connect the camshaft position (CMP) sensor electrical connector.



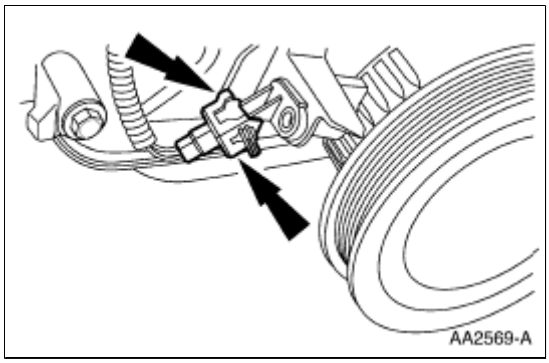
60. Connect the fuel injector electrical connectors.



61. Connect the electrical connectors:
    - engine coolant temperature (ECT) sensor
    - water temperature indicator sender unit

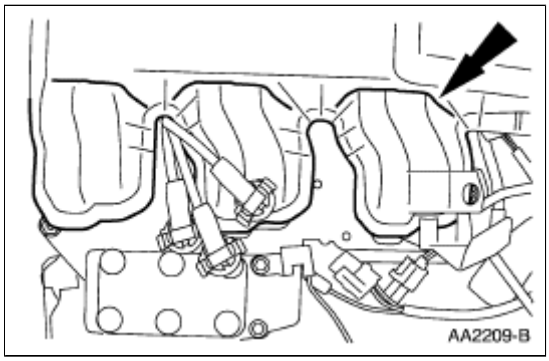


62. Connect the crankshaft position (CKP) sensor electrical connector.

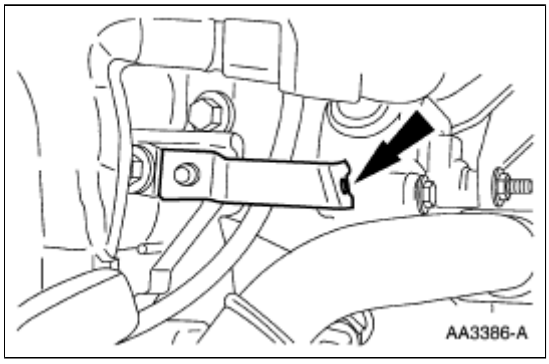


63. If removed, install a new intake manifold upper gasket.

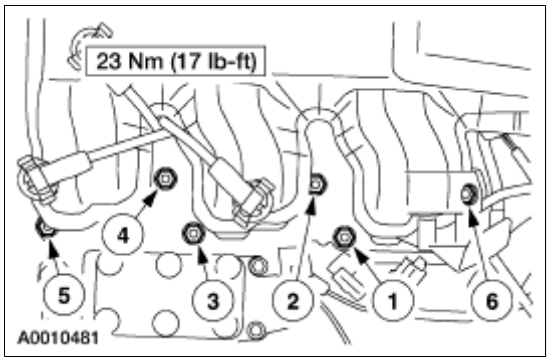
64. Install the upper intake manifold.



65. Position the fuel line bracket.



66. Tighten the nuts in the sequence shown.



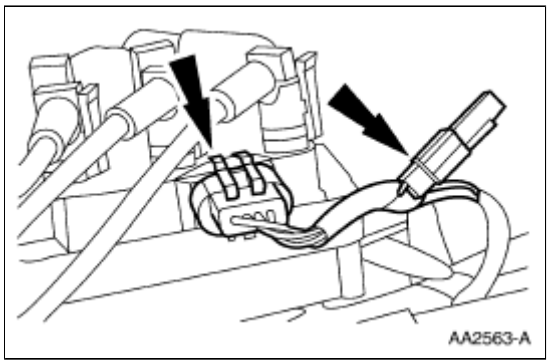
67. **CAUTION: Correct installation of the spark plug wires is critical to vehicle operation. If one spark plug wire is not correctly installed on the spark plug or the ignition coil, both spark plugs connected to that segment of the ignition coil may not fire under load.**

    NOTE: Wipe the spark plug wires with a clean, damp cloth prior to inspection.

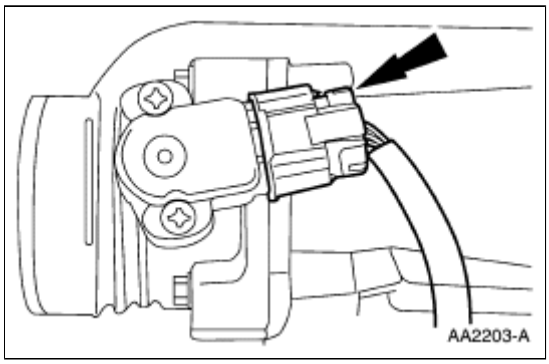
    NOTE: When a spark plug wire is removed for any reason from a spark plug or ignition coil, or a new spark plug wire is installed, Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE -M1C171-A must be applied to the spark plug wire boot prior to installation.

    Coat the entire interior surface of the boot and connect the spark plug wires to the ignition coil and to the spark plugs.

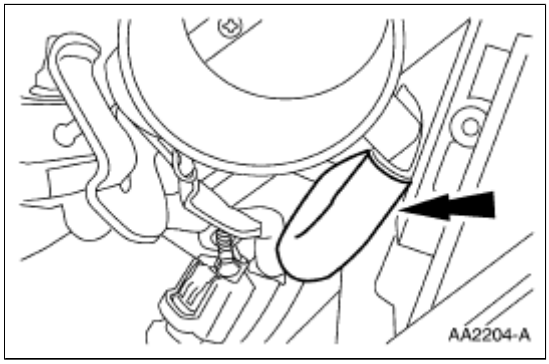
68. Connect the radio ignition interference capacitor and the ignition coil electrical connectors.



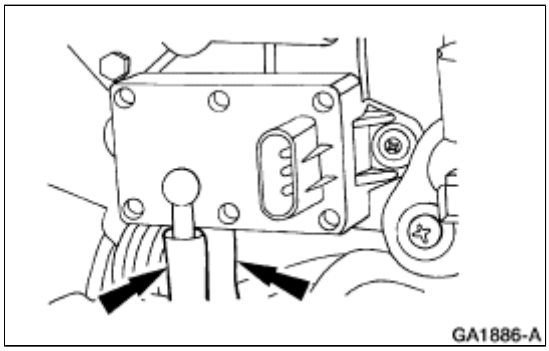
69. Connect the throttle position (TP) sensor electrical connector.



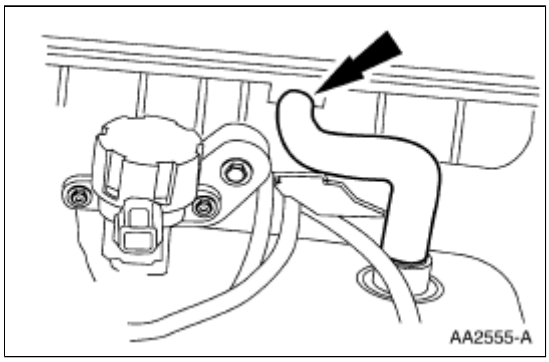
70. Connect the canister purge line from the throttle body.



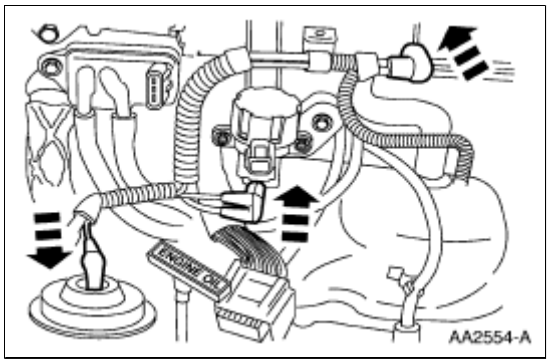
71. Connect the EGR transducer hoses.



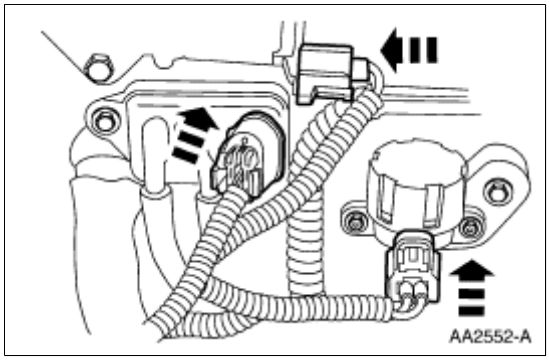
72. Connect the crankcase ventilation tube.



73. Connect the vacuum lines to the:
    - EGR solenoid.
    - upper intake manifold.
    - EGR valve.

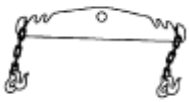


74. Connect the engine control sensor wiring to the:
    - idle air control (IAC) valve.
    - EGR transducer.
    - EGR solenoid.



Engine

Special Tool(s)

ST1831-A	Lifting Eyes 303-D030 (D81L-6001-D) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

1. **NOTE:** The Lifting Eyes should be installed on the exhaust manifold studs for number one and number six cylinders.

   Install the Lifting Eyes.

2. Install the Spreader Bar on the Lifting Eyes.

3. Position and attach a floor crane to the Spreader Bar.

4. Remove the engine from the workstand.

5. Install the spacer plate.

6. **NOTE:** For automatic transmissions.

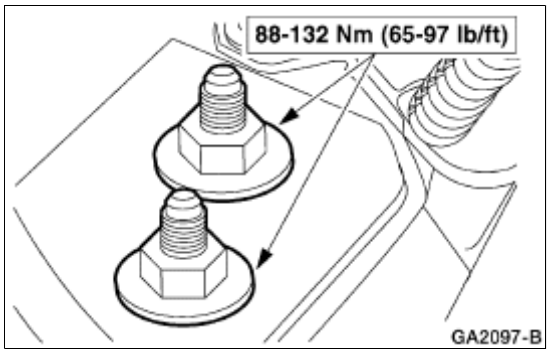
   Install the flywheel. For additional information, refer to Flywheel in this section.

7. **NOTE:** For manual transmissions.

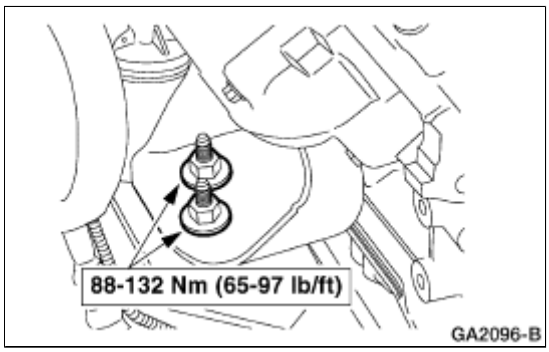
   Install the clutch. For additional information, refer to Section 308-01 .

8. Position the engine in the vehicle.

9. Install the LH engine support insulator nuts.



10. Install the RH engine support insulator nuts.



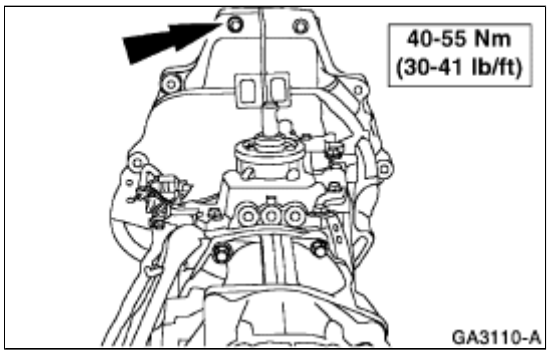
11. Remove the floor crane from the Lifting Eyes.

12. Remove the Lifting Eyes from the exhaust manifold studs.

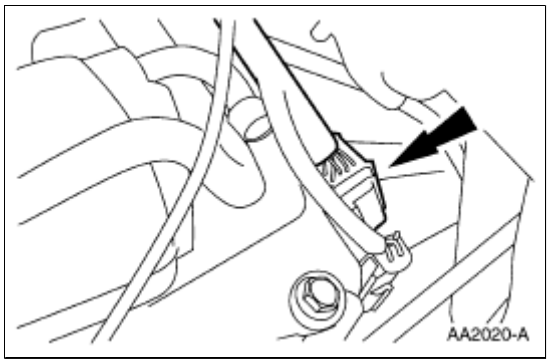
13. Raise and support the vehicle. For additional information, refer to Section 100-02 .

14. **NOTE:** Manual transmission is shown; automatic transmission is similar.

    Install the nine bolts.

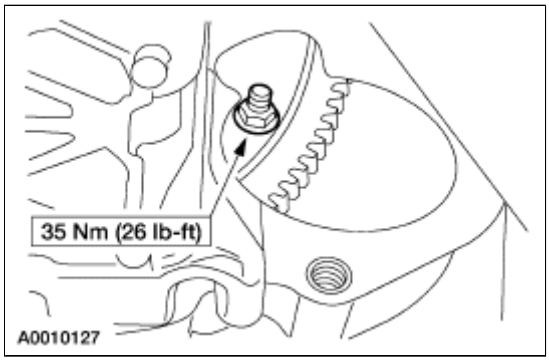


15. Connect the transmission wiring harness electrical connectors.

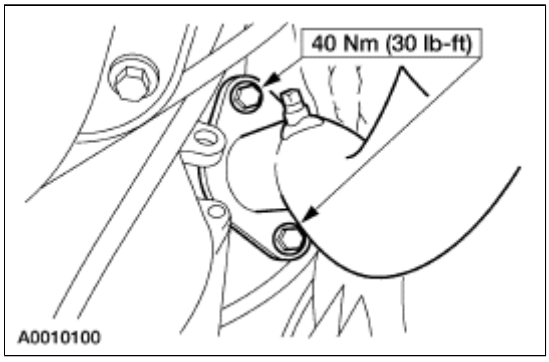


16. **NOTE:** For automatic transmission only.

    Install the four nuts.

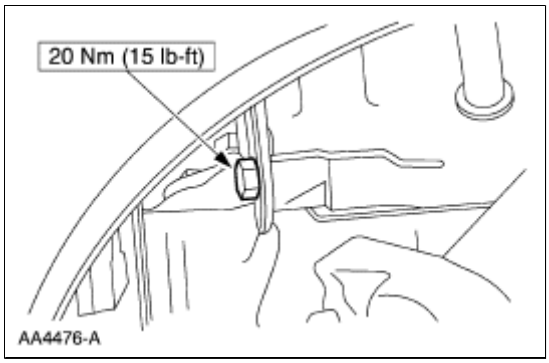


17. Install the four LH and RH exhaust manifold nuts.

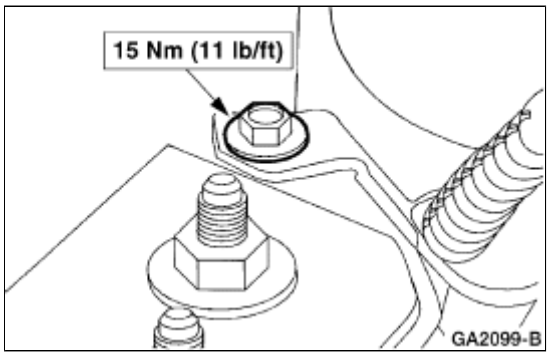


18. Connect the heated oxygen sensors.

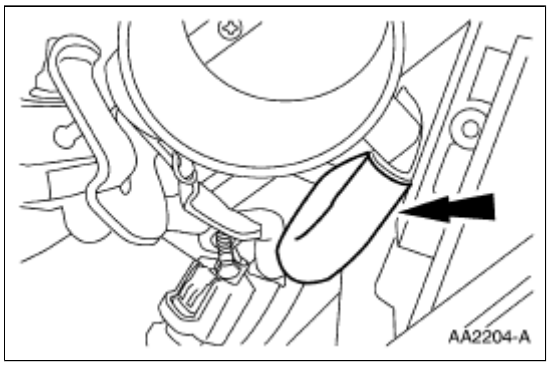
19. Position the A/C manifold tube bracket through the RH wheel well and install the bolt.



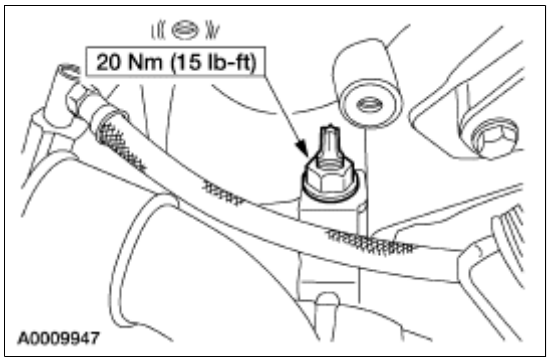
20. Install the starter motor. For additional information, refer to Section 303-06 .
21. Lower the vehicle.
22. Install the battery cable bracket.



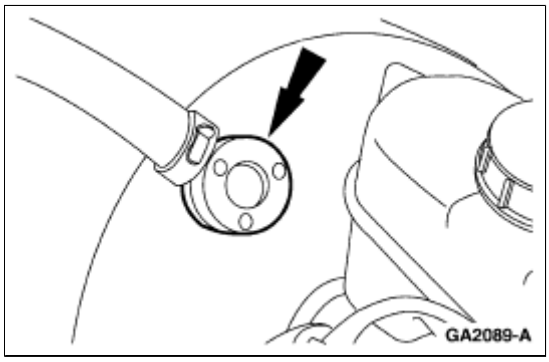
23. Connect the canister purge line.



24. Install the generator harness and the retaining clip.

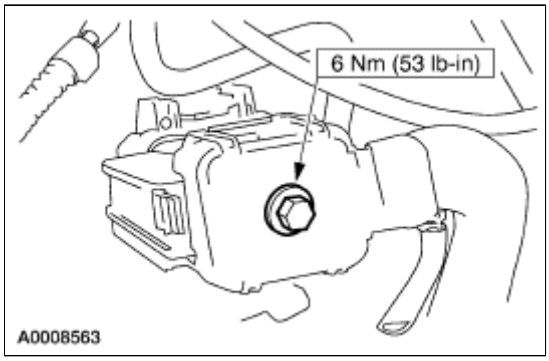


25. Connect the vacuum connector to the brake booster.

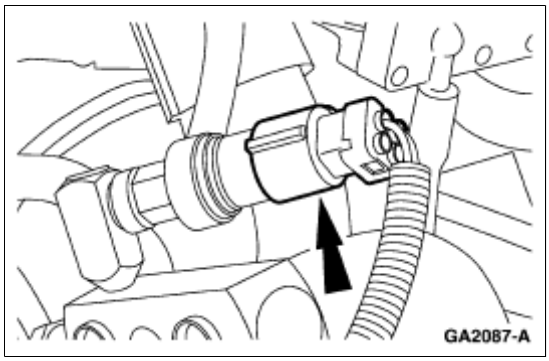


26. Connect the fuel lines. For additional information, refer to Section 310-00 .

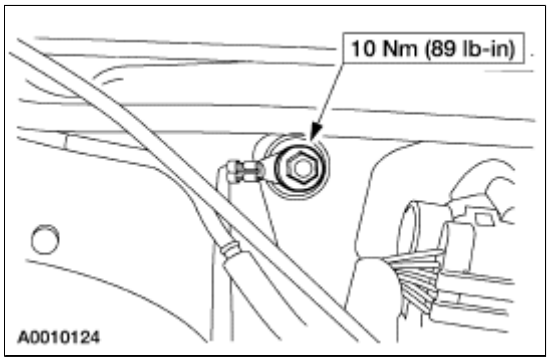
27. Connect the bulkhead connector.



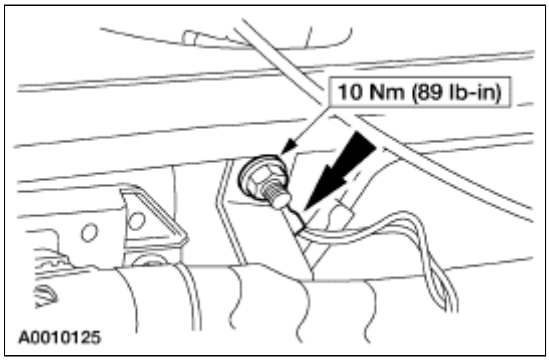
28. Connect the A/C high pressure switch electrical connector.



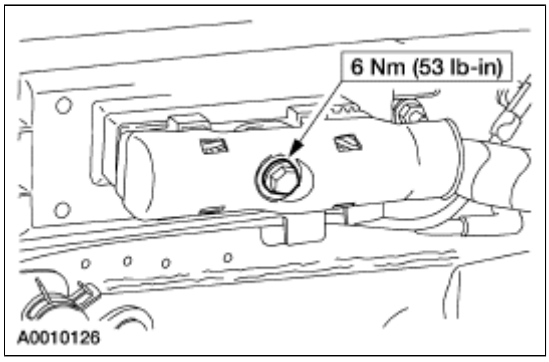
29. Install the engine-to-body ground wire.



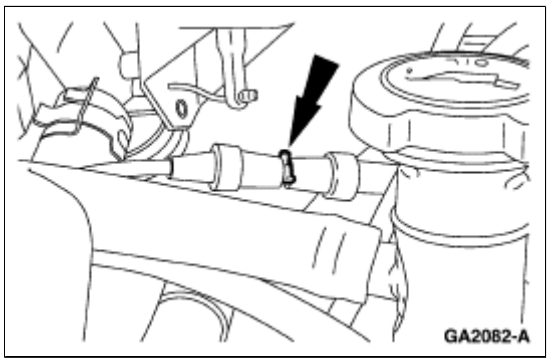
30. Install the engine harness ground wire.



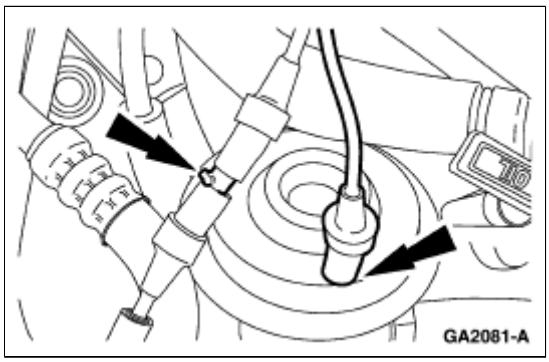
31. Install the powertrain control module (PCM) electrical connector.



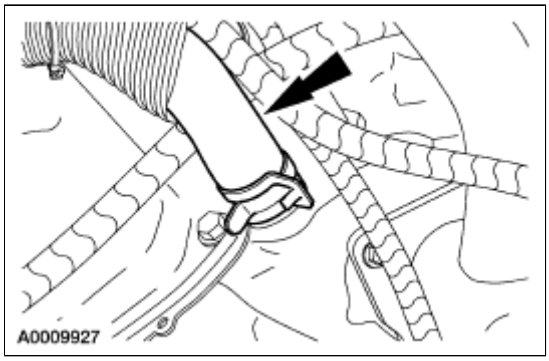
32. Connect the RH vacuum connector.



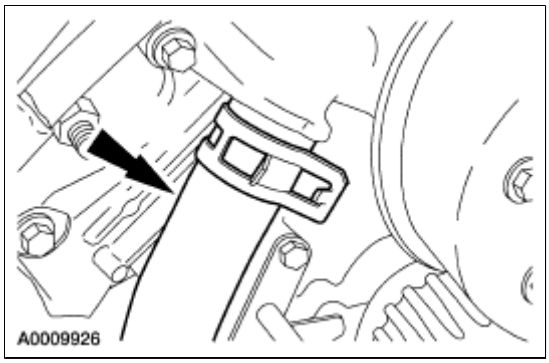
33. Connect the EGR vacuum connector and the LH vacuum connector.



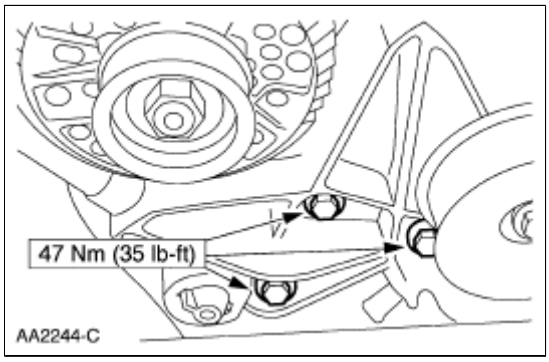
34. Connect the heater water hose to the lower intake manifold.



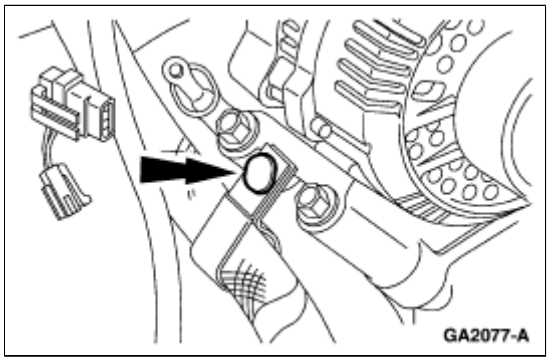
35. Connect the heater water hose to the water pump.



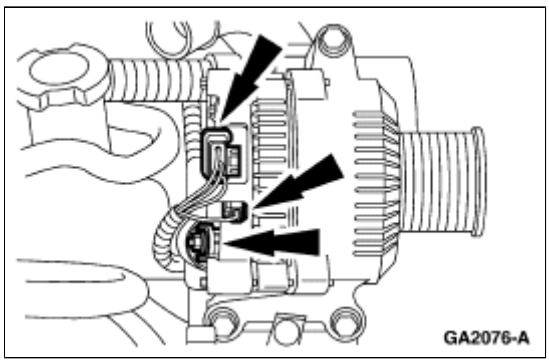
36. Install the generator mounting bracket.



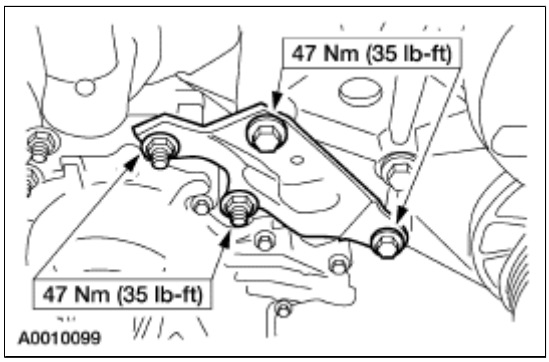
37. Connect the heater water hose retaining clip.



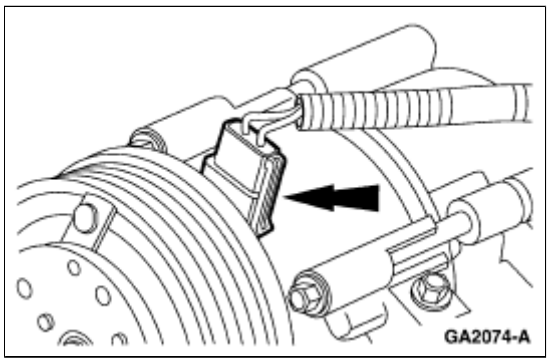
38. Connect the generator electrical connectors.



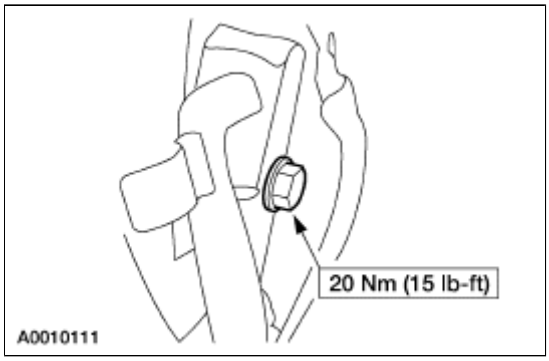
39. Install the A/C compressor mounting bracket.



40. Connect the A/C compressor electrical connector.

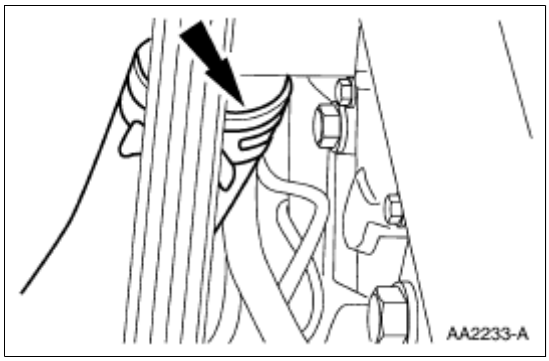


41. Install the A/C manifold tube on the A/C compressor.

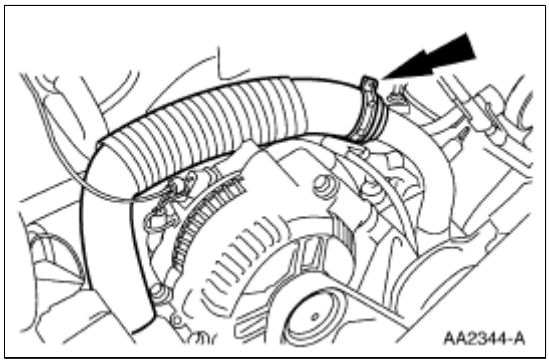


42. Install the radiator. For additional information, refer to Section 303-03 .

43. Install the lower radiator hose.

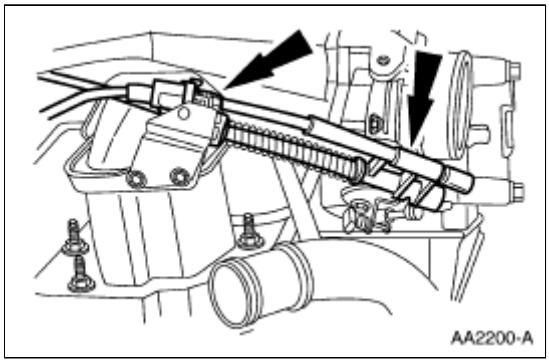


44. Install the upper radiator hose.

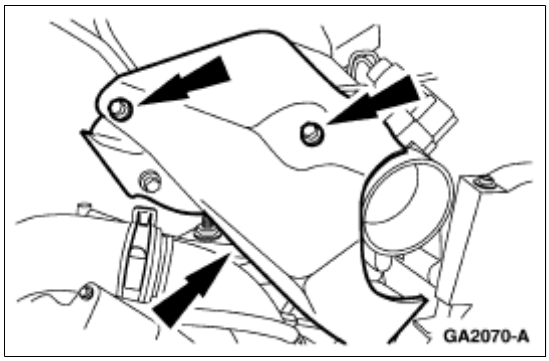


45. Connect the power steering pressure hose and the power steering return hose.

46. Connect the accelerator cable and the speed control cable (if equipped).



47. Install the accelerator cable control snow shield.



48. Install the accessory drive belt. For additional information, refer to Section 303-05 .

49. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

50. Fill the engine with SAE 5W-30 Super Premium Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

51. Recharge the A/C system. For additional information, refer to Section 412-00 .

52. Fill the power steering system. For additional information, refer to Section 211-00 .

53. Install the hood.

54. Fill the cooling system. For additional information, refer to Section 303-03 .

55. Connect the battery ground cable. For additional information, refer to Section 414-01 .

General Specifications

Item	Specification
Sealers and Lubricants	
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP	WSS-M2C153-G
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171–A

General Specifications

Item	Specification
4.0L SOHC	
Displacement liters (cubic inch)	4.0L (244)
Number of cylinders	6
Bore mm (inch)	100.4 (3.953)
Stroke mm (inch)	84.4 (3.31)
Firing order	1-4-2-5-3-6
Minimum oil pressure at 2,000 rpm (engine at normal operating temperature) kPa (psi)	103 (15)
Cylinder Head and Valve Train	
Valve guide bore diameter mm (inch)	7.00-7.018 (0.276)
Combustion chamber volume (cc)	65.197 ± 2.068-2.018
Valve arrangement front to rear	LH=I-E-I-E-I-E RH=E-I-E-I-E-I
Gasket surface flatness mm (inch)	0.08 (0.003) Total
Valve Seat	
Width (exhaust and intake) mm (inch)	1.556-2.404 (0.06-0.094) 1.273-2.121 (0.05-0.083)
Angle degrees	45°
Runout TIR maximum mm (inch)	0.059 (0.002)
Valves	
Valve stem diameter intake mm (inch)	6.965-6.98 (0.274-0.275)
Valve stem diameter exhaust mm (inch)	6.95-6.965 (0.274)
Valve stem to guide clearance exhaust mm (inch)	0.035-0.068 (0.001-0.003)

Valve stem to guide clearance intake mm (inch)	0.020-0.053 (0.001-0.002)
Head diameter intake mm (inch)	45.9-46.1 (1.807-1.815)
Head diameter exhaust mm (inch)	38.9-39.1 (1.531-1.539)
Valve face angle degrees	45°
Valve face runout limit	0.03 (0.001)
Valve Springs	
Intake valve spring compression pressure at specified height (lbs)	275-305 Nm at 35.9-36.7 mm (202.84-224.968 lb/ft at 1.413-1.445 inch)
Exhaust valve spring compression pressure at specified height (lbs)	275-305 Nm at 35.9-36.7 mm (202.84-224.968 lb/ft at 1.413-1.445 inch)
Intake valve spring free length mm (inch)	43.1 (1.7)
Exhaust valve spring free length mm (inch)	43.1 (1.7)
Intake valve spring assembled height mm (inch)	39.86-40.86 (1.569-1.601)
Exhaust valve spring assembled height mm (inch)	39.86-40.68 (1.569-1.601)
Camshaft	
Intake lobe lift mm (inch)	6.584 (0.259)
End play mm (inch)	0.075-0.185 (0.0003-0.007)
Exhaust lobe lift mm (inch)	6.584 (0.259)
Maximum allowable lobe lift loss mm (inch)	0.127 (0.005)
Journal to bearing clearance mm (inch) [a]	0.04-0.095 (0.002-0.004)
Journal to Bearing Clearance	
Service limit mm (inch) [a]	0.152 (0.006)
Camshaft Drive	
Journal diameter mm (inch)	27.935-27.96 (1.100-1.104)
Bearing inside diameter mm (inch) all	28.0-28.03 (1.102-1.104)
Maximum camshaft journal runout mm (inch)	0.05 (0.002)
Cylinder Block	
Cylinder bore diameter mm (inch)	100.4 (3.953)
Maximum cylinder out-of-round mm (inch)	0.025 (0.001)
Maximum cylinder taper mm (inch)	0.025 (0.001)
Main bearing bore diameter mm (inch)	60.634-60.620 (2.387-2.387)
Crankshaft to rear face of block runout. TIR maximum mm (inch)	0.127 (0.005)
Distributor shaft bearing bore diameter mm (inch)	72.43-72.473 (2.852-2.853)
Head gasket surface flatness mm (inch)	0.1 (0.004) overall
Head gasket surface finish RMS	60-150
Crankshaft and Flywheel	
Main bearing journal diameter mm (inch)	56.980-57.0 (2.243-2.244)
Main bearing journal runout limit mm (inch)	0.05 (0.002)

Main bearing journal taper maximum per inch mm (inch)	0.008 (0.0003)
Connecting rod journal maximum out-of-round mm (inch)	0.008 (0.0003)
Crankshaft free end play mm (inch)	0.05-0.32 (0.002-0.0126)
Main bearing journal out-of-round mm (inch)	0.008 (0.0003)
Main bearing journal runout TIR maximum mm (inch)	0.05 (0.002)
Main bearing journal runout service limit mm (inch)	0.0127 (0.005)
Main bearing thrust face runout TIR maximum mm (inch)	0.0254 (0.010)
Thrust bearing journal length mm (inch)	26.39-26.44 (1.039-1.041)
Main and rod bearing journal finish RMS maximum	72 and 88
Main bearing thrust face finish RMS maximum	20
Connecting rod journal diameter mm (inch)	53.98-54.0 (2.125-2.126)
Connecting rod journal taper per inch maximum mm (inch)	0.008 (0.0003)
Connecting Rod Bearings	
Clearance to crankshaft desired mm (inch)	0.008-0.061 (0.0003-0.0024)
Clearance to crankshaft allowable mm (inch)	0.013-0.048 (0.0005-0.002)
Bearing wall thickness mm (inch)	1.4-1.408 (0.0551-0.0554)
Main Bearings	
Clearance to crankshaft mm (inch)	0.021-0.039 (0.0008-0.0015)
Clearance to crankshaft allowable mm (inch)	0.013-0.048 (0.0005-0.002)
Bearing wall thickness mm (inch)	1.8-1.806 (0.0709-0.0711)
Connecting Rod, Piston and Rings	
Side clearance (assembled to crankshaft) mm (inch)	0.092-0.268 (0.0036-0.0106)
Piston pin bore or bushing I.D. mm (inch)	23.958-23.976 (0.943-0.944)
Rod bearing bore I.D. mm (inch)	56.82-56.84 (2.237)
Rod bearing bore out-of-round mm (inch)	0.01 (0.0004)
Rod length center to center mm (inch)	145.965-146.035 (5.746-5.749)
Alignment (bore-to-bore max. diff.) twist mm (inch)	0.038 (0.0015) per 25.4 mm (1.000)
Alignment (bore-to-bore max. diff.) bend mm (inch)	0.0125 (0.00049) per 25.4 mm (1.000)
Piston Pin	
Length mm (inch)	72.0-72.8 (2.835-2.866)
Diameter (red) mm (inch)	23.994-23.997 (.9446-.9447)
Diameter (blue) mm (inch)	23.997-24.000 (0.9447-0.9449)
To piston pin bore clearance mm (inch)	0.01-0.016 (0.0004-0.0006)
To connecting rod bushing clearance mm (inch)	Press Fit -0.018 to -0.042 (-0.0007 to -0.0017)
Piston	
Bore clearance selective fit mm (inch)	0.030-0.060 (0.0012-0.002)
Diameter — coded STD mm (inch)	100.380-100.400 (3.952-3.9528)
Diameter — coded 0.5 mm (inch)	100.880-100.900 (3.972)

Diameter — coded 1.0 mm (inch)	101.350-101.370 (3.990-3.991)
Pin bore diameter (red) mm (inch)	24.007-24.010 (0.945)
Pin bore diameter (blue) mm (inch)	24.010-24.013 (0.945)
Top ring groove width mm (inch)	1.64-1.66 (0.0645-0.0654)
Bottom ring groove width mm (inch)	1.79-1.81 (0.0705-0.0713)
Oil ring groove width mm (inch)	3.5-3.53 (0.1378-0.1399)
Piston Rings	
Top compression ring width mm (inch)	1.578-1.598 (0.062-0.063)
Bottom compression ring width mm (inch)	1.728-1.74 (0.068-0.069)
Top compression side clearance mm (inch)	0.050-0.082 (0.002-.0003)
Bottom compression side clearance mm (inch)	0.050-0.082 (0.002-0.003)
Top compression ring gap mm (inch)	0.200-0.450 (0.008-0.018)
Bottom compression ring gap mm (inch)	0.450-0.700 (0.018-0.028)
Lubrication System	
Relief valve spring pressure lbs. At 35.3 mm (1.39 in)	61.3-66.3 Nm (45.100-48.730 lb/ft)
Driveshaft to housing clearance mm (inch)	0.02-0.031 (0.0007-0.0012)
Relief valve to housing clearance mm (inch)	0.015-0.03 (0.0007-0.0012)
Rotor assembly end clearance max. mm (inch)	0.014-0.044 (0.0006-0.0017)
Outer race to end clearance mm (inch)	0.06-0.12 (0.0002-0.0004)
Engine oil capacity liters (quarts)	3.8 (4) with filter

[a] Tighten camshaft bearing cap bolts to 15 Nm (11 lb-ft) when measuring journal clearance.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor manifold bolt	20	15	—
A/C line bracket nut	20	15	—
Accelerator control splash shield bolts	4	—	35
Balance shaft bolts	26-28	19-21	—
Balance shaft chain guide	9-11	—	80-97
Balance shaft tensioner bolts	28-30	21-22	—
Camshaft bearing cap bolts	(a)	—	—
Camshaft sprocket bolt	85	63	—
Cassette and sprocket to jackshaft bolt	(a)	—	—
Cassette bolt, LH	12	9	—
Cassette bolt, RH	10	—	89
Connecting rod bolts	(a)	—	—
Crankshaft pulley bolts	(a)	—	—
Cylinder head bolts	(a)	—	—

Accessory bracket bolts	42	31	—
Engine coolant temperature (ECT) sensor	10	—	89
Engine electrical connector	6	—	53
Engine front cover bolts	19	14	—
Engine lifting eye bolts	37	27	—
Electrical harness retainer bolt	10	—	89
Lower engine mount bracket nuts	80	59	—
Fuel line bracket bolt	10	—	89
Exhaust gas recirculation (EGR) tube bracket bolts	10	—	89
EGR valve tube fittings	40	30	—
Exhaust manifold nuts	22	16	—
Exhaust manifold to exhaust pipe bolts	40	30	—
Flywheel bolts	(a)	—	—
Front cassette bolt	19	14	—
Front cylinder head bolts	(a)	—	—
Fuel injection supply manifold bolts	24	18	—
Generator bracket bolts	42	31	—
Ground wire bolt	10	—	89
Heater hose bracket bolts	37	27	—
Hydraulic camshaft tensioner, RH	(a)	—	—
Hydraulic camshaft tensioner, LH	(a)	—	—
Jackshaft chain guide bolts	19	14	—
Jackshaft chain tensioner bolts	10	—	89
Jackshaft rear sprocket bolt	(a)	—	—
Jackshaft front sprocket bolt	(a)	—	—
Jackshaft thrust plate bolts	11	8	—
Knock sensor bolt	25	18	—
Ladder frame bolts and nuts (outside)	10	—	89
Ladder frame bolts (inside)	(a)	—	—
Ladder frame Torx® bolts	8	—	71
Ladder frame inserts	3	—	27
Lower intake manifold bolts	18	13	—
Main bearing cap bolts	97	72	—
Oil bypass filter	13	10	—
Oil filter adapter bolt	57	42	—
Oil level indicator tube bracket bolt	25	18	—
Oil pan bolts	9	—	80
Oil pan drain plug	26	19	—
Oil pressure sensor	11-16	9-11	—

Oil pump bolts	19	14	—
Oil pump drive assembly	19	14	—
Oil pump screen cover and tube bolts	11	8	—
Powertrain control module (PCM) bolt	6	—	53
Powertrain control module (PCM) ground wire nut	10	—	89
Power steering pressure line nut	18	13	—
Rear cassette bolt	18	13	—
Spark plug	20	15	—
Thermostat housing bolts	11	8	—
Transmission cooler line bracket bolt	47	35	—
Transmission to engine bolts	47	35	—
Torque converter to flywheel nuts	47	35	—
Upper engine mount bracket nuts	110	81	—
Lower engine mount bracket bolts	80	59	—
Upper intake manifold bolts	7	—	62
Valve cover bolts	9	—	80
Vapor management valve (VMV) hose bracket	15	11	—
Water pump bolts	10	—	89
Water temperature indicator sender unit	10	—	89
Wiring harness retainer nuts	15	11	—

(a) Refer to the procedure.

Engine

The 4.0L SOHC engine consists of the following:

- single overhead camshafts
- sequential multiport fuel injection (SFI)
- distributorless ignition system
- aluminum cylinder heads
- cast iron, 60-degree V cylinder block
- composite two-piece intake manifold system
- balance shaft (4x4 vehicles)
- jackshaft
- unique engine timing configuration

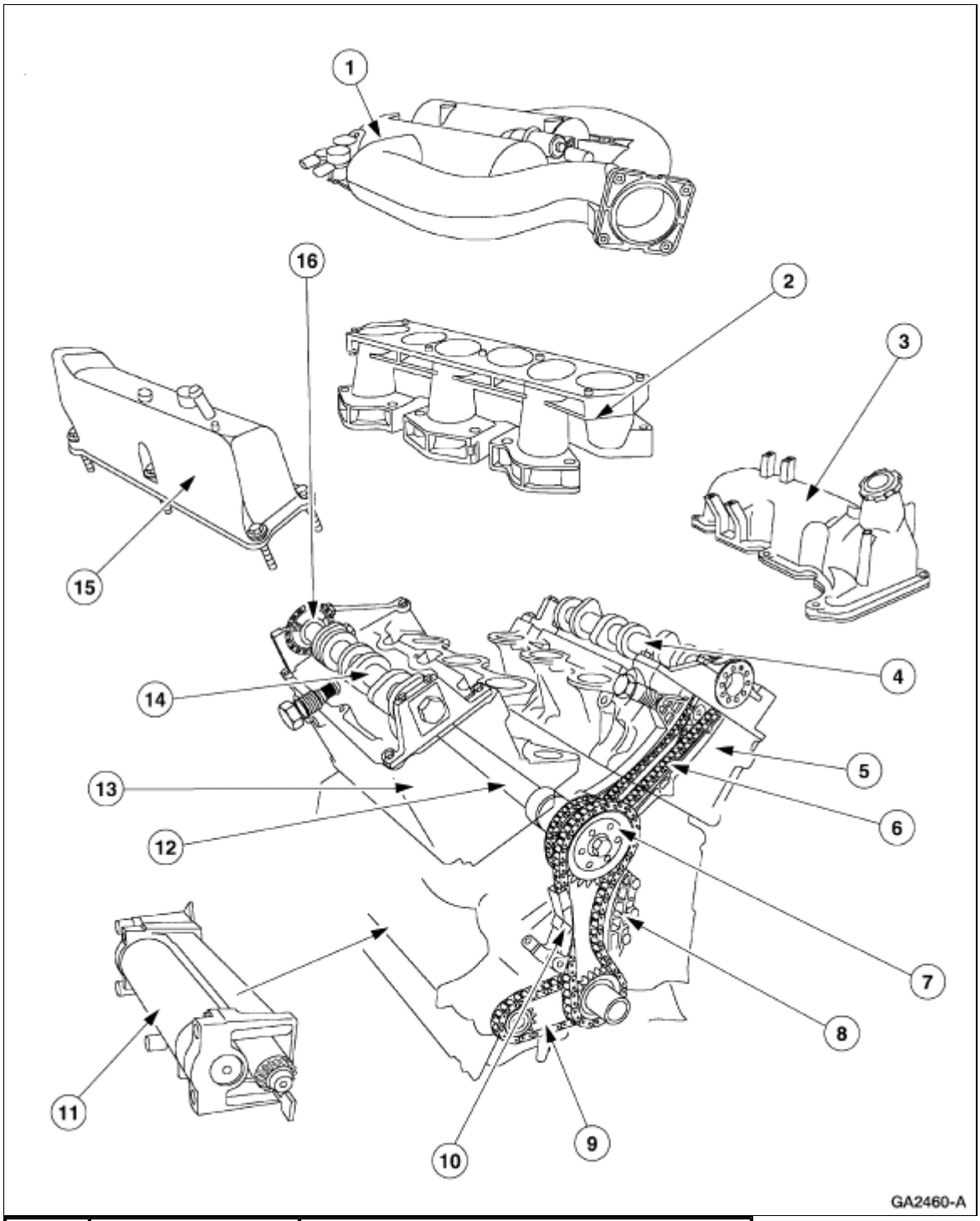
For quick identification, refer to the vehicle control information decal mounted under the hood.

- For additional information, refer to Section 100-01 .

An engine identification label is attached to the engine. The label:

- identifies the symbol code for determining parts usage. For additional information, refer to Section 100-01 .

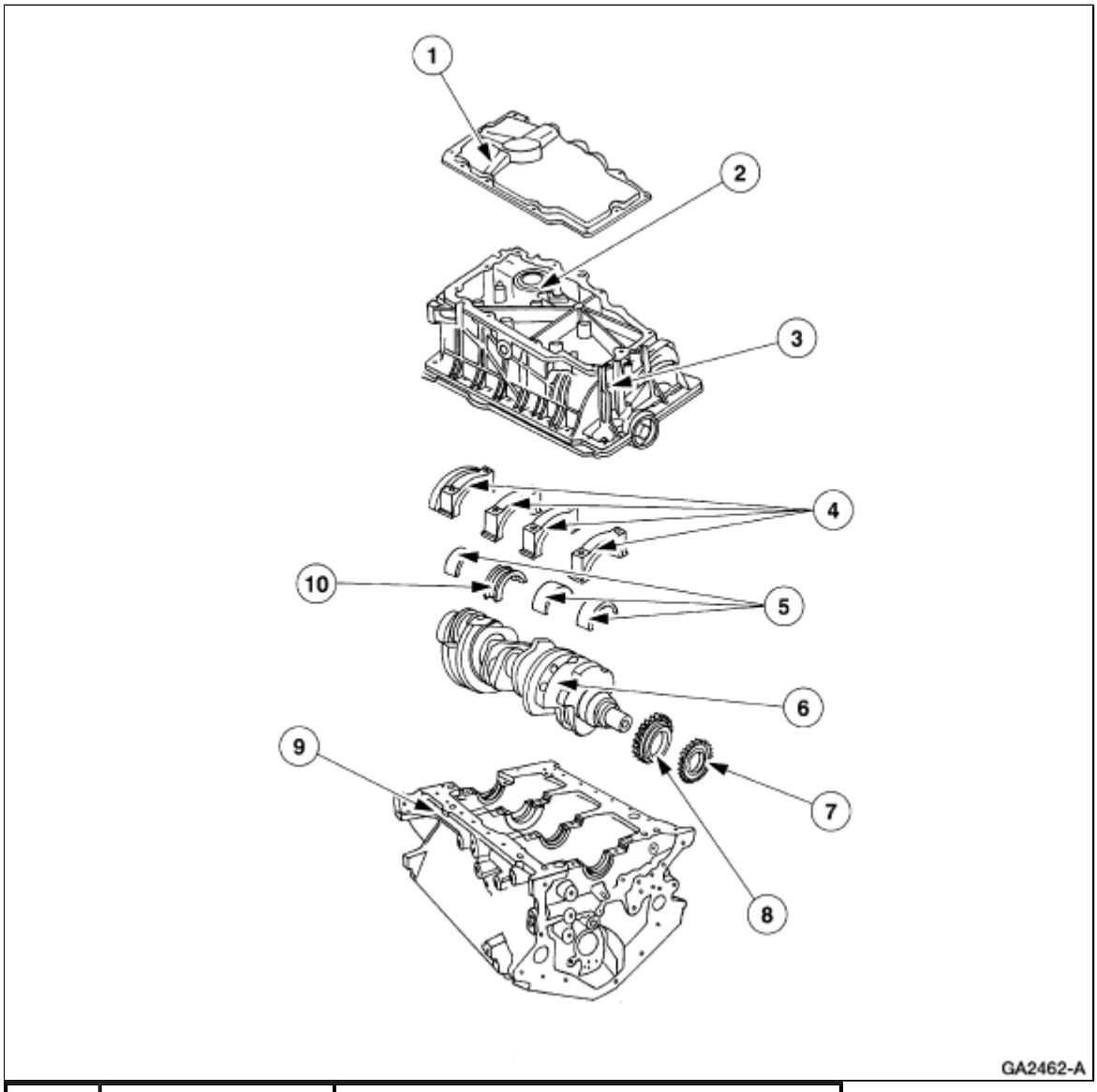
Upper End—4.0L SOHC Engine



Item	Part Number	Description
1	9424	Intake manifold, upper
2	9424	Intake manifold, lower
3	6582	Valve cover, LH
4	6250	Camshaft
5	6049	Cylinder head
6	6M289	LH cassette

7	6M270	Jackshaft chain assembly
8	6K254	Jackshaft chain guide
9	6A364	Balance shaft chain (4x4 Only)
10	6M271	Jackshaft chain tensioner
11	6A311	Balance shaft (4x4 Only)
12	6M262	Jackshaft
13	6049	Cylinder head
14	6250	Camshaft
15	6582	Valve cover, RH
16	6M290	RH cassette

Lower End—4.0L SOHC Engine



Item	Part Number	Description

1	6675	Oil pan
2	6617	Tube assembly oil pickup
3	6F092	Ladder frame
4	—	Main bearing caps
5	6333	Crankshaft main bearing
6	6303	Crankshaft
7	6306	Jackshaft sprocket
8	6K350	Balance shaft sprocket
9	6010	Cylinder block
10	6337	Crankshaft thrust main bearing

Engine

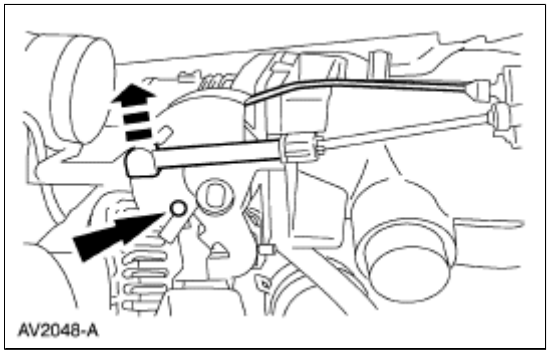
Refer to Section 303-00 .

Intake Manifold —Upper

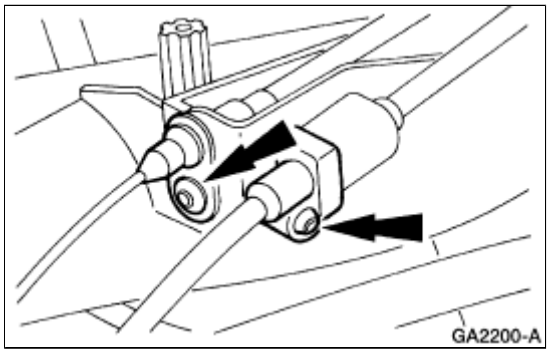
Removal and Installation

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

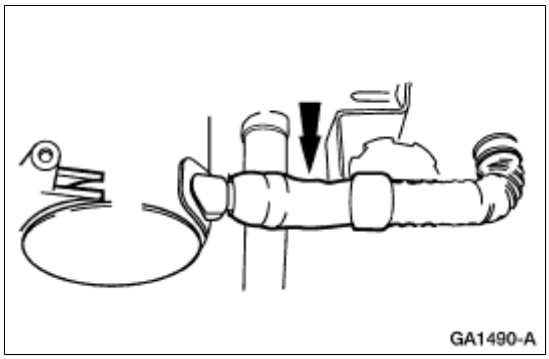
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Disconnect the accelerator cable and the speed control cable (if equipped).



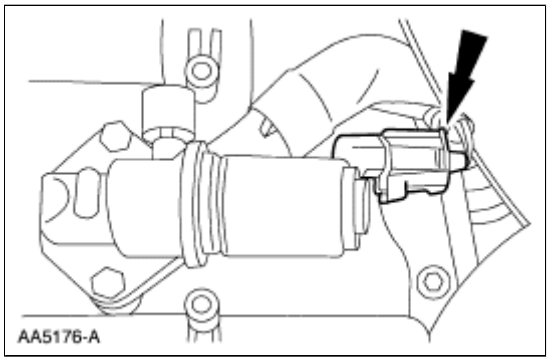
4. Remove and position the accelerator cable and speed control cable (if equipped) aside.



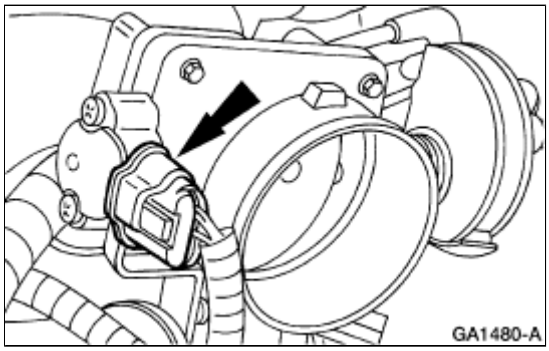
5. Disconnect the RH upper intake manifold vacuum connection.



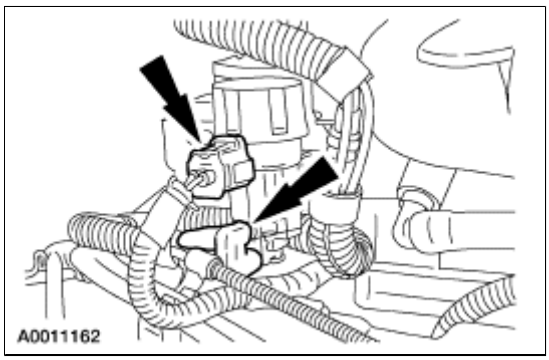
6. Disconnect the idle air control (IAC) valve electrical connector.



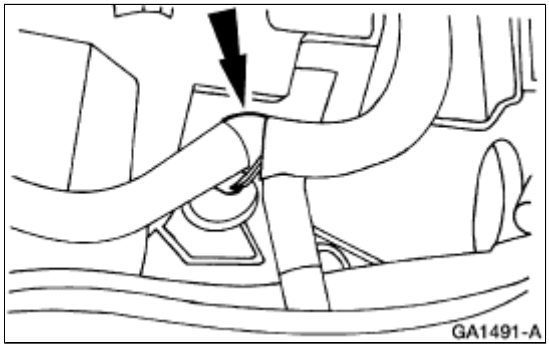
7. Disconnect the throttle position (TP) sensor electrical connector.



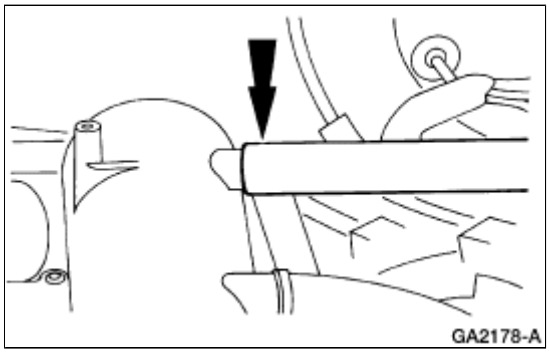
8. Disconnect the exhaust gas recirculation (EGR) vacuum regulator:
    - electrical connector
    - vacuum connector



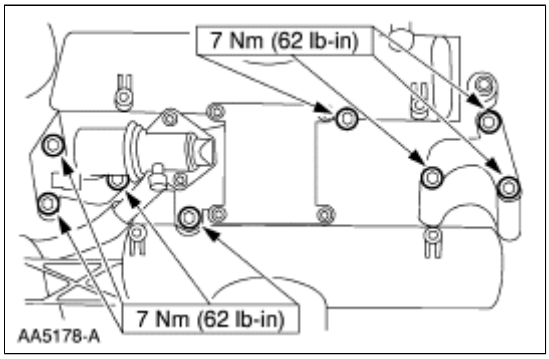
9. Disconnect the crankcase ventilation hose.



10. Disconnect the power brake booster vacuum hose.

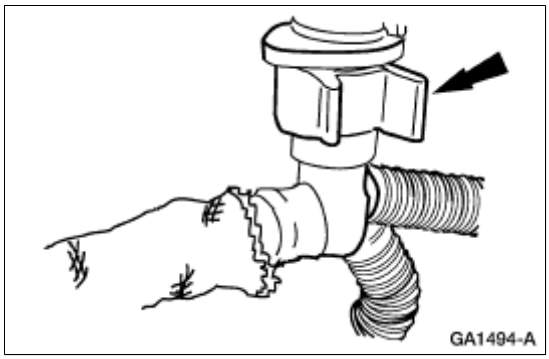


11. Remove the eight bolts.



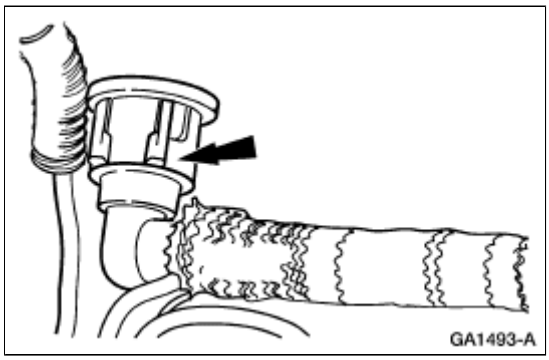
12. **NOTE:** Inspect and install new O-ring seals if necessary.

    Disconnect the LH vapor management valve (VMV) hose.



13. **NOTE:** Inspect and install new O-ring seals if necessary.

    Disconnect the RH VMV hose.



14. Remove the upper intake manifold.
    - Inspect upper intake manifold gasket and install a new one if necessary.

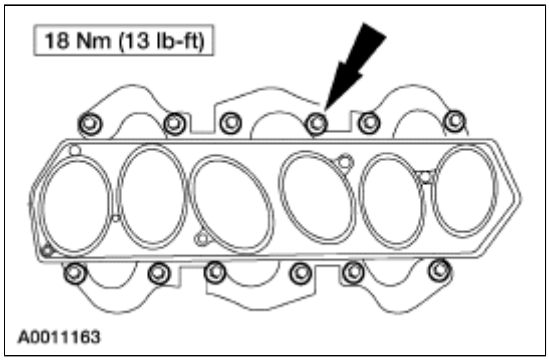
15. To install, reverse the removal procedure.

Intake Manifold —Lower

Removal and Installation

1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

2. Remove the lower intake manifold.
   - Inspect the lower intake manifold gasket and install a new one if necessary.



3. To install, reverse the removal procedure.

Valve Cover —RH

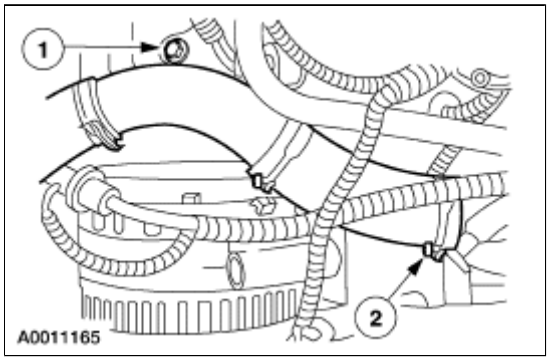
Removal and Installation

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

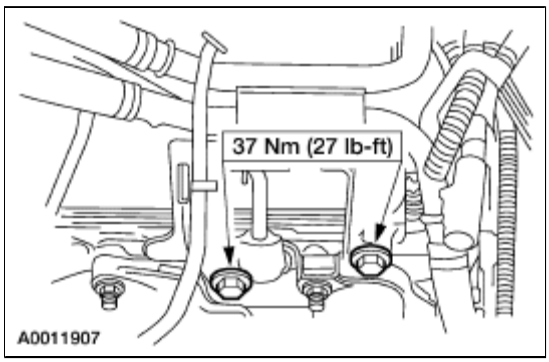
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

2. Drain the engine cooling system. For additional information, refer to Section 303-03 .

3. Disconnect the upper radiator hose and tube.
    1. Remove the bolt.
    2. Release the hose clamp and position hose and tube aside.

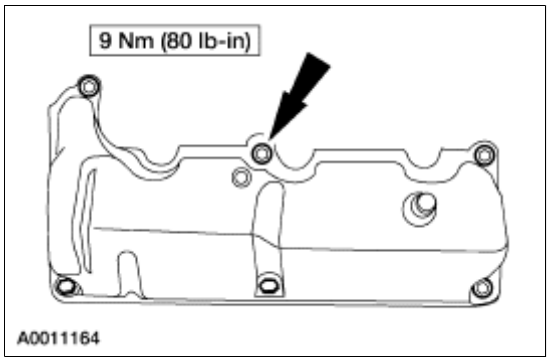


4. Remove the heater hose bracket and disconnect the transmission dipstick tube.



5. Disconnect the spark plug wires. For additional information, refer to Section 303-07A , Section 303-07B or Section 303-07C .

6. Remove the valve cover.
    - Discard the gasket.



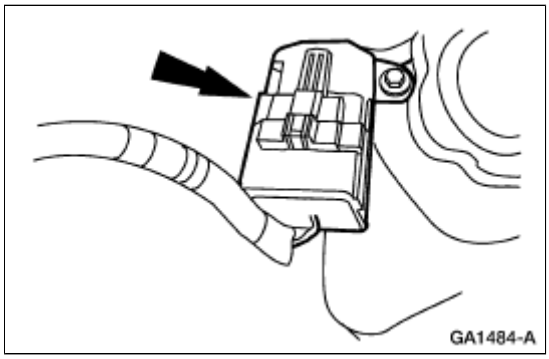
7. To install, reverse the removal procedure.

Valve Cover —LH

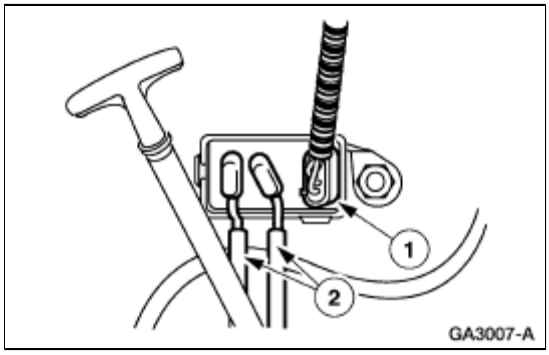
Removal

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

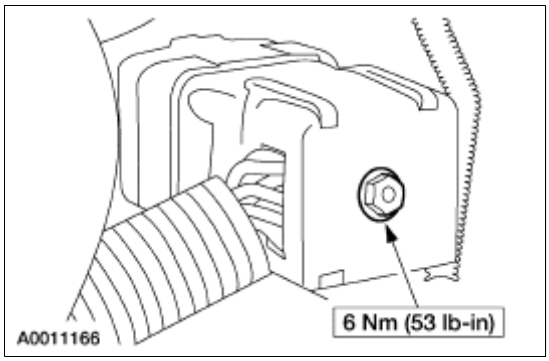
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.
2. Disconnect the fuel line. For additional information, refer to Section 310-00 .
3. Disconnect the camshaft position (CMP) sensor electrical connector.



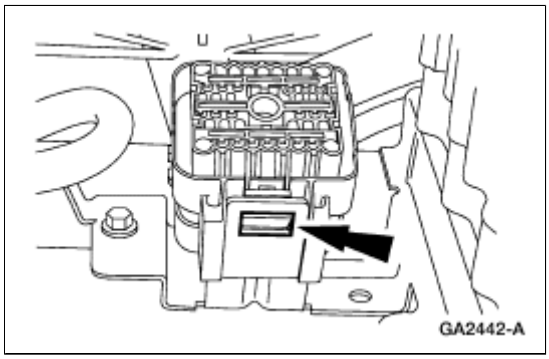
4. Disconnect the differential pressure feedback EGR transducer.
    1. Disconnect the electrical connector.
    2. Disconnect the vacuum hoses.



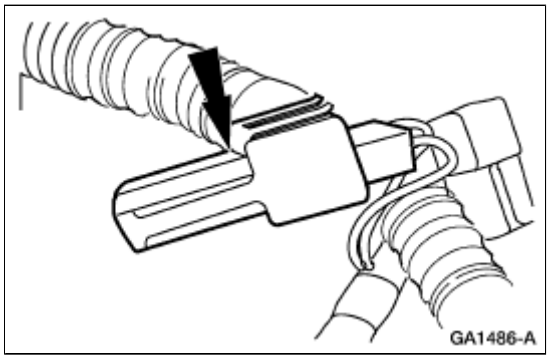
5. Disconnect the engine electrical connector.



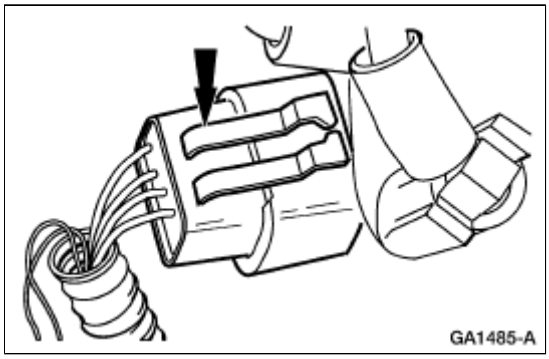
6. Disconnect the electrical connector from the valve cover.



7. Disconnect the radio ignition interference capacitor electrical connector.



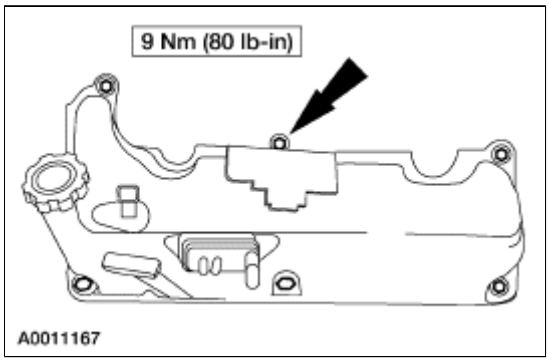
8. Disconnect the ignition coil electrical connector.



9. Disconnect the spark plug wires from the ignition coil. For additional information, refer to Section 303-

07A , Section 303-07B or Section 303-07C .

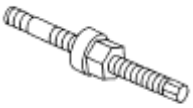
10. Remove the valve cover.
    - Discard the gasket.



11. To install, reverse the removal procedure.

Crankshaft Pulley

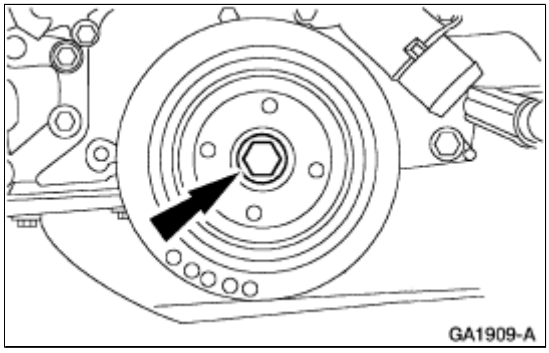
Special Tool(s)

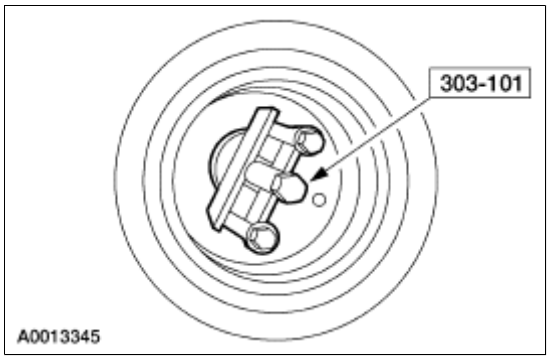
ST1784-A	Crankshaft Damper Remover 303-101 (T74P-6316-A)
 ST1287-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)

Removal

1. Remove the fan shroud. For additional information, refer to Section 303-03 .
2. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
3. **CAUTION: This bolt is torque to yield and cannot be reused.**

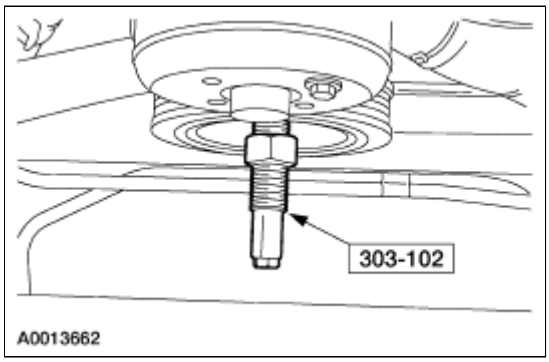
   Remove the damper bolt.

   
   GA1909-A
4. Using the special tool, remove the crankshaft pulley.

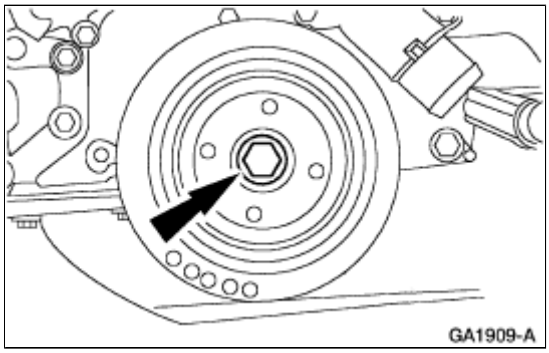


Installation

1. Using the special tool, install the crankshaft pulley.



2. Install a new crankshaft pulley bolt.
   - Tighten the bolt in two stages:
   - Stage1: Tighten the bolt to 60 Nm (44 lb-ft).
   - Stage 2: Tighten the bolt an additional 90 degrees.

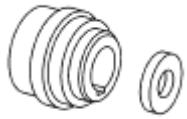


3. Install the accessory drive belt. For additional information, refer to Section 303-05 .

4. Install the fan shroud. For additional information, refer to Section 303-03 .

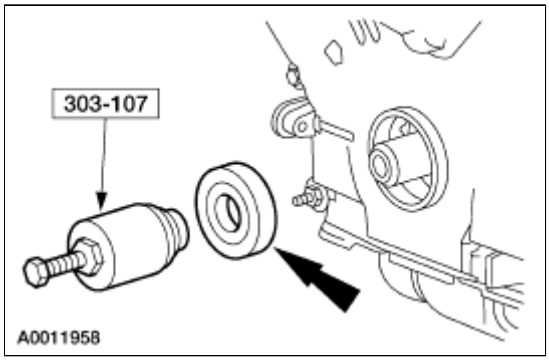
Crankshaft Front Oil Seal

Special Tool(s)

ST1288-A	Front Cover Seal Remover 303-107 (T74P-6700-A)
 ST2439-A	Front Cover Aligner Replacer 303–093 (T74P-6019-A)
ST2428-A	Crankshaft Damper Replacer 303–102 (T74P-6316-B)

Removal

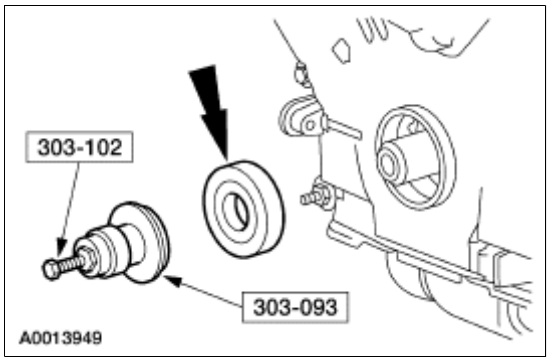
1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
2. Using the special tool, remove the crankshaft front oil seal.



Installation

1. **NOTE:** Lubricate the seal lip with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   Using the special tools and install the crankshaft front oil seal.

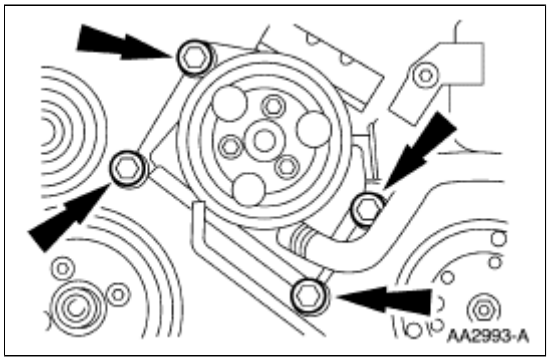


2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

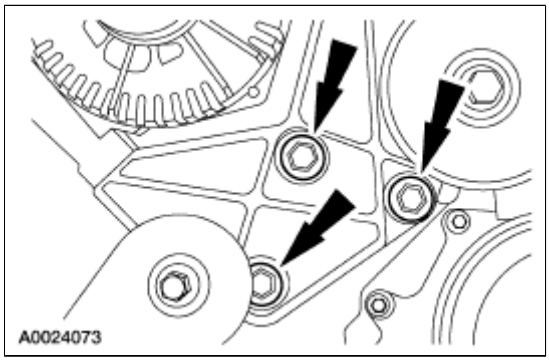
Engine Front Cover

Removal

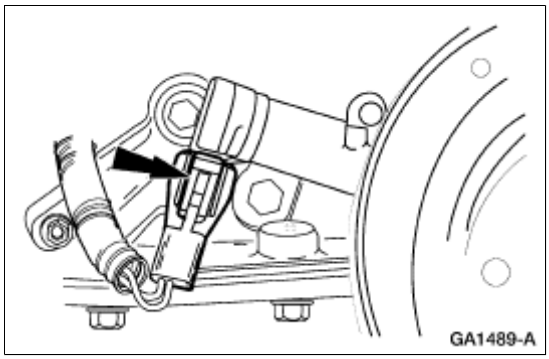
1. Disconnect the negative battery cable (14301). For additional information, refer to Section 414-01 .
2. Drain the engine coolant. For additional information, refer to Section 303-03 .
3. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
4. Remove the accessory bracket and position aside.



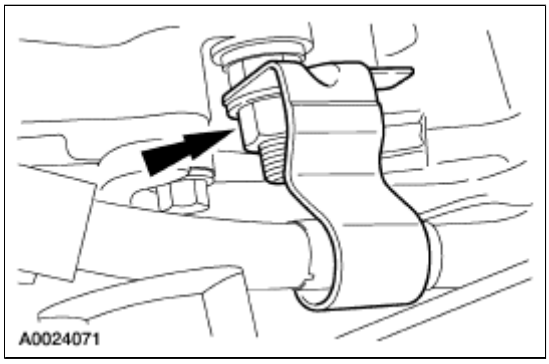
5. Disconnect the generator electrical connectors. For additional information, refer to Section 414-02 .
6. Remove the accessory drive belt tensioner. For additional information, refer to Section 303-05 .
7. Remove generator mounting bracket and position aside.



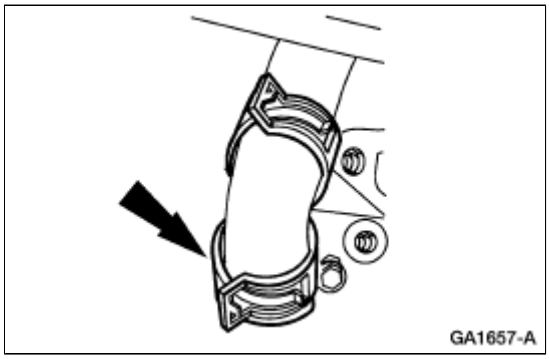
8. Disconnect the crankshaft position (CKP) sensor electrical connector.



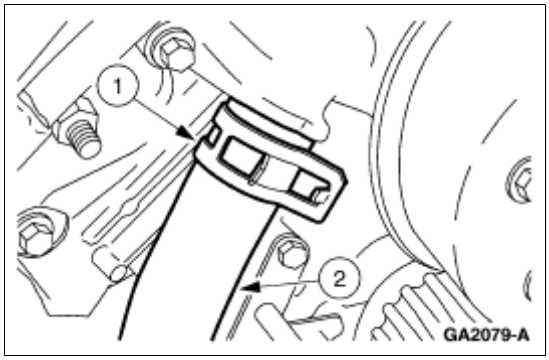
9. Remove the fuel vapor tube retaining nut and position aside.



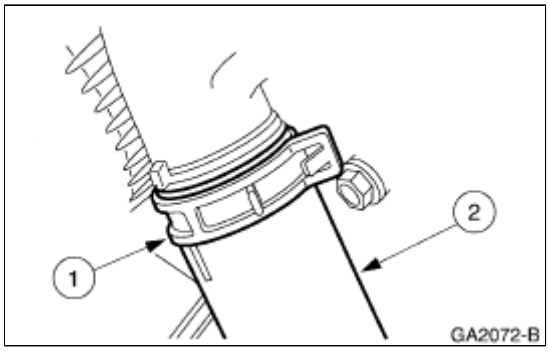
10. Remove the water bypass hose.



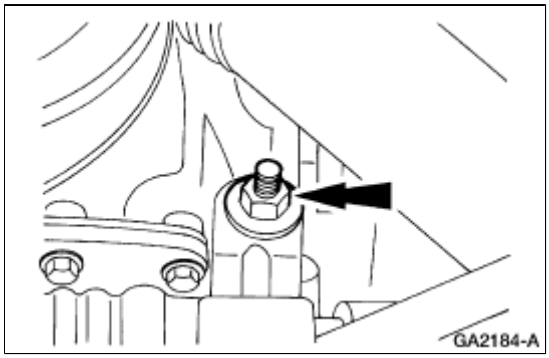
11. Remove the lower heater water hose.
    1. Squeeze the hose clamp.
    2. Remove the hose.



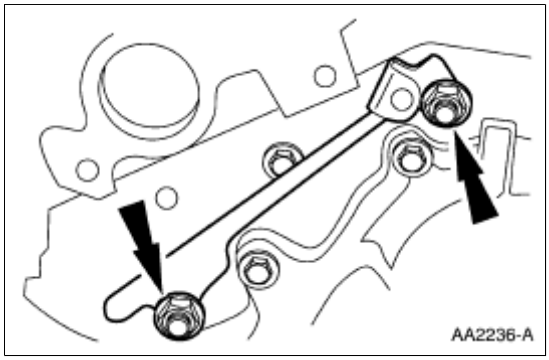
12. Disconnect the lower radiator hose.
    1. Squeeze the hose clamp.
    2. Disconnect the hose.



13. On A/C-equipped vehicles, remove the A/C line bracket and position aside.



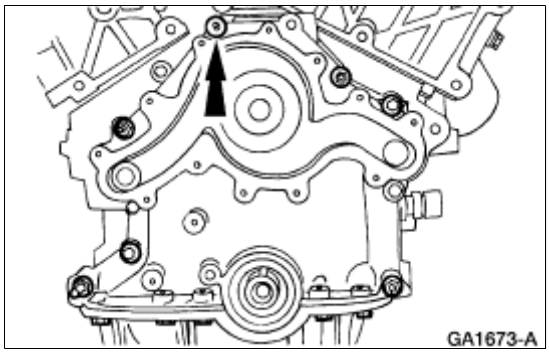
14. Remove the wiring harness retainer and position aside.



15. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

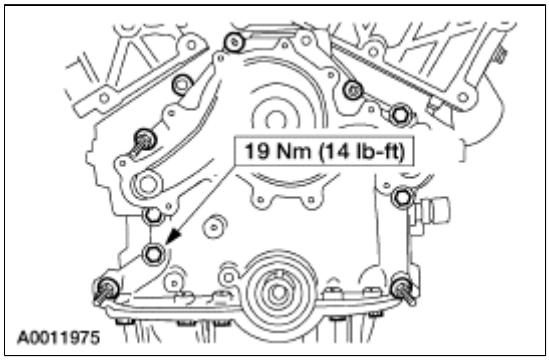
16. **NOTE:** The water pump is removed for clarity.

    Remove the engine front cover.

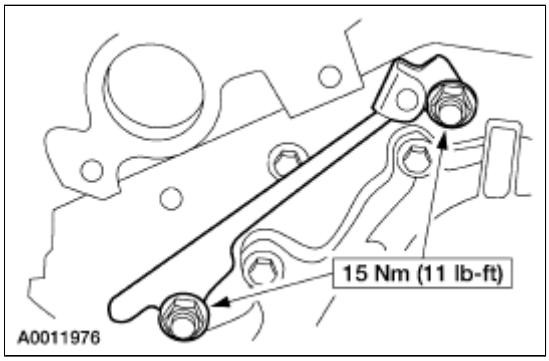


Installation

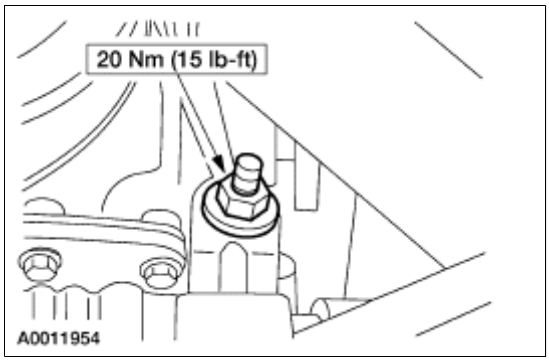
1. Clean and inspect the sealing surfaces.
2. Install the front cover gasket. For additional information, refer to Engine in this section.
3. Install the engine front cover.



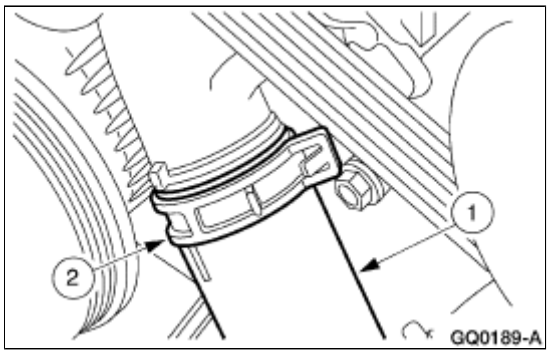
4. Install the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.
5. Install the wiring harness retainer.



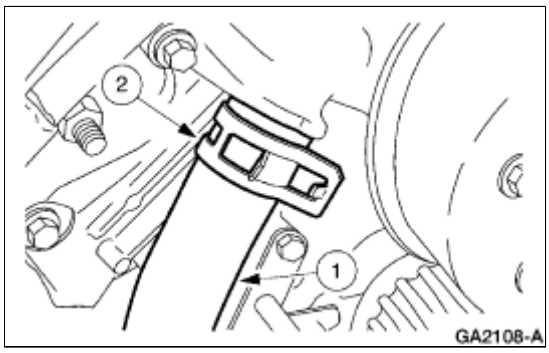
6. On A/C equipped vehicles, install the A/C line bracket nut.



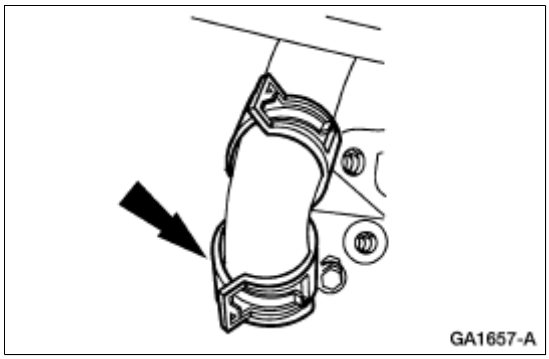
7. Connect the lower radiator hose.
    1. Position the hose
    2. Install the clamp.



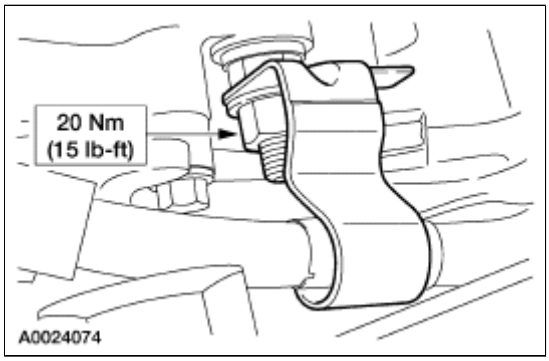
8. Connect the lower heater water hose.
    1. Position the hose.
    2. Install the hose clamp.



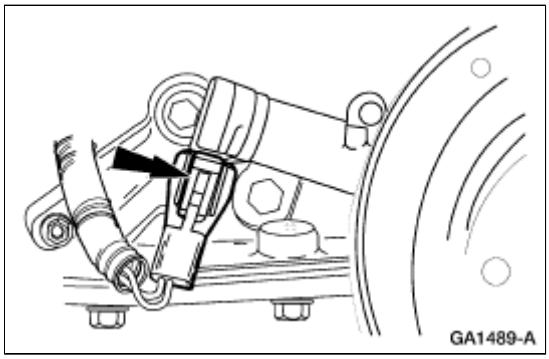
9. Install the water bypass hose.



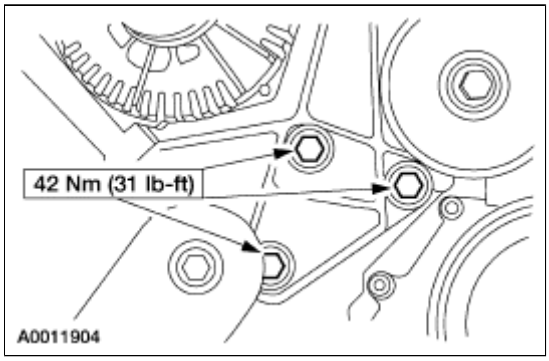
10. Position the fuel vapor tube and bracket, and install the nut.



11. Connect the crankshaft position (CKP) sensor electrical connector.



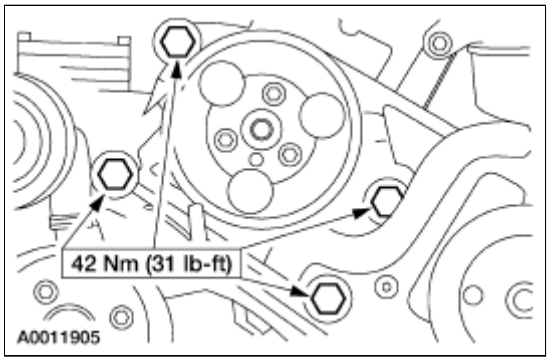
12. Install the generator mounting bracket.



13. Install the accessory drive belt tensioner. For additional information, refer to Section 303-05 .

14. Connect the generator electrical connectors. For additional information, refer to Section 414-02 .

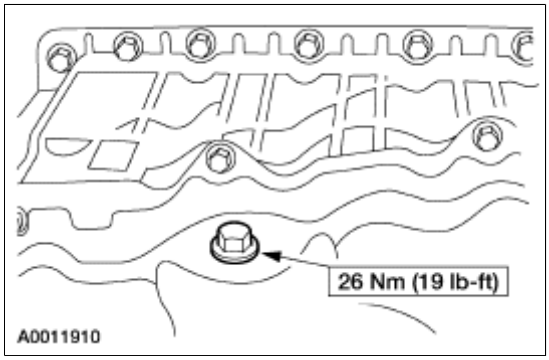
15. Install the accessory bracket.



16. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

17. Raise and support the vehicle. For additional information, refer to Section 100-02 .

18. Drain the engine oil.



19. Lower the vehicle.

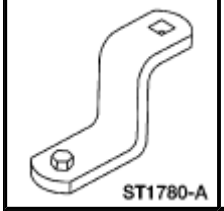
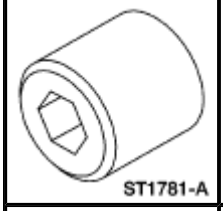
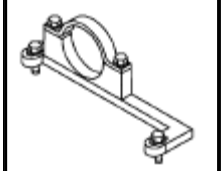
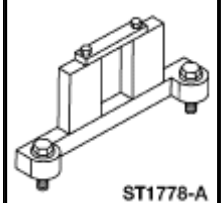
20. Fill the engine with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

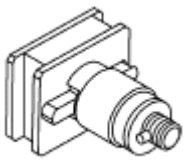
21. Fill the engine with coolant. For additional information, refer to Section 303-03 .

22. Connect the negative battery cable. For additional information, refer to Section 414-01 .

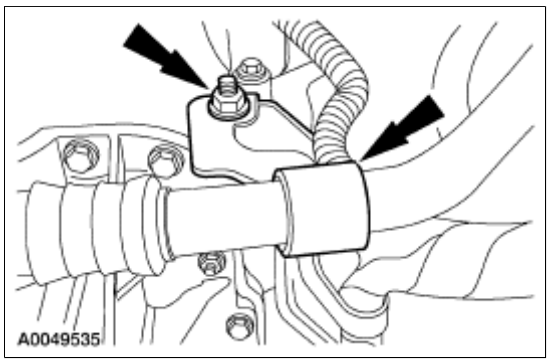
Timing Drive Components —Camshaft Timing

Special Tool(s)

ST1774-A	Timing Chain Tensioner 303–571 (T97T-6K254-A)
 ST1780-A	Camshaft Gear Removal Tool 303–575 (T97T-6256-F)
 ST1781-A	Camshaft Gear Torque Adapter 303–565 (T97T-6256-G)
 ST1777-A	Camshaft Gear Holding Tool 303–564 (T97T-6256-B)
ST1776-A	Camshaft Gear Holding Tool Adapter 303–578 (T97T-6256-A)
 ST1778-A	Camshaft Holding Tool 303–577 (T97T-6256-C)
ST1775-A	Crankshaft Holding Tool 303–573 (T97T-6303-A)

 ST1779-A	Camshaft Holding Tool Adapter 303–576 (T97T-6256-D)

1. Remove the valve covers. For additional information, refer to Valve Cover—RH Valve Cover—LH and in this section.
2. Remove the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.
3. Remove the fuel supply manifold. For additional information, refer to Section 303-04C .
4. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
5. Remove the thermostat housing. For additional information, refer to Section 303-03 .
6. Remove the roller followers. For additional information, refer to Roller Followers in this section.
7. Remove the nut and position the A/C manifold and tube assembly bracket aside.

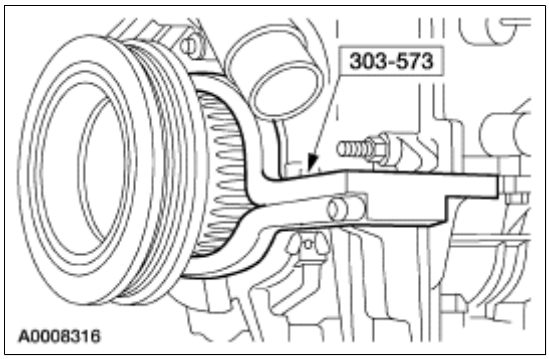


8. **NOTE:** You must re-time the LH and RH camshafts when either camshaft is disturbed.

   Turn the crankshaft one revolution clockwise.

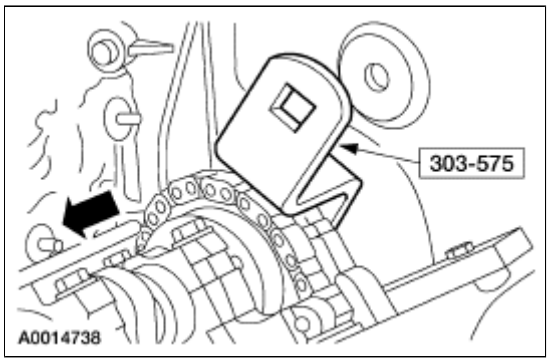
9. **NOTE:** The special tool must be installed on the damper and should contact the engine block, this positions the engine at top dead center (TDC).

   Install the special tool.



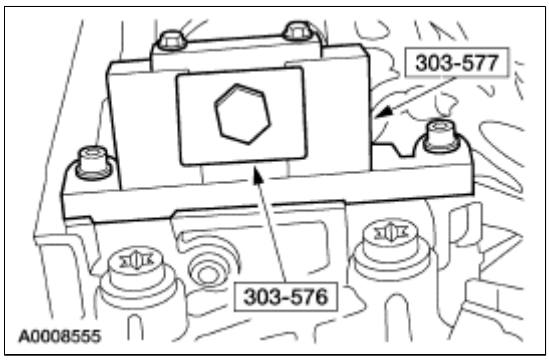
10. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

    Using the special tool, loosen the RH camshaft sprocket bolt.



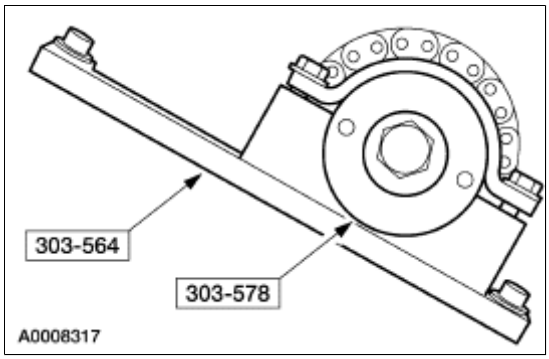
11. **NOTE:** The camshaft timing slots are off-center.

    Position the camshaft timing slots below the centerline of the camshaft to correctly fit the special tools and install the special tools on the front of the RH cylinder head.



12. **NOTE:** Leave the top two special tool clamp bolts loose.

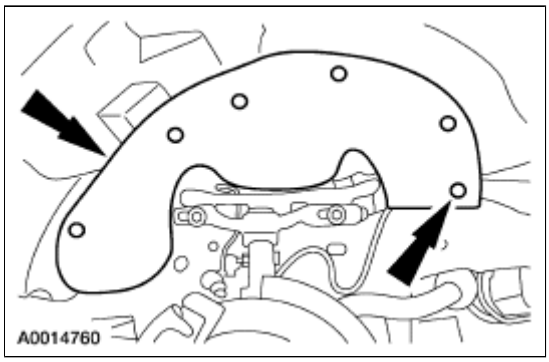
    Install the special tools on the rear of the RH cylinder head.



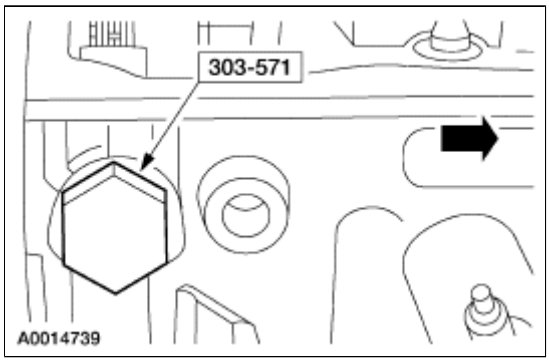
13. Raise and support the vehicle. For additional information, refer to Section 100-02 .

14. Remove the RH wheel and tire. For additional information, refer to Section 204-04 .

15. Remove the RH lower splash splash.



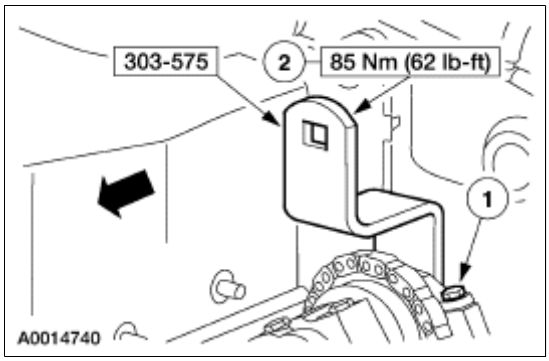
16. Remove the RH camshaft tensioner and install the special tool.



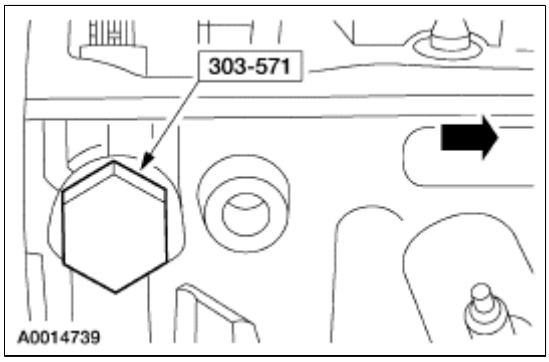
17. Lower the vehicle.

18. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

Tighten the bolts.
1. Tighten the special tool top two clamp bolts to 10 Nm (89 lb-in).
2. Tighten the camshaft bolt.

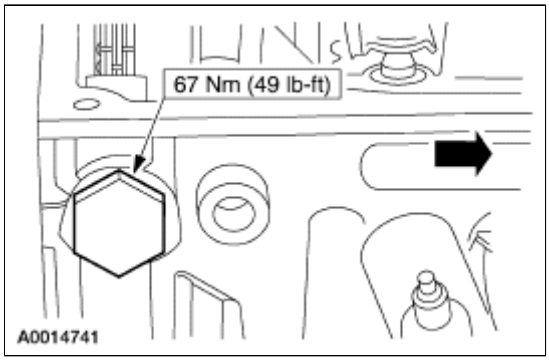


19. Remove the special tool.



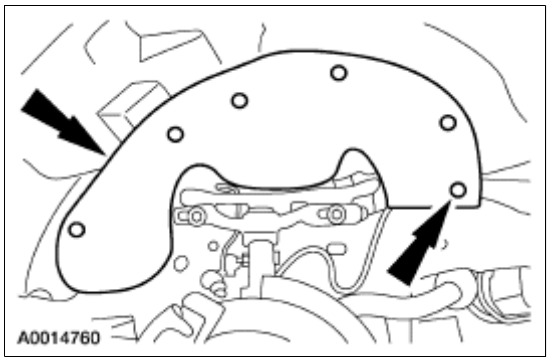
20. **NOTE:** When using a new washer the camshaft tensioner must be torqued to 44 Nm (32 lb-ft).

    Install the RH camshaft tensioner.



21. Raise the vehicle.

22. Install the RH lower splash shield.

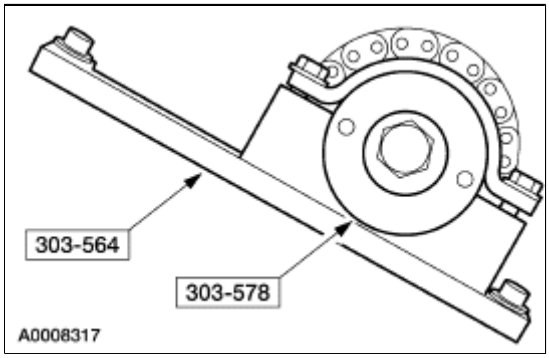


23. Install the RH wheel and tire. For additional information, refer to Section 204-04 .

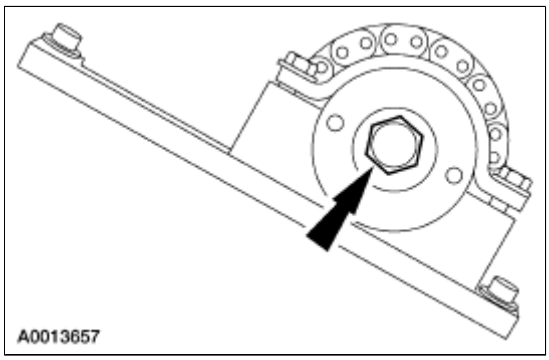
24. Lower the vehicle.

25. Remove the special tools from the RH cylinder head.

26. Install the special tools on the front of the LH cylinder head and tighten the top two clamp bolts to 10 Nm (89 lb-in).



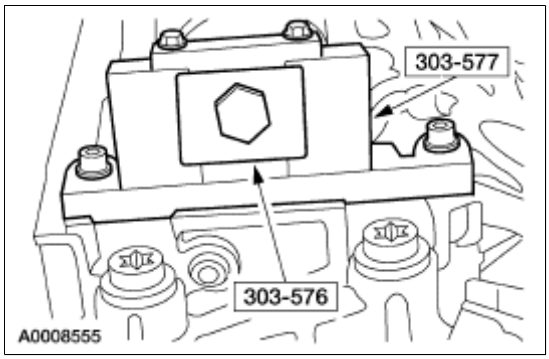
27. Loosen the LH camshaft sprocket bolt.



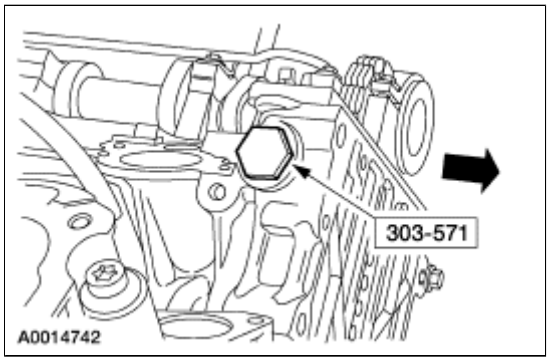
28. Loosen the top two clamp bolts on the special tool to allow the camshaft sprocket to rotate freely.

29. **NOTE:** The camshaft timing slots are off-center.

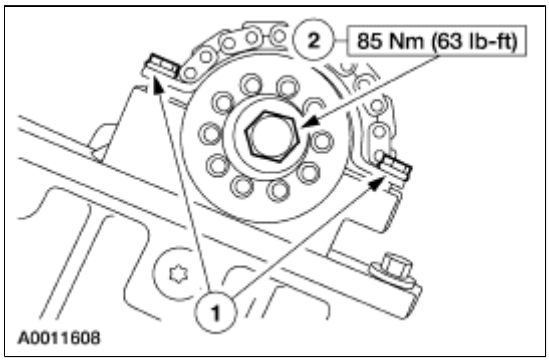
    Position the camshaft timing slots below the centerline of the camshaft to correctly fit the special tools, and install the special tools on the rear of the LH cylinder head.



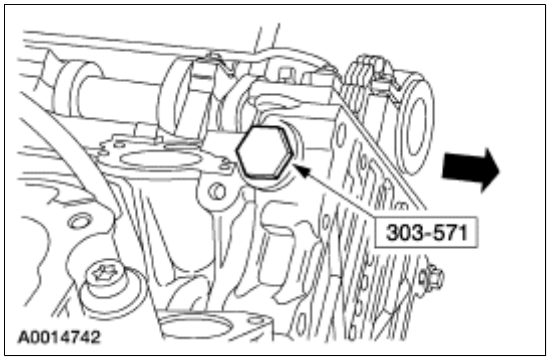
30. Remove the LH camshaft tensioner and install the special tool.



31. Tighten the bolts.
    1. Tighten the special tool top two clamp bolts to 10 Nm (89 lb-in).
    2. Tighten the camshaft bolt.

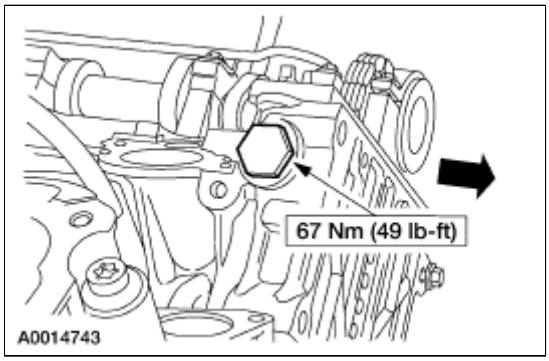


32. Remove the special tool.



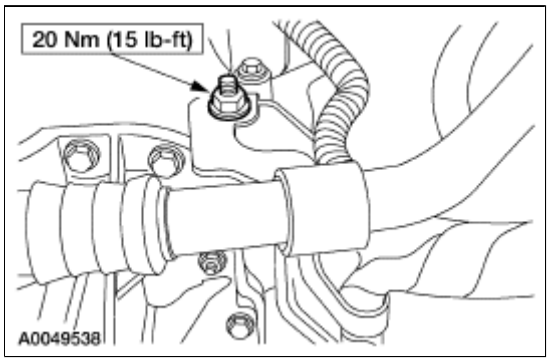
33. **NOTE:** When using a new washer the camshaft tensioner must be torqued to 44 Nm (32 lb-ft).

    Install the LH camshaft tensioner.



34. Remove all of the special tools.

35. Install the A/C manifold and tube assembly bracket.



36. Install the roller followers. For additional information, refer to Roller Followers in this section.

37. Install the thermostat housing. For additional information, refer to Section 303-03 .

38. Install the accessory drive belt. For additional information, refer to Section 303-05 .

39. Install the fuel supply manifold. For additional information, refer to Section 303-04C .

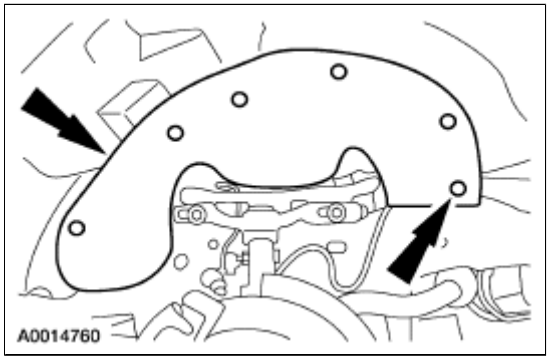
40. Install the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.

41. Install the valve covers. For additional information, refer to Valve Cover—LH and Valve Cover—RH in this section.

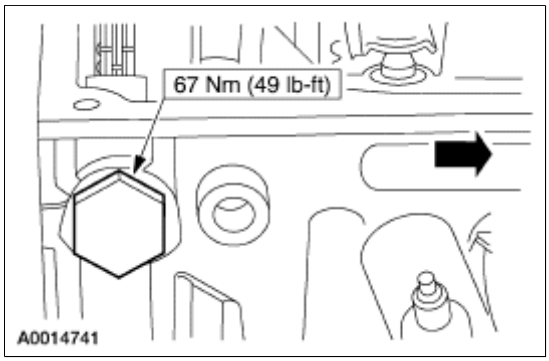
Timing Drive Components —RH Hydraulic Chain Tensioner

Removal and Installation

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. Remove the lower splash shield.



3. Remove the RH camshaft tensioner.
   - If using a new washer, tighten to 44 Nm (32 lb-ft).
   - If using the old washer, tighten to 67 Nm (49 lb-ft).



4. To install, reverse the removal procedure.

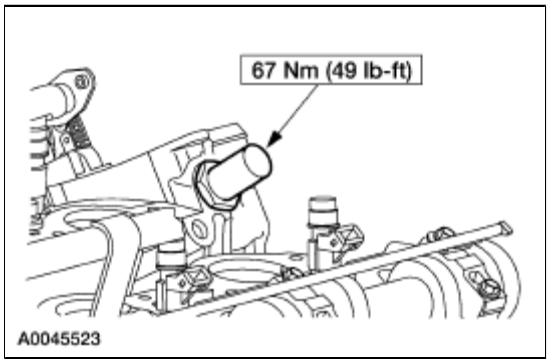
Timing Drive Components —LH Hydraulic Chain Tensioner

Removal and Installation

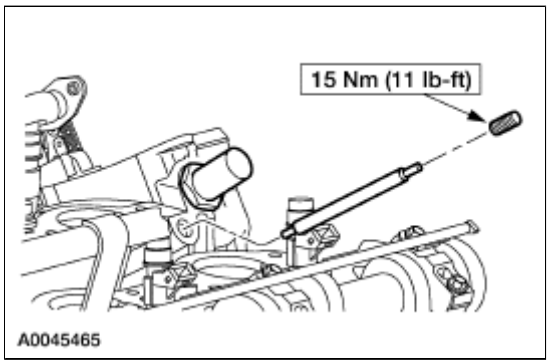
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

2. Remove the thermostat housing. For additional information, refer to Section 303-03 .

3. Remove the LH camshaft tensioner.
   - If using a new washer, tighten to 44 Nm (32 lb-ft).
   - If using the old washer, tighten to 67 Nm (49 lb-ft).



4. Remove the pipe plug, and the oil volume reduction plug.



5. **NOTE:** Be sure to install the new oil volume reduction plug supplied with the hydraulic chain tensioner.

   To install, reverse the removal procedure.

Valve —Valve Spring

Special Tool(s)

ST1330-A	Valve Spring Compressor 303–581 (T97T-6565-A)

Removal and Installation

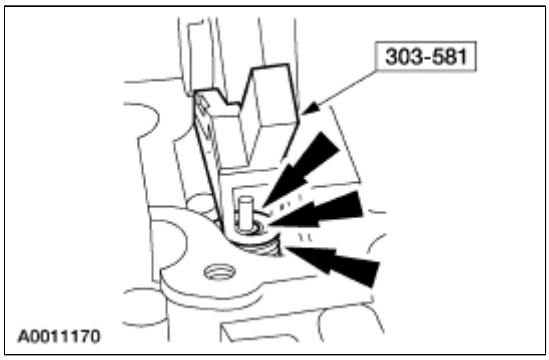
1. Remove the camshaft roller followers. For additional information, refer to Roller Followers in this section.

2. Position the piston at top dead center.

3. Hold the valve in the cylinder head.
   - Remove the spark plugs. For additional information, refer to Section 303-07A , Section 303-07B or Section 303-07C .
   - Use a suitable tool to apply air pressure to the cylinder.

4. **CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.**

   Using the special tool, remove the valve spring retainer keys, the valve spring and the retainer.



5. Inspect the components. For additional information, refer to Section 303-00 .

6. **NOTE:** Lubricate the parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G prior to installing.

   To install, reverse the removal procedure.

Valve —Valve Seals

Special Tool(s)

ST1824-A	Valve Stem Seal Replacer 303–370 (T90T-6571-A)

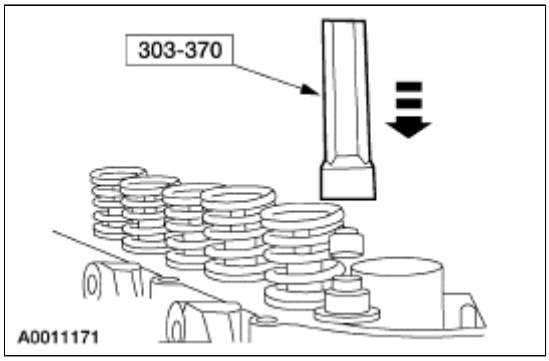
Removal

1. Remove the valve springs. For additional information, refer to Valve —Valve Spring in this section.
2. Remove the valve stem seals.

Installation

1. **NOTE:** Lubricate parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G prior to installing.

   Using the special tool, install the valve stem seals.

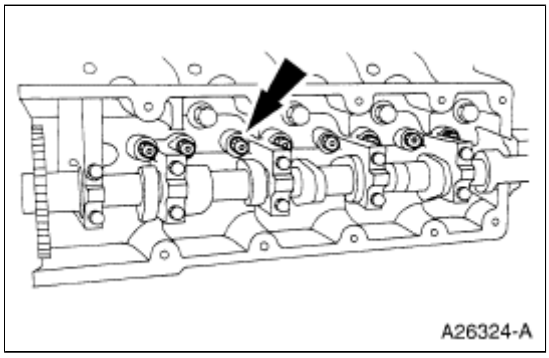
2. Install the valve springs. For additional information, refer to Valve —Valve Spring in this section.

Hydraulic Lash Adjusters

Removal and Installation

1. Remove the camshaft roller followers. For additional information, refer to Roller Followers in this section.

2. Remove the hydraulic lash adjusters.



3. **NOTE:** Lubricate the parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specifications WSS-M2C153-G prior to installing.

   To install, reverse the removal procedure.

Roller Followers

Special Tool(s)

ST1330-A	Valve Spring Compressor 303-581 (T97T-6565-A)

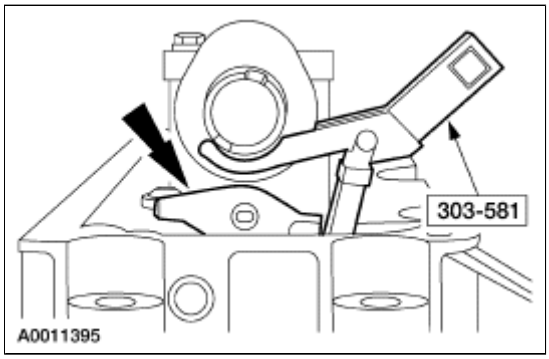
Removal

1. Remove the valve covers. For additional information, refer to Valve Cover—LH or Valve Cover—RH in this section.

2. Remove the fuel supply manifold. For additional information, refer to Section 303-04B .

3. **NOTE:** Mark each camshaft roller follower to ensure its original position during reassembly.

   Using the special tool, remove the camshaft roller followers.



4. **NOTE:** Lubricate the parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G prior to installing.

   To install, reverse the removal procedure.

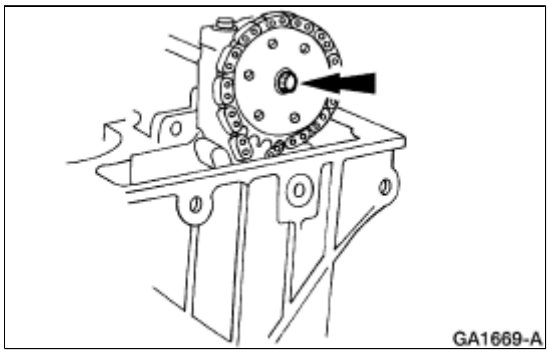
Camshaft —LH

Removal

1. Remove the camshaft roller followers. For additional information, refer to Roller Followers in this section.

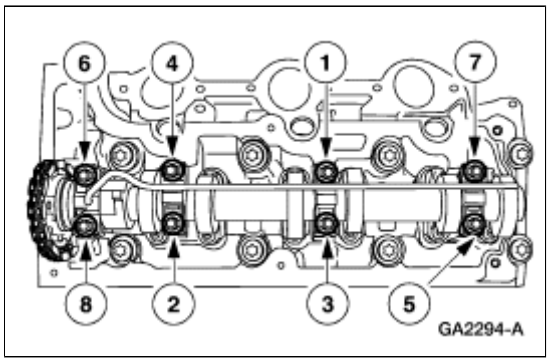
2. Remove the LH hydraulic camshaft tensioner. For additional information, refer to Timing Drive Components—LH Hydraulic Chain Tensioner in this section.

3. Remove the bolt and the camshaft sprocket.

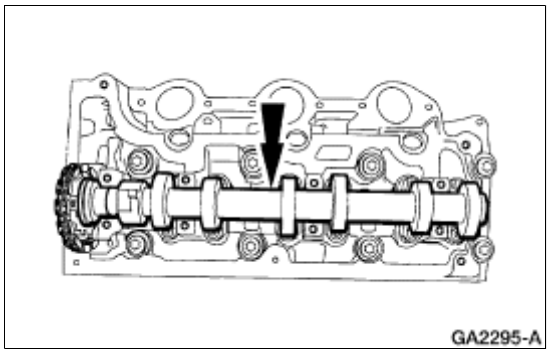


4. **NOTE:** Mark the position of the camshaft bearing caps so they can be installed in the original position.

   Remove the bolts in the sequence shown and remove the camshaft bearing caps and the oil supply tube.



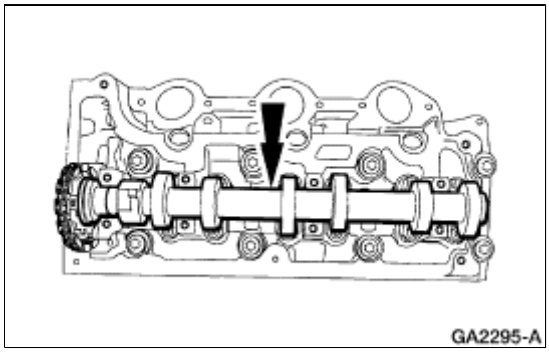
5. Remove the camshaft.



Installation

1. **NOTE:** Lubricate the parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G before installing.

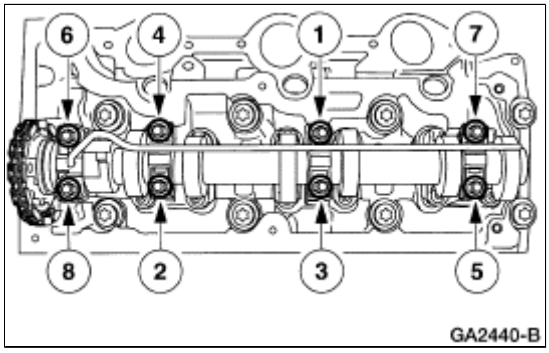
   Install the camshaft.



2. **NOTE:** The camshaft bearing caps must be installed in the original position.

   NOTE: After installing the bolts, check the camshaft for free rotation.

   Position the oil supply tube, the camshaft bearing caps, and the bolts.
   - Tighten the bolts in the sequence shown in two stages.
   - Stage 1: Tighten the bolts to 6 Nm (53 lb-in).
   - Stage 2: Tighten the bolts to 16 Nm (12 lb-ft).

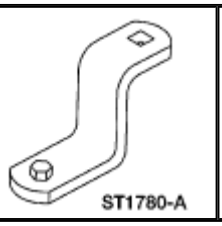


3. The camshaft must be re-timed. For additional information, refer to Timing Drive Components—Camshaft Timing in this section.

4. Install the camshaft roller followers. For additional information, refer to Roller Followers in this section.

Camshaft —RH

Special Tool(s)

	Camshaft Gear Removal Tool 303–575 (T97T-6256-F)

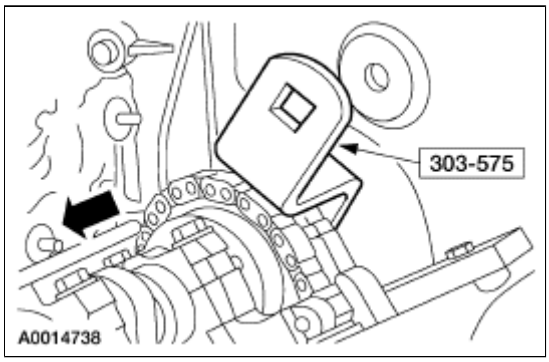
Removal

1. Remove the camshaft roller followers. For additional information, refer to Roller Followers in this section.

2. Remove the RH hydraulic camshaft tensioner. For additional information, refer to Timing Drive Components in this section.

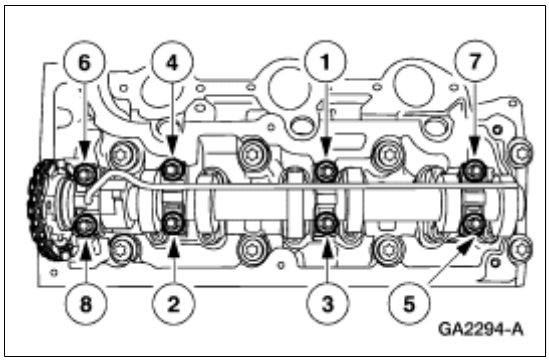
3. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

   Using the special tool, remove the bolt and the camshaft sprocket.

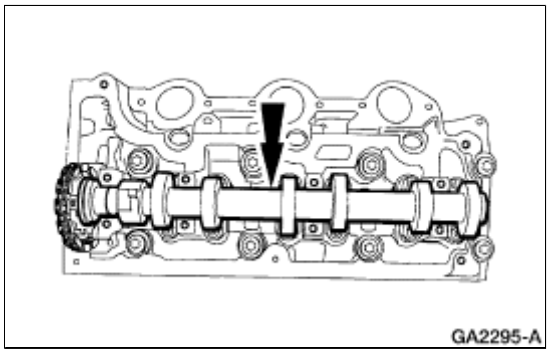
   

4. **NOTE:** Mark the position of the camshaft bearing caps so they can be installed in the original position.

   Remove the bolts in the sequence shown and remove the camshaft bearing caps and the oil supply tube.



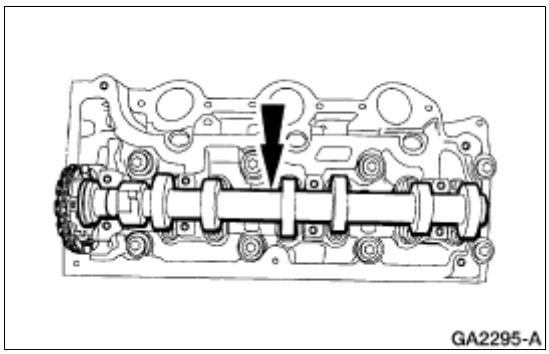
5. Remove the camshaft.



Installation

1. **NOTE:** Lubricate the parts with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford Specification WSS-M2C153-G before installing.

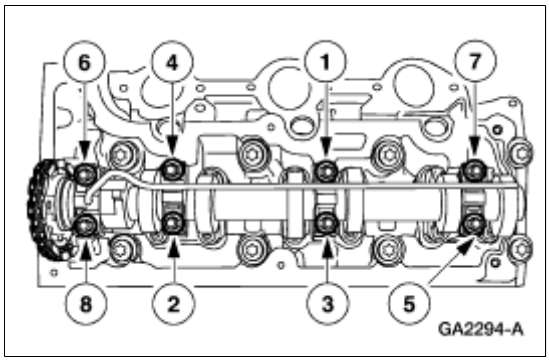
   Install the camshaft.



2. **NOTE:** The camshaft bearing caps must be installed in their original position.

   NOTE: After installing the bolts, check the camshaft for free rotation.

   Position the oil supply tube, the camshaft bearing caps, and the bolts.
   - Tighten the bolts in the sequence shown in two stages:
   - Stage 1: Tighten the bolts to 6 Nm (53 lb-in).
   - Stage 2: Tighten the bolts to 16 Nm (12 lb-ft).



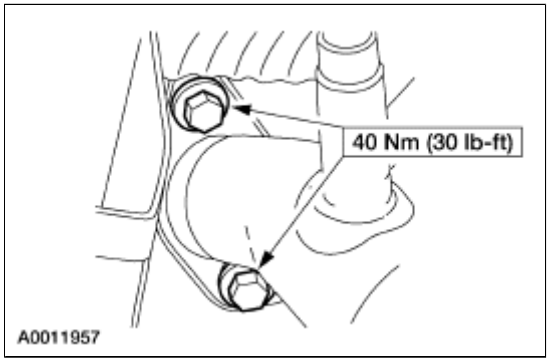
3. The camshaft must be re-timed. For additional information, refer to Timing Drive Components—Camshaft Timing in this section.

4. Install the camshaft roller followers. For additional information, refer to Roller Followers in this section.

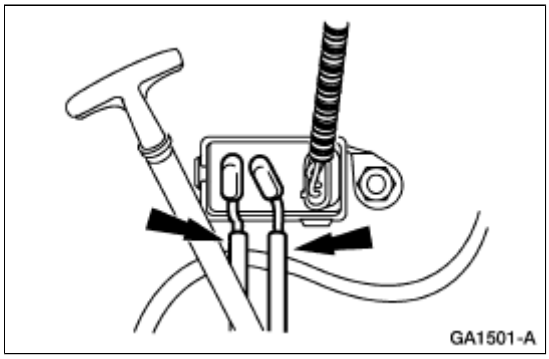
Exhaust Manifold —LH

Removal and Installation

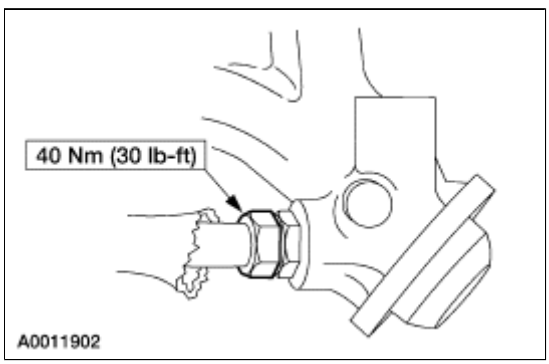
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts.



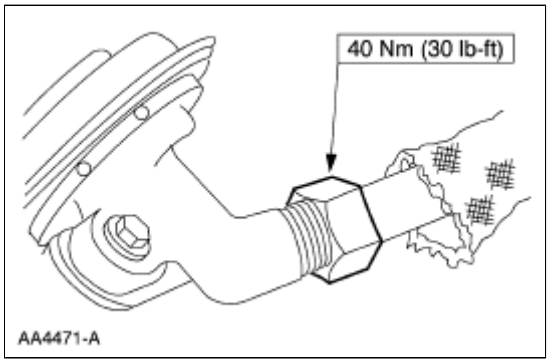
3. Lower the vehicle.
4. Disconnect the hoses from the differential pressure feedback (EGR) transducer.



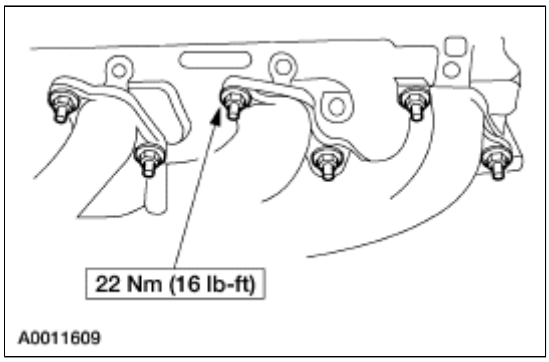
5. Disconnect the EGR valve to exhaust manifold tube from the exhaust manifold.



6. Disconnect the EGR valve to exhaust manifold tube from the EGR valve and remove the EGR valve to exhaust manifold tube.



7. Remove the LH exhaust manifold.



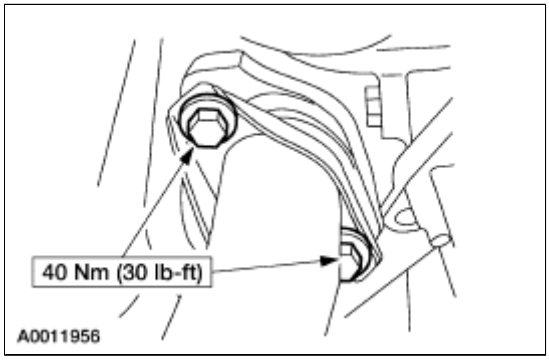
8. **NOTE:** Use new exhaust manifold gaskets and nuts.

   To install, reverse the removal procedure.

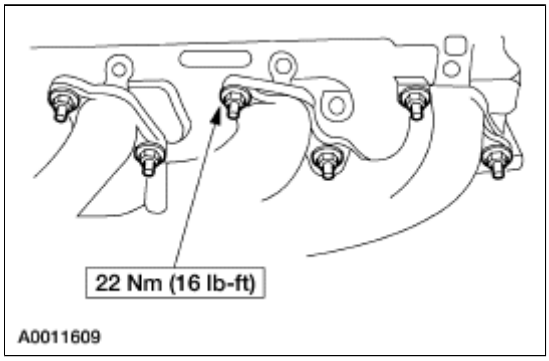
Exhaust Manifold —RH

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts.



3. Lower the vehicle.
4. Remove the RH exhaust manifold.

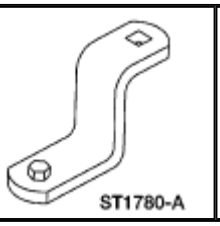


5. **NOTE:** Use new exhaust manifold gaskets and nuts.

   To install, reverse the removal procedure.

Cylinder Head

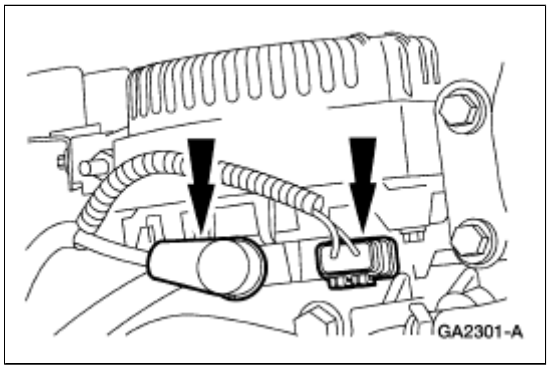
Special Tool(s)

 ST1780-A	Camshaft Gear Removal Tool 303-575 (T97T-6256-F)

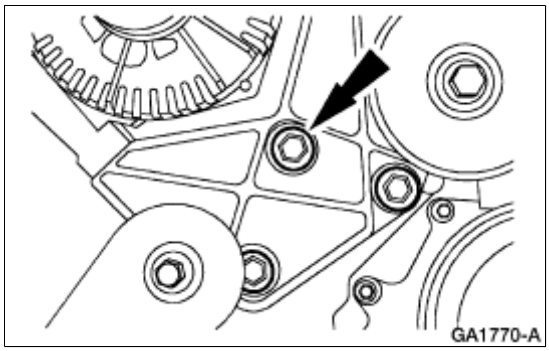
Removal

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

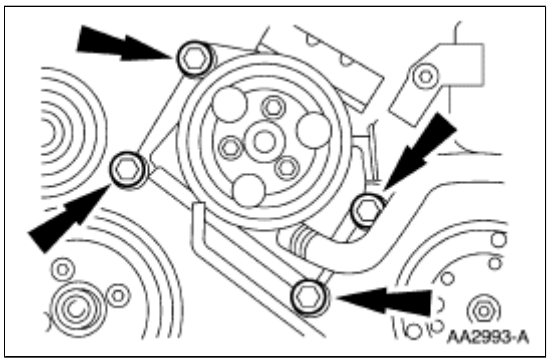
1. Remove the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.
2. Remove the roller followers. For additional information, refer to Roller Followers in this section.
3. Remove the fan shroud. For additional information, refer to Section 303-03 .
4. Remove the belt tensioner. For additional information, refer to Section 303-05 .
5. Disconnect the generator electrical connectors.



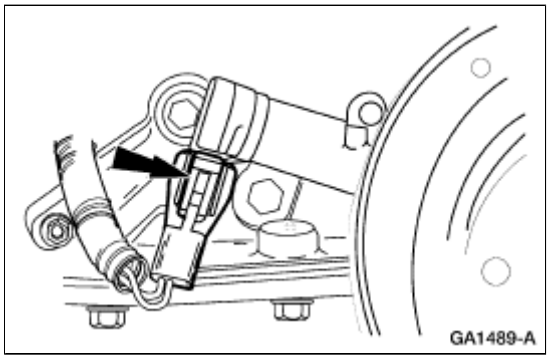
6. Remove the generator mounting bracket.



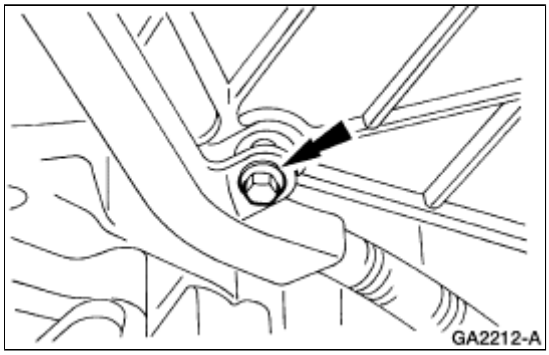
7. Remove the bolts and position the accessory bracket aside.



8. Disconnect the crankshaft position (CKP) sensor electrical connector.

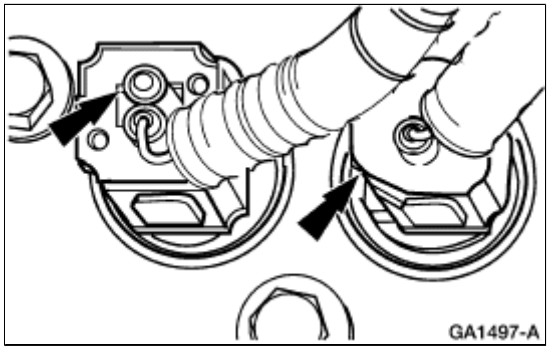


9. Remove the electrical harness retainer.

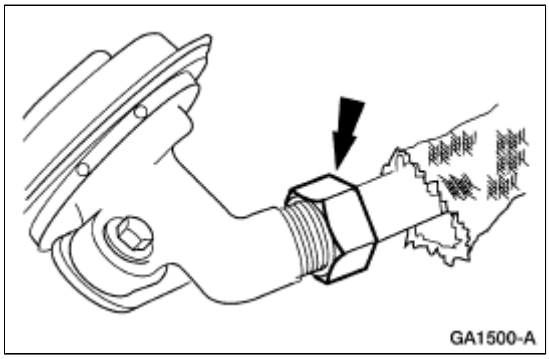


10. Disconnect the water temperature indicator sender unit and the engine coolant temperature (ECT)

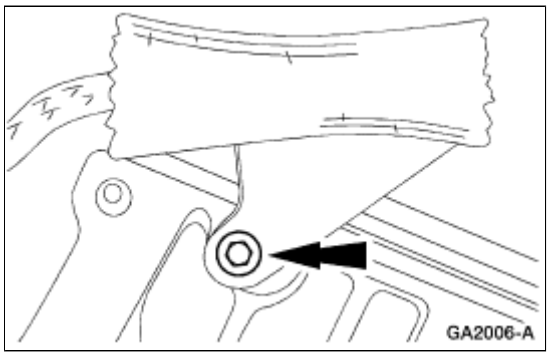
sensor electrical connectors.



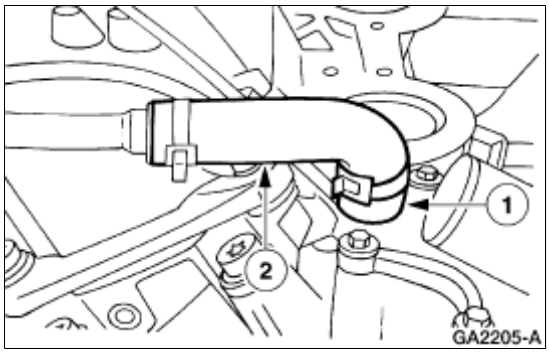
11. Disconnect the EGR tube nut.



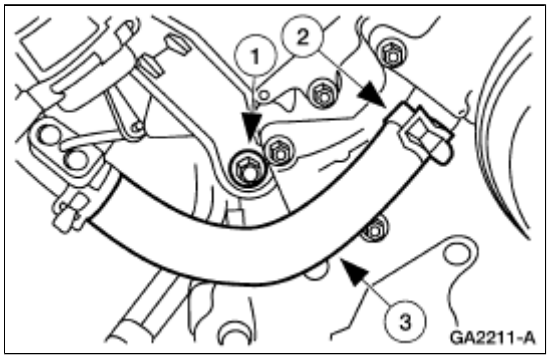
12. Position the EGR valve bracket aside.



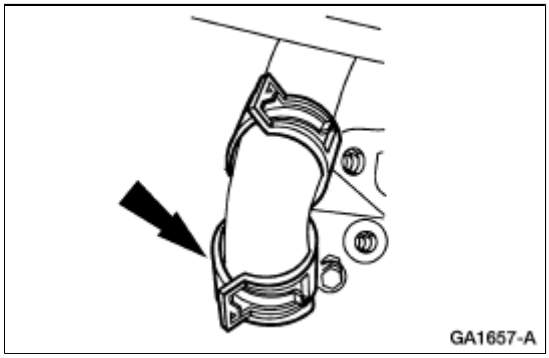
13. Remove the upper heater water hose.
    1. Squeeze the heater hose clamp.
    2. Remove the heater water hose.



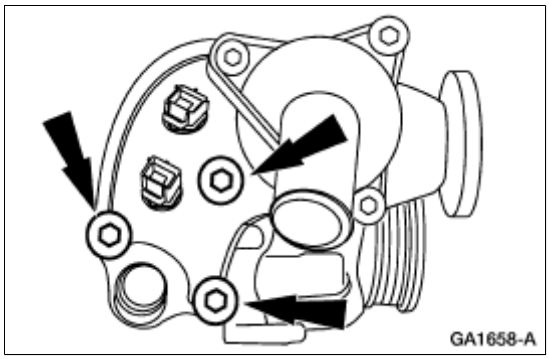
14. Remove the lower heater water hose and position aside.
    1. Remove the bolt.
    2. Squeeze the hose clamp.
    3. Remove the heater water hose and position aside.



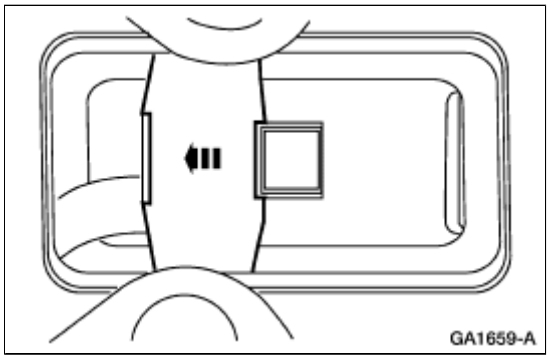
15. Disconnect the water bypass hose and position aside.



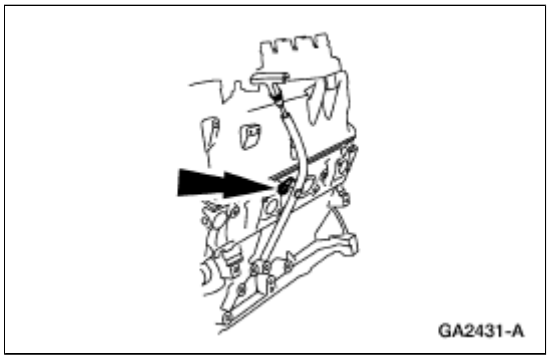
16. Remove the thermostat housing.



17. Remove the crankcase vent separator spring steel clip and remove the separator.

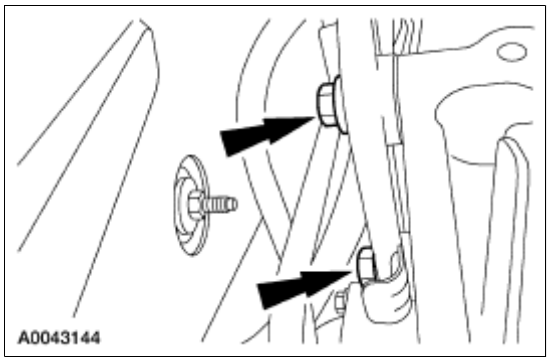


18. Remove the oil level indicator tube.

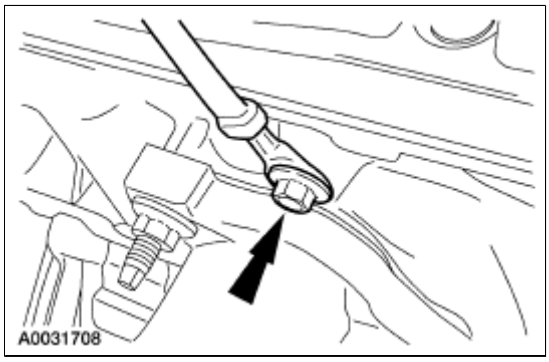


19. Remove the exhaust manifolds. For additional information, refer to Exhaust Manifold—RH and Exhaust Manifold—LH in this section.

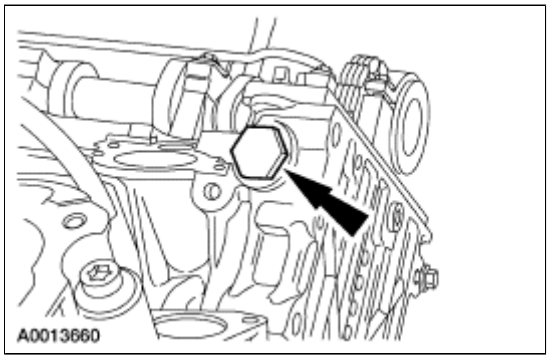
20. Remove the engine wiring harness bolts and position the wiring harness aside.



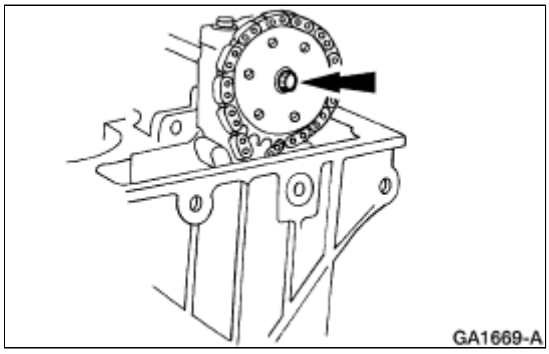
21. Remove the engine compartment ground strap.



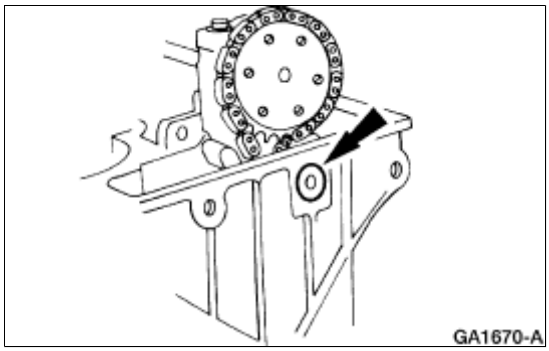
22. Remove the LH hydraulic chain tensioner.



23. Remove the bolt.



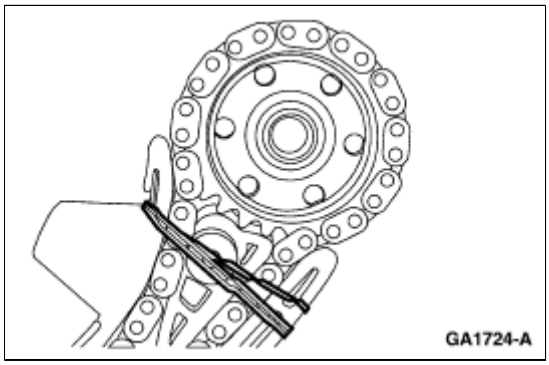
24. Remove the bolt.



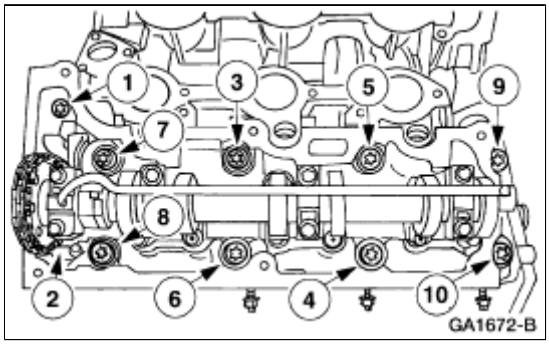
25. **CAUTION: To avoid breaking the cassette, remove the camshaft sprocket from the chain and cassette to gain clearance to remove cylinder the head.**

    NOTE: Hold the chain and cassette with a rubber band to aid in removal and prevent the chain from falling into the cylinder block.

    Remove the LH camshaft sprocket from the cassette.



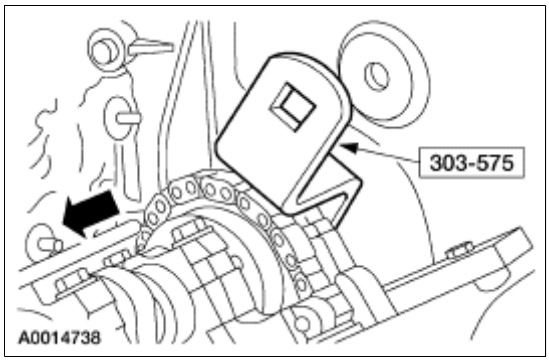
26. Remove the eight 12 mm bolts and two 8 mm bolts in the sequence shown and remove the LH cylinder head.
    - Discard the head gasket.



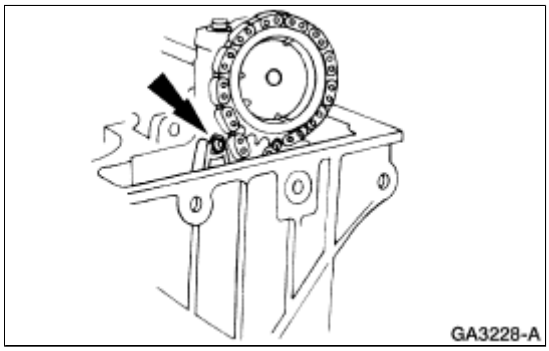
27. Remove the RH hydraulic chain tensioner. For additional information, refer to Timing Drive Components—LH Hydraulic Chain Tensioner in this section.

28. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

    Using the special tool, remove bolt and the camshaft sprocket.



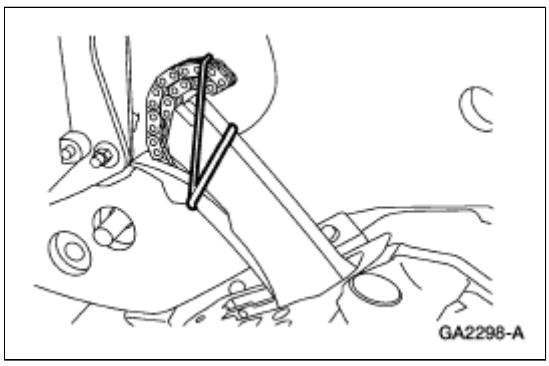
29. Remove the bolt.



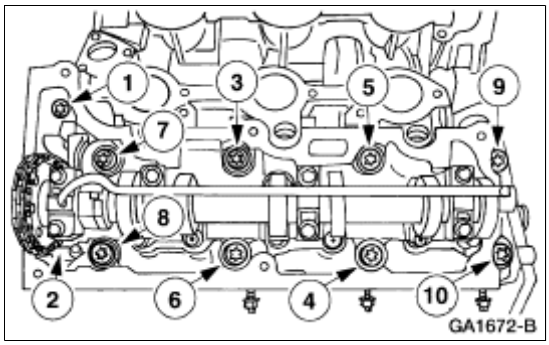
30. **CAUTION: To avoid breaking the cassette, remove the camshaft sprocket from the chain and cassette to gain clearance to remove cylinder the head.**

    NOTE: Hold the chain and cassette with a rubber band to aid in removal and prevent the chain from falling into the cylinder block.

    Remove the RH camshaft sprocket from the cassette.



31. Remove the two 8 mm bolts and the eight 12 mm bolts in the sequence shown, and remove the RH cylinder head.
    - Discard the head gasket.

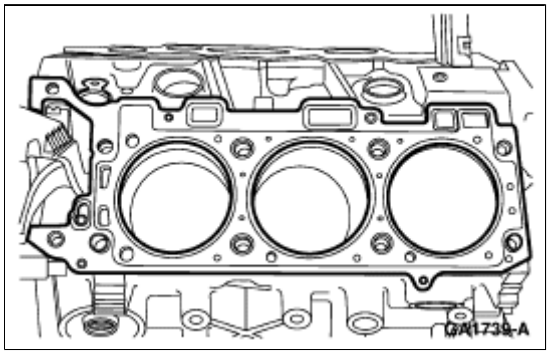


32. Inspect the cylinder head and block for flatness. For additional information, refer to Section 303-00 .

Installation

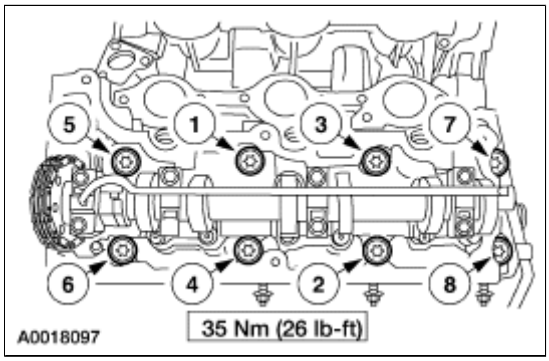
1. **NOTE:** The LH is shown, the RH is similar.

   Position the cylinder head gasket and the cylinder head.



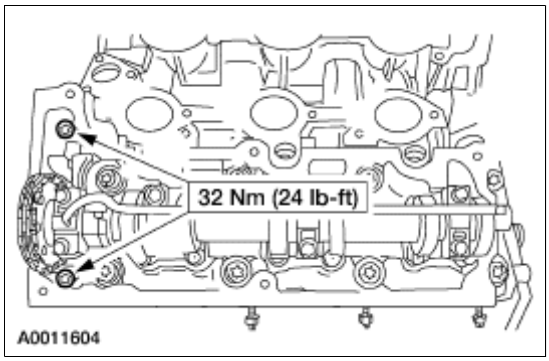
2. **NOTE:** LH shown, RH similar.

   Install the 12 mm bolts and tighten in the sequence shown.



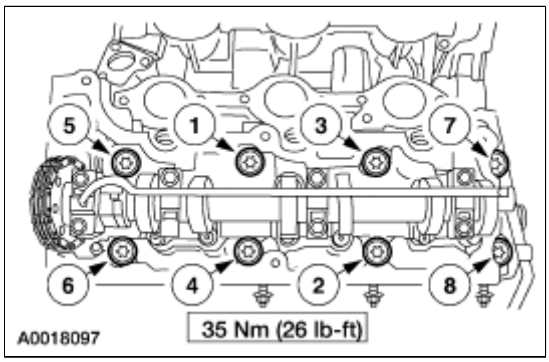
3. **NOTE:** LH shown, RH similar.

   Install the two 8 mm bolts.



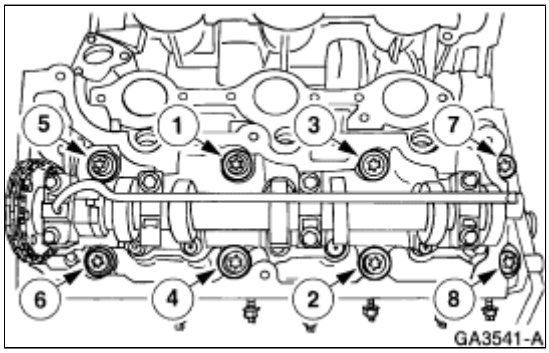
4. **NOTE:** LH shown, RH similar.

   Tighten the 12mm bolts in the sequence shown.

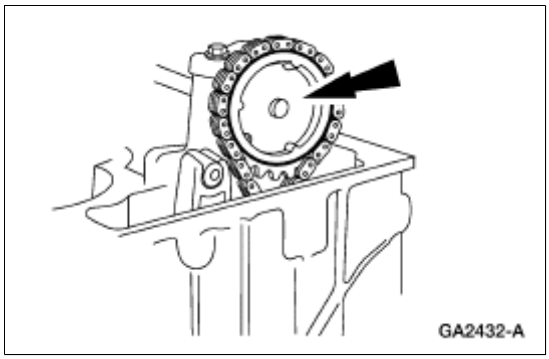


5. **NOTE:** LH shown, RH similar.

   Tighten the eight 12 mm bolts in the sequence shown in two stages.
   - Stage 1: Tighten the bolts 90 degrees.
   - Stage 2: Tighten the bolts an additional 90 degrees.

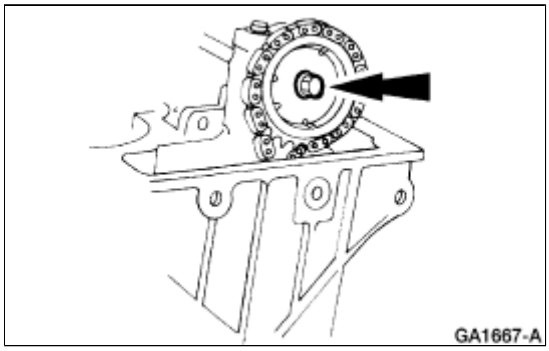


6. Install the RH rear camshaft sprocket in the cassette.

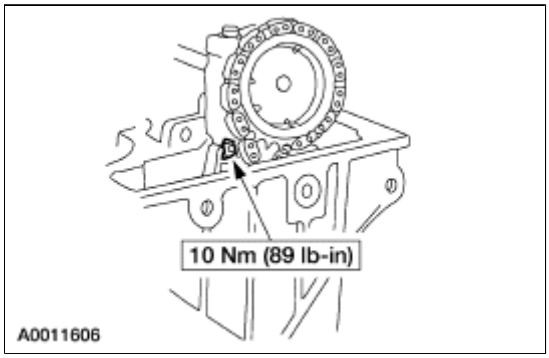


7. **CAUTION: The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**

   Install the RH rear camshaft bolt.

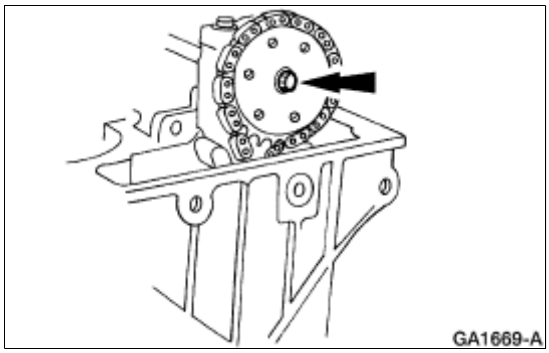


8. Install the bolt.

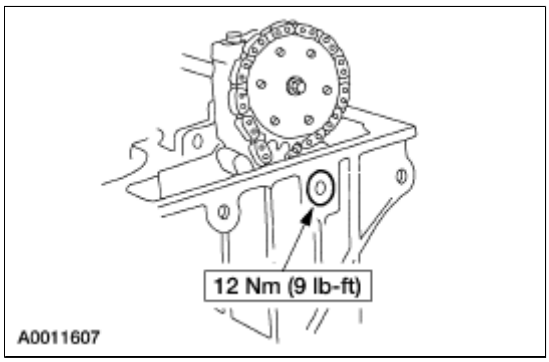


9. **CAUTION: The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**

   Install the LH front camshaft bolt.

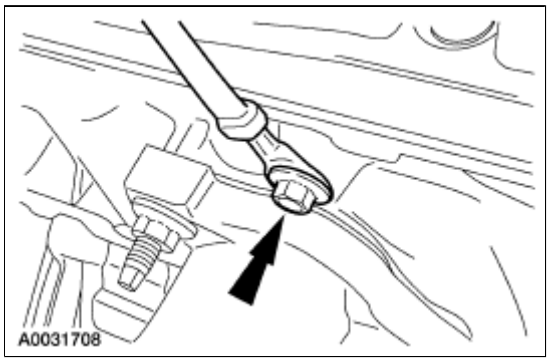


10. Install the LH bolt.

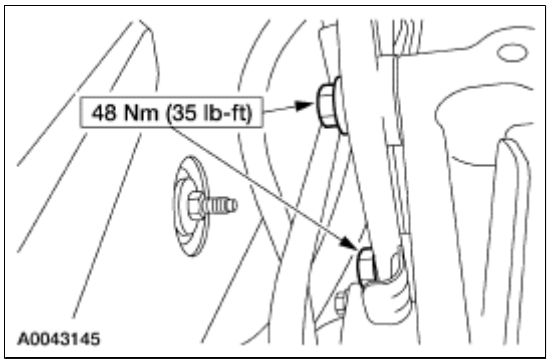


11. Carry out camshaft timing. For additional information, refer to Timing Drive Components—Camshaft Timing in this section.

12. Install the engine compartment ground strap.

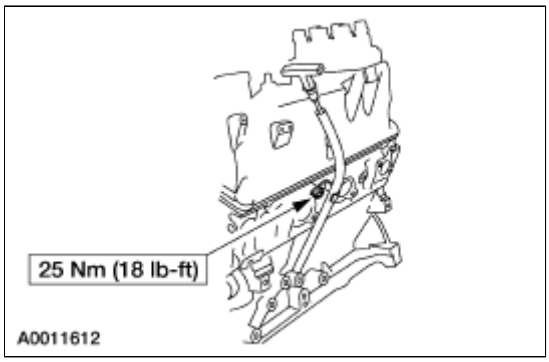


13. Install the wiring harness.

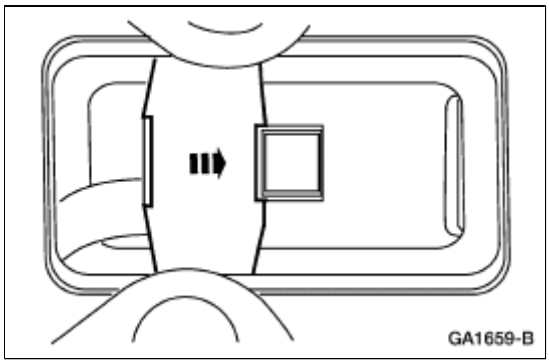


14. Install the exhaust manifolds. For additional information, refer to Exhaust Manifold—LH and Exhaust Manifold—RH in this section.

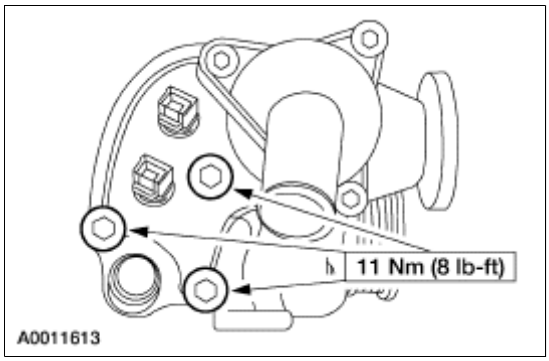
15. Install the oil level indicator tube.



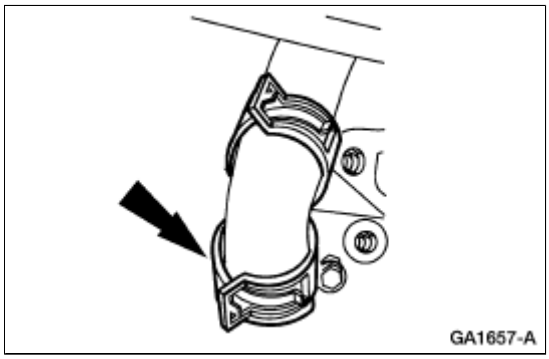
16. Install the crankcase vent separator and the spring steel clip.



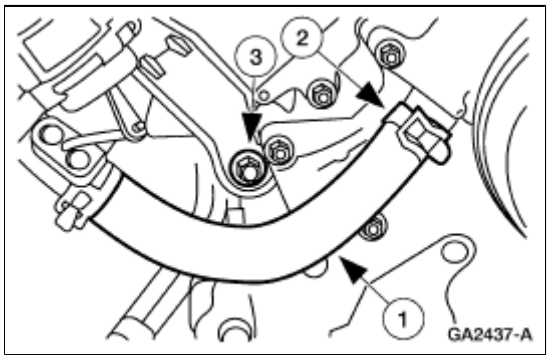
17. Install the thermostat housing.



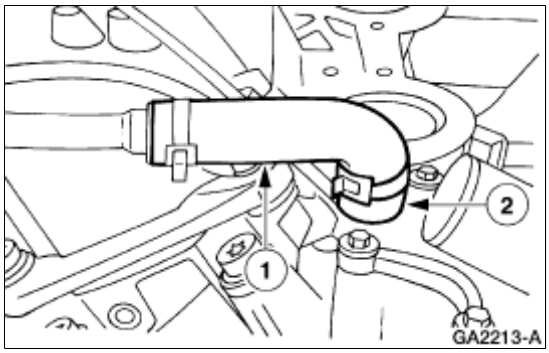
18. Connect the water bypass hose.



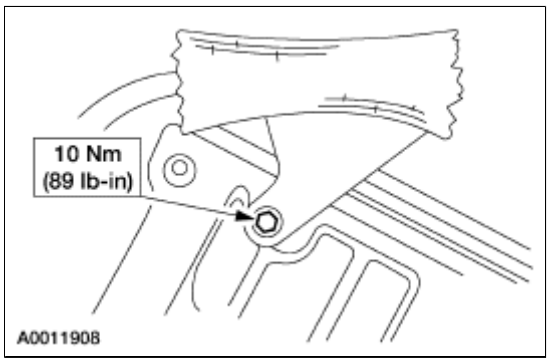
19. Install the lower heater water hose.
    1. Position the heater water hose.
    2. Squeeze the heater hose clamp and position.
    3. Install the bolt.



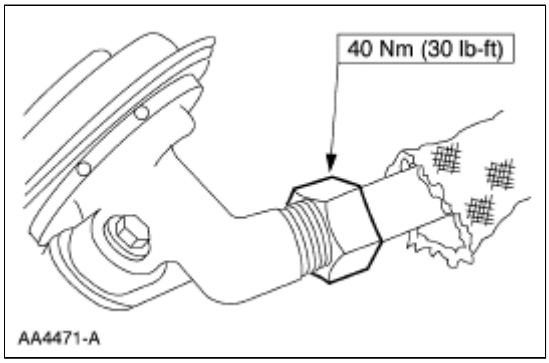
20. Install the upper heater water hose.
    1. Position the heater water hose.
    2. Squeeze the hose clamp and position.



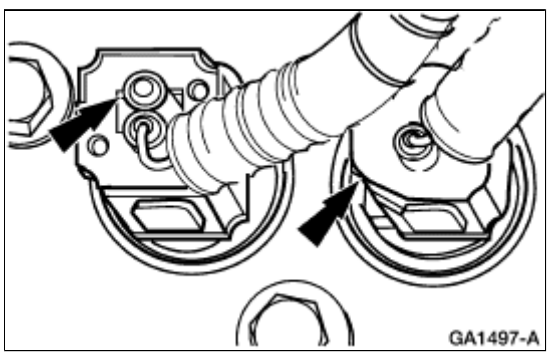
21. Install the EGR bracket.



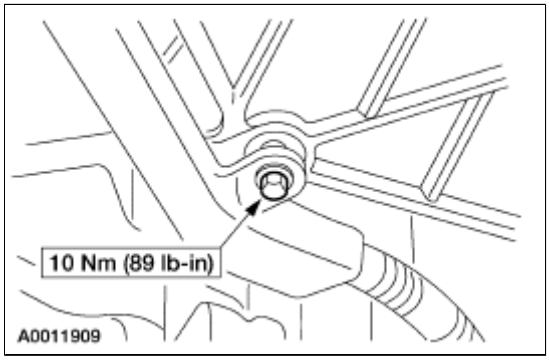
22. Connect the EGR tube nut.



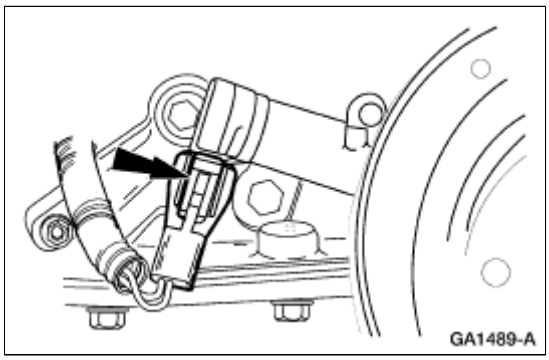
23. Connect the water temperature indicator sender unit and the engine coolant temperature (ECT) sensor electrical connectors.



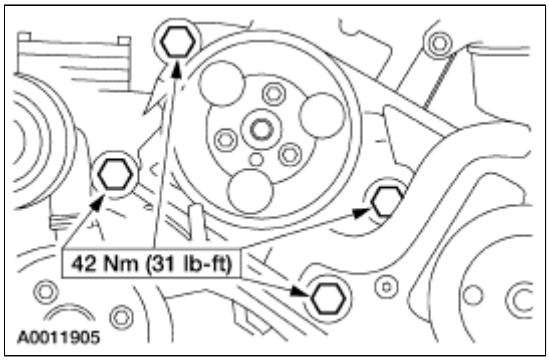
24. Install the electrical harness retainer.



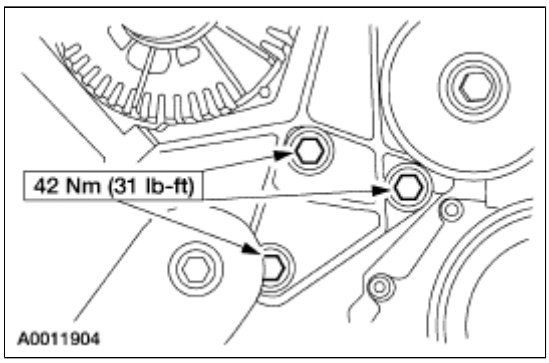
25. Connect the crankshaft position (CKP) sensor electrical connector.



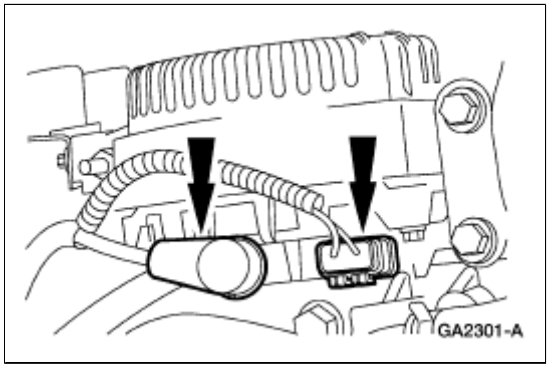
26. Install the accessory bracket.



27. Install the generator mounting bracket.



28. Connect the generator electrical connectors.



29. Install the belt tensioner. For additional information, refer to Section 303-05 .

30. Install the fan shroud. For additional information, refer to Section 303-03 .

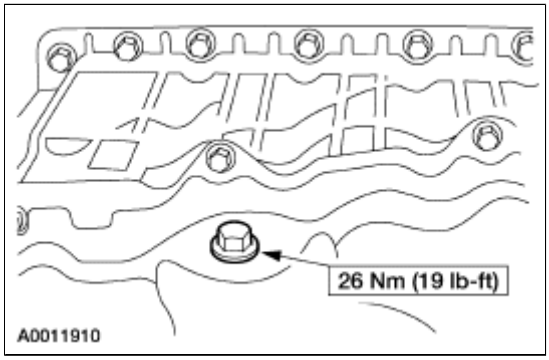
31. Install the roller followers. For additional information, refer to Roller Followers in this section.

32. Install the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.

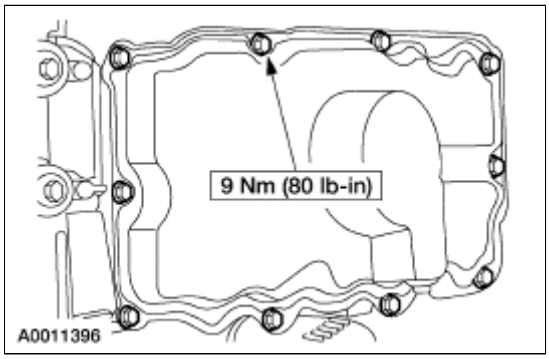
Oil Pan

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the engine oil.



3. Remove the bolts and the oil pan.



4. **NOTE:** All sealing surfaces must be cleaned prior to assembly. Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A to clean the sealing surfaces.

   NOTE: Inspect integral oil pan gasket for cuts or damage that may cause leaks. Install a new gasket if necessary.

   NOTE: Fill the engine with Super Premium SAE 5W-30 Motor Oil X0-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   To install, reverse the removal procedure.

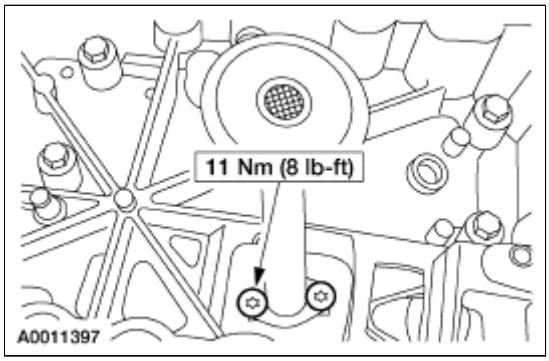
Oil Pump Screen and Pickup Tube

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

Removal and Installation

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the oil pump screen and pickup tube and the gasket.



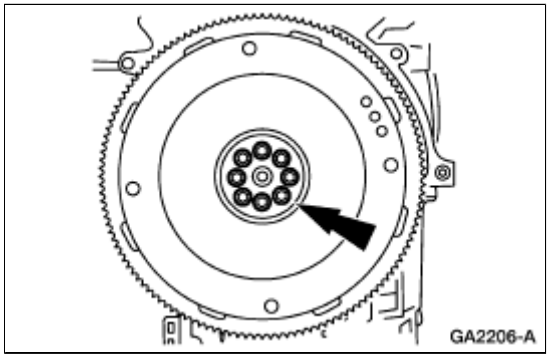
3. **NOTE:** Clean the gasket mating surfaces with metal surface cleaner.

   To install, reverse the removal procedure.

Flywheel

Removal

1. Remove the transmission. For additional information, refer to Section 307-01A or Section 307-01B .
2. Remove the flywheel.

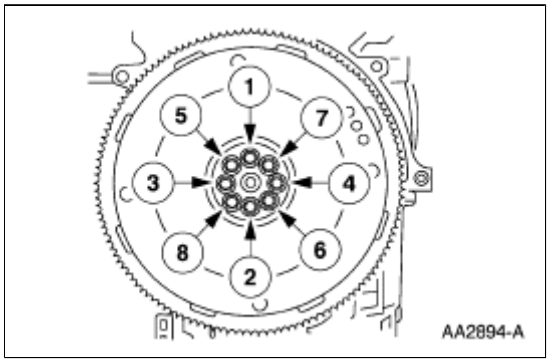


3. Clean and inspect the flywheel. For additional information, refer to Section 303-00 .

Installation

1. **NOTE:** Special bolts are used for flywheel installation; do not use standard bolts.

   Install the flywheel.
   - Tighten the bolts in the sequence shown in two stages.
   - Stage 1: Tighten the bolts to 13 Nm (10 lb-ft).
   - Stage 2: Tighten the bolts to 71 Nm (52 lb-ft).



2. Install the transmission. For additional information, refer to Section 307-01A or Section 307-01B .

Crankshaft Rear Oil Seal

Special Tool(s)

ST1385-A	Seal Remover 303-409 (T92C-6700-CH)
ST1785-A	Rear Oil Seal Replacer 303–S524 (T95T-6701-AR)

Material

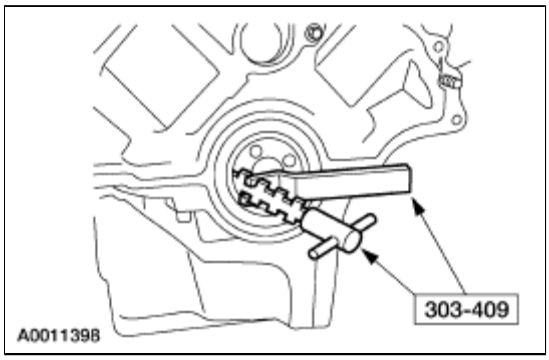
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

Removal

1. Remove the flywheel. For additional information, refer to Flywheel in this section.

2. **CAUTION: Avoid scratching or damaging the oil crankshaft seal running surface during removal of the crankshaft rear oil seal.**

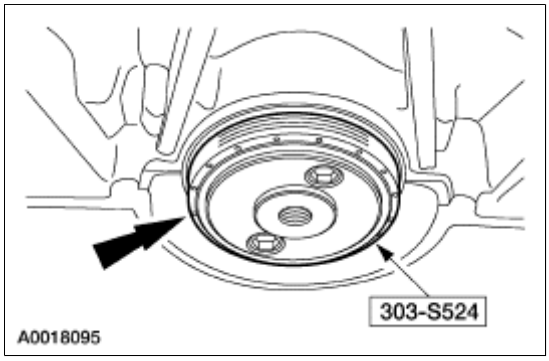
   Using the special tool, remove the crankshaft rear oil seal.



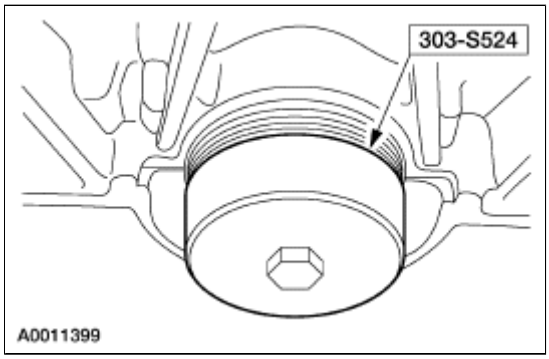
Installation

1. **NOTE:** Be sure the crankshaft rear sealing surface is clean and free of any rust or corrosion. To clean the crankshaft rear sealing surface, use extra-fine emery cloth or extra-fine 0000 steel wool with metal surface cleaner.

   Lubricate the crankshaft rear oil seal with clean engine oil and install on the special tool.



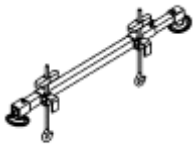
2. Using the special tool, install the crankshaft rear oil seal.



3. Install the flywheel. For additional information, refer to Flywheel in this section.

Cylinder Block Cradle

Special Tool(s)

ST1831-A	Lifting Eyes 303-D050 (D81L-6000-D) or equivalent
 ST2363-A	3 Bar Engine Support Kit 303-290A

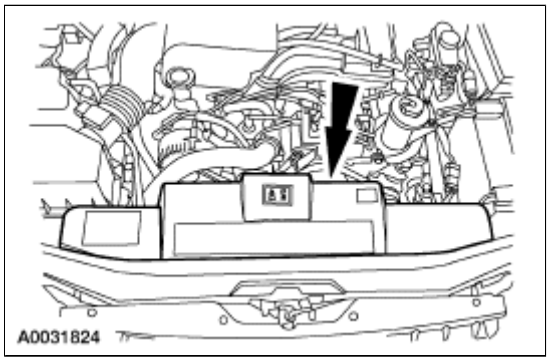
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M5B392-A

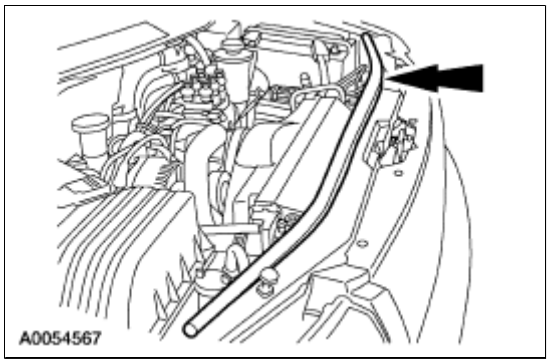
Removal

All vehicles

1. Disconnect the negative battery cable. For additional information, refer to Section 414-01 .
2. Remove the upper air deflector.

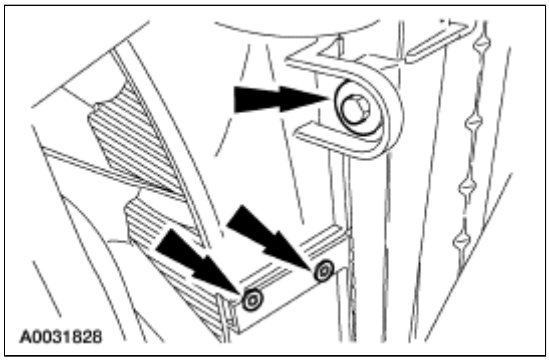


3. Remove the weatherstrip.



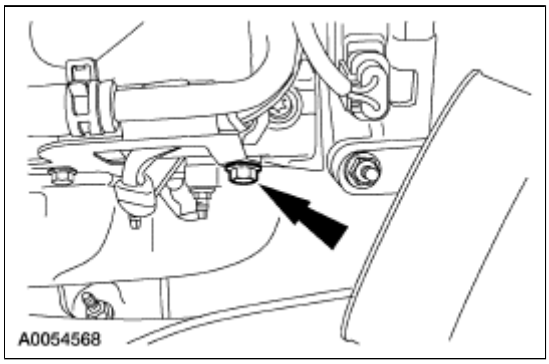
4. **NOTE:** Not all vehicles will have screws installed in the radiator fan shroud.

   Remove and discard the screws. Remove the bolts and the fan shroud.

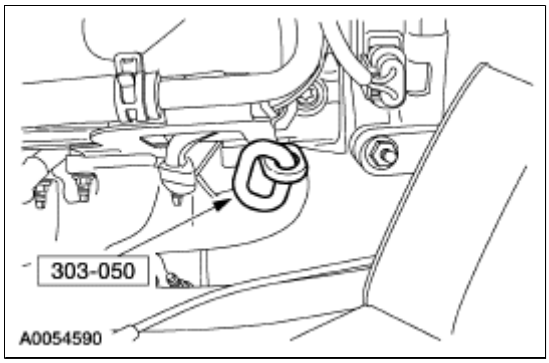


5. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

6. Remove the bolt.

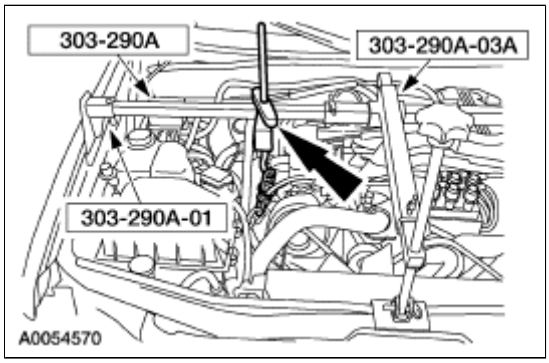


7. Install the RH lifting eye using the previously removed bolt.



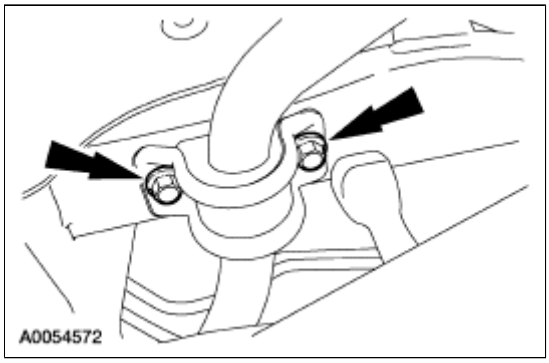
8. **NOTE:** This is not a typical setup. Only the right side of the motor will be raised.

   Install the special tools.

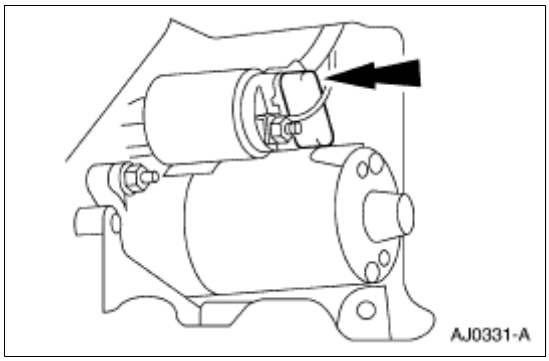


9. Raise and support the vehicle. For additional information, refer to Section 100-02 .

10. Remove the four bolts allowing the stabilizer bar to droop.

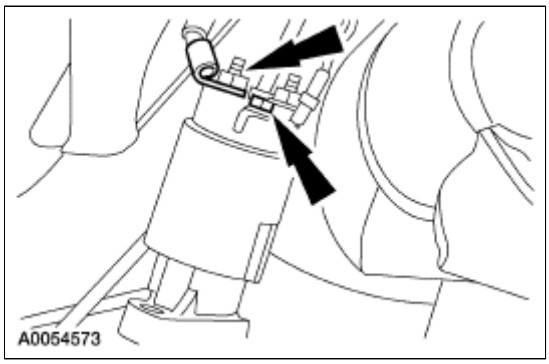


11. Remove the starter solenoid terminal cover.

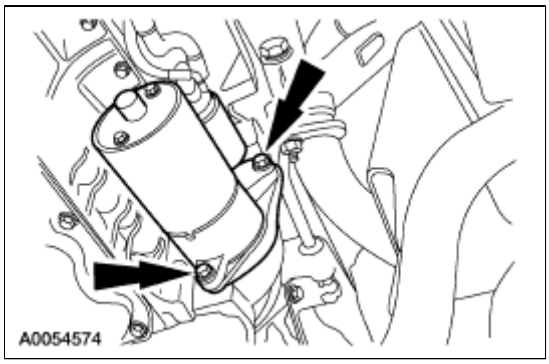


12. **NOTE:** The starter is shown removed for clarity. It is important to keep the starter motor from applying tension on the starter motor cables.

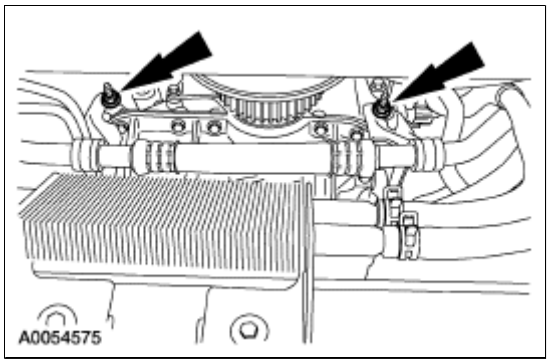
    Disconnect the starter motor electrical connectors.



13. Remove the three starter motor bolts.

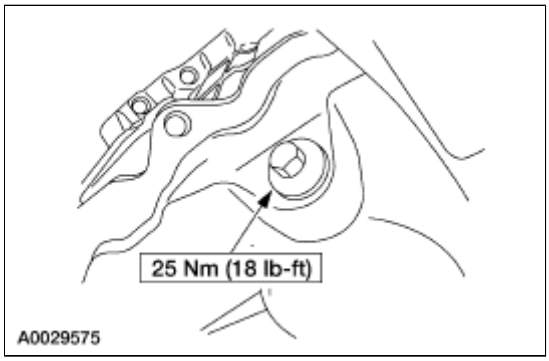


14. Remove the A/C line bracket nuts and position the brackets aside.



15. **NOTE:** Install the drain plug when finished draining.

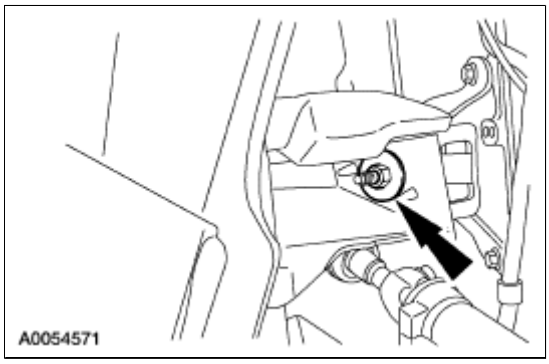
    Drain the engine oil.



4x2 vehicles

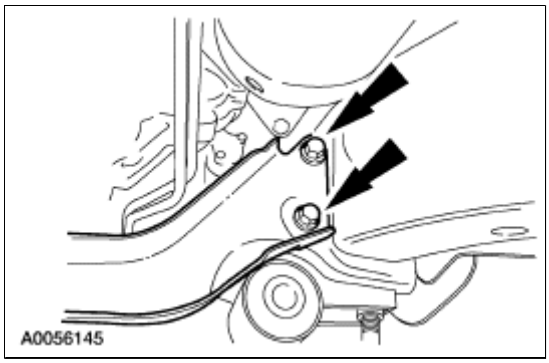
16. **NOTE:** LH side shown, RH side similar.

    Remove the motor mount nuts.

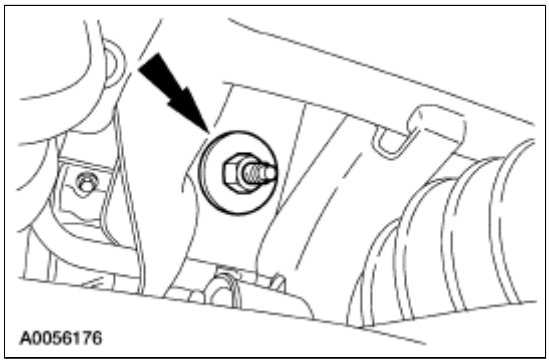


4x4 vehicles

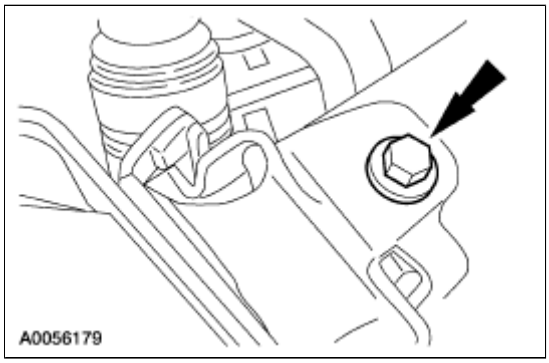
17. Remove the four bolts and the crossmember bolts.



18. Remove the RH motor mount nut.



19. Remove the LH side through bolt and nut.

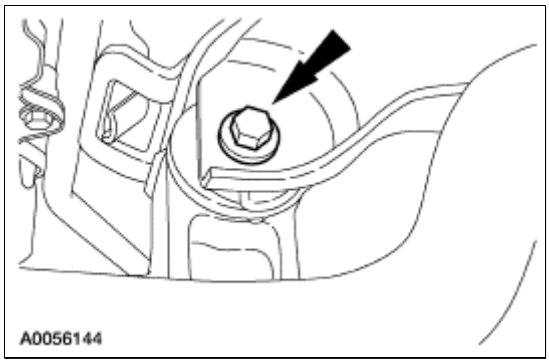


All vehicles

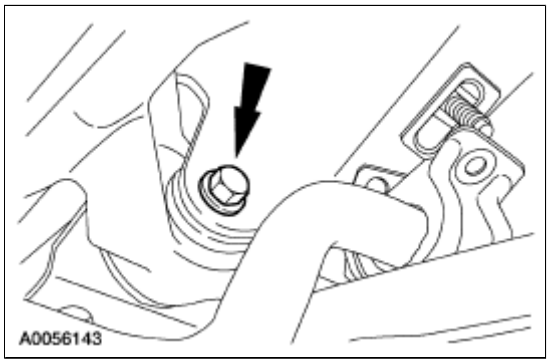
20. Raise the engine.

21. **NOTE:** Use a floor jack to support the front axle assembly.

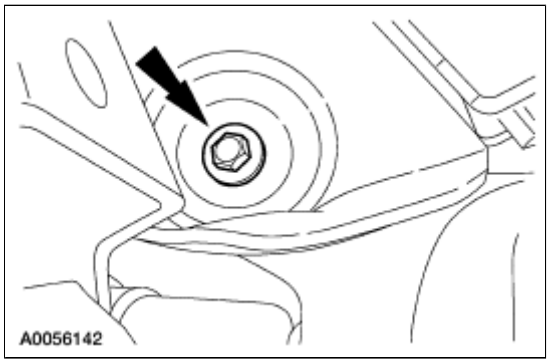
    Remove the bolt from the right side of the axle housing. Discard the nut and bolt.



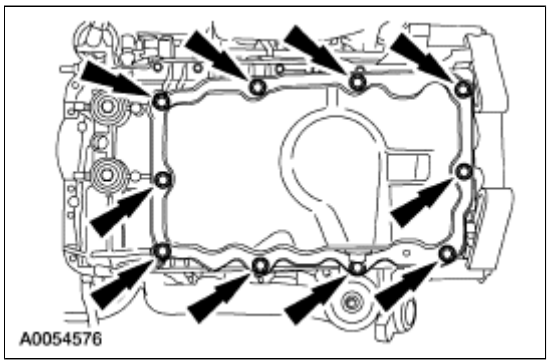
22. Remove the LH side lower axle housing bolt and nut. Discard the bolt and nut.



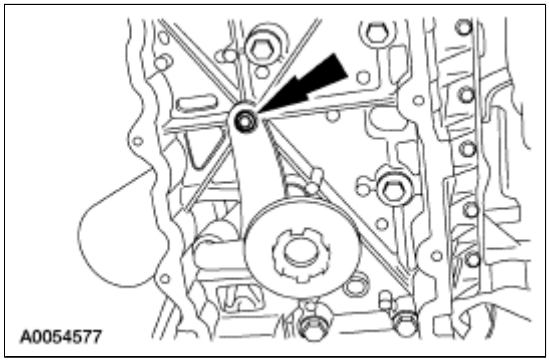
23. Remove the LH side upper axle housing axle bolt and nut. Discard the bolt and nut.



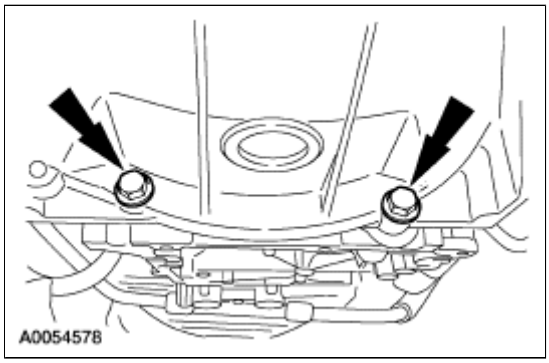
24. Remove the oil pan.



25. Remove the oil pump pickup tube.

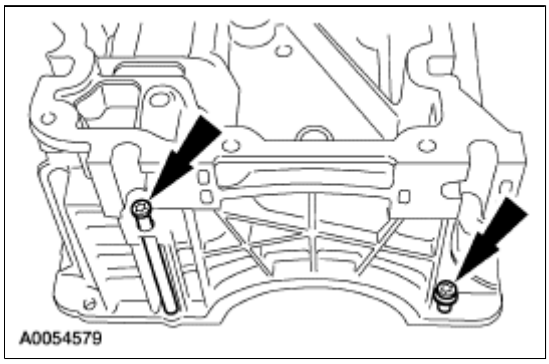


26. Remove the bolts.

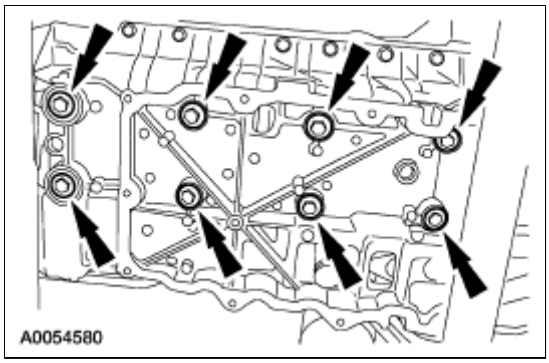


27. **NOTE:** The lower block cradle is shown removed for clarity. Note the location of the two torx bolts at the rear of the lower block cradle.

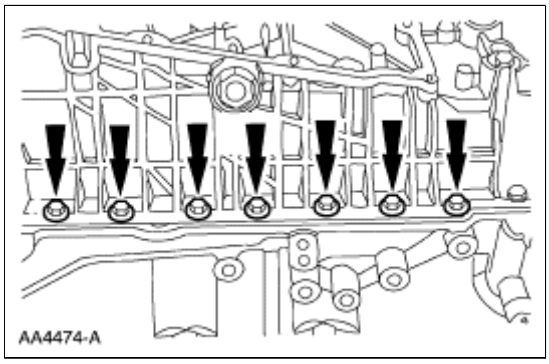
    Remove the rear lower block cradle bolts.



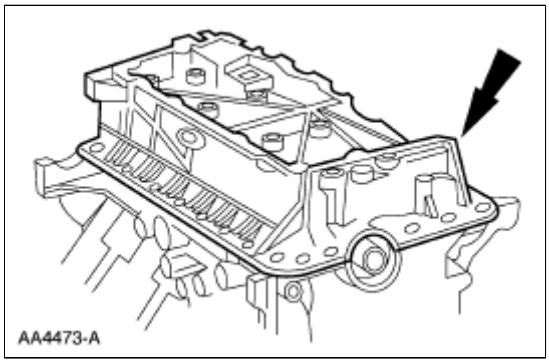
28. Remove the eight inner bolts. Discard the washer seals.



29. Remove the outer bolts and nuts.



30. Remove the ladder frame and the gasket.



Installation

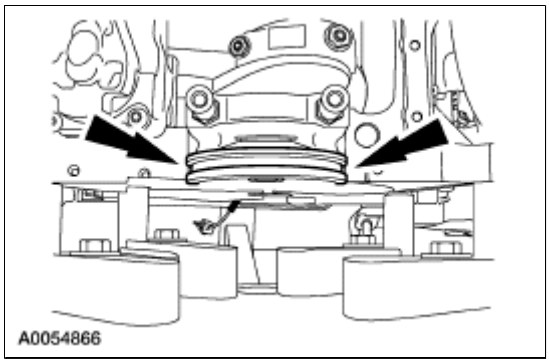
All vehicles

1. **NOTE:** Inspect the integral oil pan gasket for cuts or damage that may cause leaks. Install a new gasket if necessary.

   All sealing surfaces must be cleaned prior to assembly. Use metal surface cleaner to clean the sealing surfaces.

2. **NOTE:** Gasket material as well as silicone sealant may be present in the cavities in the main bearing cap. This material must be removed completely prior to assembly.

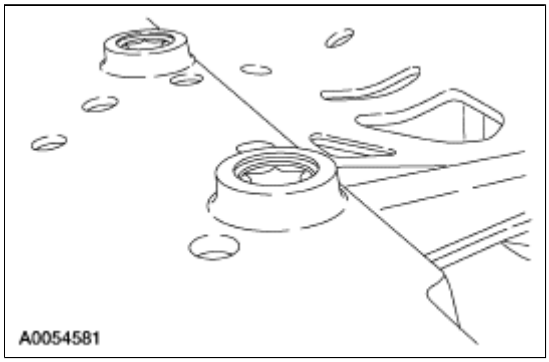
   Clean the sealant from the cavities on the rear main bearing cap.



3. **CAUTION: Failure to back off the set screws can result in damage to the lower block cradle.**

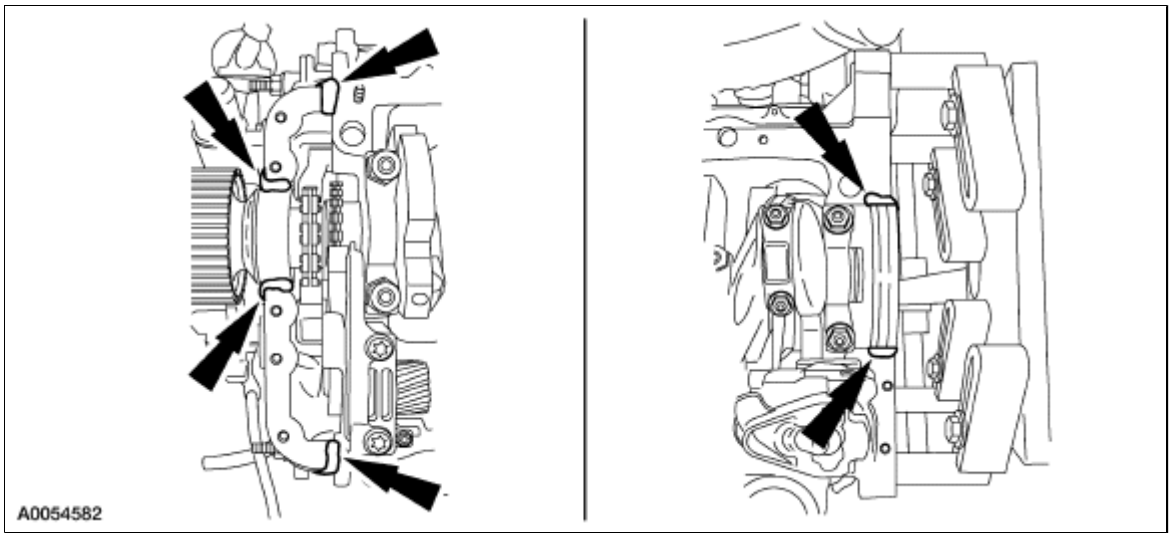
   NOTE: The set screw is shown from the top (crankshaft) side of the lower block cradle.

   Back the set screws off until they are below the lower block cradle boss.

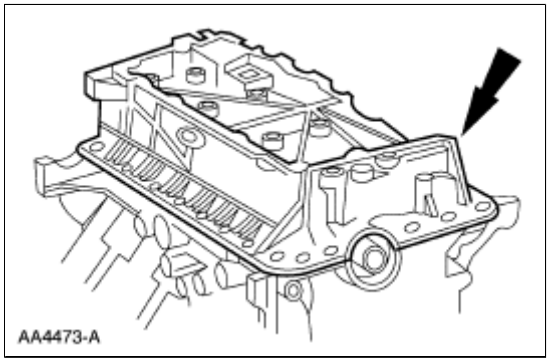


4. **NOTE:** If the block cradle gasket is not secured within four minutes of the sealant application, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow the metal surface cleaner to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

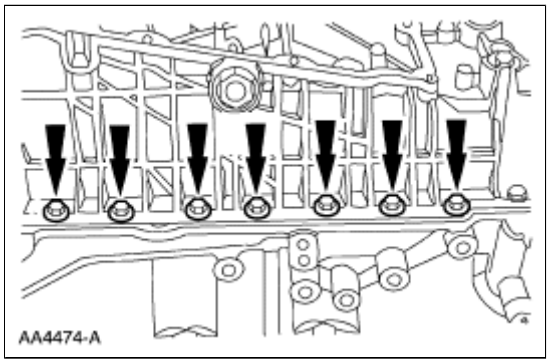
   Apply silicone in the six places shown.



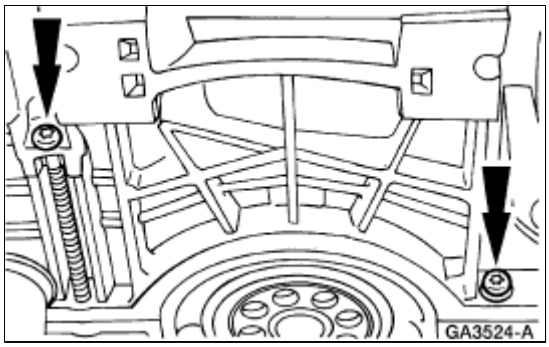
5. Position the lower block cradle and gasket assembly.



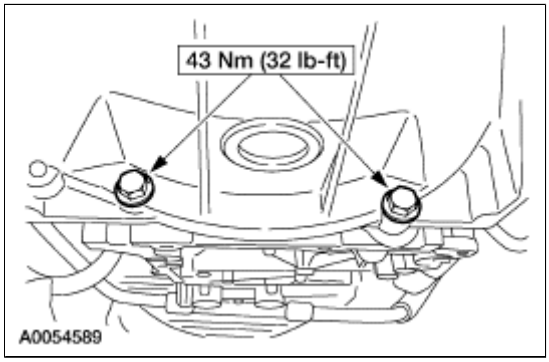
6. Install and hand-tighten the outer bolts and nuts.



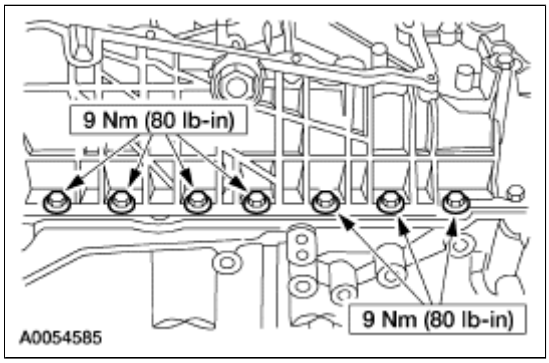
7. Install and hand-tighten the rear lower block cradle bolts.



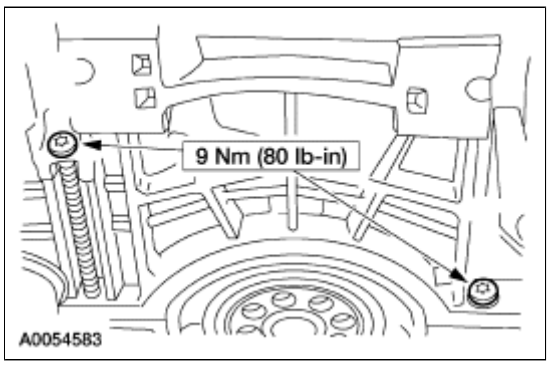
8. Install the two rear lower block cradle-to-bell housing bolts.



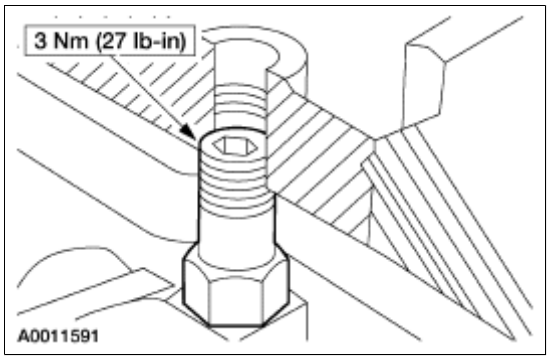
9. Tighten the outer bolts.



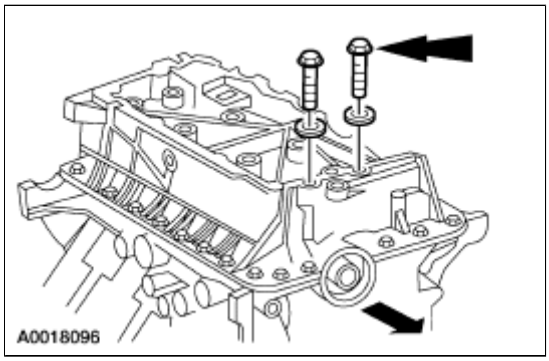
10. Tighten the rear lower block cradle bolts.



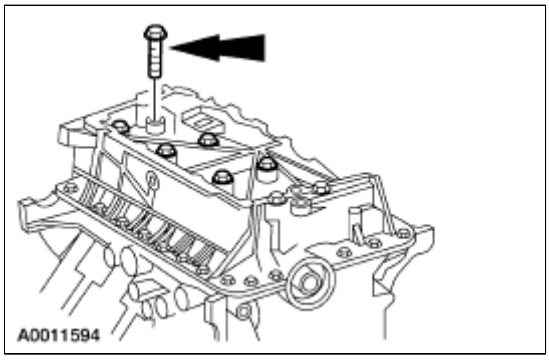
11. Tighten the eight inserts.



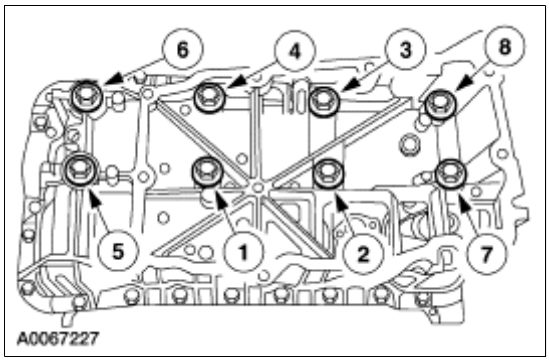
12. Install the two silver covered bolts and new washer seals. Hand-tighten them at this time.



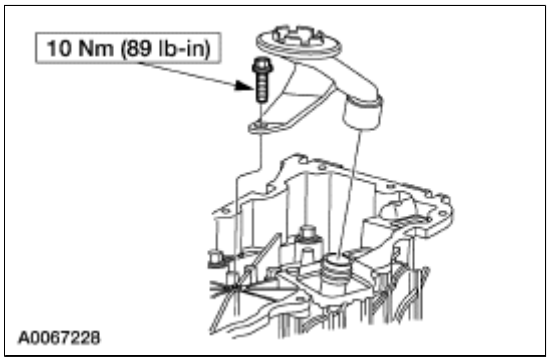
13. Install and hand-tighten the six remaining bolts.



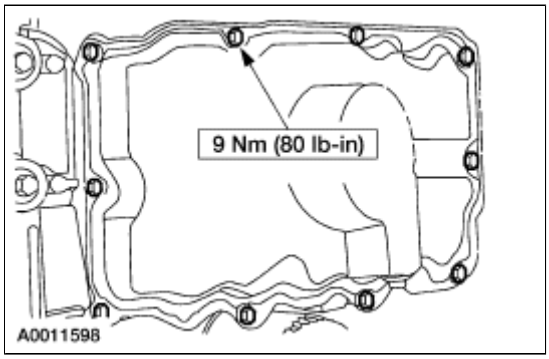
14. Tighten the lower block cradle bolts in two stages:
    - Stage 1: Tighten to 15 Nm (11 lb-ft).
    - Stage 2: Tighten to 33 Nm (24 lb-ft).



15. Install the oil pump screen cover and tube.

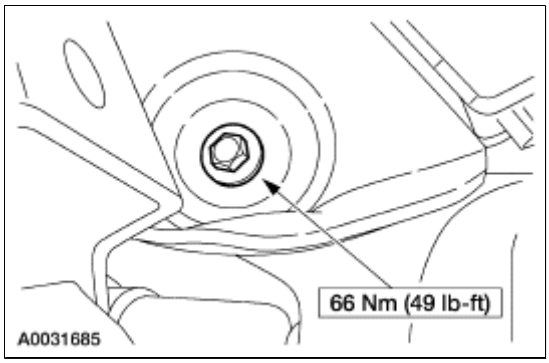


16. Install the oil pan and gasket.

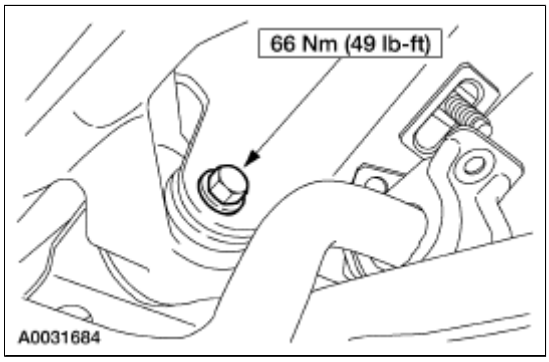


NOTE: Axle housing support bolts must be replaced each time they are removed. Do not reuse axle housing support bolts.

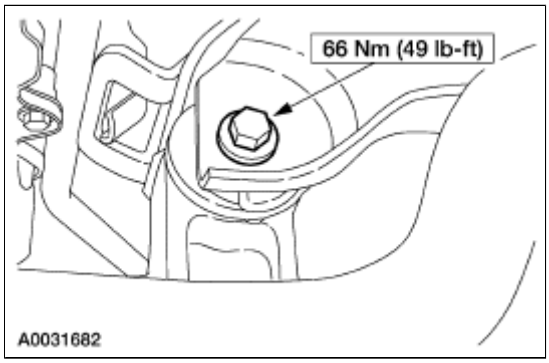
17. Install the new LH side upper axle housing axle bolt and nut.



18. Install the new LH side lower axle housing bolt and nut.



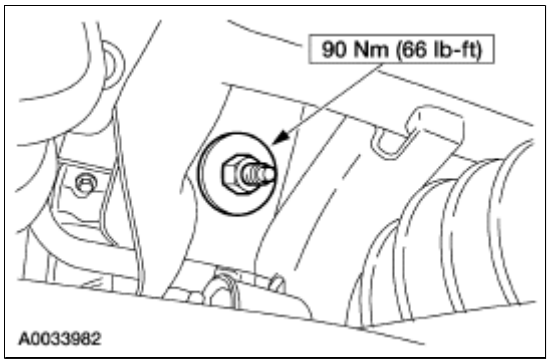
19. Install the new RH side axle housing bolt and nut.



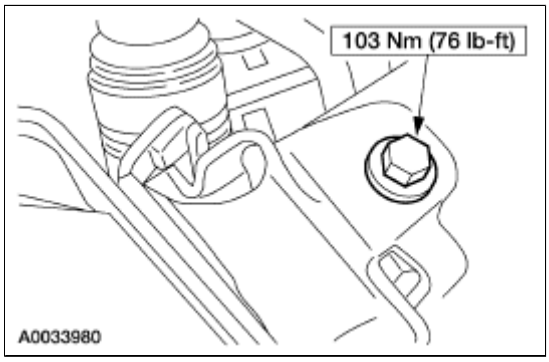
20. Remove the jack supporting the front axle assembly.
21. Lower the engine.

4x4 vehicles

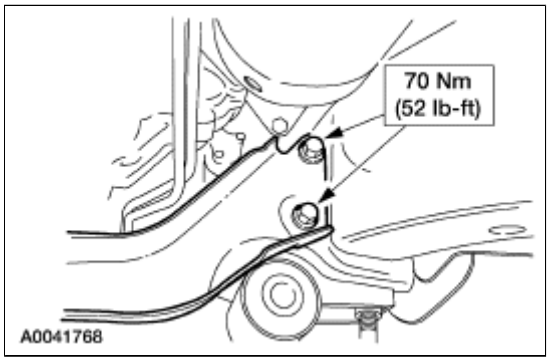
22. Install the RH motor mount nut.



23. Install the LH side through-bolt and nut.

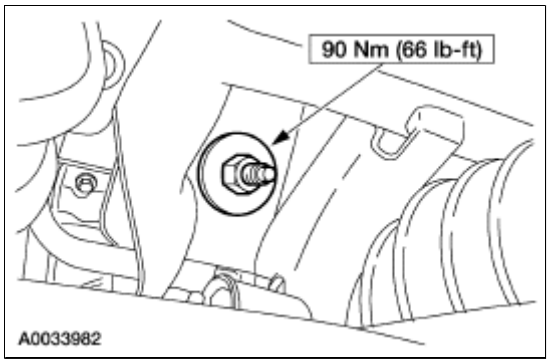


24. Install the crossmember.



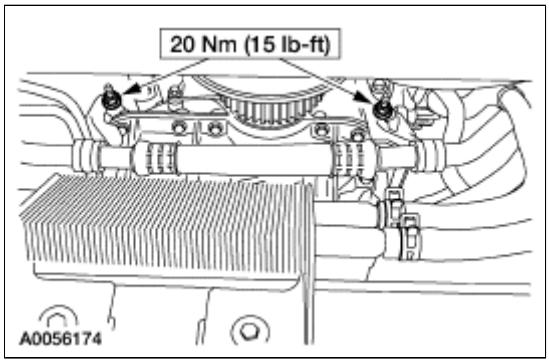
4x2 vehicles

25. Install the motor mount nuts.

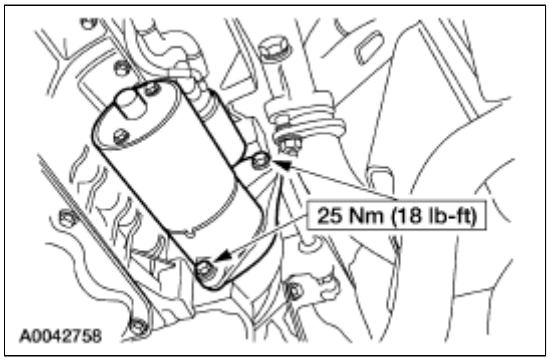


All vehicles

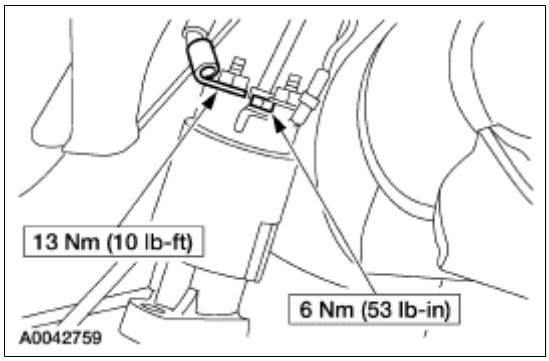
26. Position the A/C line and install the nuts.



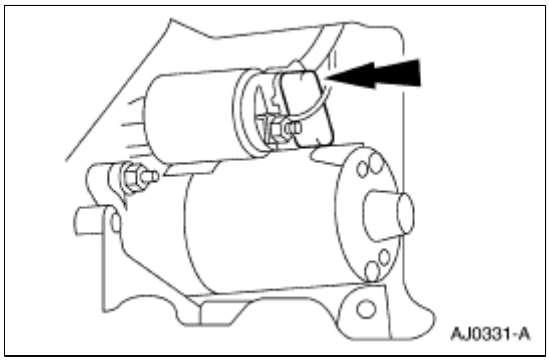
27. Install the starter motor.



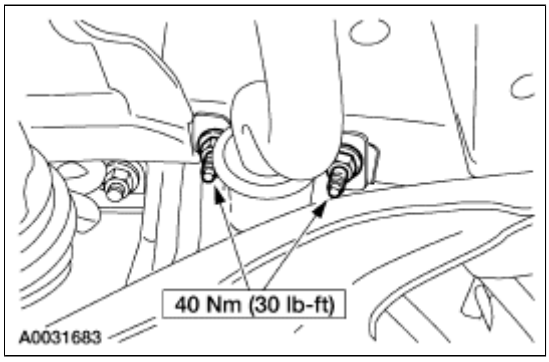
28. Connect the starter motor electrical connectors.



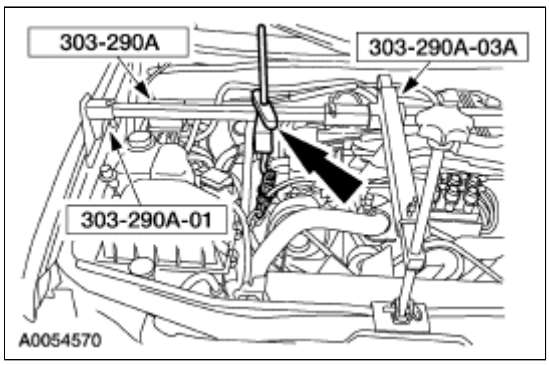
29. Install the starter motor solenoid terminal cover.



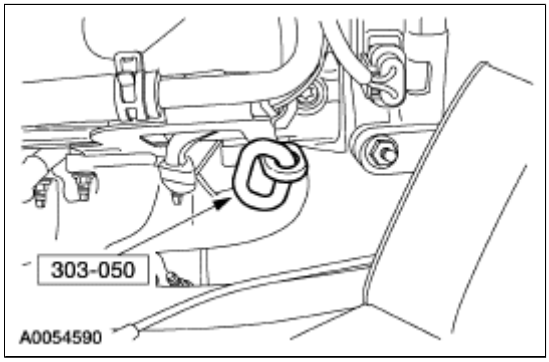
30. Position the stabilizer bar and install the sway bar bracket bolts.



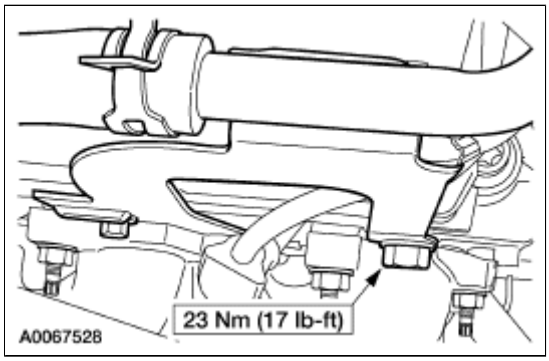
31. Remove the special tools.



32. Remove the RH lifting eye.

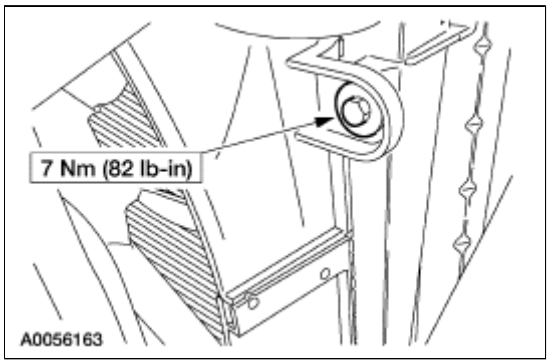


33. Install the bolt.

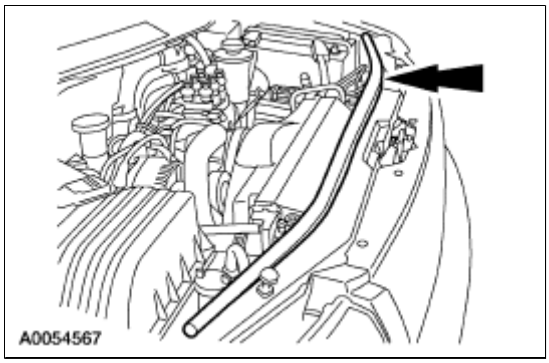


34. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

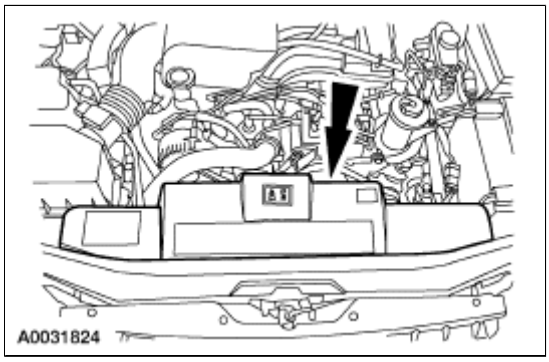
35. Install the upper fan shroud.



36. Install the weatherstrip.



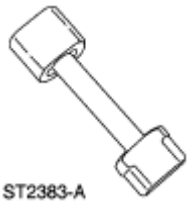
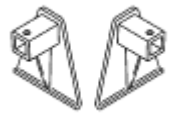
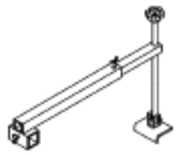
37. Install the upper air deflector.



38. Connect the negative battery cable. For additional information, refer to Section 414-01 .

Engine Support Insulators

Special Tool(s)

ST1831-A	Lifting Eyes 303-D030 (D81L-6001-D) or equivalent
 ST2383-A	Support Bar, Engine 303-290A
 ST2378-A	Adapters for 303-290 303-290A-01
 ST2379-A	Adapters for 303-290A (Support Leg) 303-290A-03A

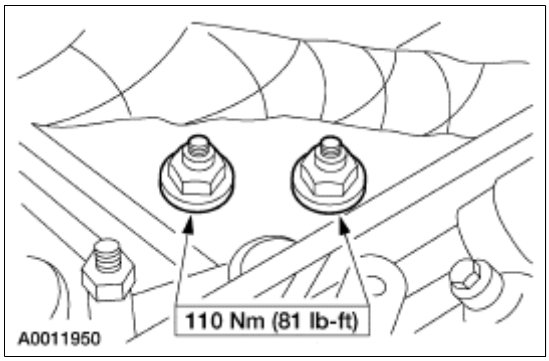
Removal and Installation

All vehicles

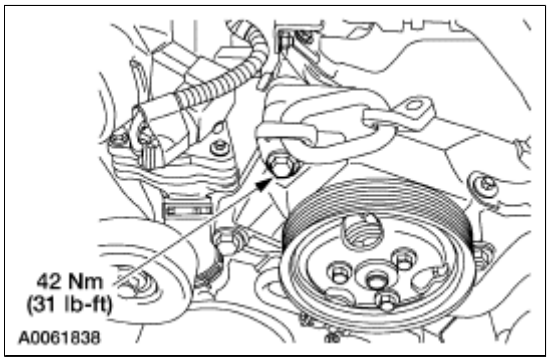
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the fan shroud. For additional information, refer to Section 303-03 .

LH side

3. Remove the LH engine insulator nuts.

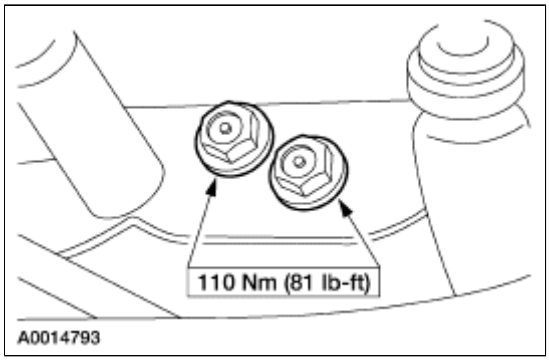


4. Remove the bolt and install the Lifting Eye.

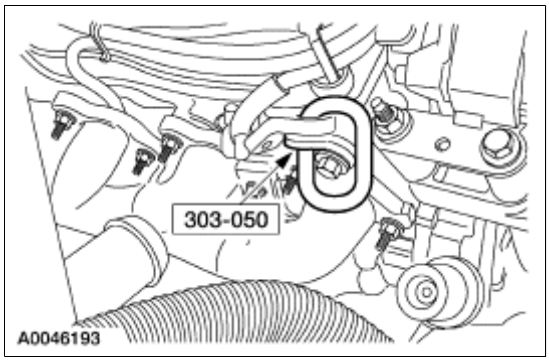


RH side

5. Remove the RH engine insulator nuts.



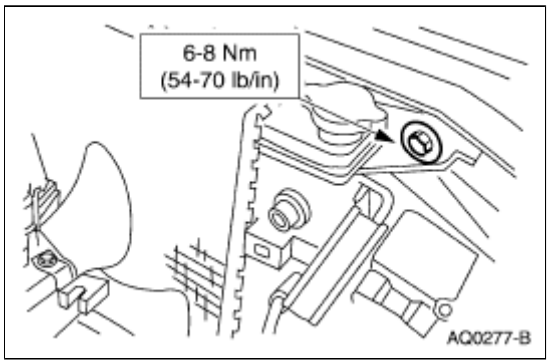
6. Remove the bolt and install the Lifting Eye.



Both sides

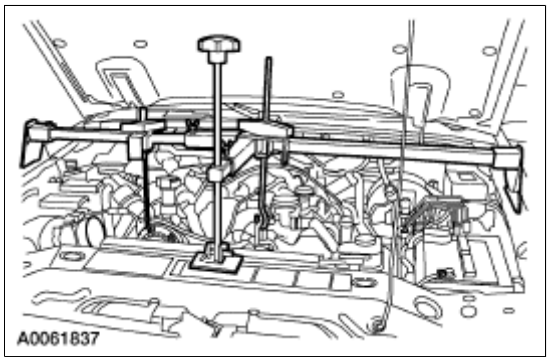
7. **NOTE:** Right side shown, left side similar.

   Remove the radiator mounting bolts.



8. **NOTE:** The weight of the engine should be fully supported by the three bar support.

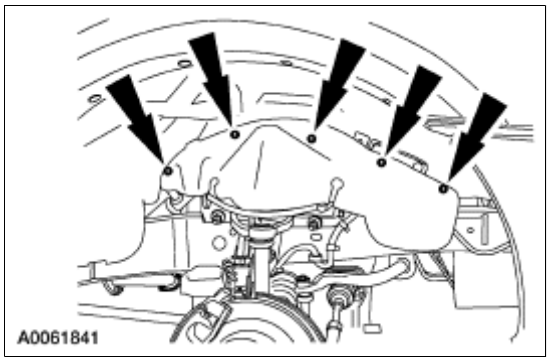
   Install the three bar support equipment.



9. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

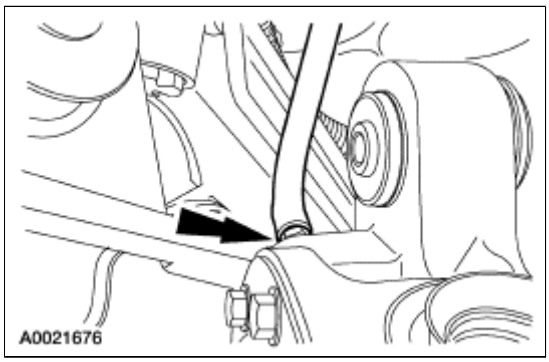
10. **NOTE:** Right side shown, left side similar.

    If equipped, remove the pin-type retainers and the corresponding inner fender well splash shield(s).



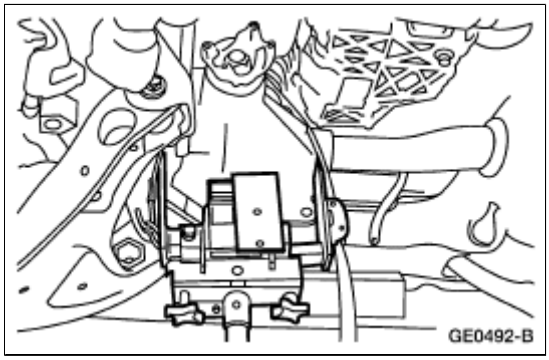
4x4 vehicles

11. Disconnect the vent hose from the differential housing vent tube.



12. **WARNING: Secure the axle to the jack with a safety strap. Failure to follow these instructions can result in personal injury.**

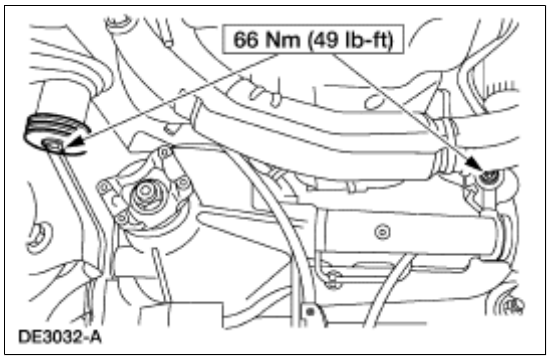
    Secure the axle housing to a suitable lift.



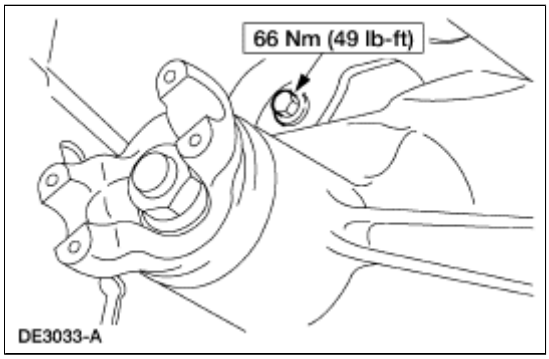
13. **CAUTION: Any time bolts, washers, spacers or nuts are loosened in the differential support for any reason, install new components to prevent damage.**

    NOTE: Driveshaft shown removed for clarity.

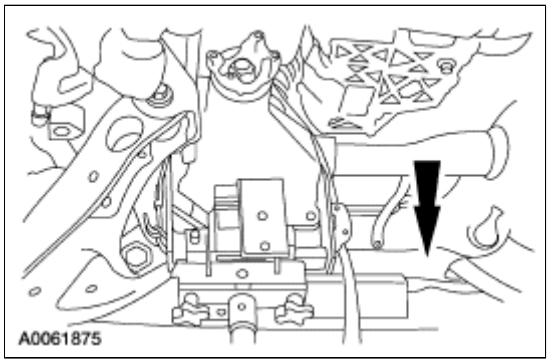
    Remove and discard the bolts.



14. Remove and discard the bolt.

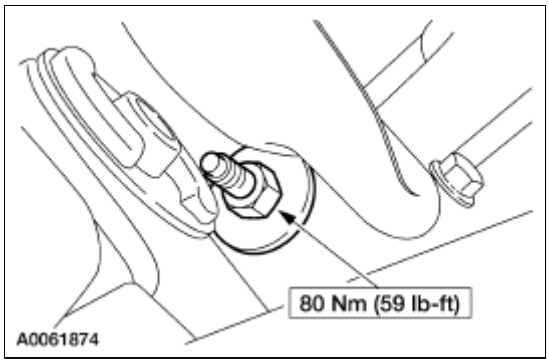


15. Lower the axle housing approximately 25 mm (1 in).

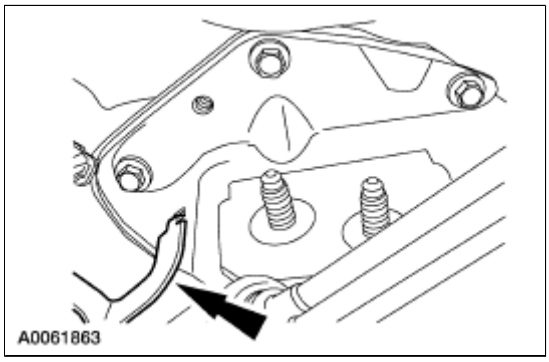


LH side

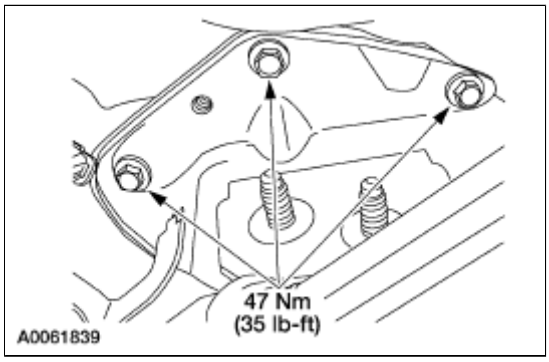
16. Remove the lower motor mount nut and washer.



17. If equipped, remove the wire harness bracket from the upper motor mount bracket.

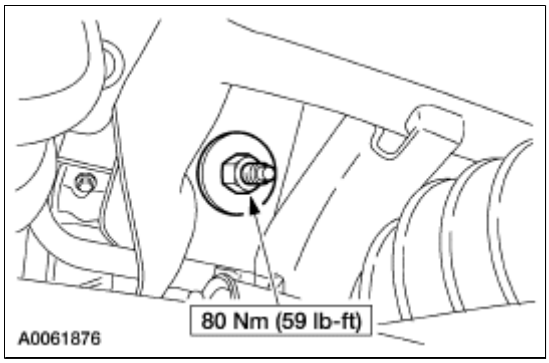


18. Remove the three bolts and the upper motor mount bracket and the motor mount.

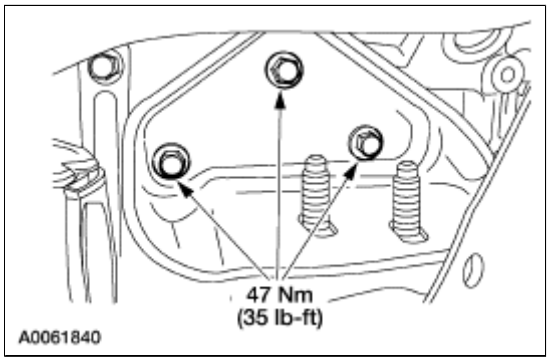


RH side

19. Remove the lower motor mount nut and washer.



20. Remove the bolts and upper motor mount bracket and the motor mount.



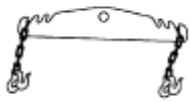
Both sides

21. **NOTE:** Remove the jack after the front differential retainers have been installed to provide clearance for torque access.

    To install, reverse the removal procedure.

Engine

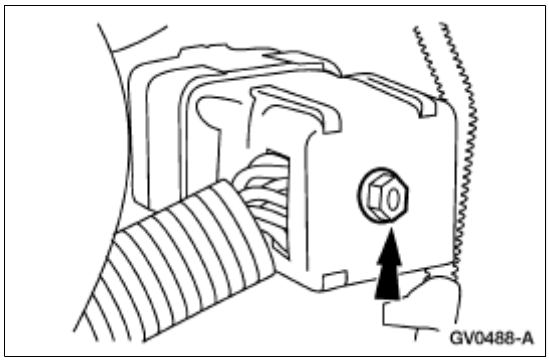
Special Tool(s)

ST1831-A	Lifting Eyes 303-D030 (D81L-6001-D) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

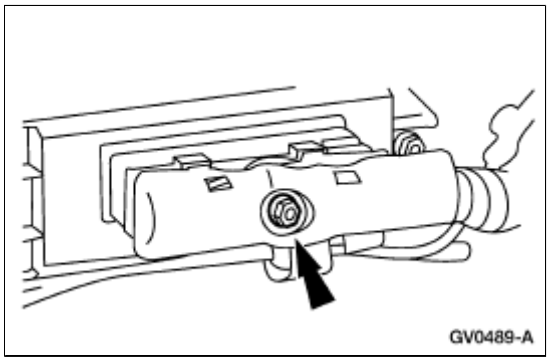
Removal

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

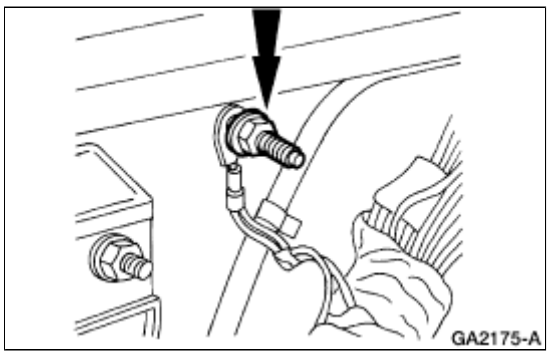
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the hood.
3. Discharge and recover the A/C system. For additional information, refer to Section 412-00 .
4. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
5. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
6. Disconnect the accelerator cable from the engine. For additional information, refer to Section 310-02 .
7. Disconnect the speed control cable from the engine. For additional information, refer to Section 310-03 .
8. Remove the radiator, the fan blade, and the fan shroud. For additional information, refer to Section 303-03 .
9. Disconnect the engine electrical connector.



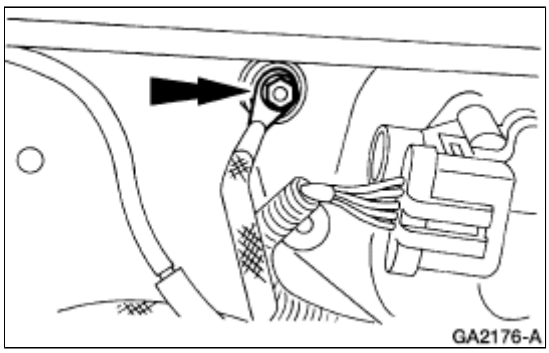
10. Disconnect the powertrain control module (PCM) electrical connector.



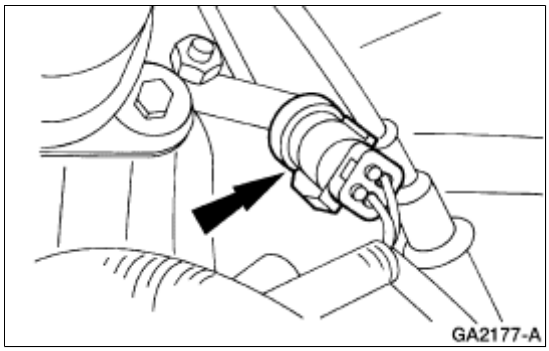
11. Disconnect the PCM electrical ground wire.



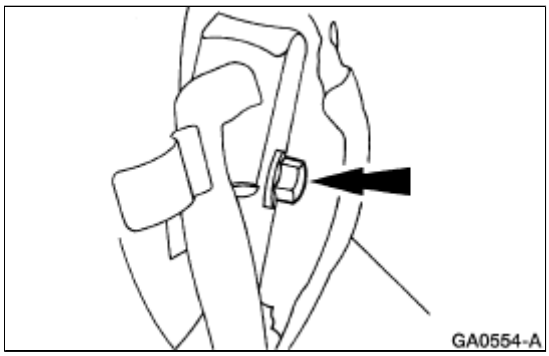
12. Disconnect the engine ground wire.



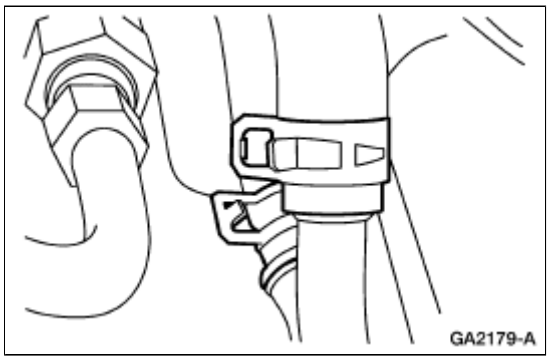
13. Disconnect the A/C high pressure switch electrical connector.



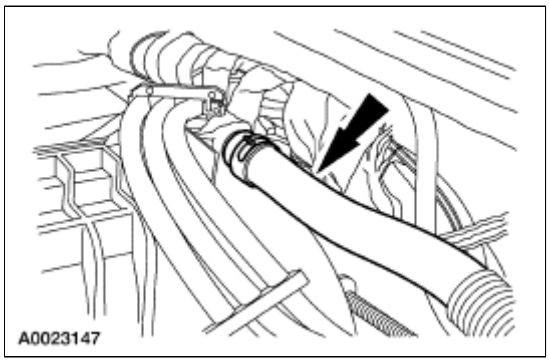
14. Remove the bolt and position the A/C lines aside.



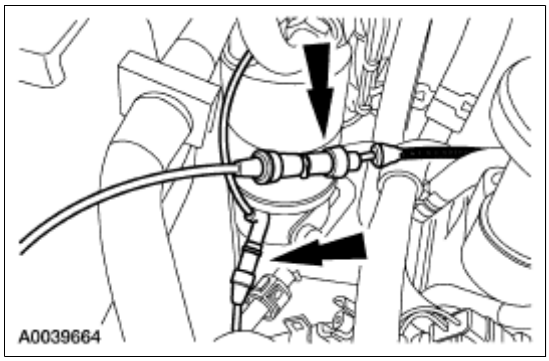
15. Disconnect the two heater water hoses.



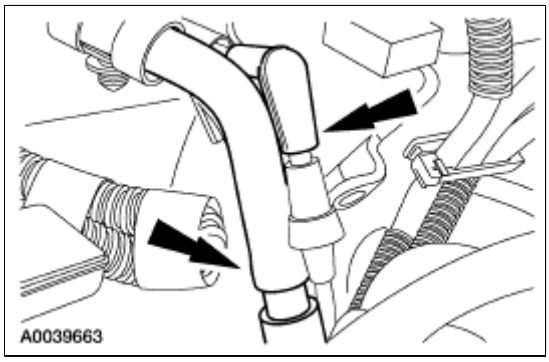
16. Disconnect the vacuum hose.



17. Disconnect the vacuum hoses.



18. Disconnect the vacuum and evaporative emissions (EVAP) hoses.

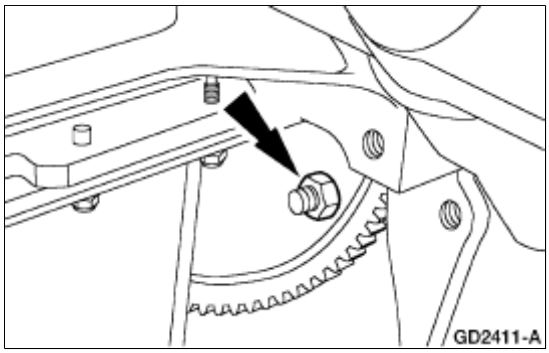


19. Disconnect the fuel line. For additional information, refer to Section 310-00 .

20. Raise and support the vehicle. For additional information, refer to Section 100-02 .

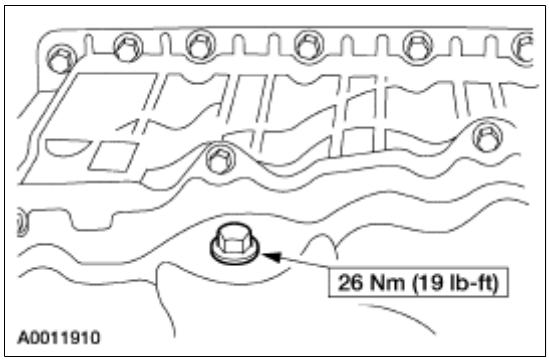
21. Remove the starter motor. For additional information, refer to Section 303-06 .

22. Remove the four nuts.

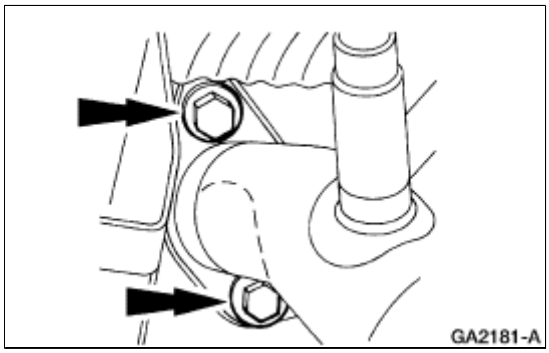


23. Drain the engine oil.

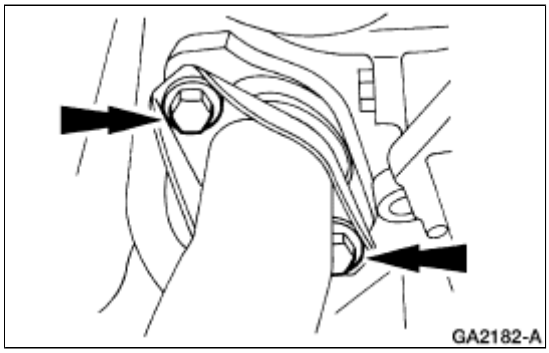
24. Install the oil drain plug.



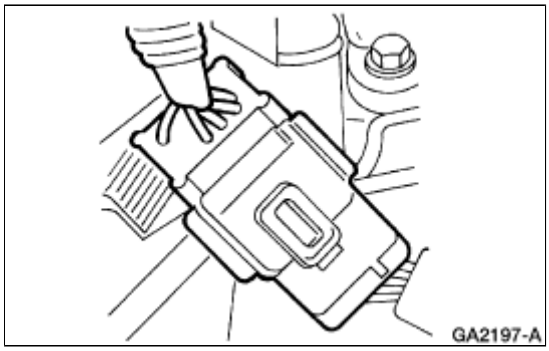
25. Remove the bolts.



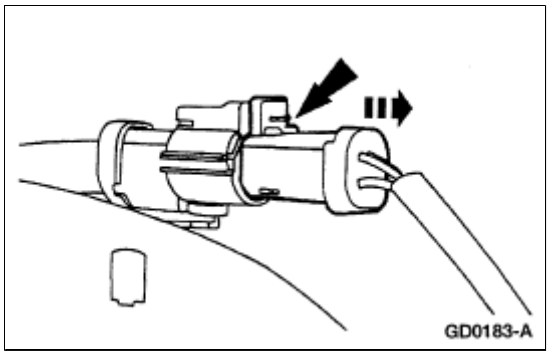
26. Remove the bolts.



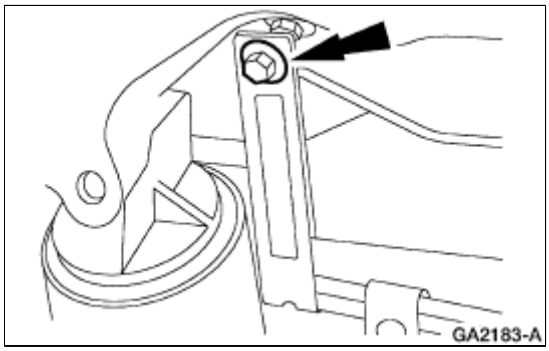
27. Disconnect the transmission electrical harness connector.



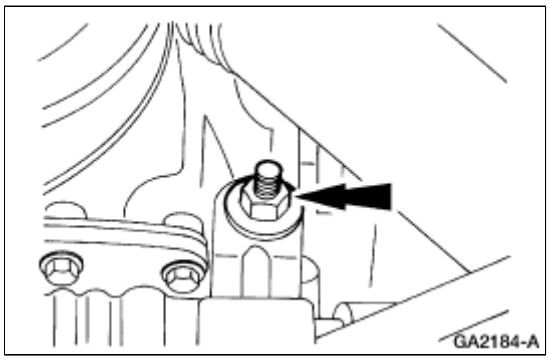
28. Disconnect the RH and LH heated oxygen (HO2S) sensor electrical connectors.



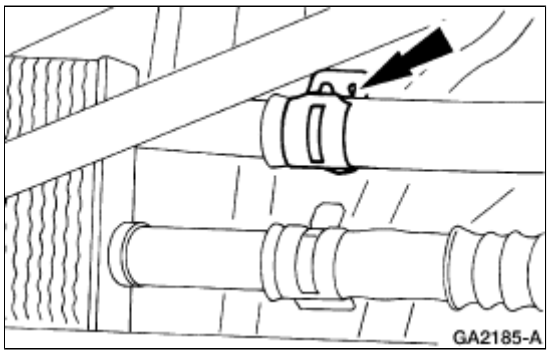
29. Remove the bolt and position the transmission cooling line bracket aside.



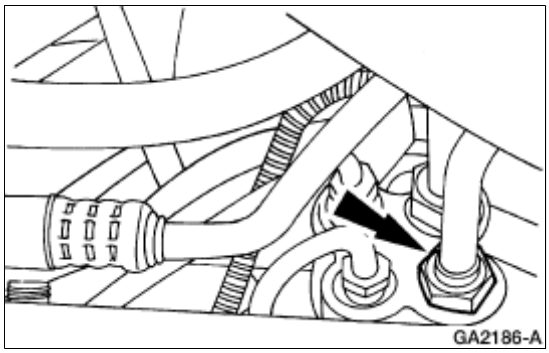
30. Remove the A/C line bracket nut and position it aside.



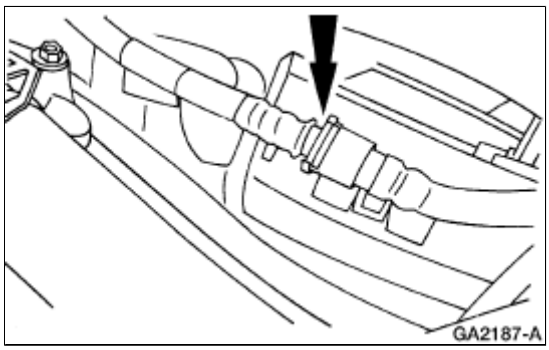
31. Disconnect the power steering return hose.



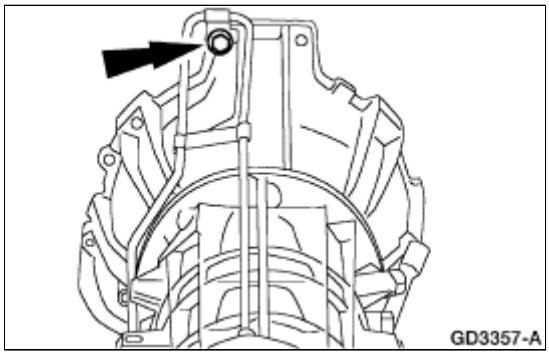
32. Disconnect the power steering pressure hose.



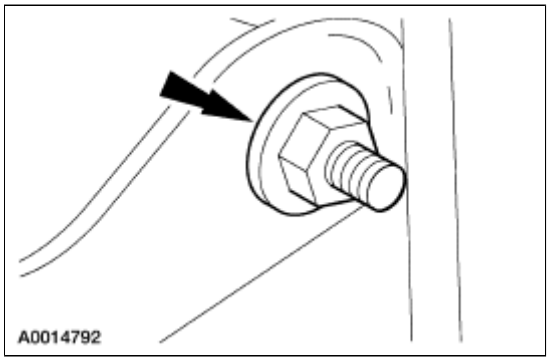
33. Disconnect the vapor management valve (VMV) hose connector.



34. Remove the eight bolts.

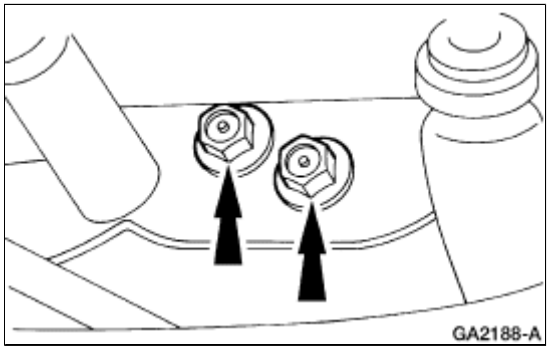


35. Remove the LH and the RH engine support insulator nuts.

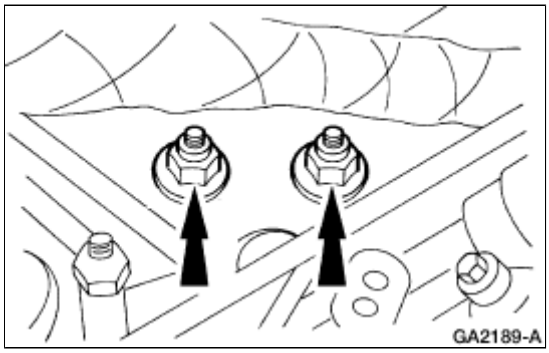


36. Lower the vehicle.

37. Remove the RH engine insulator nuts.



38. Remove the LH engine insulator nuts.



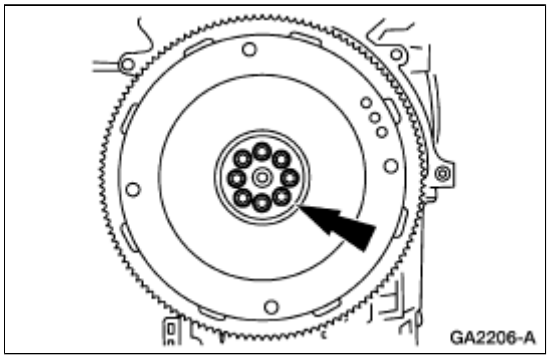
39. **NOTE:** The lifting eyes should be installed on the exhaust manifold studs for number three and number four cylinders.

    Install the lifting eyes.

40. Install the spreader bar to the lifting eyes.

41. Attach a floor crane to the spreader bar and remove the engine.

42. Remove the flywheel.

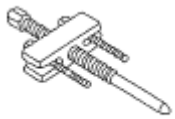
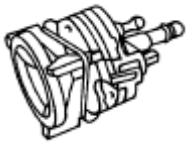


43. Remove the spacer plate.

44. Install the engine on a suitable engine stand.

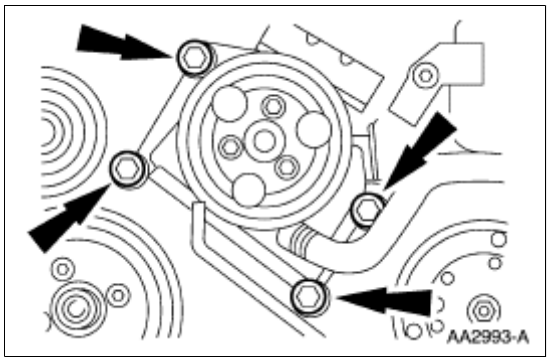
Engine

Special Tool(s)

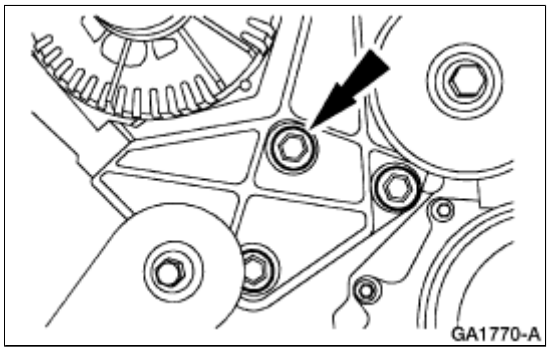
 ST1829-A	Crankshaft Damper Remover 303-101 (T74P-6316-A)
 ST1276-A	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)
ST1330-A	Valve Spring Compressor 303-581 (T97T-6565-A)
ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666-A)
ST2191-A	Rear Jackshaft Socket 303-634

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

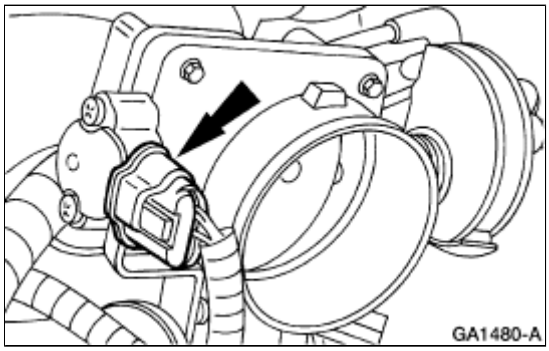
1. Rotate the drive belt tensioner counterclockwise and remove the drive belt.
2. Remove the bolts and position the accessory bracket aside.



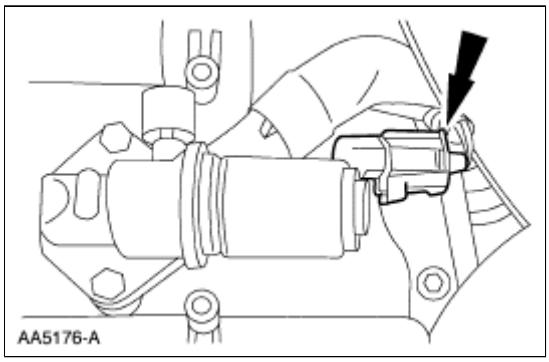
3. Remove the generator mounting bracket.



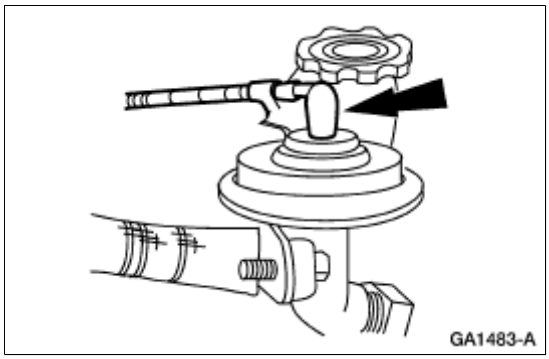
4. Disconnect the throttle position (TP) sensor electrical connector.



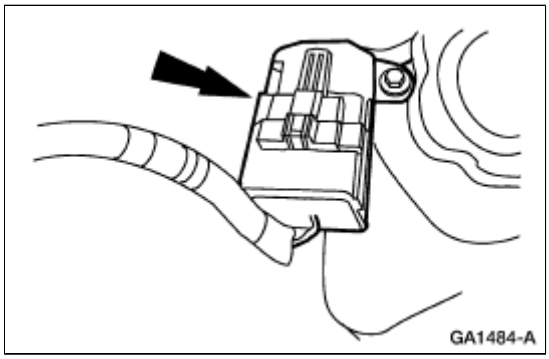
5. Disconnect the idle air control (IAC) valve electrical connector.



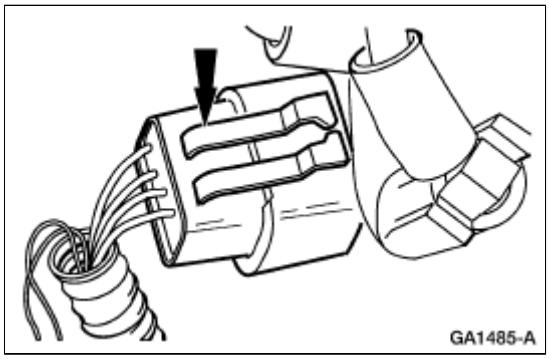
6. Disconnect the EGR valve vacuum hose.



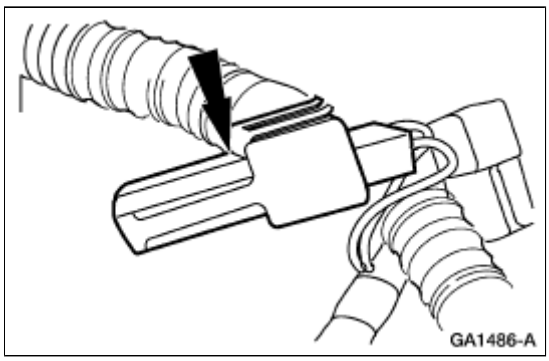
7. Disconnect the camshaft position (CMP) sensor electrical connector.



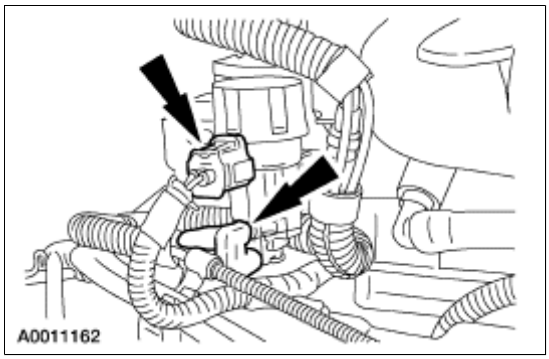
8. Disconnect the ignition coil electrical connector.



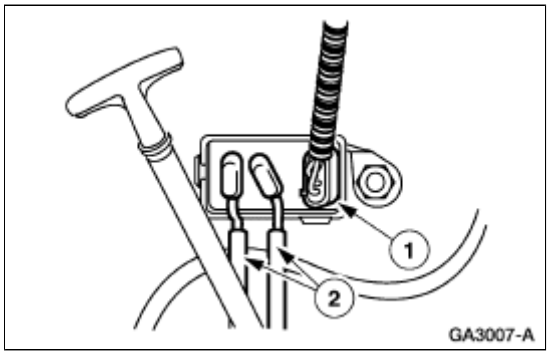
9. Disconnect the radio ignition interference capacitor electrical connector.



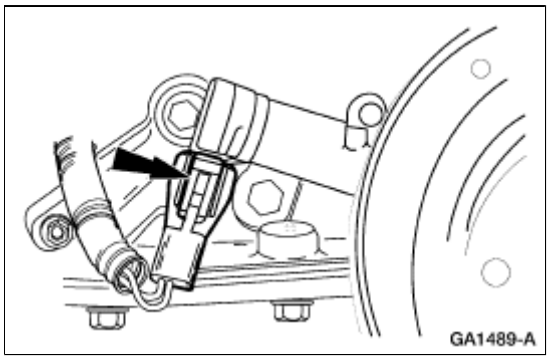
10. Disconnect the exhaust gas regulator (EGR) vacuum regulator.



11. Disconnect the differential pressure feedback EGR transducer.
    1. Disconnect the electrical connector.
    2. Disconnect the vacuum hoses.

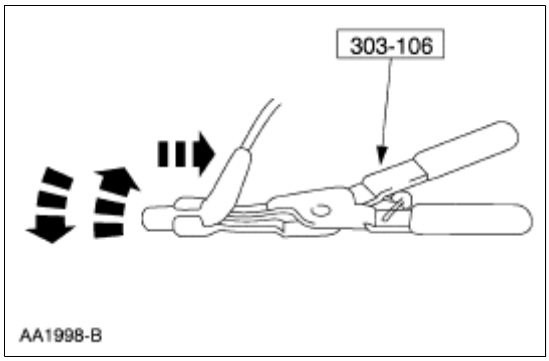


12. Disconnect the crankshaft position (CKP) sensor electrical connector.

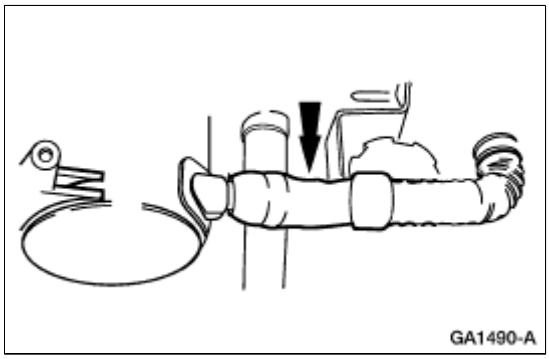


13. **CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

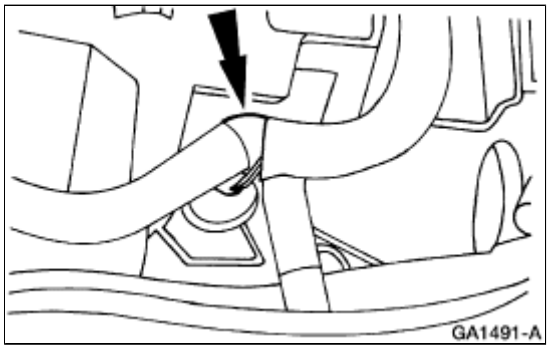
    Using the special tool, remove the spark plug wires from the spark plug.



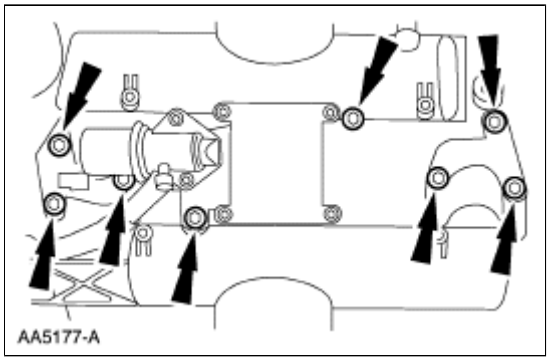
14. Disconnect the RH upper intake manifold vacuum hose.



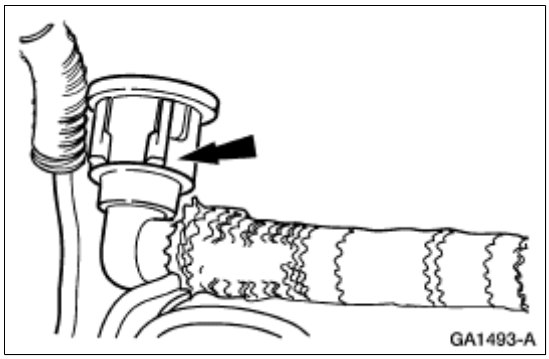
15. Disconnect the crankcase ventilation hose.



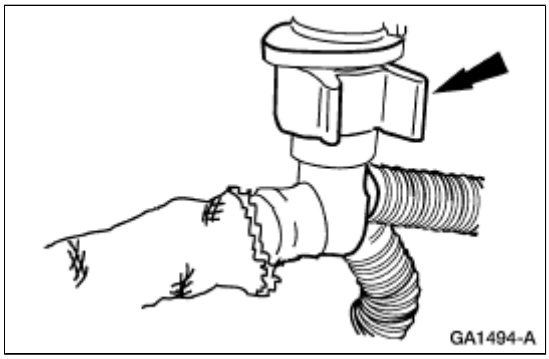
16. Remove the upper intake manifold.



17. Disconnect the RH vapor management valve (VMV) hose.

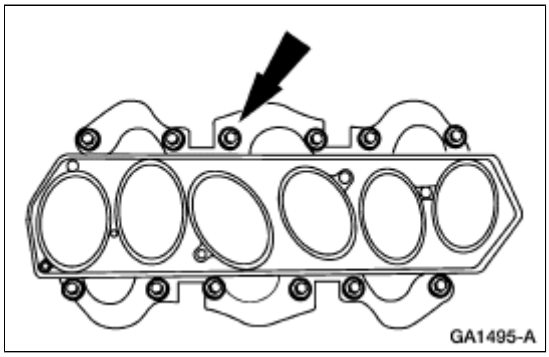


18. Disconnect the LH VMV hose.

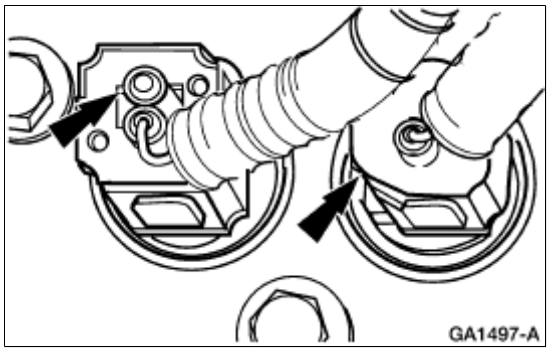


19. Remove the upper intake manifold.

20. Remove the lower intake manifold.

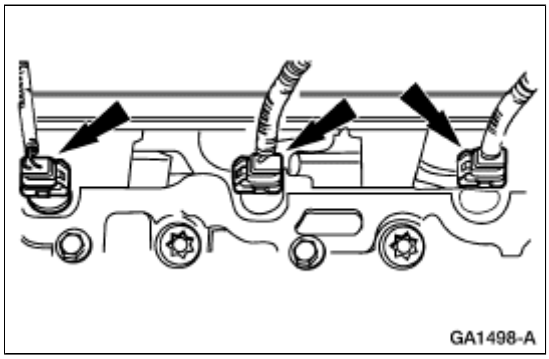


21. Disconnect the water temperature indicator sender unit and the engine coolant temperature (ECT) sensor electrical connectors.

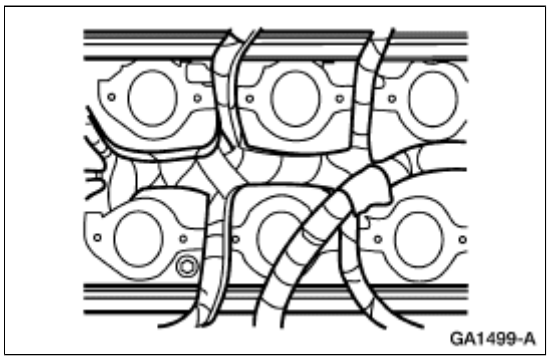


22. **NOTE:** The LH side is shown, the RH side is similar.

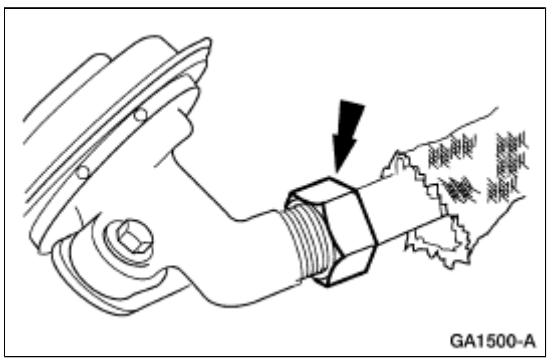
    Disconnect the six fuel injector electrical connectors.



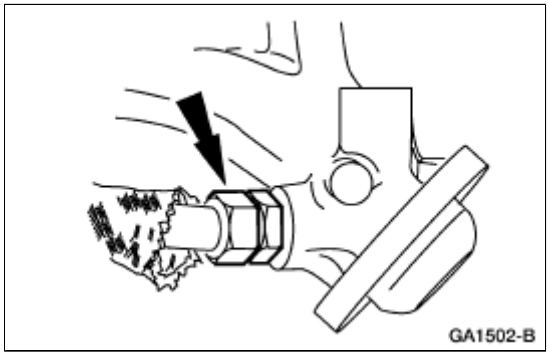
23. Remove the fuel charging wiring.



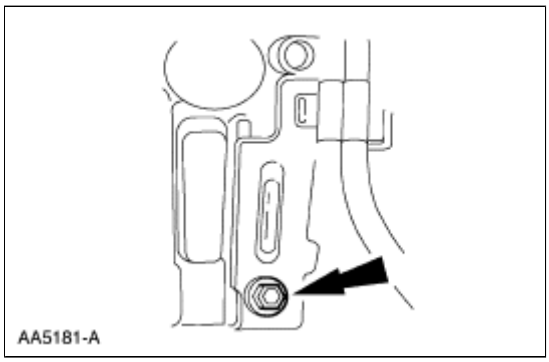
24. Disconnect the EGR valve to exhaust manifold tube from the EGR valve.



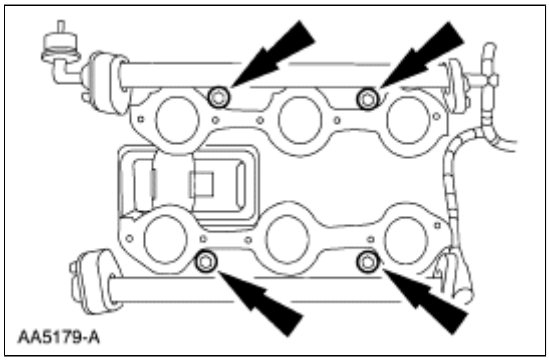
25. Disconnect the EGR valve to exhaust manifold tube from the exhaust manifold.



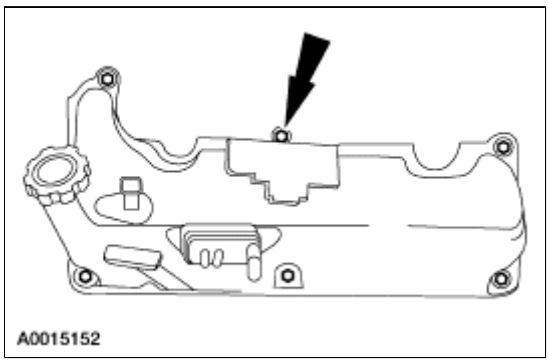
26. Remove the bolt and position the lower fuel line bracket aside.



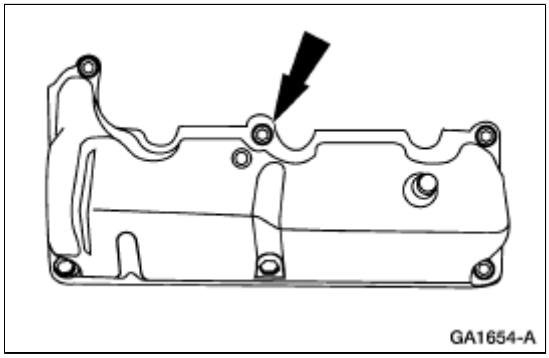
27. Remove the fuel injection supply manifold.



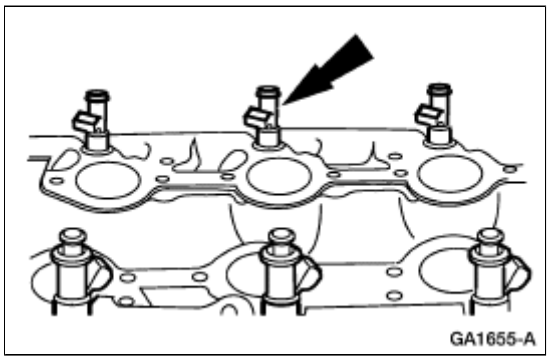
28. Remove the LH valve cover and the gasket.



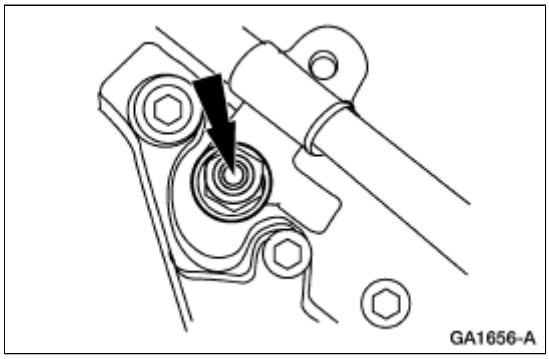
29. Remove the RH valve cover and the gasket.



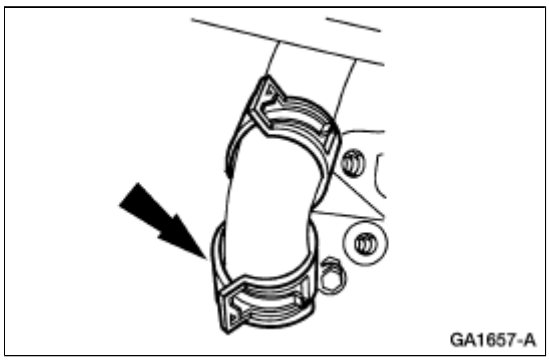
30. Remove the fuel injectors.



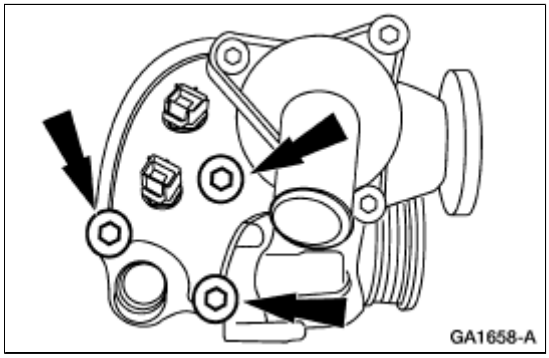
31. Remove the VMV hose bracket and position aside.



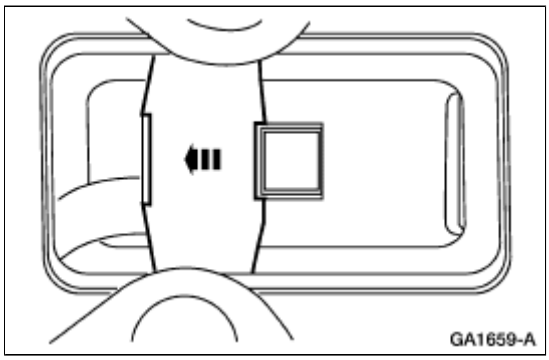
32. Disconnect the water bypass hose.



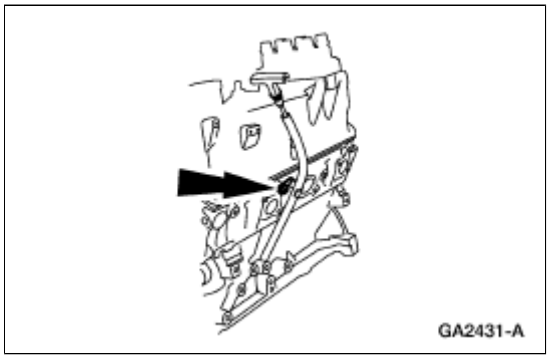
33. Remove the thermostat housing.



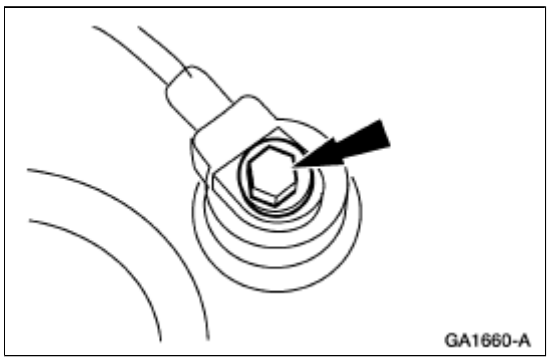
34. Remove the crankcase vent separator spring steel clip and remove the separator.



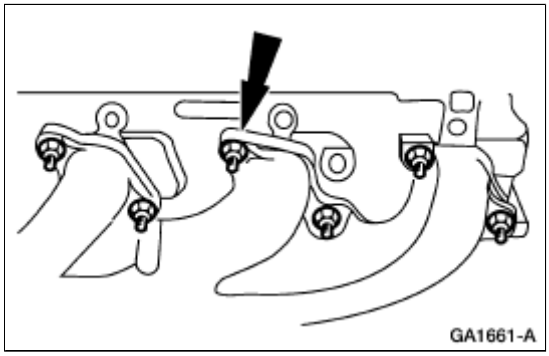
35. Remove the oil level indicator tube.



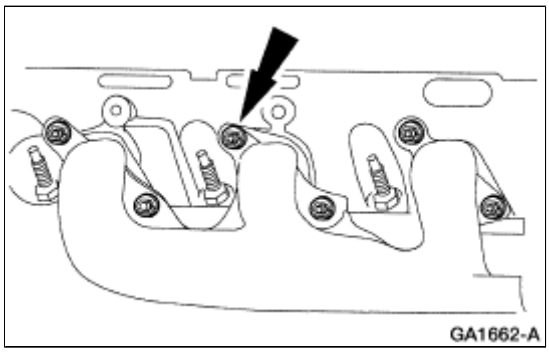
36. Remove the knock sensor.



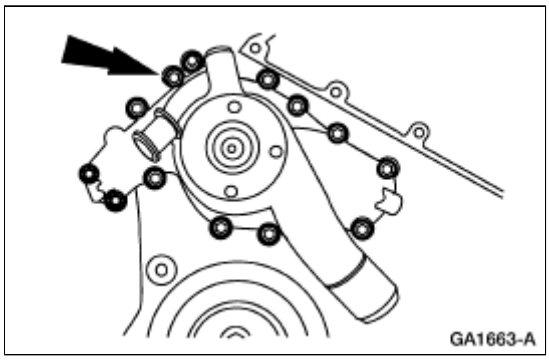
37. Remove the RH exhaust manifold and the gasket.



38. Remove the LH exhaust manifold and the gasket.

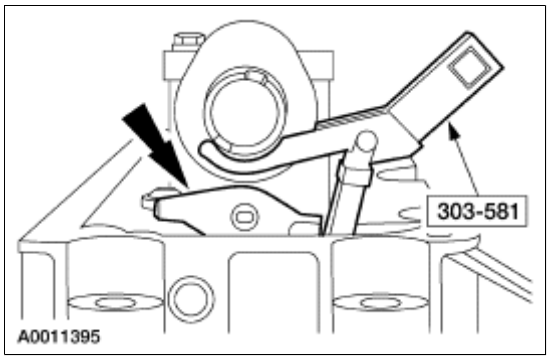


39. Remove the water pump.

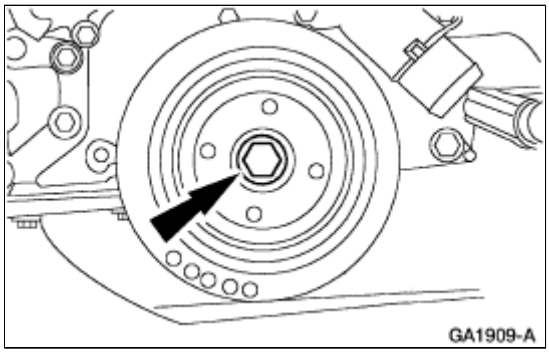


40. **NOTE:** Mark each camshaft roller follower to make sure of its original position during reassembly.

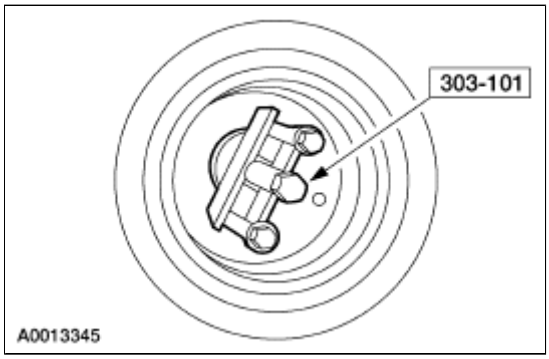
    Using the special tool, remove the camshaft roller followers.



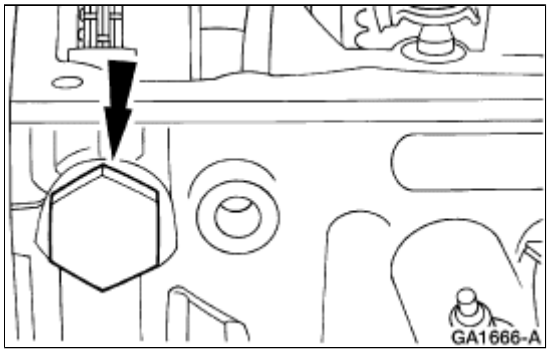
41. Remove the bolt.



42. Using the special tool, remove the crankshaft pulley.

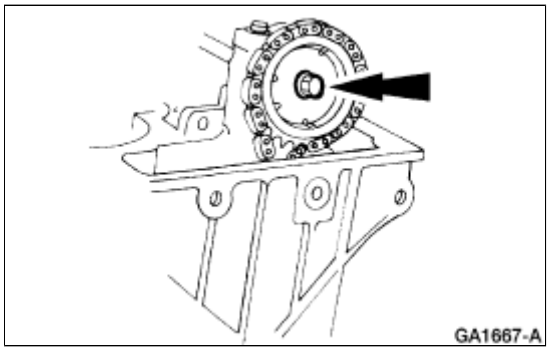


43. Remove the RH hydraulic chain tensioner.

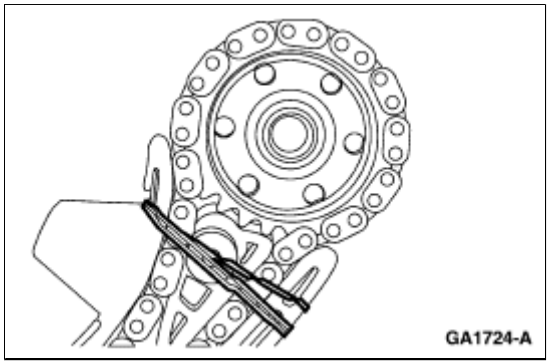


44. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

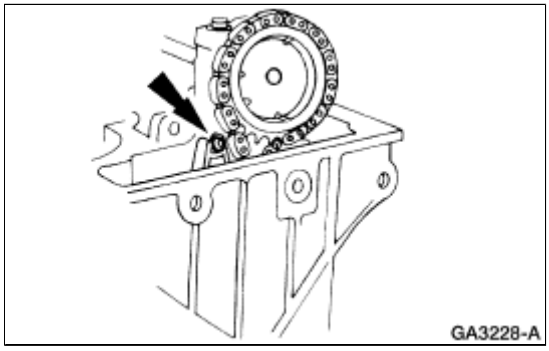
    Remove the RH camshaft sprocket bolt.



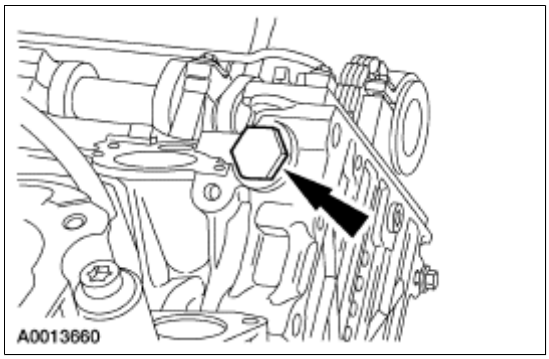
45. Remove the camshaft sprocket from the camshaft and install a rubber band on the cassette to hold the chain and camshaft sprocket in place.



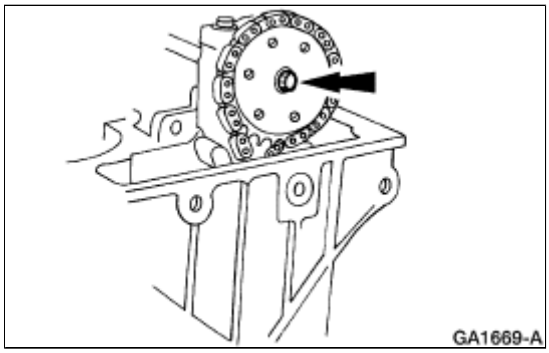
46. Remove the bolt.



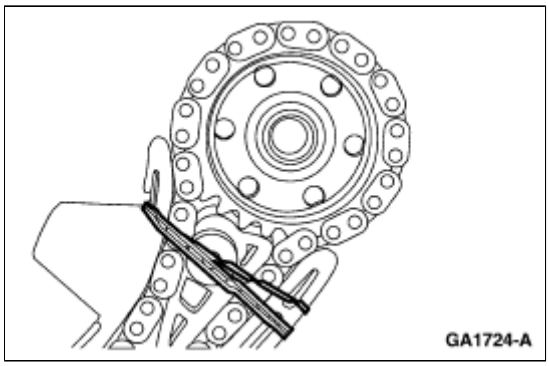
47. Remove the LH hydraulic chain tensioner.



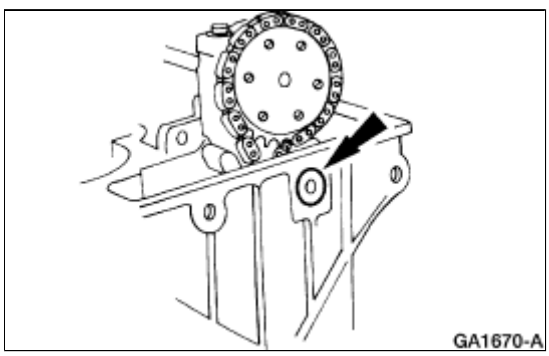
48. Remove the LH camshaft sprocket bolt.



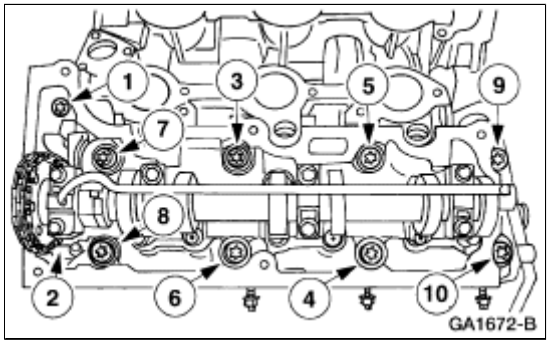
49. Remove the camshaft sprocket from the camshaft and install a rubber band on the cassette to hold the chain and camshaft sprocket in place.



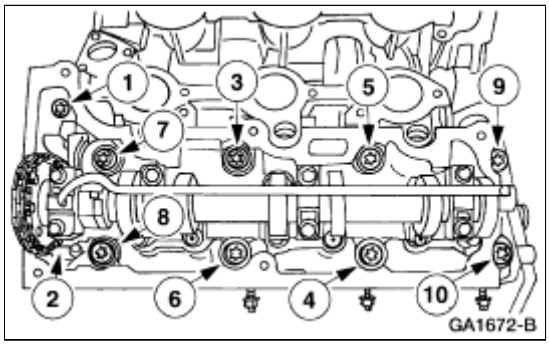
50. Remove the bolt.



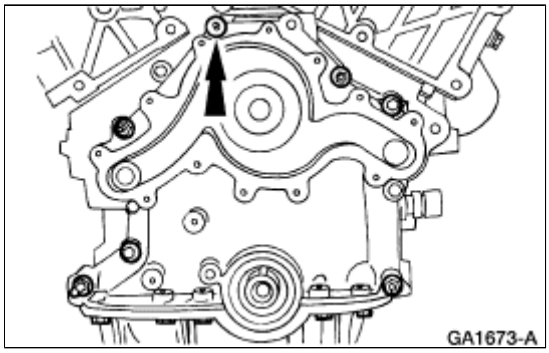
51. Remove the bolts in the sequence shown and remove the LH cylinder head.



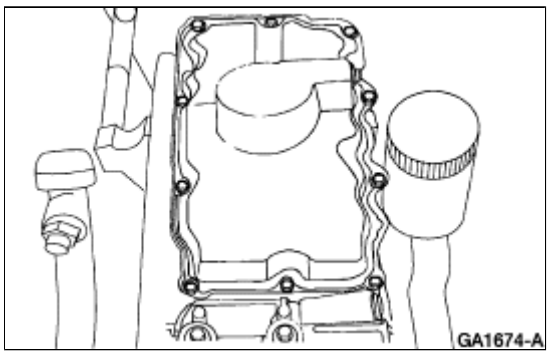
52. Remove the bolts in the sequence shown and remove the RH cylinder head.



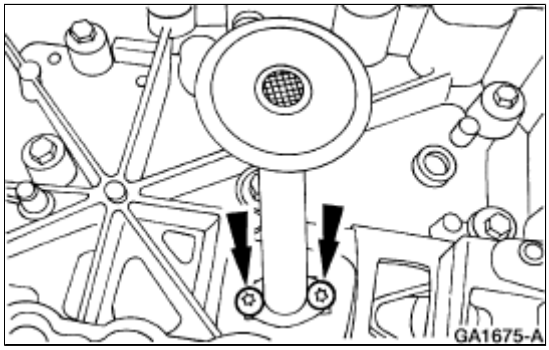
53. Remove the engine front cover.



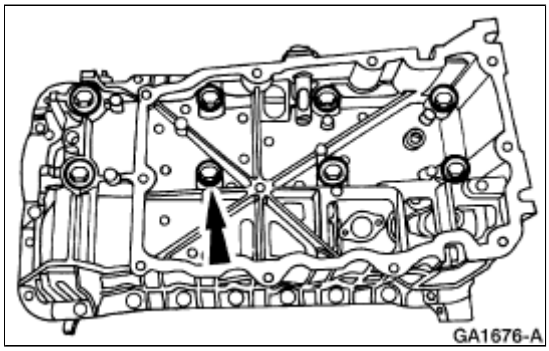
54. Remove the oil pan.



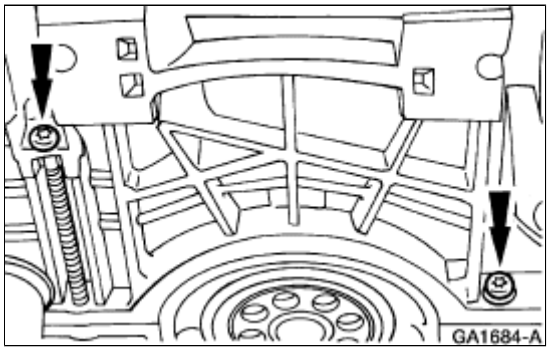
55. Remove the oil pump screen and pickup tube and the gasket.



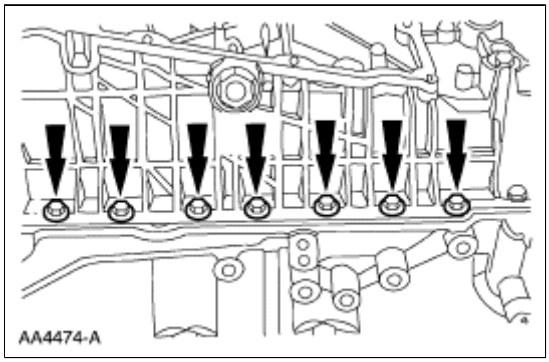
56. Remove the bolts.



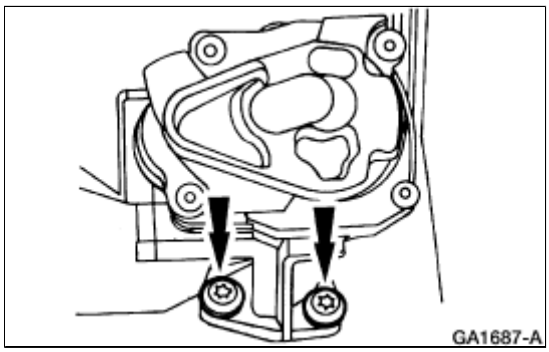
57. Remove the ladder frame bolts.



58. Remove the 15 bolts and the two nuts. Remove the ladder frame.

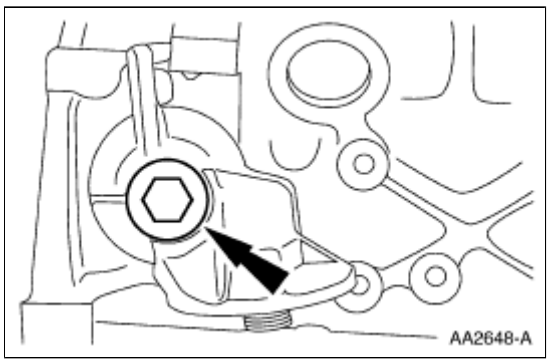


59. Remove the oil pump.

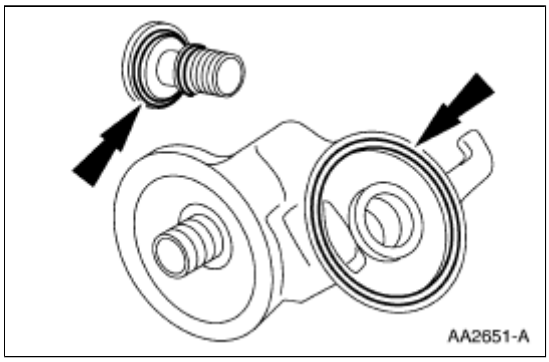


60. Remove the oil filter.

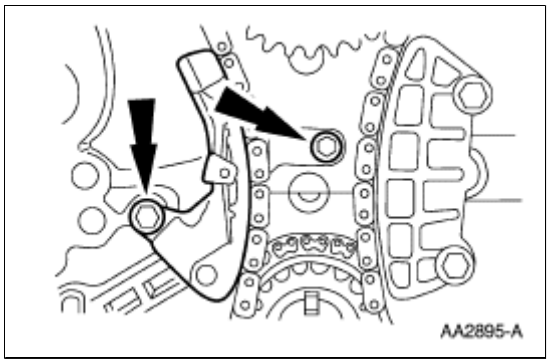
61. Remove the oil filter adapter.



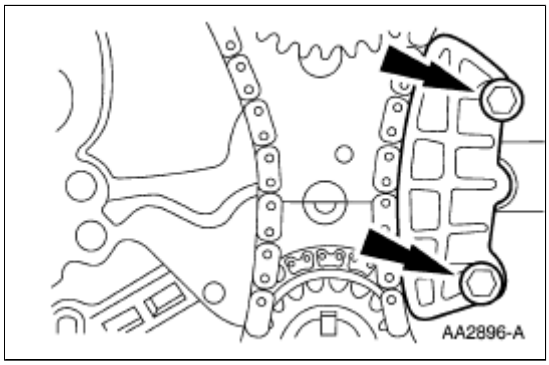
62. Inspect and install new O-ring seals if necessary.



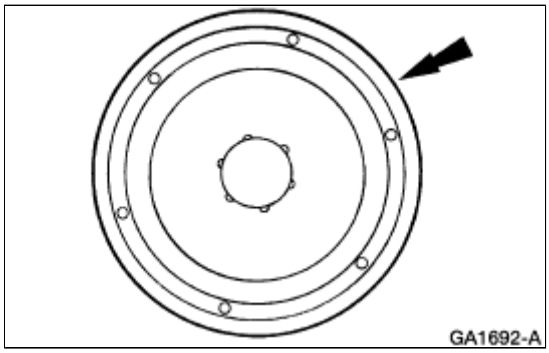
63. Remove the chain tensioner.



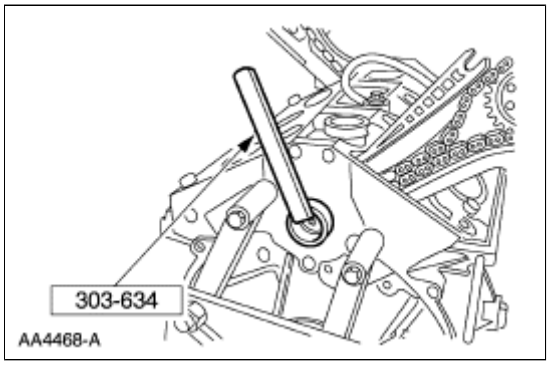
64. Remove the chain guide.



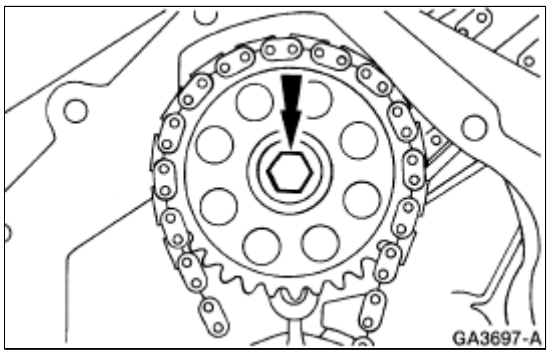
65. Remove the rear jackshaft plug.



66. Install the special tool at the rear of the jackshaft.



67. Loosen the front sprocket retaining bolt.

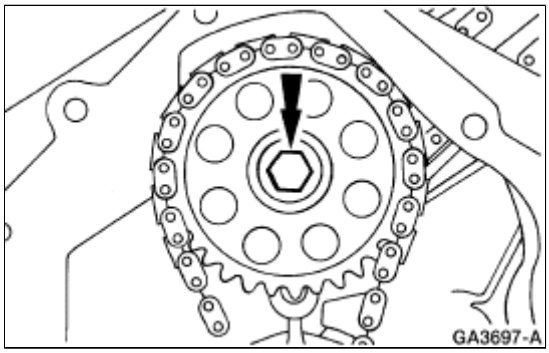


68. With special tool still in place, loosen the rear sprocket retaining bolt.

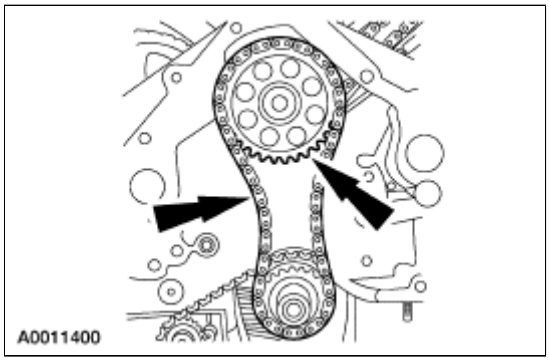
69. Remove the special tool.

70. **NOTE:** It may be required to hold the oil pump intermediate shaft, using an E-12 external TORX® socket, in order to remove the bolts if bolts do not turn out easily at this time.

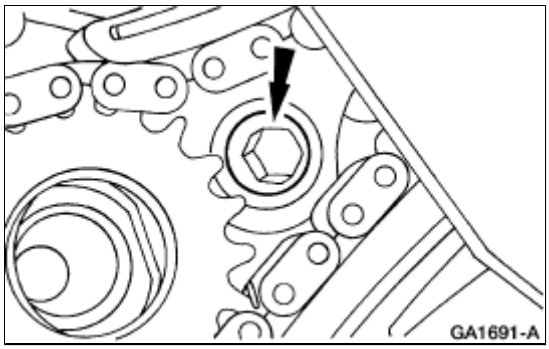
    Remove the bolt.



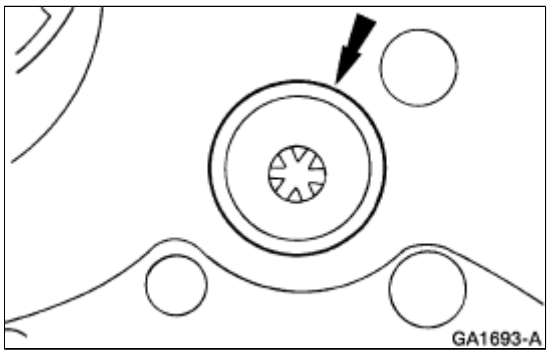
71. Remove the jackshaft sprocket and chain.



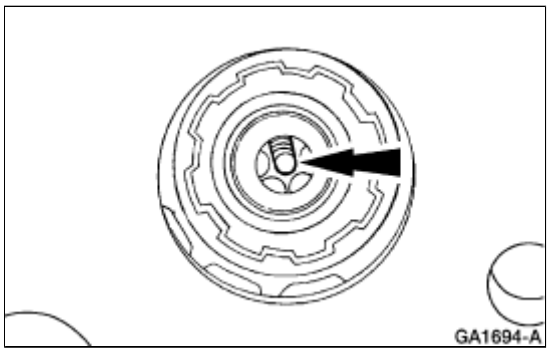
72. Remove the bolt and the front cassette.



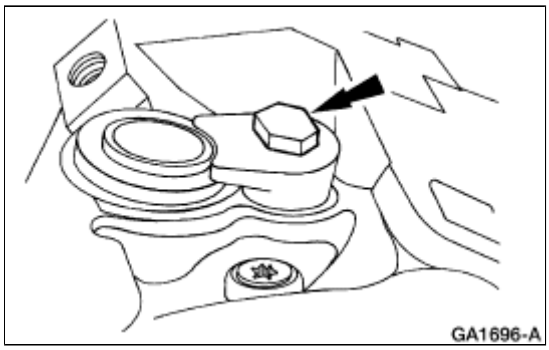
73. Remove the bolt and spacer.



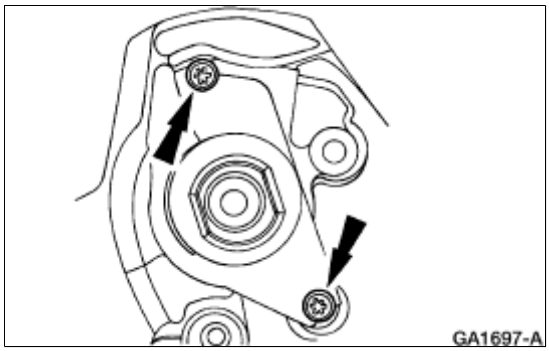
74. Remove the bolt and remove the cassette.



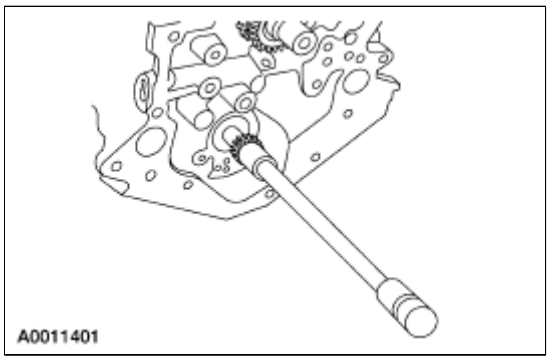
75. Remove the oil pump drive.



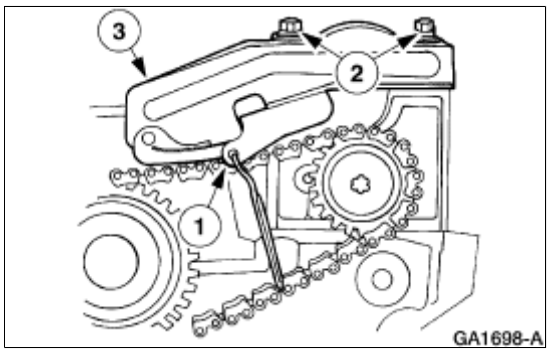
76. Remove the jackshaft thrust plate.



77. Remove the jackshaft.

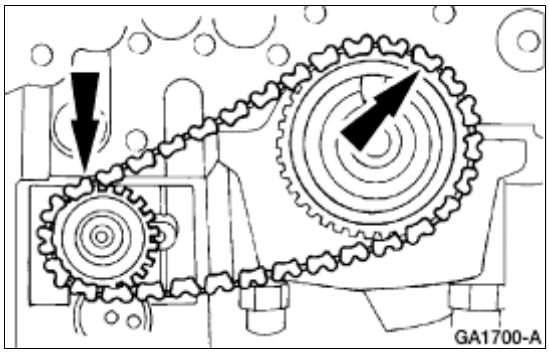


78. On 4 x 4 vehicles, remove the balance shaft tensioner.
    1. Install a pin in the balance shaft tensioner.
    2. Remove the bolts.
    3. Remove the balance shaft tensioner.

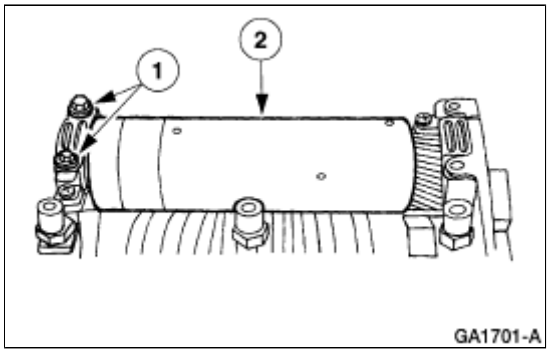


79. **NOTE:** DO NOT remove the balance shaft sprocket bolt.

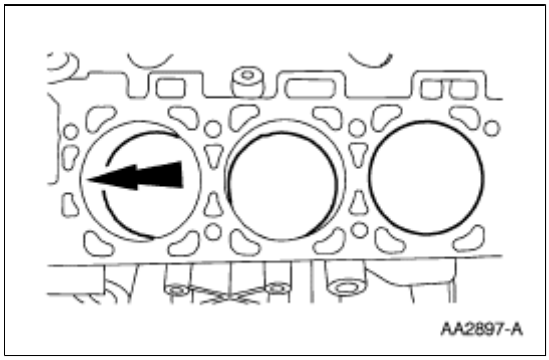
    On 4 x 4 vehicles, remove the balance shaft chain and crankshaft sprocket.



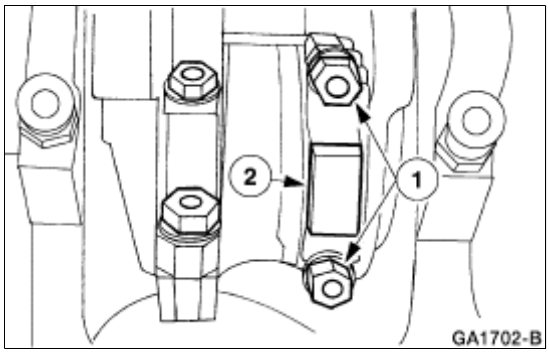
80. On 4 x 4 vehicles, remove the balance shaft.
    1. Remove the bolts.
    2. Remove the balance shaft.



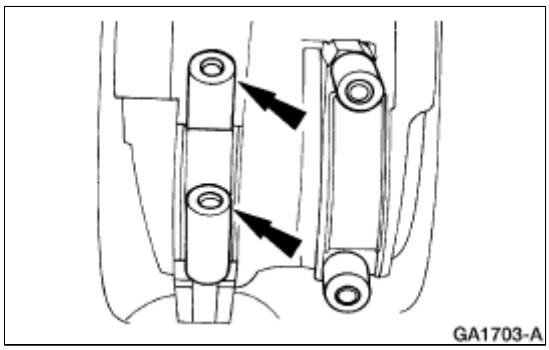
81. Using the cylinder ridge reamer, remove the ridge and carbon deposits from the top of each cylinder.



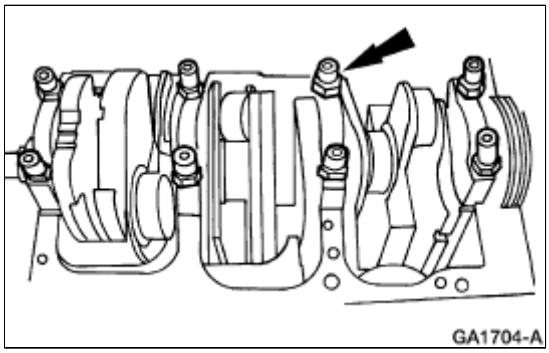
82. Remove the piston and connecting rod assemblies.
    1. Remove the connecting rod nuts.
    2. Remove the connecting rod cap.



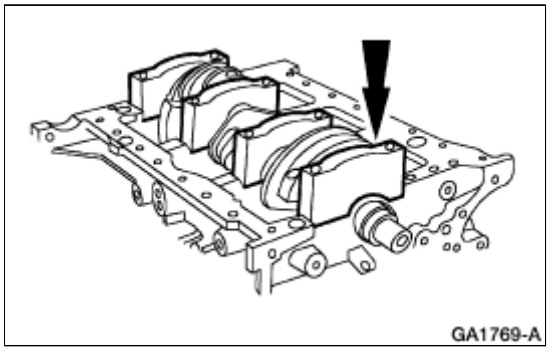
83. Install rubber hose pieces on the bolts to protect the crankshaft and remove the pistons.



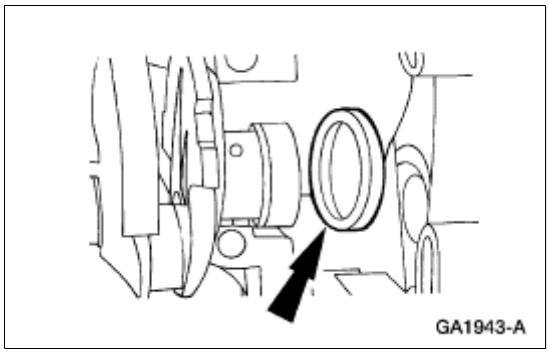
84. Remove the bolts.



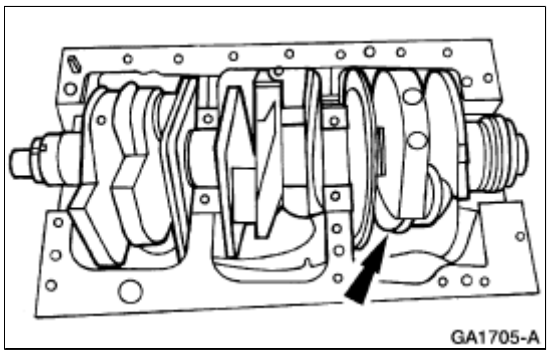
85. Remove the crankshaft main bearing caps.



86. Remove the crankshaft rear oil seal from the crankshaft.



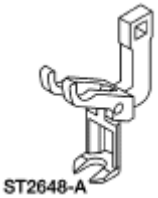
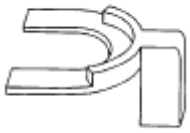
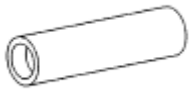
87. Remove the crankshaft.



88. Remove the crankshaft main bearings and the thrust bearing.

Cylinder Head

Special Tool(s)

 ST2648-A	Compressor, Valve Spring 303-567 (T97P-6565-A)
 ST1331-A	Spacer, Valve Spring Compressor 303-382 (T91P-6565-AH)
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)

Material

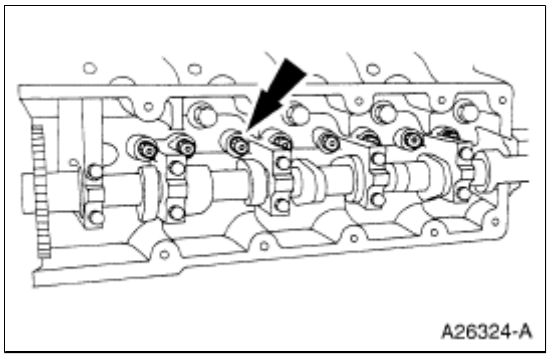
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Disassembly

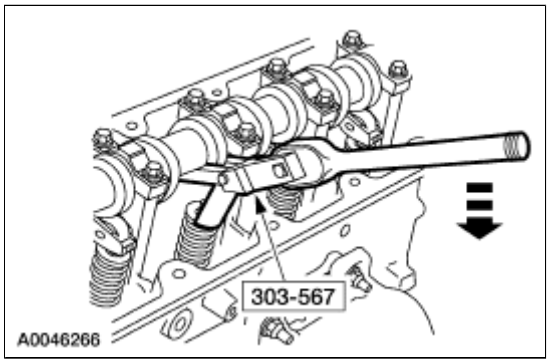
1. **CAUTION: Place the cylinder head on a cardboard or wood surface to prevent damage to the joint face.**

   NOTE: The hydraulic lash adjusters must be installed in their original locations. Record hydraulic lash adjuster locations.

   Remove the hydraulic lash adjusters.



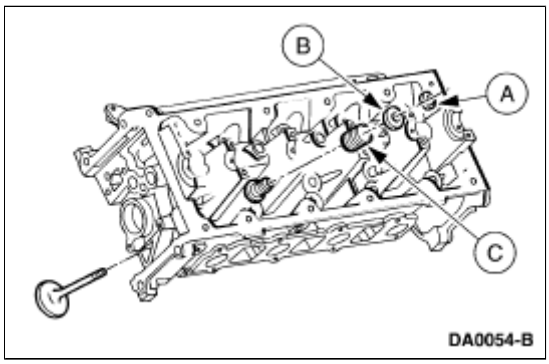
2. Use the special tool to compress the valve springs.



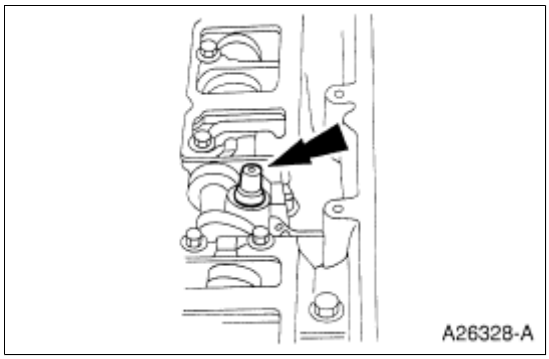
3. **CAUTION: Keep the valves and valve spring retainer keys (6518) in order so they can be installed in the same positions.**

   NOTE: Shown without camshaft for clarity.

   Remove the (A) valve spring retainer keys, the (B) valve spring retainers (6514), the (C) valve springs, and the valves.

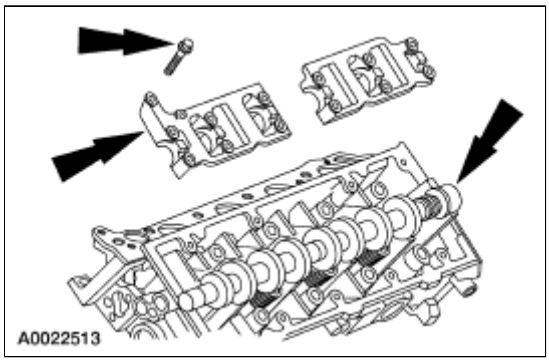


4. Remove the valve stem seals (6571).



5. **NOTE:** The camshaft bearing caps must be installed in their original location. Record camshaft bearing cap location.

   Remove the bolts, the bearing caps and the camshaft.

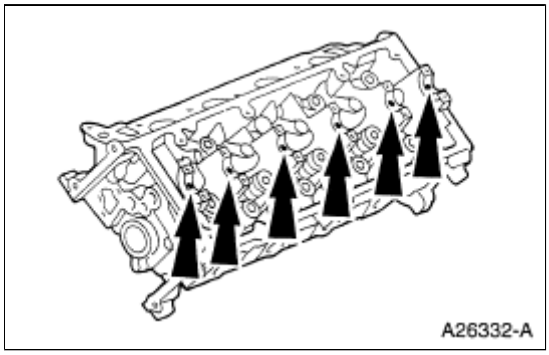


Assembly

1. **CAUTION: Do not use metal scrapers or other tools to clean the cylinder head or damage to the head can occur.**

   Use a plastic scraper and metal surface cleaner to clean the cylinder head.

2. Lubricate the camshaft journals with clean engine oil.



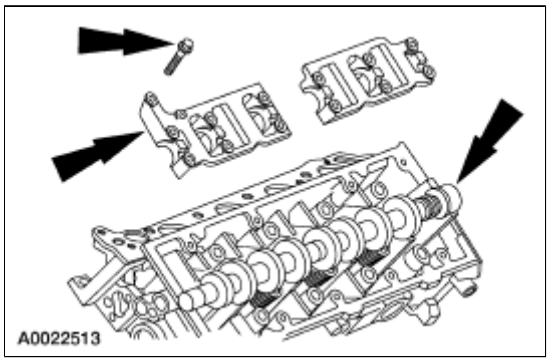
3. Lubricate the camshaft bearing caps with clean engine oil.

4. **CAUTION: Make sure the camshaft sprocket keyway is up and 90 degrees from the valve**

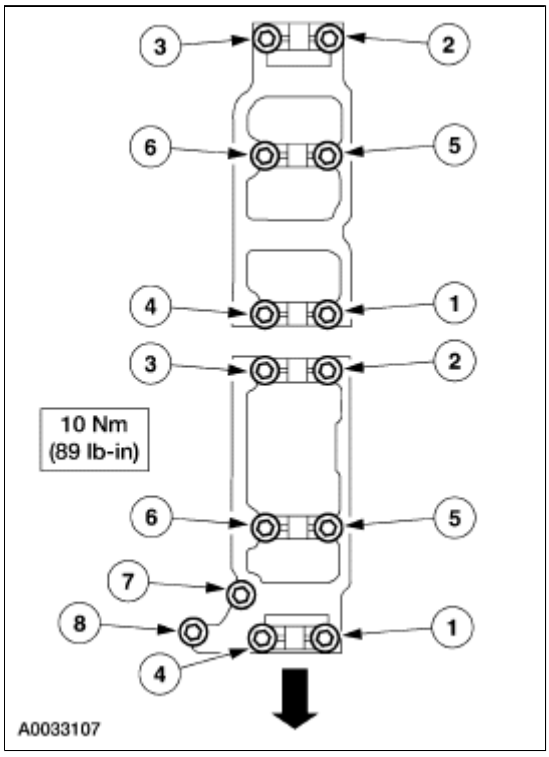
cover mounting surface.

Install the camshaft and the camshaft bearing caps in their original locations.

- Install the bolts loosely.

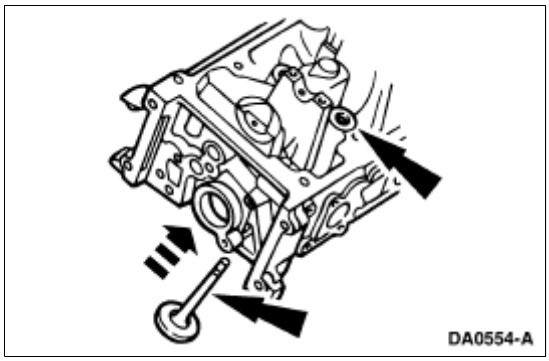


5. Tighten the bolts in the sequence shown.



6. **NOTE:** Lubricate the valve stems with clean engine oil.

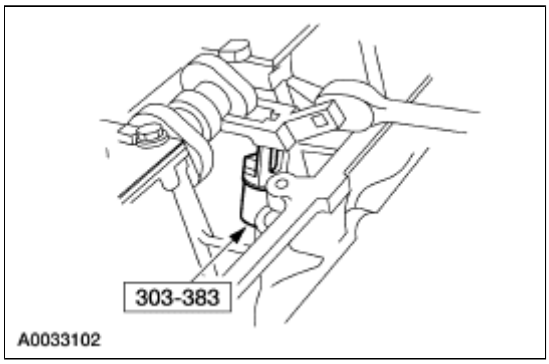
   Install the valves in the valve guides located in the cylinder head.



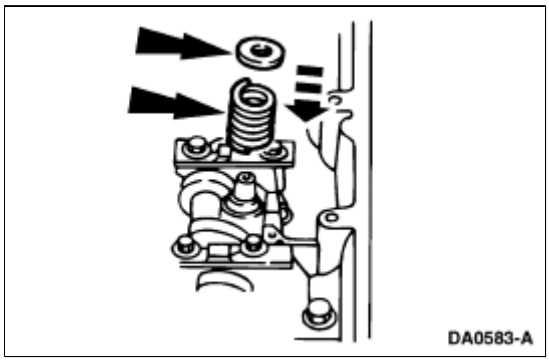
7. **NOTE:** The valve stem seal must be bottomed on the valve seat.

   NOTE: Make sure that the garter spring is present in the valve stem seal.

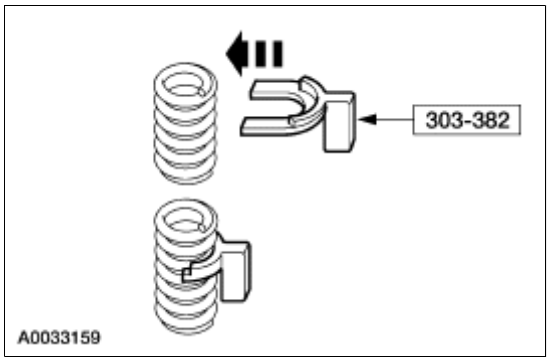
   Use the special tool to install the valve stem seals.



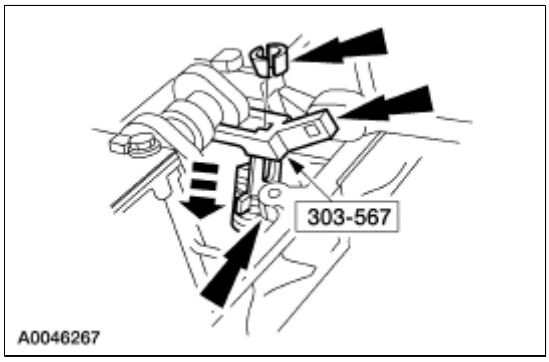
8. Install the valve springs and the valve spring retainers onto the valves.



9. Install the special tool between the valve spring coils to prevent valve stem seal damage.

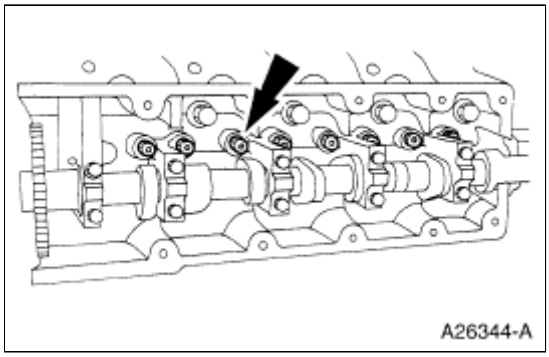


10. Use the special tool to compress the valve springs. Install the valve spring retainer keys.

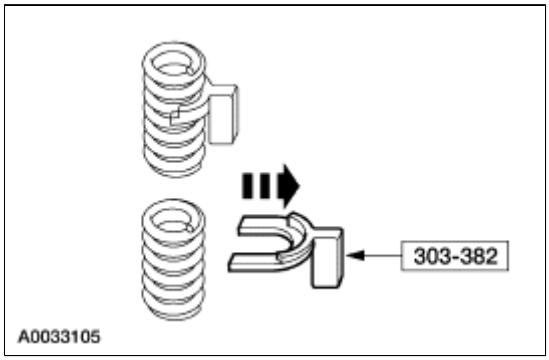


11. **NOTE:** Lubricate the hydraulic lash adjusters with clean engine oil.

    Install the hydraulic lash adjusters in their original location.



12. Remove the special tool.



Piston

Special Tool(s)

ST1336-A	Pin Remover/Replacer 303-S024 (T68P-6135-A)

Disassembly

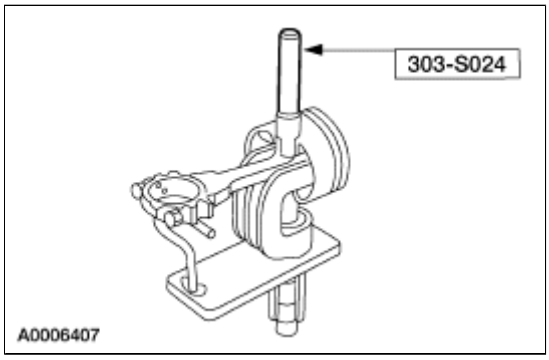
1. **NOTE:** The connecting rod bolts and nuts cannot be reused.

   NOTE: Mark the position of the parts, so they can be installed in their original position.

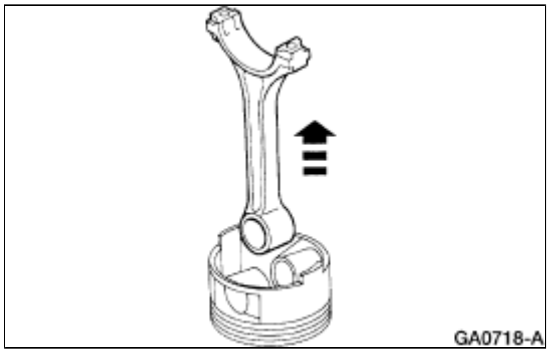
   Remove the connecting rod bearings from the connecting rod and caps.

2. Remove the piston rings. For additional information, refer to Section 303-00 .

3. Using the special tool, press the piston pin out of the connecting rod and piston assembly.



4. Remove the connecting rod from the piston.



5. Clean and inspect the connecting rod and piston. For additional information, refer to Section 303-00 .

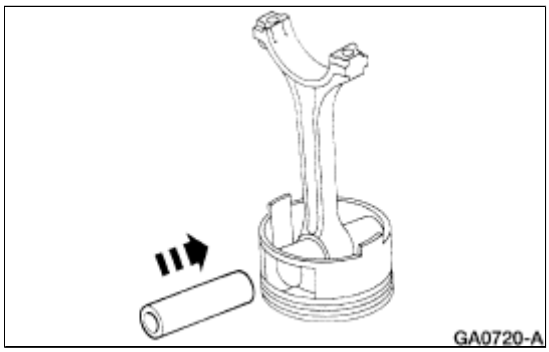
Assembly

1. **NOTE:** Apply a light coat of Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G to all parts. Install the piston in the connecting rod with the cylinder number side of the rod and the indentation notch in the piston on the same side.

   Install the large chamfered side of the connecting rod bearing bore facing toward the engine front on the RH bank connecting rod and facing toward the rear of the engine on LH bank connecting rod.

2. **NOTE:** The oil hole in connecting rod must face the RH side of the cylinder block and the arrow on the piston must face the front of the engine block.

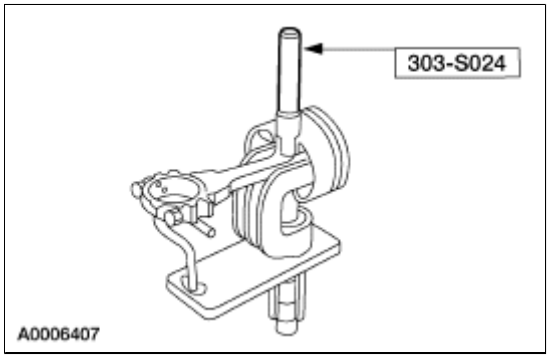
   Position the piston pin in the bore aligned with the connecting rod bore.



3. **NOTE:** If the piston pin is removed from the piston, a new piston and pin assembly must be used. Do not reuse the piston or piston pin.

   Gradually heat the pin bore side of the connecting rod to approximately 232°C-316°C (467°F-626°F) and immediately install the piston pin.

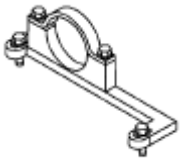
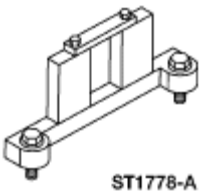
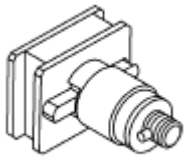
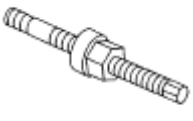
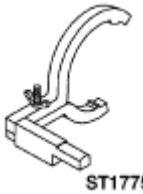
4. Using the special tool, press the piston pin into the piston and connecting rod assembly.

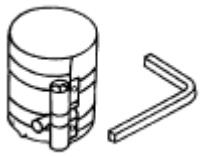


5. Install the piston rings. For additional information, refer to Section 303-00 .

Engine

Special Tool(s)

ST1774-A	Timing Chain Tensioner 303-571 (T97T-6K254-A)
 ST1777-A	Camshaft Gear Holding Tool 303-564 (T97T-6256-B)
ST1776-A	Camshaft Gear Holding Tool Adapter 303-578 (T97T-6256-A)
 ST1778-A	Camshaft Holding Tool 303-577 (T97T-6256-C)
 ST1779-A	Camshaft Holding Tool Adapter 303-576 (T97T-6256-D)
 ST1287-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)
 ST1775-A	Crankshaft Holding Tool 303-573 (T97T-6303-A)

	Piston Ring Compressor 303-D032 (D81L-6002-C)
 ST1330-A	Valve Spring Compressor 303–581 (T97T-6565-A)
 ST2191-A	Rear Jackshaft Socket 303-634

Material

Item	Specification
Metal Surface Cleaner F4AZ-219A536-RA	WSE-M5B392-A
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Motorcraft Silicone Brake Caliper Grese and Dielectric Compound XG-3	ESE-M1C171-A

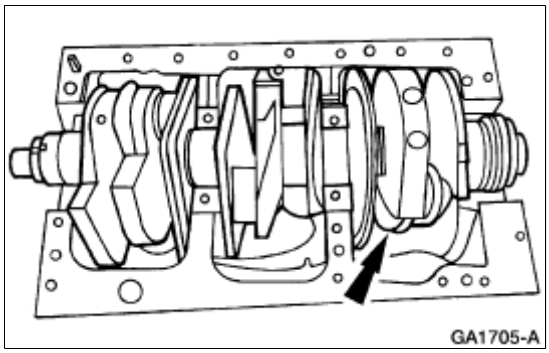
CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

NOTE: Before engine assembly, use metal surface cleaner and a suitable plastic or wooden scraper to clean the sealing surfaces. All sealing surfaces must be clean. Make sure coolant and oil passages are clear.

1. Install the crankshaft main bearings and the thrust bearing.
   - Lubricate the crankshaft main bearings with clean engine oil.

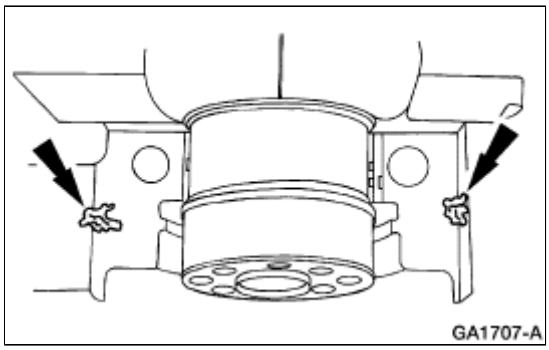
2. **NOTE:** The crankshaft main bearings are precision selective fit. Inspect the bearing clearance. For additional information, refer to Section 303-00 .

   Install the crankshaft.



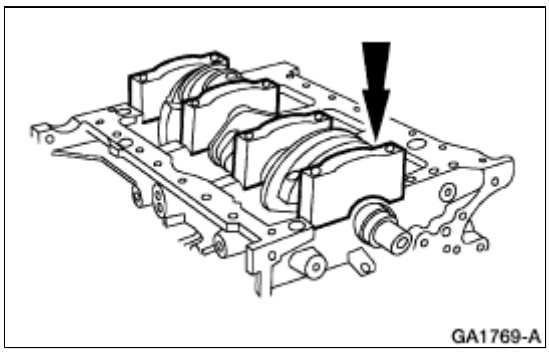
3. **NOTE:** The rear main bearing cap must be installed within four minutes after applying the silicone.

   Apply silicone gasket and sealant to the rear main bearing cap to cylinder block parting line.

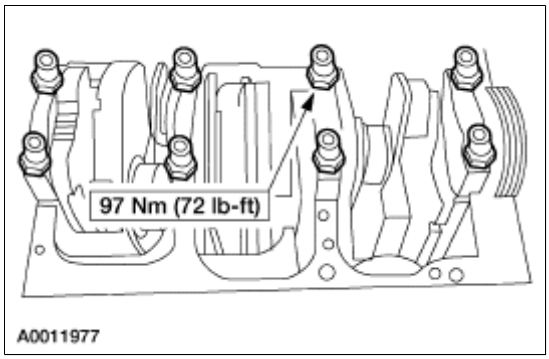


4. Install the crankshaft main bearings in the main bearing caps.

5. Install the main bearing caps.



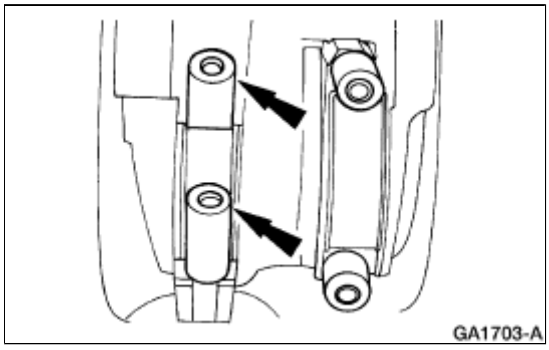
6. Tighten the bolts.



7. Lubricate the piston rings with clean engine oil.

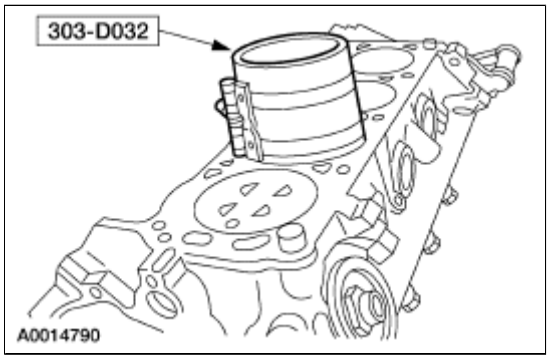
8. Make sure that the piston rings are correctly spaced. For additional information, refer to Section 303-00 .

9. Install rubber hose pieces on the connecting rod bolts to protect the crankshaft.



10. **NOTE:** Position the piston with the indentation arrow toward the front of the cylinder block.

    Using the special tool, install the pistons.



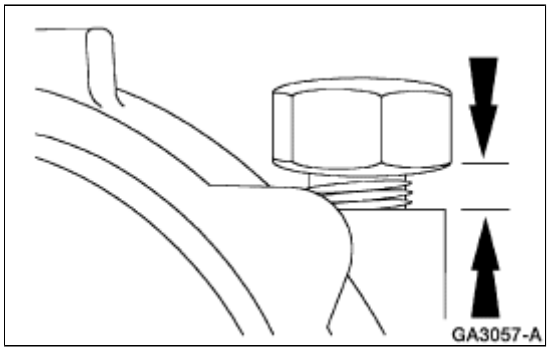
11. **NOTE:** The old nuts and bolts are used for checking clearances. New nuts and bolts must be used for reassembly.

    Check the clearance of each connecting rod bearing. For additional information, refer to Section 303-00 .

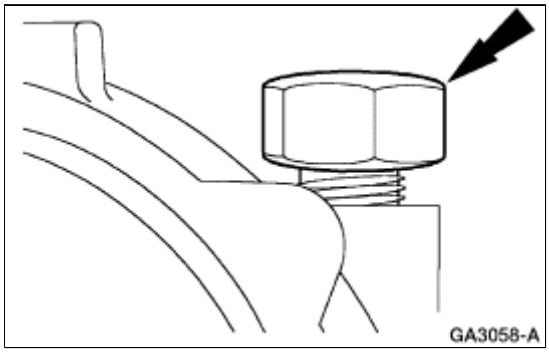
12. Rotate the crankshaft until the piston is at the bottom of its stroke.

13. **NOTE:** For cylinders 1, 2, and 3, remove the connecting rod nut at the oil split hole side first. For cylinders 4, 5, and 6, remove the opposite nut first.

    Loosen the first nut until the face is approximately 2 mm (0.08 in) over the end of the bolt.

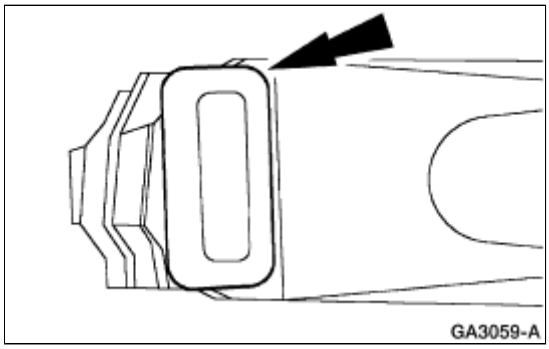


14. Tap the bolt on the nut until it can be removed by hand.



15. Repeat previous two steps for the opposite bolt.

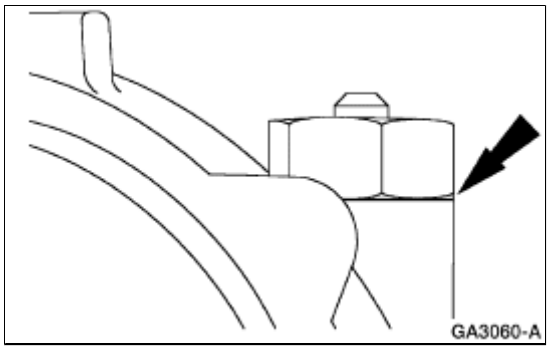
16. Install the new bolts making certain that the bolt head is parallel to the sideward face of the connecting rod.



17. Install the connecting rod cap in the original position.

18. **NOTE:** Do not exceed 20 Nm (15 lb-ft) when tightening the connecting rod nuts.

    Install and tighten the connecting rod nuts until they touch the connecting surface of the connecting rod cap.

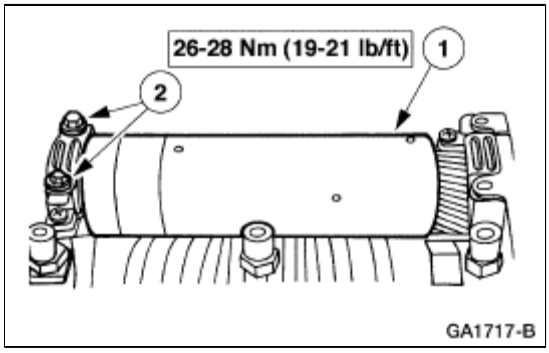


19. Tighten the connecting rod nuts simultaneously in two stages:
    - Stage 1: Tighten 20 Nm (15 lb-ft) .
    - Stage 2: Tighten 90 degrees.

20. Repeat previous four steps for the remaining connecting rods.

21. Rotate the crankshaft until the number one cylinder is at top dead center (TDC) of the compression stroke.

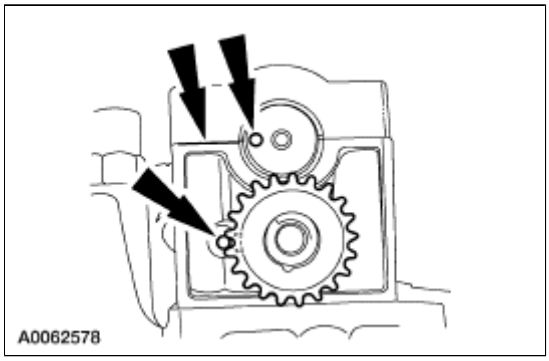
22. On 4 x 4 vehicles, install the balance shaft.
    1. Install the balance shaft assembly.
    2. Install the bolts.



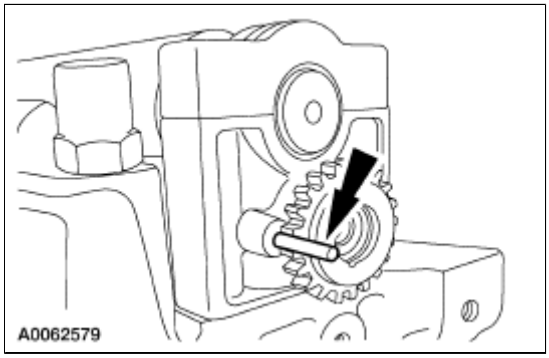
23. **NOTE:** Due to the gear ratio between the reversal shaft and the balance shaft, up to seven complete turns of the balance shaft may be required to find the correct position.

    NOTE: The reverse shaft sprocket timing marks are located on the rear face of the sprocket.

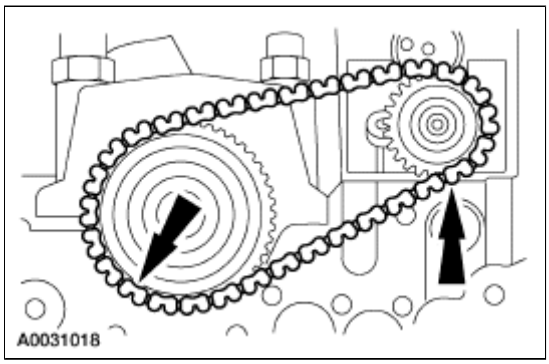
    On 4 x 4 vehicles, align the timing marks.



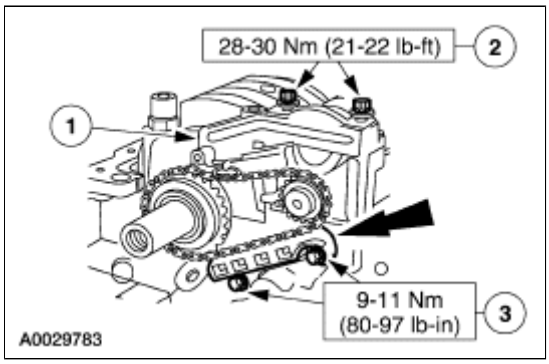
24. Install a 4 mm pin to hold the reverse shaft sprocket in place.



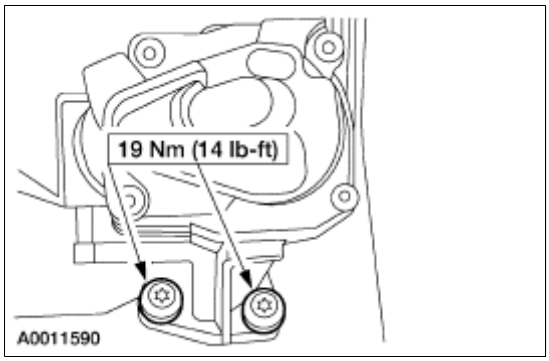
25. On 4 x 4 vehicles, install the balance shaft chain and crankshaft sprocket.



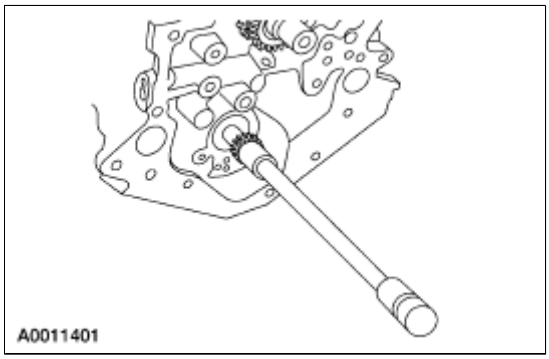
26. On 4 x 4 vehicles, install the balance shaft tensioner.
    1. Install the balance shaft tensioner.
    2. Install the bolts.
    3. Position the balance shaft chain guide and install the two bolts.
    - Remove the pin from the tensioner.



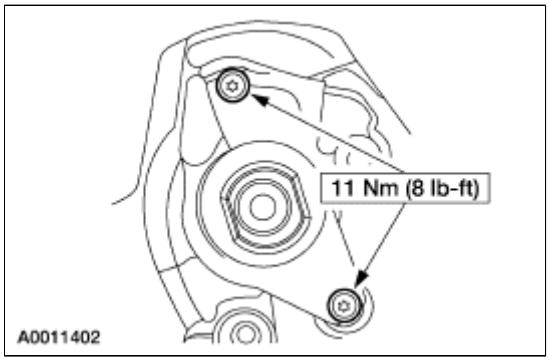
27. Install the oil pump.



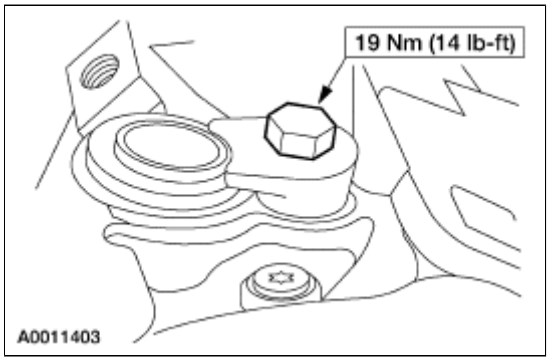
28. Install the jackshaft.



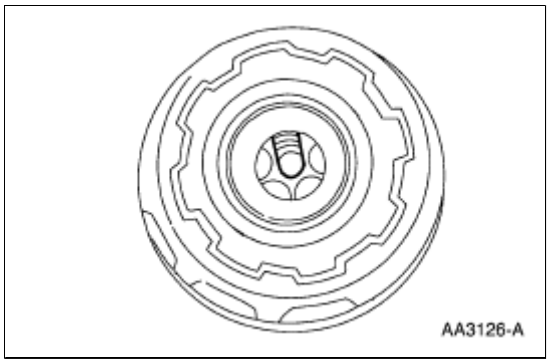
29. Install the jackshaft thrust plate and bolts.



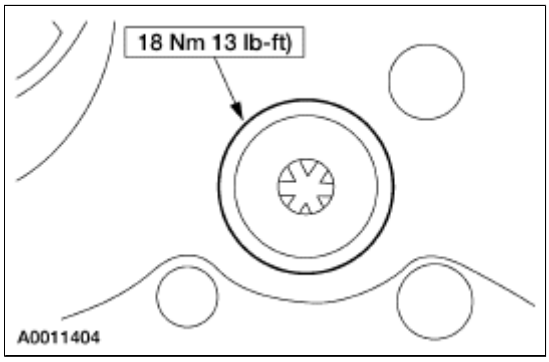
30. Install the oil pump drive.



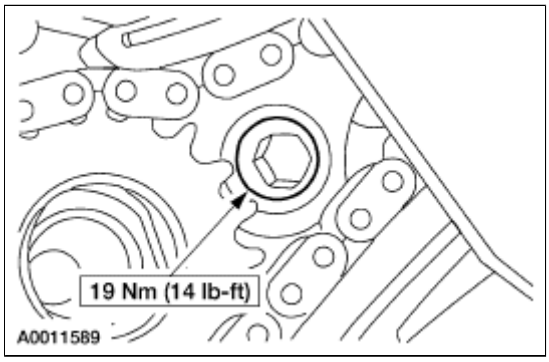
31. Attach the rear cassette and sprocket to the bolt. Do not tighten at this time.



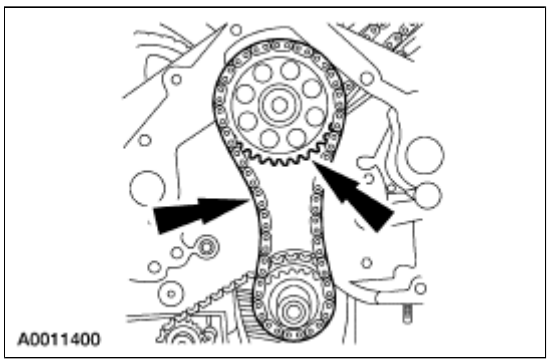
32. Install the rear cassette and bolt.



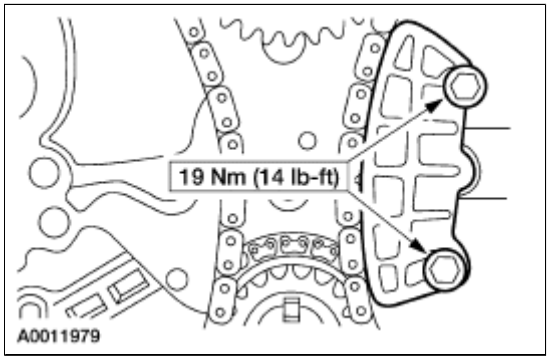
33. Install the front cassette and bolt.



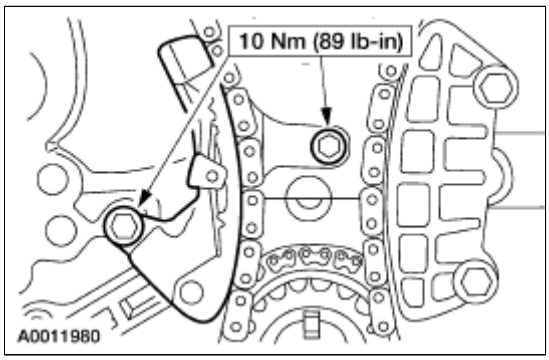
34. Position the jackshaft sprocket and chain.



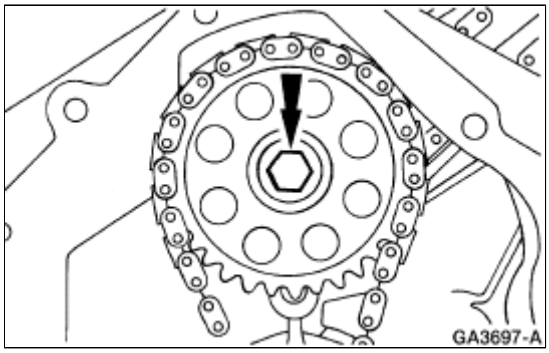
35. Install the chain guide.



36. Install the chain tensioner.

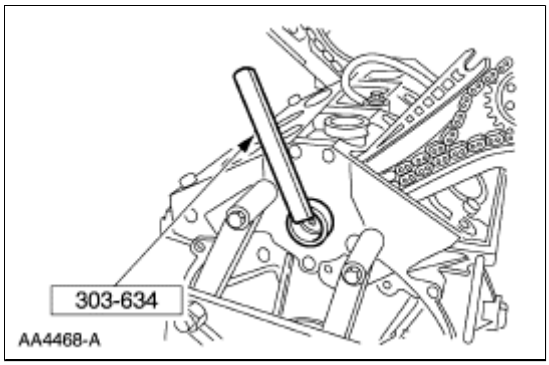


37. Install the bolt. Do not tighten at this time.

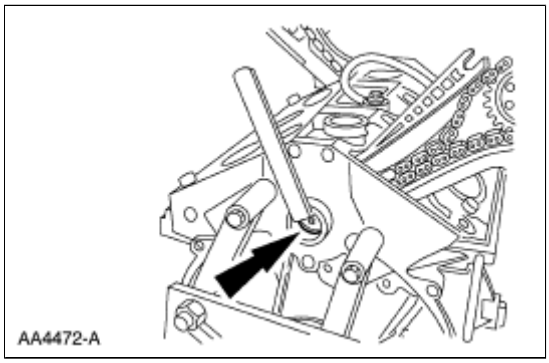


38. While holding the front jackshaft sprocket bolt secure, tighten the rear bolt to 20 Nm (15 lb-ft).

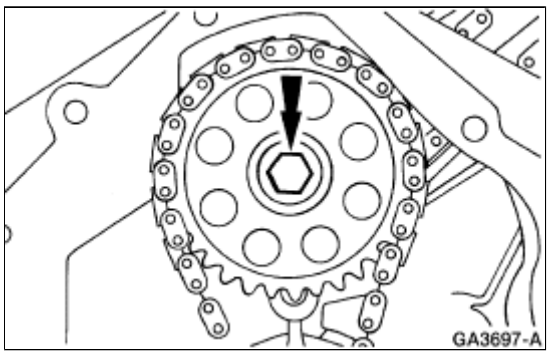
39. Install the special tool on the rear of the jackshaft.



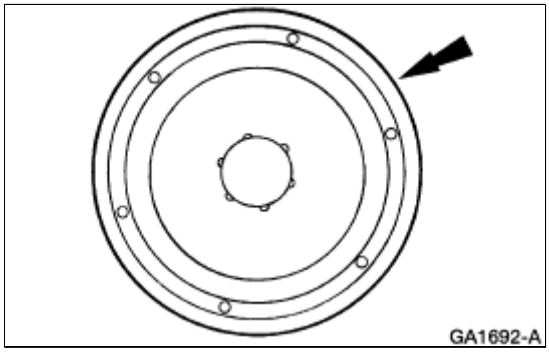
40. Tighten the rear bolt an additional 90 degrees.



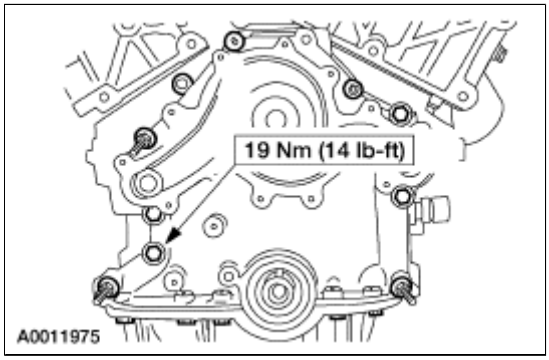
41. Tighten the front bolt in two stages.
    - Stage 1: Tighten to 45 Nm (33 lb-ft).
    - Stage 2: Tighten 90 degrees.



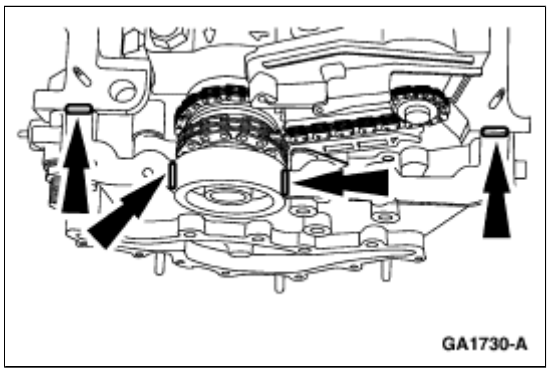
42. Remove the special tool and install the rear jackshaft plug.



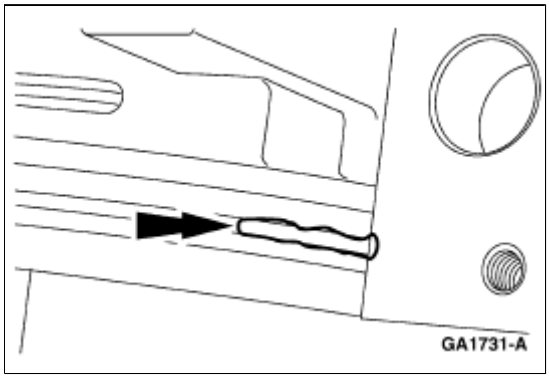
43. Position the front cover gasket and install the front cover.



44. Apply silicone gasket and sealant to the front cover in four places.

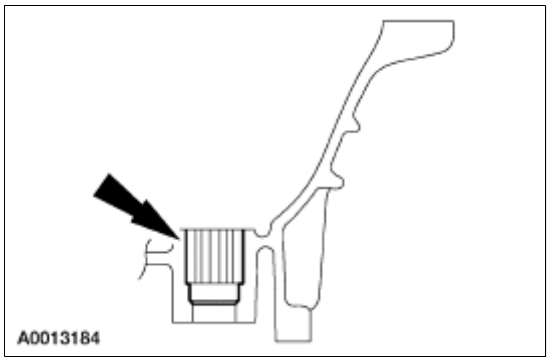


45. Apply silicone gasket and sealant to the rear main bearing cap as shown.
    - Position the ladder frame gasket.

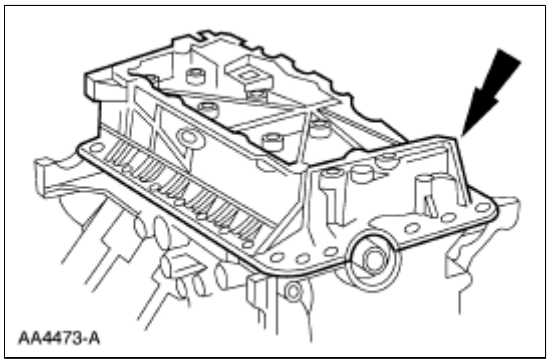


46. **CAUTION: The ladder frame inserts must be loosened completely or damage to the ladder frame and/or oil leaks may result.**

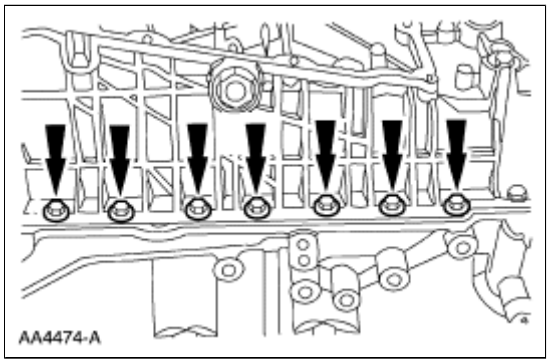
    Loosen the ladder frame inserts.



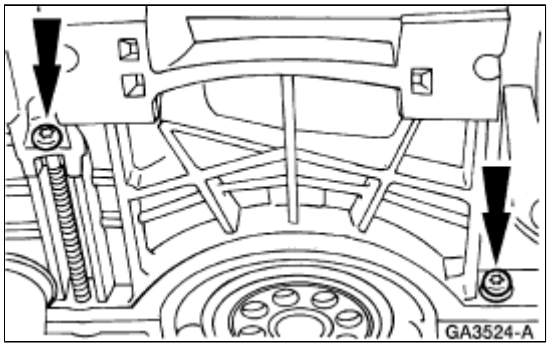
47. Position the ladder frame and gasket assembly.



48. Install and hand tighten the fifteen bolts and two nuts.



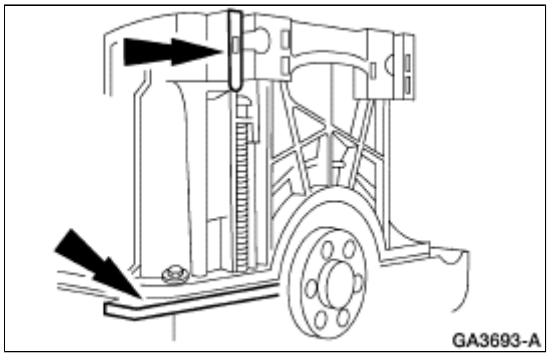
49. Install and hand tighten the bolts.



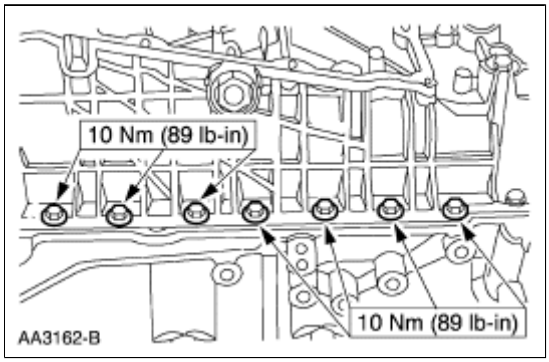
50. **NOTE:** The ladder frame to cylinder block alignment must be within a maximum mismatch of 0.25

mm (0.01 in) ladder frame underflush or 0.05 mm (0.00196 in) ladder frame protrusion.

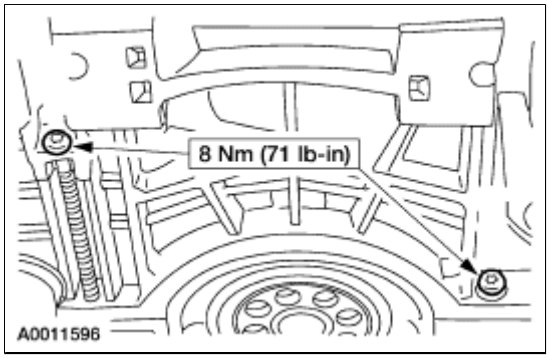
Using a straightedge, align the transmission face of the ladder frame with the rear face of the cylinder block.



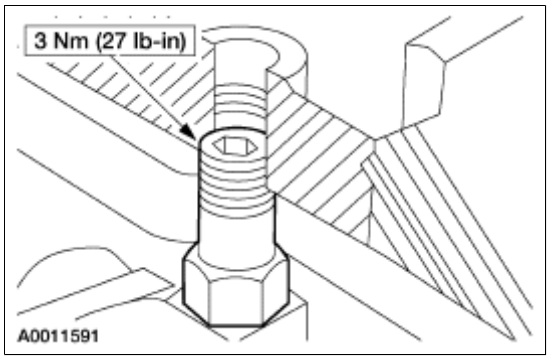
51. Tighten the fifteen bolts and two nuts.



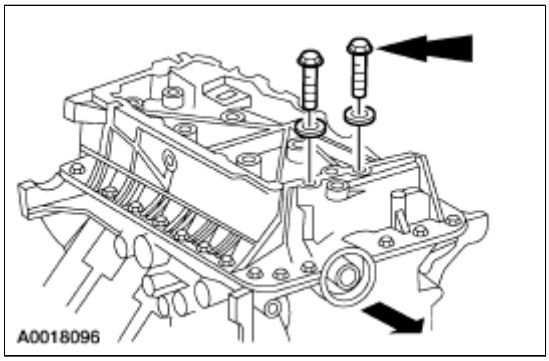
52. Tighten the bolts.



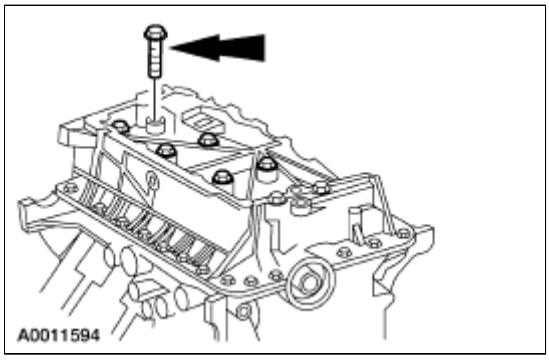
53. Tighten the inserts.



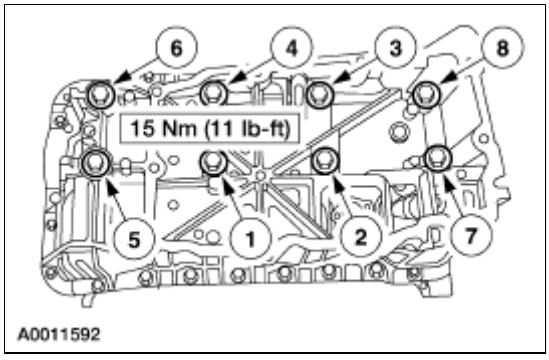
54. Install new seals on the two silver bolts and position them in the ladder frame.



55. Position the six remaining bolts.

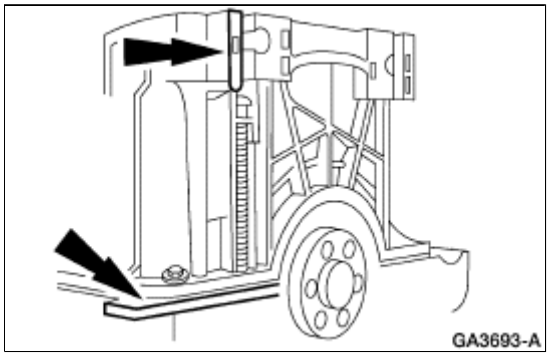


56. Tighten the ladder frame bolts in two stages.
    - Stage 1: Tighten to 15 Nm (11 lb-ft).
    - Stage 2: Tighten to 33 Nm (24 lb-ft).

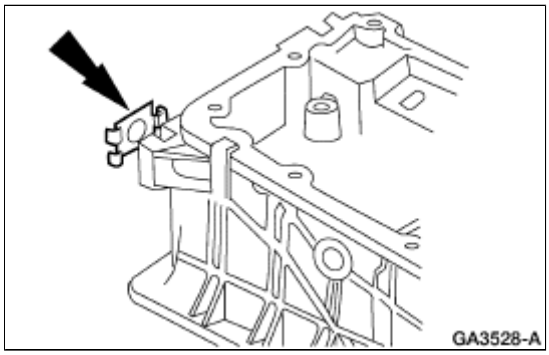


57. **NOTE:** Assemblies that measure out of specification must have the entire assembly procedure repeated.

    Measure the step between the rear face of the cylinder block and the transmission face of the ladder frame.

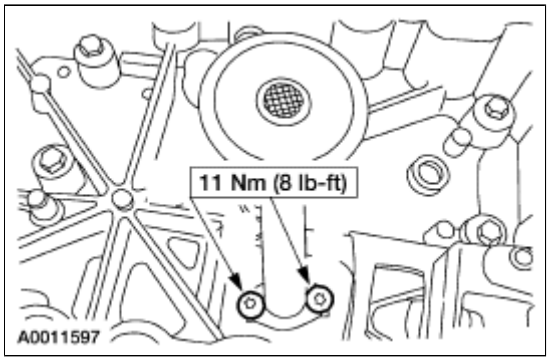


58. Repair all assemblies that exceed underflush specification by installing shims on one or both sides of the ladder frame.

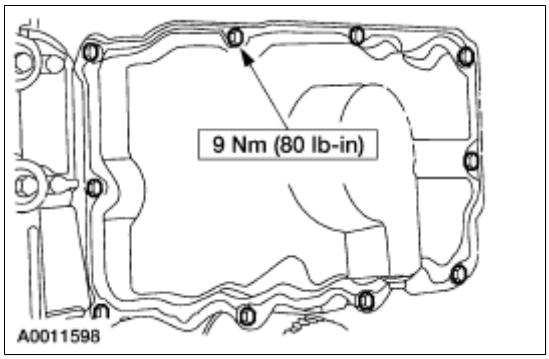


59. **NOTE:** Clean the gasket mating surfaces with metal surface cleaner.

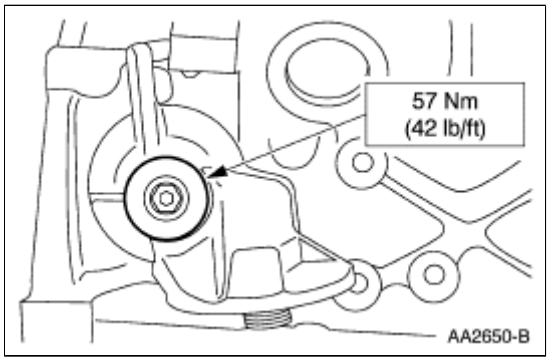
    Install a new gasket and the oil pump screen and pickup tube.



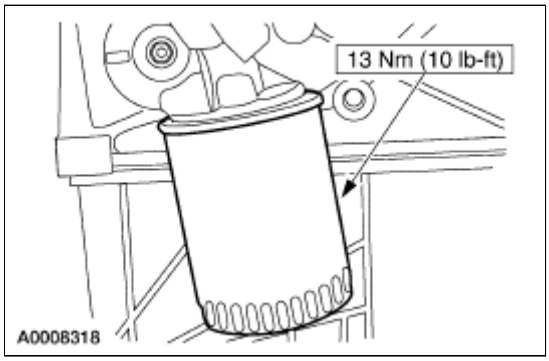
60. Install the gasket, and the oil pan.



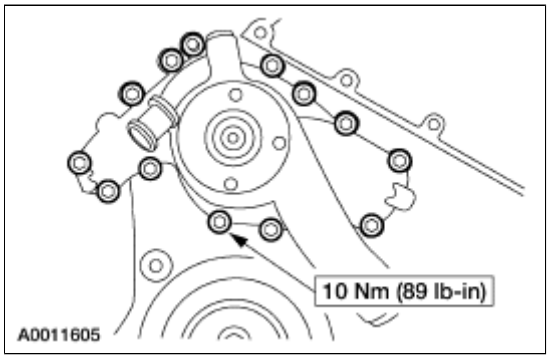
61. Install the oil filter adapter.



62. Install the oil filter.

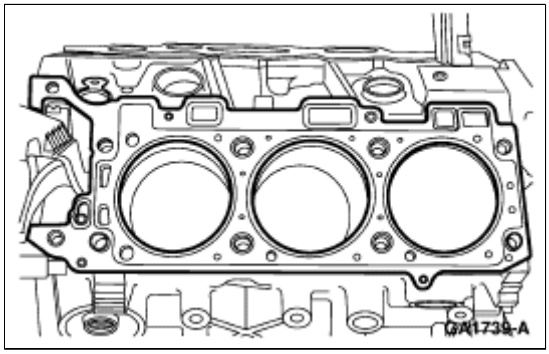


63. Install the water pump.



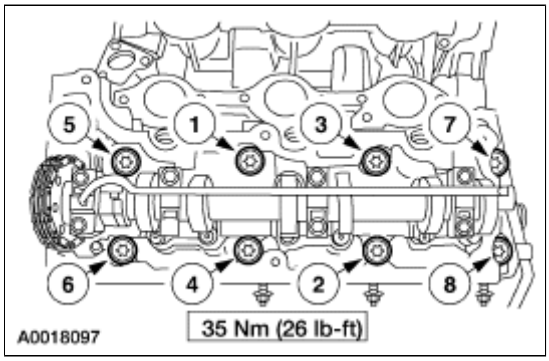
64. **NOTE:** LH shown, RH similar.

Install the cylinder head gasket.



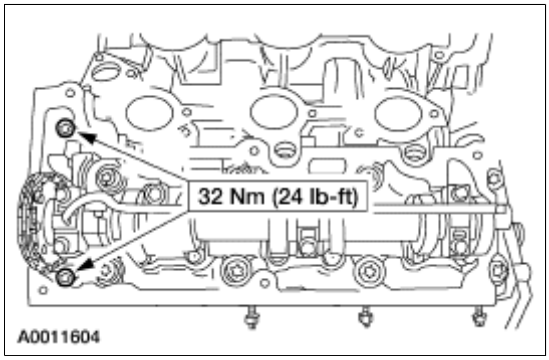
65. **NOTE:** LH shown, RH similar.

Install the cylinder head and tighten the bolts in the sequence shown.



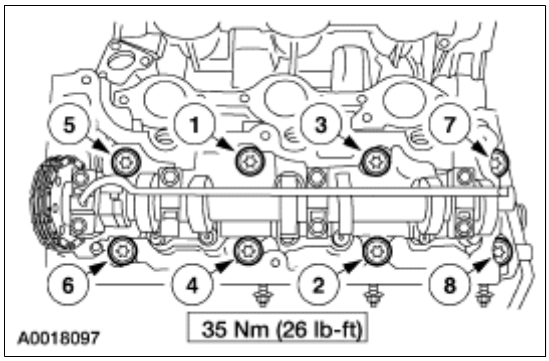
66. **NOTE:** LH shown, RH similar.

Install the two 8 mm bolts.



67. **NOTE:** LH shown, RH similar.

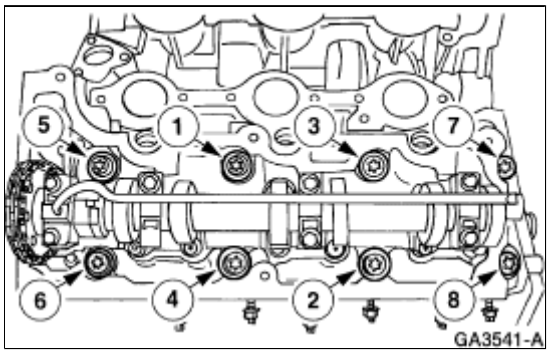
Tighten the 12mm bolts in the sequence shown.



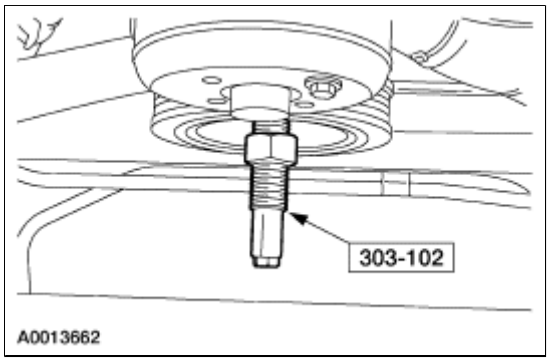
68. **NOTE:** LH shown, RH similar.

Tighten the bolts in the sequence shown in two stages.

- Stage 1: Rotate 90 degrees.
- Stage 2: Rotate an additional 90 degrees.



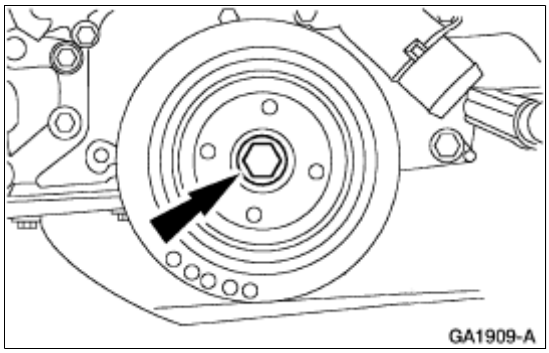
69. Using the special tool, install the crankshaft pulley.



70. **CAUTION: A new bolt must be used each time it is removed.**

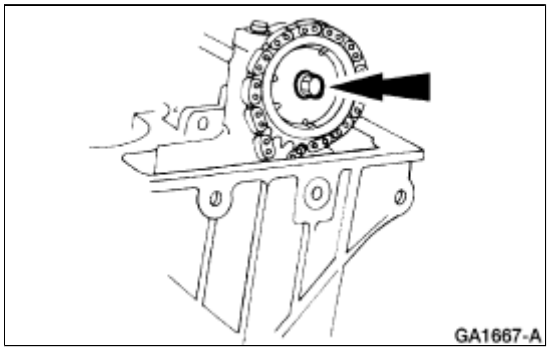
Tighten the bolt in two stages.

- Stage 1: Tighten to 45 Nm (33 lb-ft).
- Stage 2: Rotate an additional 90 degrees.

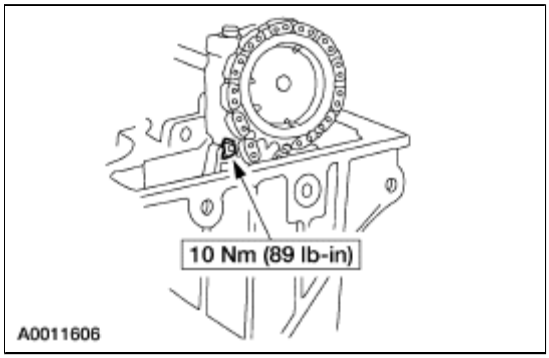


71. **CAUTION: The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**

    Install the RH rear camshaft bolt.

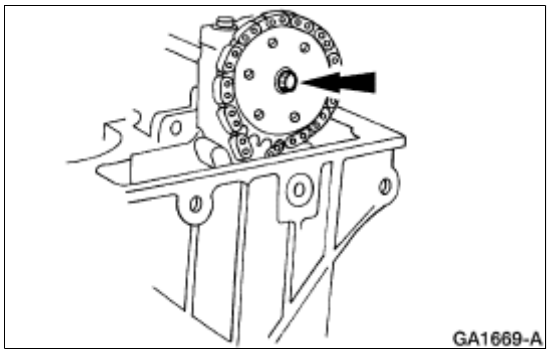


72. Install the bolt.

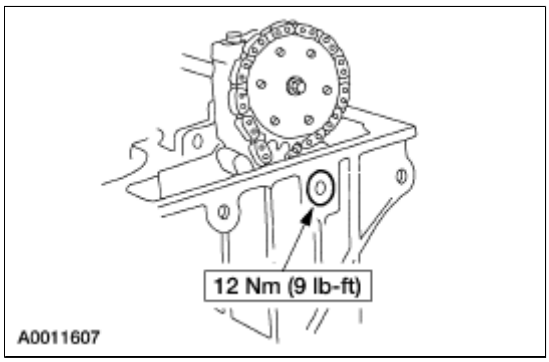


73. **CAUTION: The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**

    Install the LH front camshaft bolt.



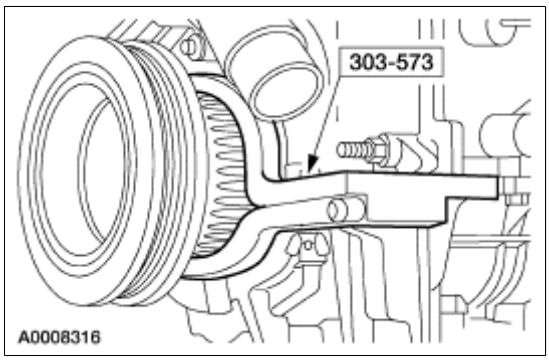
74. Install the bolt.



75. Turn the crankshaft one revolution clockwise.

76. **NOTE:** The special tool must be installed on the damper and should contact the engine block, this positions the engine at top dead center (TDC).

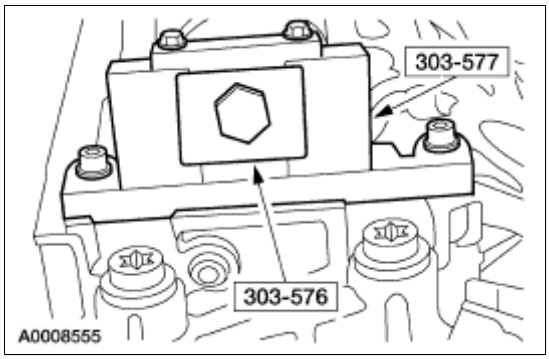
    Install the special tool.



77. **NOTE:** Camshaft timing slots are off-center.

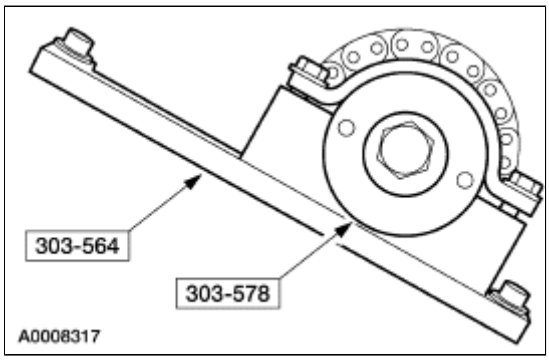
    NOTE: Position the camshaft timing slots below centerline of camshaft to correctly fit the special tools.

    Install the special tools on the front of the RH cylinder head.

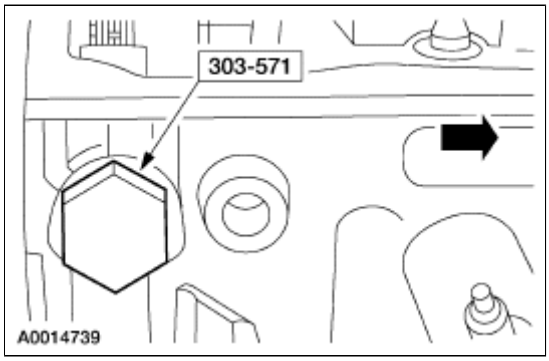


78. **NOTE:** Leave the top two special tool clamp bolts loose.

    Install the special tools on the rear of the RH cylinder head.

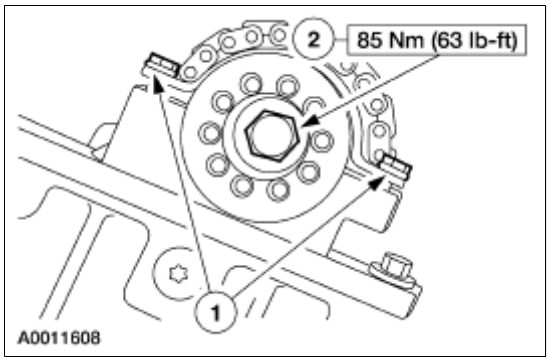


79. Install the special tool.



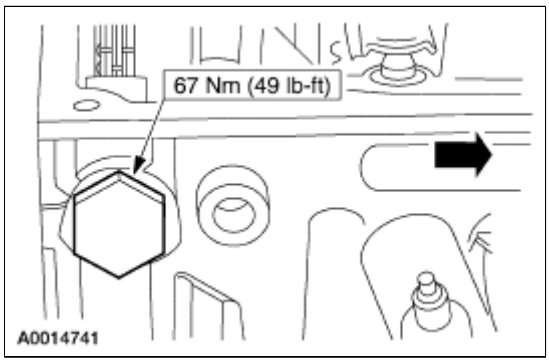
80. **CAUTION: The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**

    Tighten the bolts.
    1. Tighten the special tool top two clamp bolts to 10 Nm (89 lb-in).
    2. Tighten the camshaft bolt.



81. **NOTE:** When using a new washer the camshaft tensioner must be torqued to 44Nm (32lb-ft).

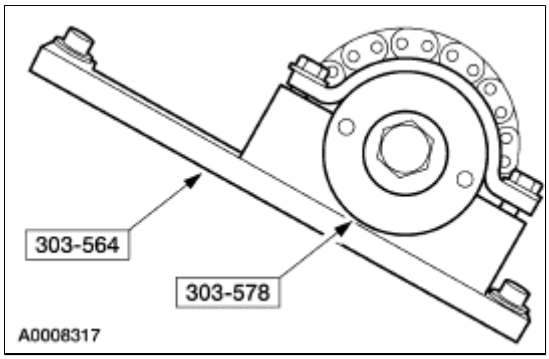
    Remove the special tool and install the RH camshaft tensioner.



82. Remove the special tools from the RH cylinder head.

83. **NOTE:** Do not tighten the special tool top two clamp bolts. Camshaft sprocket must rotate freely.

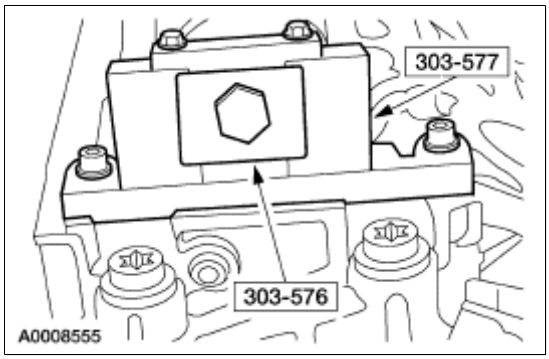
    Install the special tools on the front of the LH cylinder head.



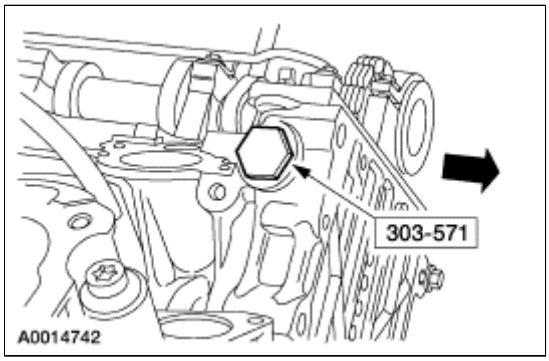
84. **NOTE:** Camshaft timing slots are off-center.

    NOTE: Position the camshaft timing slots below centerline of camshaft to correctly fit the special tools.

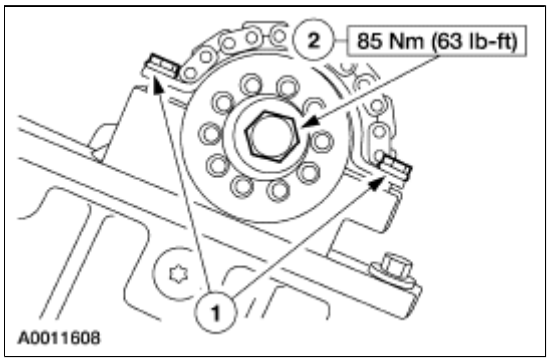
    Install the special tools on the rear of the LH cylinder head.



85. Install the special tool.

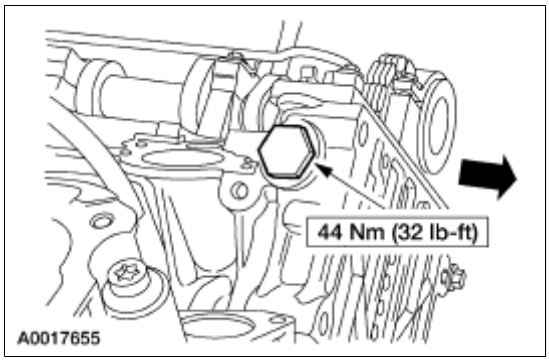


86. Tighten the bolts.
    1. Tighten the special tool top two clamp bolts to 10 Nm (89 lb-in).
    2. Tighten the camshaft bolt.



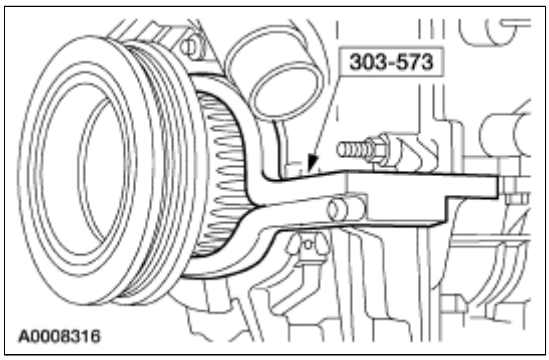
87. **NOTE:** When using a new washer the camshaft tensioner must be torqued to 44Nm (32lb-ft).

    Remove the special tool and install the LH camshaft tensioner.



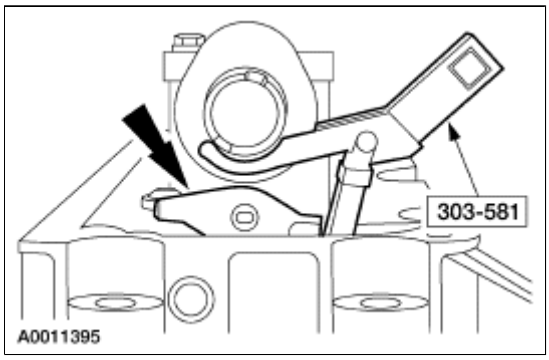
88. Remove the special tools from the LH cylinder head.

89. Remove the special tool.

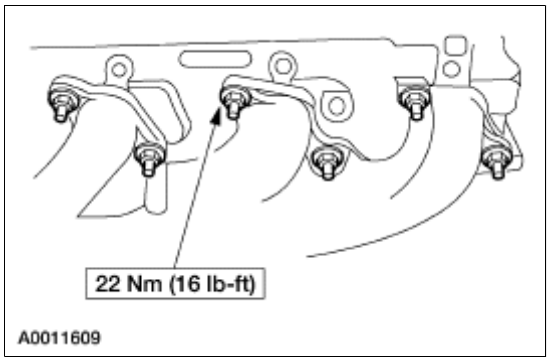


90. **NOTE:** Lubricate the parts with clean engine oil.

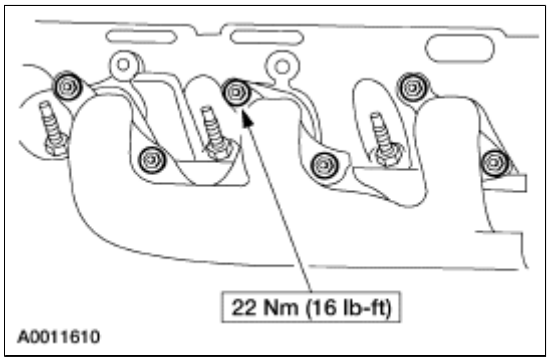
    Using the special tool, install the roller followers in their original position.



91. Install the gasket and the LH exhaust manifold.

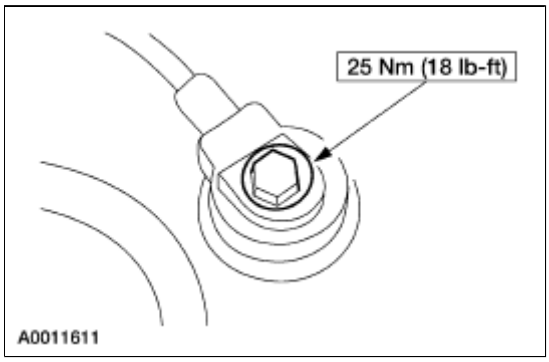


92. Install the gasket and the RH exhaust manifold.

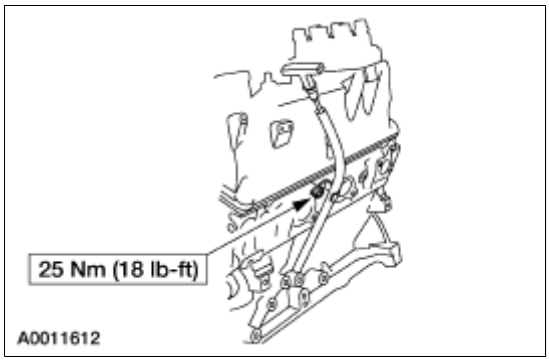


93. **NOTE:** Prior to installation, use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A to clean mating surfaces.

    Install the knock sensor.

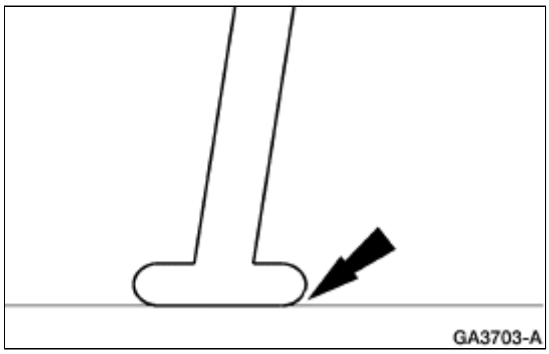


94. Install the oil level indicator tube.

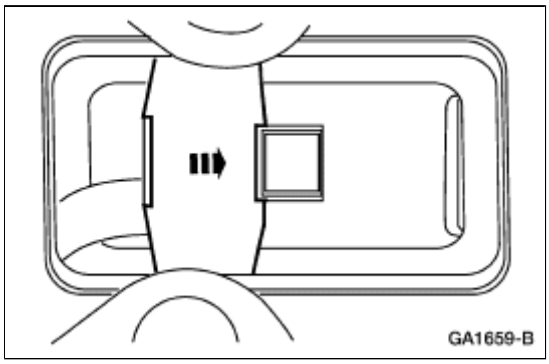


95. **NOTE:** If the oil level indicator tube is not installed flush with the cylinder block, false readings of the oil level may occur.

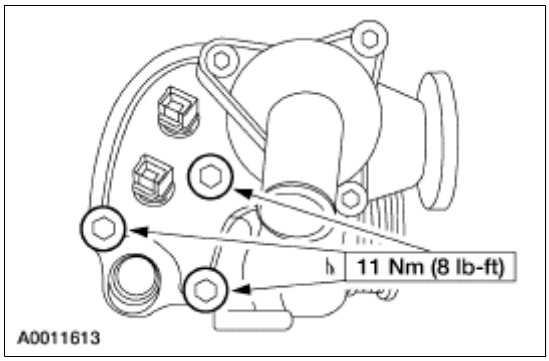
    Make sure the oil level indicator tube is flush with the cylinder block.



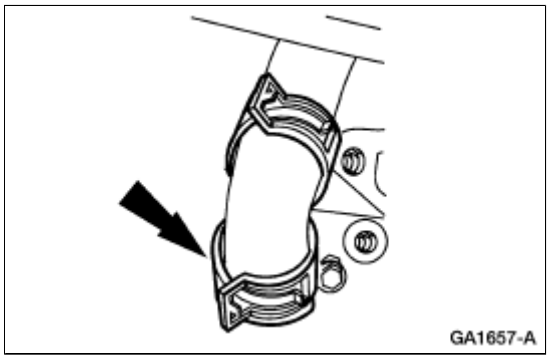
96. Install the crankcase vent separator.



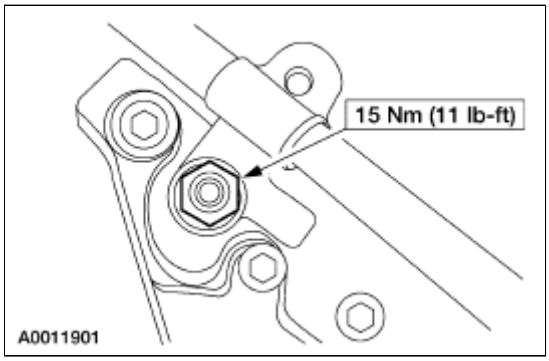
97. Install the thermostat housing.
    - Inspect and install a new gasket if necessary.



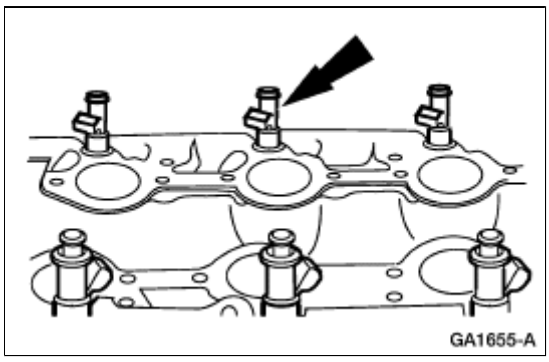
98. Connect the water bypass hose.



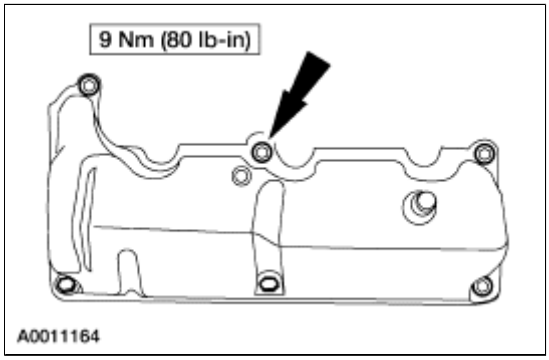
99. Install the vapor management valve (VMV) hose bracket.



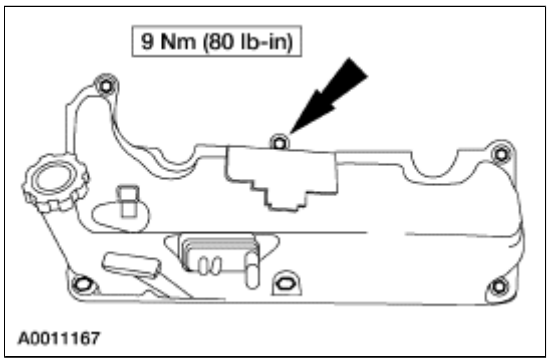
100. Install the fuel injectors.
    - Lubricate the fuel injector O-ring seals with clean engine oil.



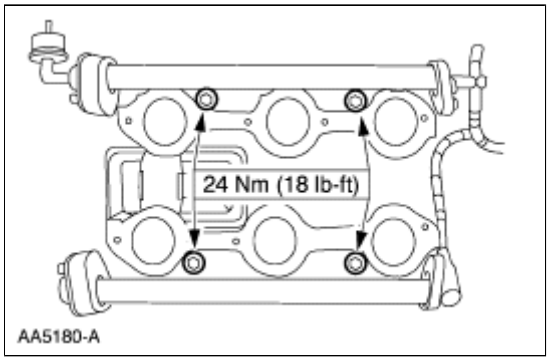
101. Install the gasket and the RH valve cover.



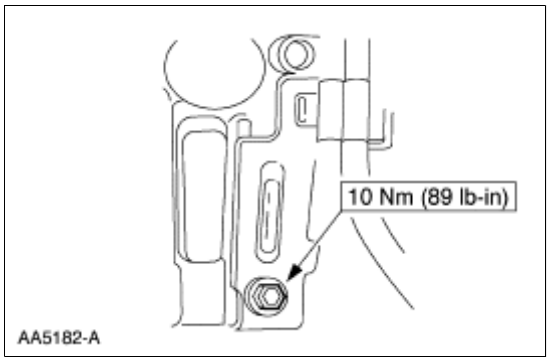
102. Install the gasket and the LH valve cover.



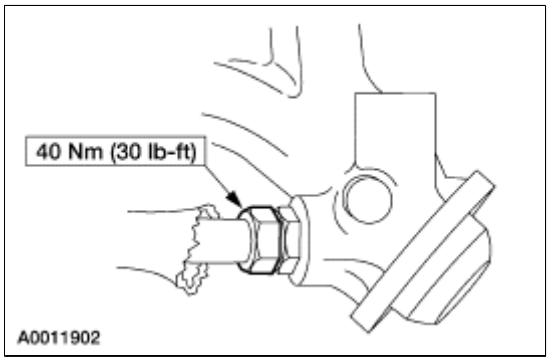
103. Install the fuel injection supply manifold.



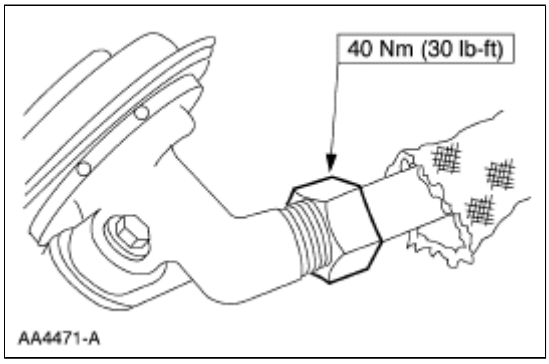
104. Install the lower fuel line bracket.



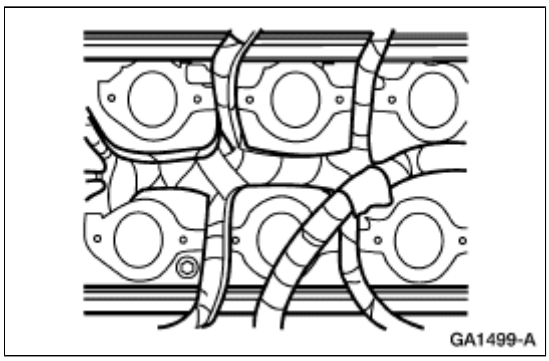
105. Connect the EGR valve to exhaust manifold tube to the exhaust manifold.



106. Connect the EGR valve to exhaust manifold tube to the EGR valve.

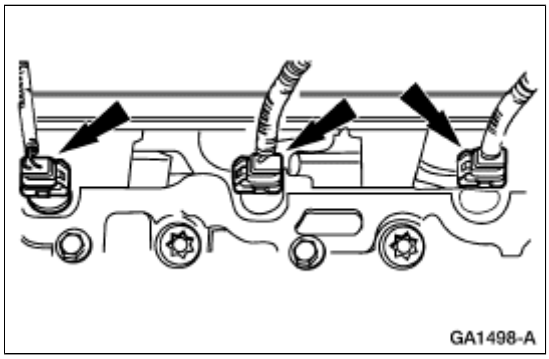


107. Install the fuel charging wiring.

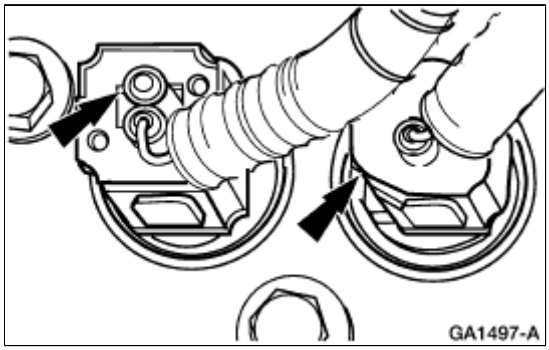


108. **NOTE:** LH shown, RH similar.

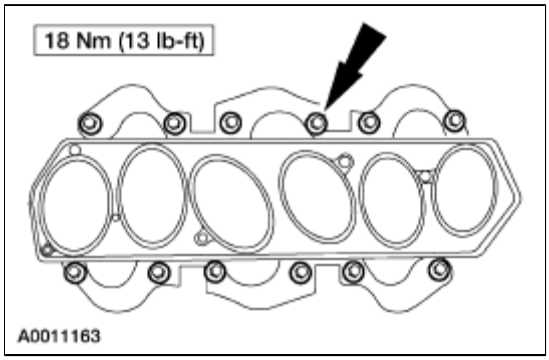
Connect the six fuel injector electrical connectors.



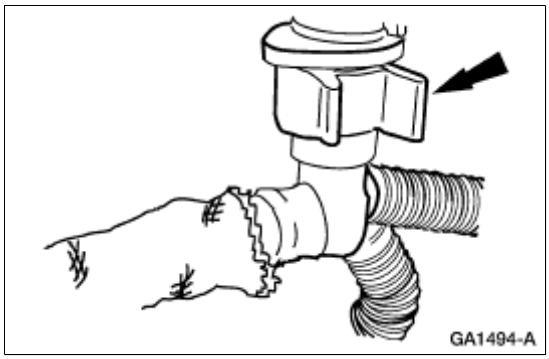
109. Connect the water temperature indicator sender unit and the engine coolant temperature (ECT) sensor electrical connectors.



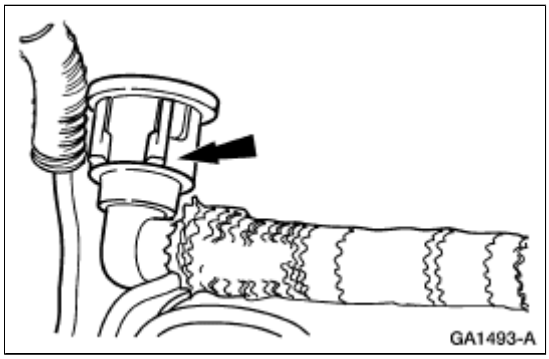
110. Install the lower intake manifold.



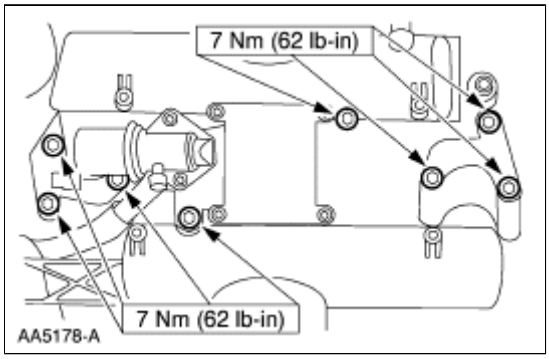
111. Connect the LH VMV hose.



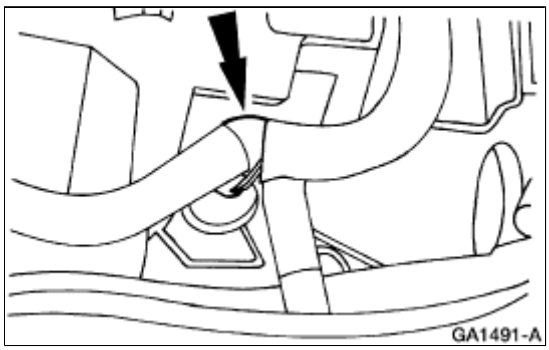
112. Connect the RH VMV hose.



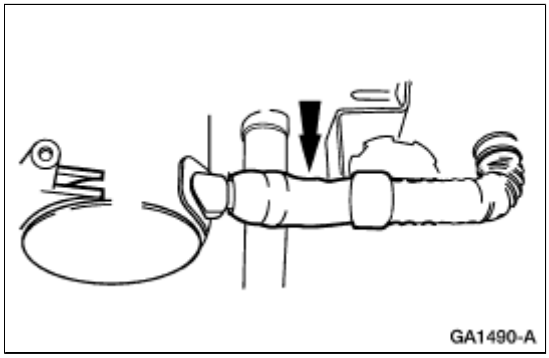
113. Install the upper intake manifold.
    - Inspect and install a new gasket if necessary.



114. Connect the crankcase ventilation hose.



115. Connect the RH upper intake manifold vacuum hose.

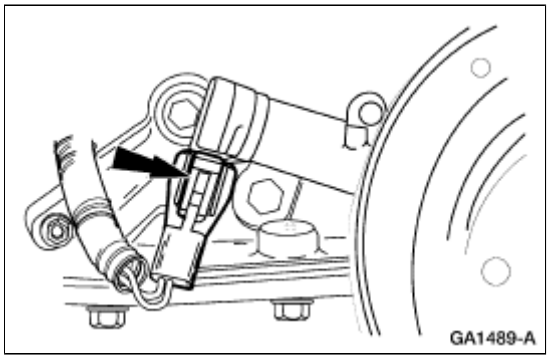


116. **CAUTION: Make sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifolds. Wire contact can send voltage spikes to other electronic modules.**

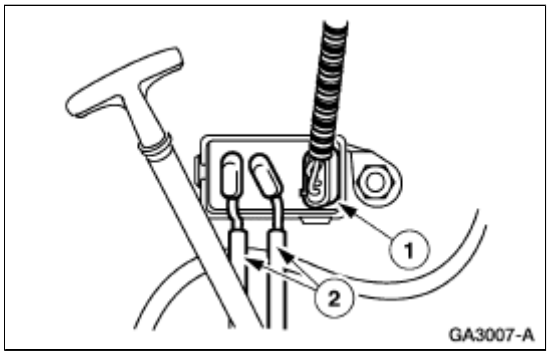
NOTE: Apply silicone brake caliper and dielectric compound to the inside of the spark plug boots.

Connect the spark plug wires to the spark plugs.

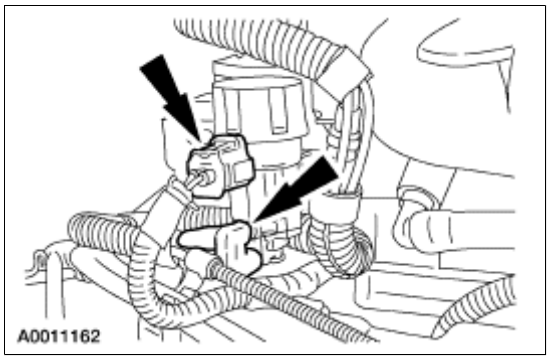
117. Connect the crankshaft position (CKP) sensor electrical connector.



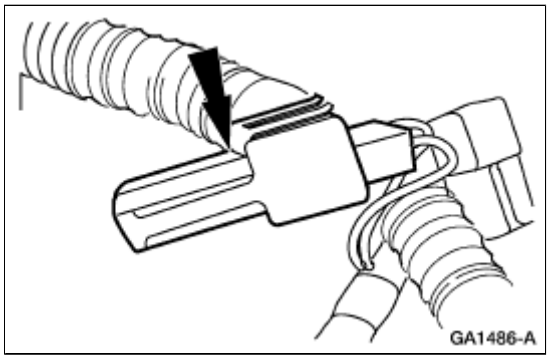
118. Connect the differential pressure feedback EGR transducer.
    1. Connect electrical connector.
    2. Connect vacuum hoses.



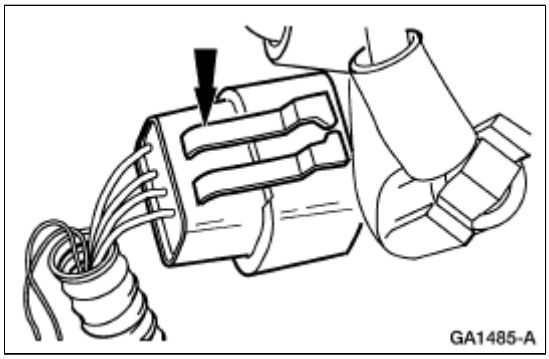
119. Connect the exhaust gas recirculation (EGR) vacuum regulator.



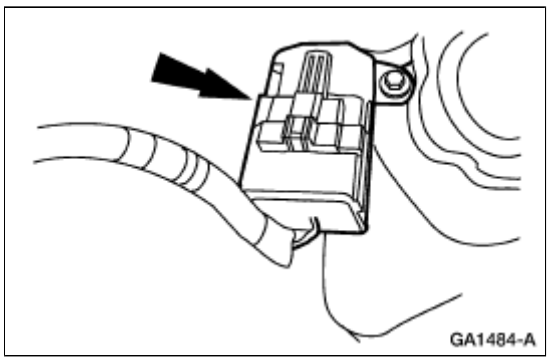
120. Connect the radio ignition interference capacitor electrical connector.



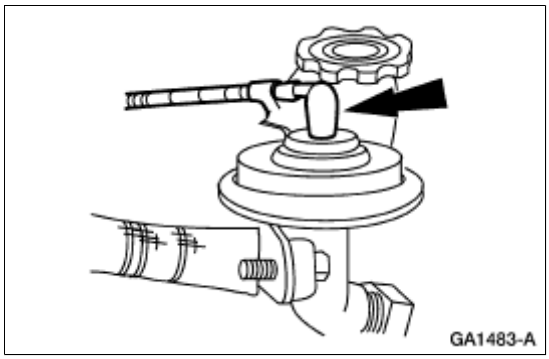
121. Connect the ignition coil electrical connector.



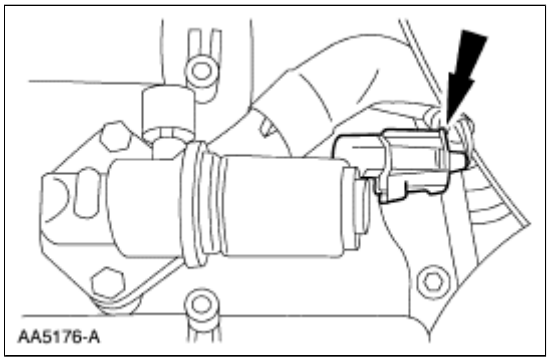
122. Connect the camshaft position (CMP) sensor electrical connector.



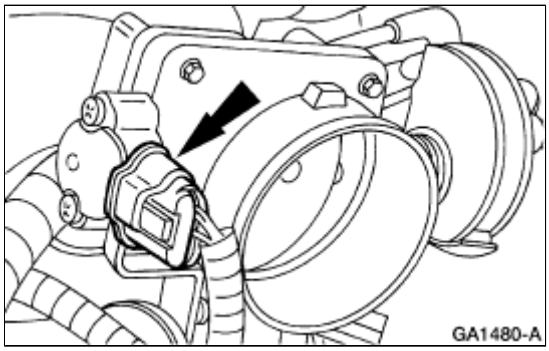
123. Connect the EGR valve vacuum hose.



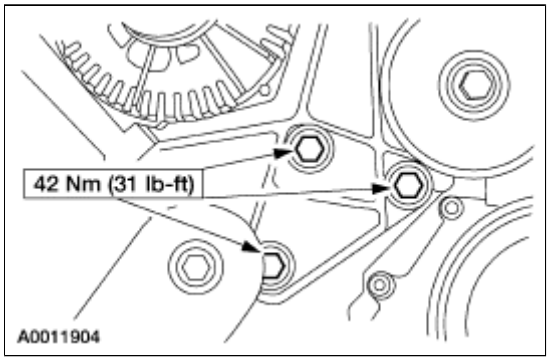
124. Connect the idle air control (IAC) valve electrical connector.



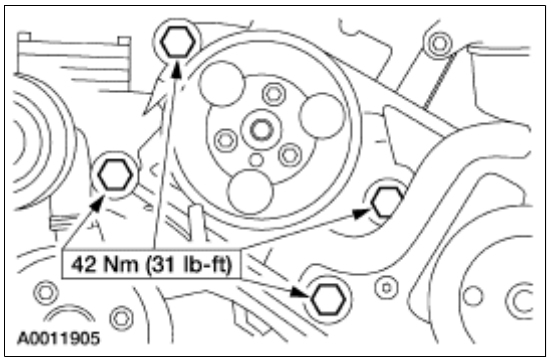
125. Connect the throttle position (TP) sensor electrical connector.



126. Install the generator mounting bracket.



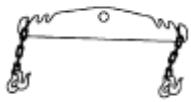
127. Install the accessory bracket and tighten the bolts.



128. Rotate the drive belt tensioner counterclockwise and install the drive belt.

Engine

Special Tool(s)

ST1831-A	Lifting Eyes 303-D030 (D81L-6001-D) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

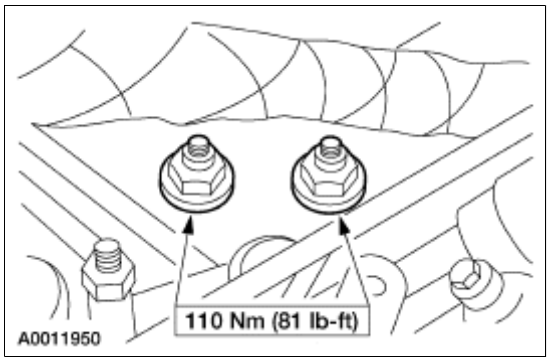
Installation

CAUTION: This vehicle is equipped with a composite material fuel supply manifold. If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the fuel supply manifold.

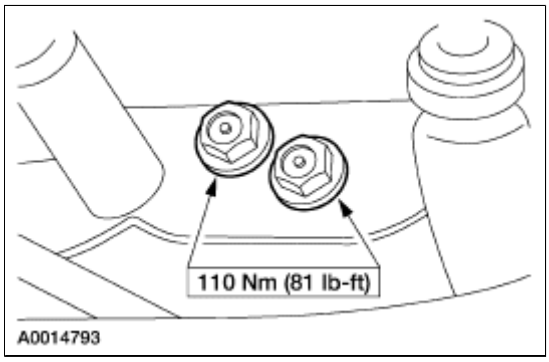
1. **NOTE:** The lifting eyes should be installed on the exhaust manifold studs for number three and number four cylinders.

   Install the lifting eyes.

2. Install the spreader bar on the lifting eyes.
3. Attach the floor crane to the spreader bar and remove the engine from the engine stand.
4. Install the rear crankshaft oil seal. For additional information, refer to Crankshaft Rear Oil Seal in this section.
5. Install the spacer plate.
6. Install the flywheel. For additional information, refer to Flywheel in this section.
7. Install the engine, remove the floor crane and the spreader bar.
8. Remove the lifting eyes.
9. Install the LH engine insulator nuts.

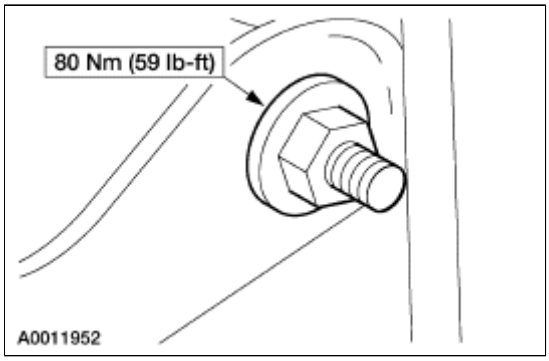


10. Install the RH engine insulator nuts.

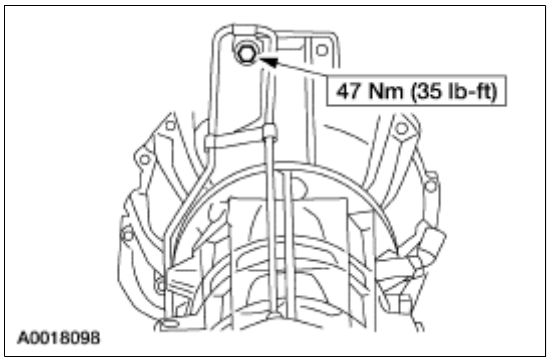


11. Raise and support the vehicle. For additional information, refer to Section 100-02 .

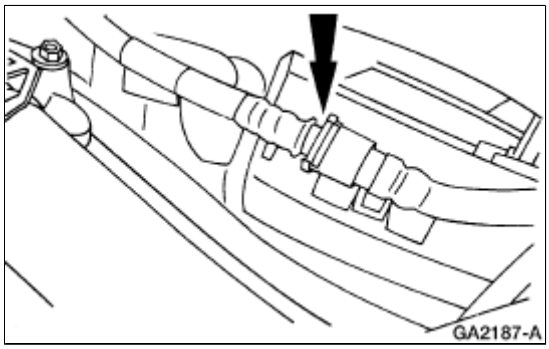
12. Install the LH and the RH engine support insulator nuts.



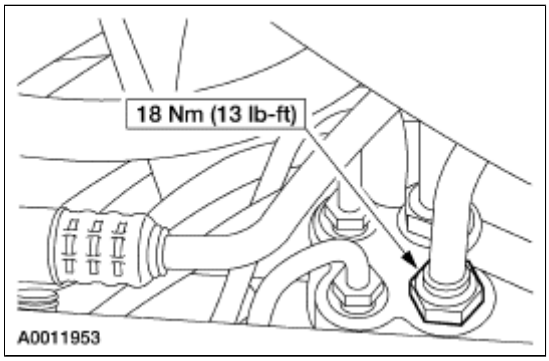
13. Install the eight bolts.



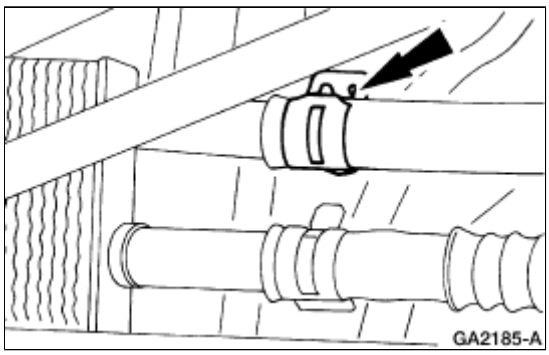
14. Connect the vapor management valve (VMV) hose connector.



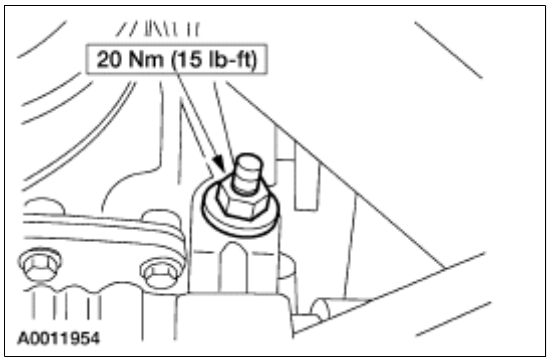
15. Connect the power steering pressure hose.



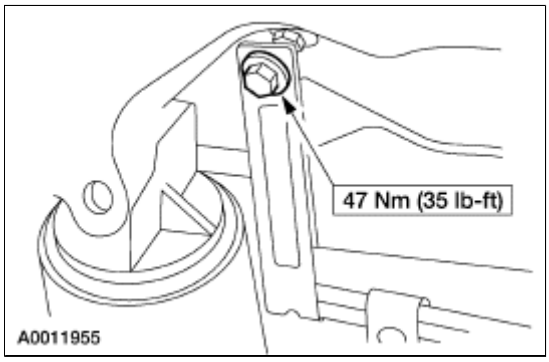
16. Connect the power steering return hose.



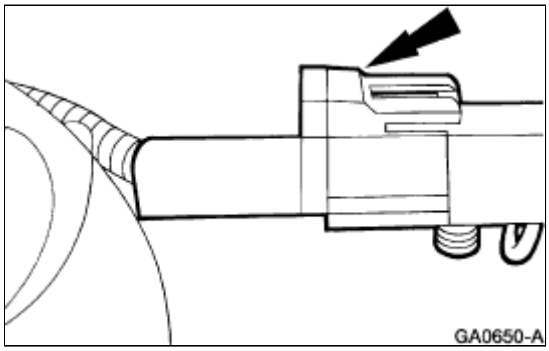
17. Position the A/C line bracket and install the nut.



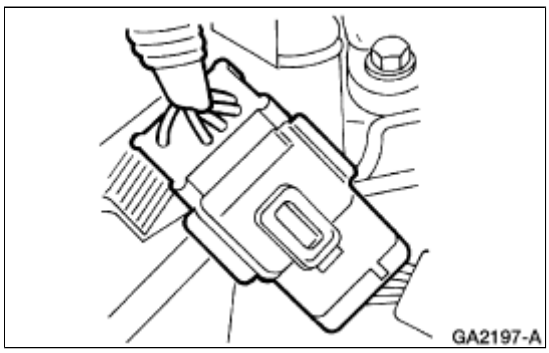
18. Position the transmission cooling line bracket and install the bolt.



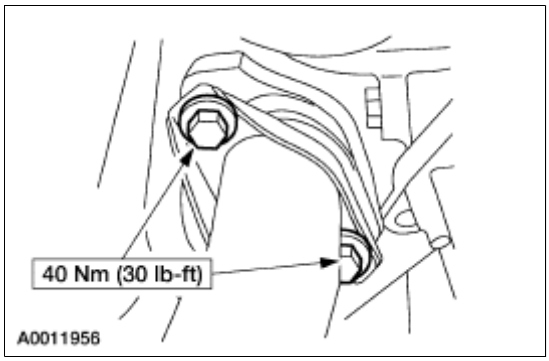
19. Connect the RH and LH heated oxygen sensor (HO2S) electrical connectors.



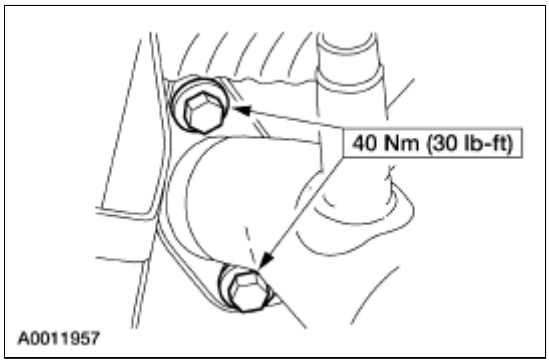
20. Connect the transmission harness electrical connector.



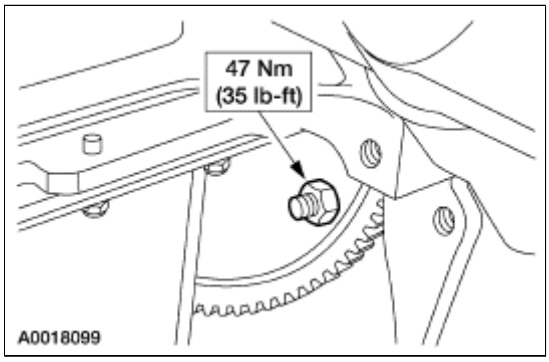
21. Install the bolts.



22. Install the bolts.



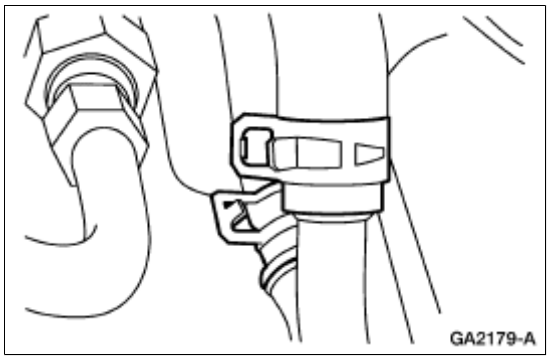
23. Install the four bolts.



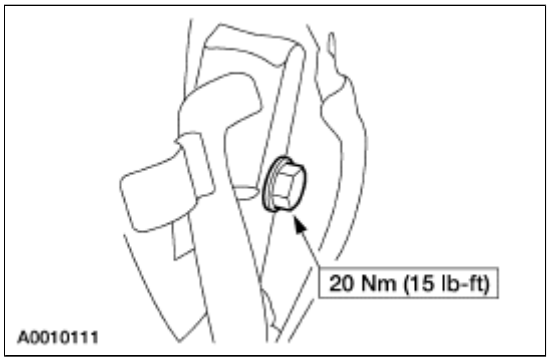
24. Install the starter. For additional information, refer to Section 303-06 .

25. Connect the fuel line. For additional information, refer to Section 310-00 .

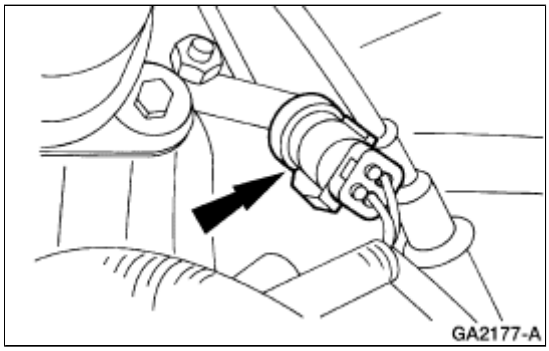
26. Connect the two heater water hoses.



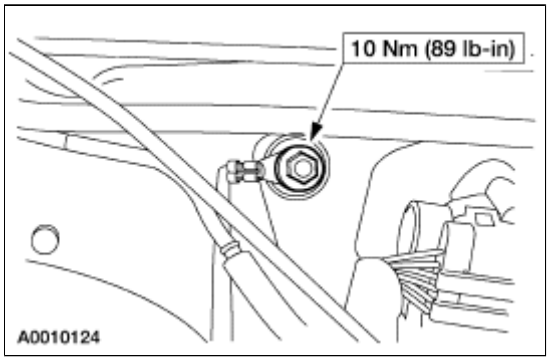
27. Position the A/C compressor manifold tube and install the bolt.



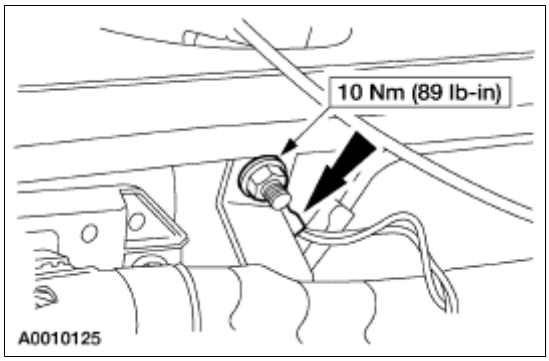
28. Connect the A/C high pressure switch electrical connector.



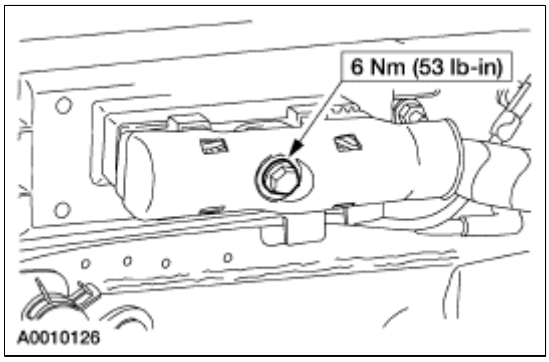
29. Connect the engine ground wire.



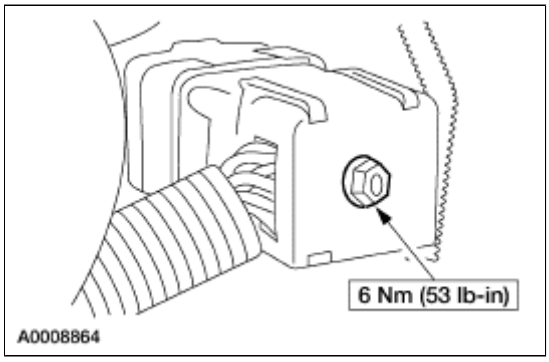
30. Connect the PCM electrical ground wire.



31. Connect the PCM electrical connector.



32. Connect the engine bulkhead electrical connector.



33. Install the radiator, the fan blade, and the fan shroud. For additional information, refer to Section 303-03 .

34. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

35. Install the hood.

36. Connect the battery ground cable. For additional information, refer to Section 414-01 .

37. Fill the engine to the proper oil level with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

38. Fill and bleed engine cooling system. For additional information, refer to Section 303-03 .

39. Recharge A/C system. For additional information, refer to Section 412-00 .

General Specifications

Item	Specification
5.0L	
Displacement liters (cubic inch)	5.0 (302)
Number of cylinders	8
Bore mm (inch)	101.6 (4.00)
Stroke mm (inch)	76.2 (3.00)
Firing order	1-3-7-2-6-5-4-8
Oil pressure at 2000 RPM Hot kPa (psi)	275-413 (40-60)
Cylinder Head and Valve Train	
Combustion chamber volume c.c.	58.3-61.3
Valve guide bore diameter mm (inch)	8.719-8.745 (0.343-0.344)
Valve arrangement front to rear	(RT)I-E-I-E-I-E-I-E (LT)E-I-E-I-E-I-E-I
Gasket surface flatness mm (inch)	0.076 (0.003) in 6 inches 0.152 (0.006) Overall
Gasket surface finish RMS	60-150
Valve Seat	
Width mm (inch)	1.524-2.032 (0.060-0.080)
Angle degrees	45°
Runout TIR maximum mm (inch)	0.050 (0.002)
Valves	
Valve stem diameter standard	
Intake Exhaust	0.3415-0.3423 0.3410-0.3418
Valve stem diameter 0.015 oversize	
Intake Exhaust	0.3565-0.3573 0.3561-0.3568
Valve stem diameter 0.030 oversize	
Intake Exhaust	0.3715-0.3723 0.3711-0.3718
Valve stem to guide clearance intake mm (inch)	0.026-0.069 (0.0010-0.0027)
Valve stem to guide clearance exhaust mm (inch)	0.038-0.081 (0.0015-0.0032)
Service limit mm (inch)	0.14 (0.0055)
Head diameter intake mm (inch)	46.66-46.913 (1.837-1.847)
Head diameter exhaust mm (inch)	39.014-39.268 (1.536-1.546)

Valve face angle degrees	44°
Valve face runout limit mm (inch)	0.0510 (0.002)
Valve Rocker Arm Shaft, Push Rods and Tappets	
Maximum valve rocker arm lift ratio to 1 mm (inch)	1.59 (.062)
Push rod runout TIR maximum mm (inch)	0.15 (0.005)
Tappet diameter mm (inch)	22.2-22.212 (0.8740-0.8745)
Tappet to bore clearance mm (inch)	0.018-0.069 (0.0007-0.0027)
Service limit mm (inch)	0.127 (0.005)
Hydraulic lifter leakdown rate for 1/16 in travel	10-50 seconds
Collapsed tappet gap allowable mm (inch)	1.803-4.343 (0.071-0.171)
Collapsed tappet gap desired mm (inch)	2.311-3.385 (0.091-0.151)
Valve Springs	
Intake valve spring compression pressure at specified height (lbs)	190-210 at 1.20 74-82 at 1.78
Exhaust valve spring compression pressure at specified height (lbs)	190-210 at 1.20 76-84 at 1.60
Intake valve spring free length mm (inch)	52.324 (2.06)
Exhaust valve spring free length mm (inch)	47.452 (1.88)
Intake valve spring assembled height mm (inch)	44.45-45.974 (1.75-1.81)
Exhaust valve spring assembled height mm (inch)	40.132-41.656 (1.58-1.64)
Valve spring out of square mm (inch)	1.98 (0.078)
Camshaft	
Intake lobe lift mm (inch)	6.698 (0.2637)
Exhaust lobe lift mm (inch)	7.115 (0.2801)
Maximum allowable lobe lift loss mm (inch)	0.127 (0.005)
End play mm (inch)	0.025-0.178 (0.001-0.007)
End play wear limit mm (inch)	0.229 (0.009)
Journal to bearing clearance mm (inch)	0.025-.076 (0.001-0.003)
Service limit mm (inch)	0.152 (0.006)
Camshaft drive	
No. 1 journal diameter mm (inch)	52.857 (2.0815)
No. 2 Journal diameter mm (inch)	52.489 (2.0665)
No. 3 journal diameter mm (inch)	52.108 (2.0515)
No. 4 journal diameter mm (inch)	51.727 (2.0365)
No. 5 journal diameter mm (inch)	51.346 (2.0215)
Maximum camshaft journal runout mm (inch)	0.127 (0.005)
No. 1 bearing inside diameter mm (inch)	52.912 (2.0835)
No. 2 bearing inside diameter mm (inch)	52.565 (2.0685)
No. 3 bearing inside diameter mm (inch)	52.159 (2.0535)

No. 4 bearing inside diameter mm (inch)	51.778 (2.0385)
No. 5 bearing inside diameter mm (inch)	51.397 (2.0235)
Front bearing location depth mm (inch)	0.127-0.508 (0.005-0.020)
Cylinder Block	
Cylinder bore diameter mm (inch)	101.6-101.63 (4.0000-4.0012)
Maximum cylinder out-of-round mm (inch)	0.38 (.0015)
Service limit mm (inch)	0.127 (0.005)
Maximum cylinder taper mm (inch)	0.254 (0.010)
Main bearing bore diameter mm (inch)	62.006-62.026 (2.4412-2.4420)
Crankshaft to rear face of block runout. TIR maximum mm (inch)	0.127 (0.005)
Distributor shaft bearing bore diameter mm (inch)	11.492-11.534 (0.4525-0.4541)
Head gasket surface flatness mm (inch)	0.076 (0.003) in 6 inches 0.152 (0.006) overall
Head gasket surface finish root mean square (RMS)	60-150
Crankshaft and Flywheel	
Main bearing journal diameter mm (inch)	57.105-57.125 (2.2482-2.2490)
Main bearing journal out-of-round mm (inch)	0.015 (0.0006)
Main bearing journal runout TIR maximum mm (inch)	0.051 (0.002)
Main bearing journal runout service limit mm (inch)	0.127 (0.005)
Main bearing thrust face runout TIR maximum mm (inch)	0.025 (0.001)
Main bearing journal taper maximum per inch mm (inch)	0.013 (0.0005)
Thrust bearing journal length mm (inch)	28.88-28.931 (1.137-1.139)
Main and rod bearing journal finish RMS maximum	12
Main bearing thrust face finish RMS maximum	25 Front, 20 Rear
Connecting rod journal diameter mm (inch)	53.919-53.939 (2.1228-2.1236)
Connecting rod journal maximum out-of-round mm (inch)	0.015 (0.0006)
Connecting rod journal taper per inch maximum mm (inch)	0.015 (0.0006)
Crankshaft free end play mm (inch)	0.102-0.203 (0.004-0.008)
Crankshaft free end play service limit mm (inch)	0.127 (0.005)
Connecting Rod Bearings	
Clearance to crankshaft desired mm (inch)	0.02-0.039 (0.0008-0.0015)
Clearance to crankshaft allowable mm (inch)	0.018-0.061 (0.0007-0.0024)
Bearing wall thickness (STD) mm (inch)	1.453-1.466 (0.0572-0.0577)
Main Bearings	
Clearance to crankshaft desired mm (inch)	0.02-0.038 (0.0008-0.0015)
Clearance to Crankshaft Allowable mm (inch)	0.027-0.065 (0.0008-0.003)
Bearing wall thickness (STD) mm (inch)	2.431-2.438 (0.0957-0.0960)
Connecting Rod, Piston and Rings	
Piston pin bore or bushing I.D. mm (inch)	23.106-23.145 (0.909-0.911)

Rod bearing bore I.D. mm (inch)	56.871-56.879 (2.2390-2.2393)
Rod bearing bore out-of-round mm (inch)	0.01 (0.0004)
Rod length center to center mm (inch)	129.248-129.324 (5.0885-5.0915)
Alignment (bore-to-bore max. Diff.) twist mm (inch)	0.381 (0.015)
Service limit mm (inch)	0.584 (0.023)
Alignment (bore-to-bore max. Diff.) bend mm (inch)	0.305 (0.012)
Side clearance (assembled to crank) mm (inch)	0.254-0.508 (0.010-0.020)
Piston Pin	
Length mm (inch)	76.45-77.22 (3.010-3.040)
Diameter mm (inch)	23.1673-23.1698 (0.9121-0.9122)
To piston pin bore clearance mm (inch)	0.01016-0.01778 (0.0004-0.0007)
To connecting rod bushing clearance mm (inch)	Interference Fit
Piston	
Diameter — coded red mm (inch)	101.5670-101.5822 (3.9987-3.9993)
Diameter — coded blue mm (inch)	101.5746-101.6127 (3.9999-4.0005)
Diameter — coded yellow mm (inch)	101.6279-101.6432 (4.0011-4.0017)
Bore clearance selective fit mm (inch)	0.03-0.051 (0.0012-0.0020)
Pin bore diameter mm (inch)	23.180-23.185 (0.9126-0.9128)
Top ring grove width mm (inch)	1.524-1.5494 (0.060-0.061)
Bottom ring grove width mm (inch)	1.524-1.5494 (0.060-0.061)
Oil ring grove width mm (inch)	4.0310-4.06538 (0.1587-0.1597)
Piston Rings	
Top compression ring width mm (inch)	1.46558-1.49098 (0.0577-0.0587)
Bottom compression ring width mm (inch)	1.46558-1.49098 (0.0577-0.0587)
Top compression side clearance mm (inch)	0.033-0.084 (0.0013-0.0033)
Bottom compression side clearance mm (inch)	0.033-0.084 (0.0013-0.0033)
Oil ring side clearance mm (inch)	Snug
Top compression ring gap mm (inch)	0.254-0.508 (0.010-0.020)
Bottom compression ring gap mm (inch)	0.457-0.711 (0.018-0.028)
Oil ring gap mm (inch)	0.254-1.016 (0.010-0.040)
Lubrication System	
Relief valve spring pressure lbs. At 44.2 mm (1.74 inch)	14.4-16.6 Nm (10.6-12.2 lb/ft)
Driveshaft to housing clearance mm (inch)	0.038-0.076 (0.0015-0.0030)

Relief valve to housing clearance mm (inch)	0.038-0.076 (0.0015-0.0030)
Rotor assembly end clearance max. Mm (inch)	0.102 (0.004)
Outer race to end clearance mm (inch)	0.025-0.076 (0.001-0.003)
Engine oil capacity liters (quarts) [a]	4.7 (5)
Lubricant	
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP	WSS-M2C153-G
Sealer	
Devcon Aluminum Liquid F2	M3D354-A (E)
Silicone gasket and sealant F7AZ-19554-EA	WSE-M4G323-A4
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6
Dye	
Diesel engine oil dye 164-R3708	ESE-M99C103-B1
Fluid Capacity	
Premium Cooling System Fluid E2FZ-19549-AA or E2FZ-19549-B (in Oregon, F5FZ-19549-CC, in Canada CXC-10)	ESE-M97B44-A
Cleaner	
Metal surface cleaner F4AZ-19A536-RA	WSE-M5B392-A

[a] With filter change.

Torque Specifications

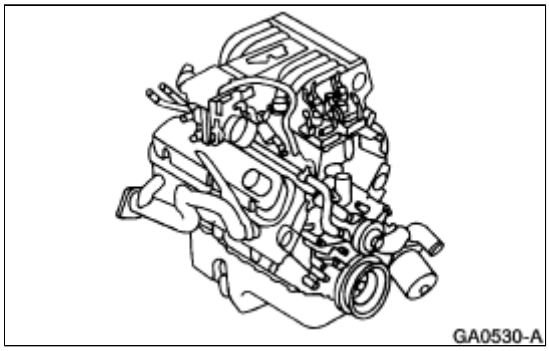
Description	Nm	lb-ft	lb-in
A/C compressor bolts	21-28	16-21	—
Camshaft sprocket bolt	54-61	40-45	—
Camshaft thrust plate bolt	12.3-16.3	9-12	—
Connecting rod cap nuts	26-33	19-24	—
Cover plate screws	2.6-3.7	—	23-33
Crankshaft position (CKP) sensor bolts	8-12	—	71-106
Crankshaft main bearing cap bolts	82-93	61-68	—
Crankshaft vibration damper bolt	149-177	110-130	—
Cylinder head bolts [a]	a	a	a
Drive belt tensioner bolts	21-29	16-21	—
EGR spacer bolts	20	15	—
Engine front cover bolts	16-25	12-18	—
Engine mount nuts	148	109	—
Exhaust inlet pipe-to-exhaust manifold bolts	34-46	26-33	—
Exhaust manifold bolts	30	22	—
Exhaust manifold shield bolts	7	—	61

Flywheel bolts	102-115	75-85	—
Fuel injection supply manifold bolts	8-12	—	71-106
Generator bolts and nut	40-55	30-40	—
Idler pulley	40-55	30-40	—
Ignition coil bracket nuts	16-25	12-18	—
Lower intake manifold bolts [a]	a	a	a
Lower steering column shaft bolt	40-55	30-40	—
Oil cooler bolt	53	39	—
Oil bypass filter	12	9	—
Oil level indicator tube nut	25	18	—
Oil pan side bolts	15	11	—
Oil pan end bolts	20	15	—
Oil pressure sensor	16-25	12-18	—
Oil pump bolts	30-40	23-31	—
Oil pump screen cover and tube bolts	16-25	12-18	—
Oil pump screen cover and tube nut	30-43	23-31	—
Power steering pump bolts	21-29	16-21	—
Power steering reservoir bolts	8-12	—	67-106
Accelerator control snow shield bolts	8-12	—	67-106
Upper intake manifold bolts [a]	a	a	a
Valve cover bolts	16-21	12-15	—
Rocker arm bolts	24-34	18-25	—
Valve tappet guide plate retainer bolts	8-12	—	71-106
Water pump bolts	21-28	15-21	—
Wire harness nut	16-25	12-18	—
Water pump pulley bolts	16-25	12-18	—
Water heater tube nut fitting	16-25	12-18	—
Spark plug wire bracket nut	8-12	6-9	—
PCM connector bolt	5-7	—	45-61
PCM harness bracket bolt	10	—	89
Transmission bulkhead connector bolt	2-3	—	18-26
Engine bulkhead connector bolt	5-7	—	45-62
EGR valve to exhaust manifold tube nut	34-46	25-34	—
Accelerator bracket bolt	20	15	—
Accelerator bracket nuts	9	—	80
Generator bracket bolts [a]	a	a	a
Generator bracket bolt [a]	a	a	a
Transmission oil fill tube	25-34	18-25	—

A/C and power steering pump bolts	65	48	—

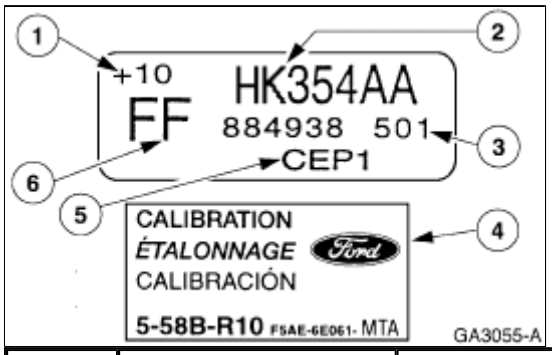
[a] Refer to text for tightening sequence.

Engine



The cylinder block is made of special high-grade cast iron, with thin-wall construction. The crankshaft (6303) has five crankshaft main bearings (6333) and is precision-cast iron. Piston, pin and rings (6102) are aluminum alloy, tin plated. Valve rocker arms (6564) are individually bolt-mounted. The valve tappets (6500) are hydraulic-roller design. These engines are also equipped with aluminum intake manifold systems.

Engine Identification



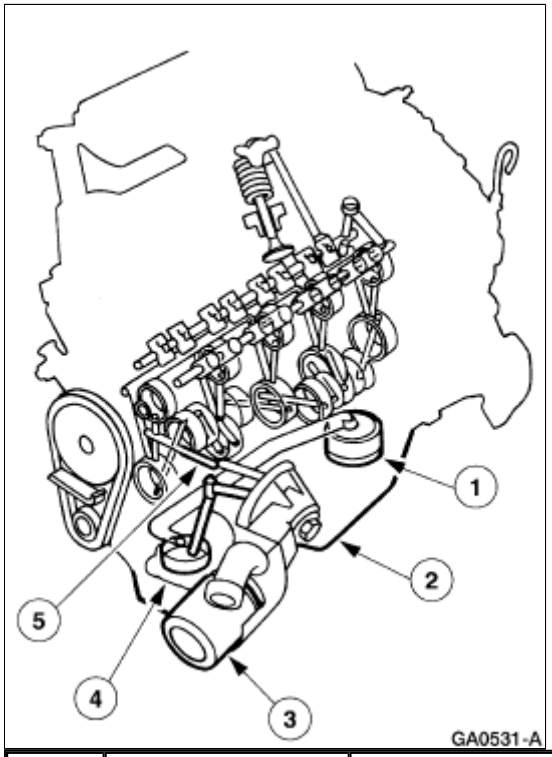
Item	Part Number	Description
1	—	Initial ignition timing
2	—	Engine code
3	—	Engine build date
4	—	Emission calibration label
5	—	Engine plant code
6	—	Shipping information

The engine code information label, located on the RH valve cover (6582), contains the engine build date, engine plant code, and engine code.

The emission calibration number label is located on the LH door or LH door post pillar. It identifies the engine calibration number, engine code number, and revision level.

It is critical that the engine codes and the calibration number be used when ordering parts or making inquiries about the engine.

Engine Lubrication System



Item	Part Number	Description
1	6622	Oil pump screen cover and tube
2	6675	Oil pan
3	6714	Oil bypass filter
4	6600	Oil pump
5	—	Oil galley

The engine lubrication system is the force-feed type in which oil is supplied to these components:

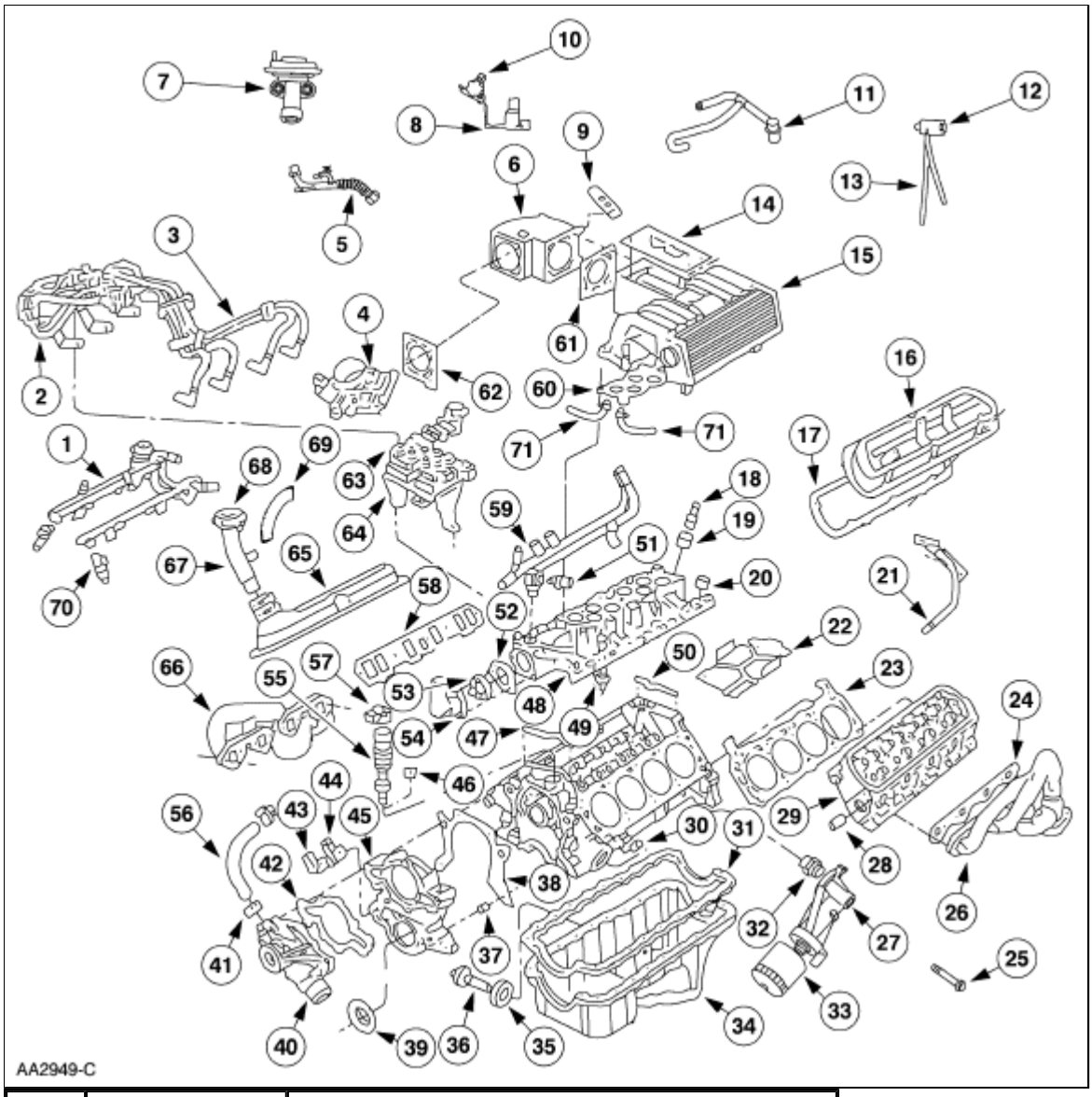
- crankshaft
- connecting rod (6200)
- valve tappets
- camshaft bearings (6261)

From the valve tappets, a controlled volume of oil is supplied to the rocker arms through hollow push rods (6565). All other moving parts are lubricated by gravity flow or splash.

The lubrication system consists of a full-pressure, cast-iron pump driven by the oil pump intermediate shaft from the camshaft synchronizer (12A362). The oil pressure is controlled by a relief valve.

The oil pan (6675) acts as a reservoir, holding the oil that is pumped through the engine by the oil pump (6600) after start-up.

External Components

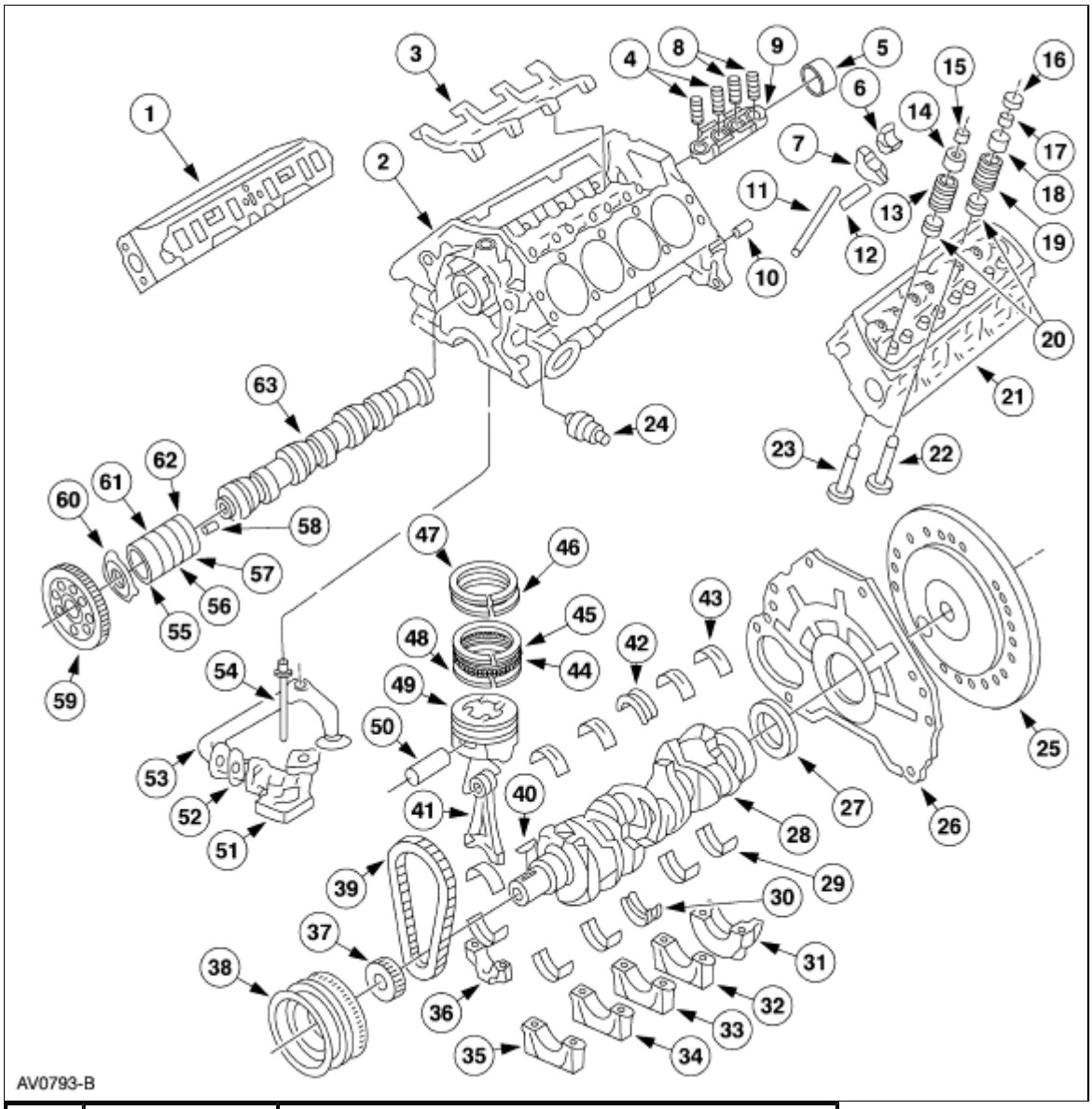


Item	Part Number	Description
1	9F792	Fuel injection supply manifold
2	12280	Ignition wire and bracket (RH)
3	12281	Spark plug wire set (LH)
4	9E926	Throttle body
5	9D477	EGR valve to exhaust manifold tube
6	9E945	Throttle body spacer
7	9D475	EGR valve (late model)
8	9S430	EVR bracket
9	9D476	EGR valve gasket
10	9J459	EGR vacuum regulator
11	6758	PCV hose
12	9J433	EGR backpressure transducer

13	—	EGR backpressure transducer hoses
14	9E434	Intake manifold cover
15	9424	Intake manifold (upper)
16	6582 (6A505)	Valve cover (LH)
17	6584	Valve cover gasket
18	6A666	Positive crankcase ventilation valve
19	6K780	Crankcase ventilation grommet
20	87617	Port plug
21	6754	Oil level indicator tube
22	6L678	Intake manifold baffle
23	6051	Head gasket
24	9448	Exhaust manifold gasket
25	6895	Oil filter adapter bolt
26	9431	Exhaust manifold (LH)
27	6881	Adapter
28	351418	Cylinder head fitting
29	6049	Cylinder head
30	6A008	Cylinder head to block dowel
31	6710	Oil pan gasket
32	6890	Oil filter mounting insert
33	6714	Oil bypass filter
34	6675	Oil pan
35	—	Low oil level sensor washer
36	6C644	Low oil level sensor
37	—	Engine front cover dowels
38	6020	Engine front cover gasket
39	6700	Crankshaft front seal
40	8501	Water pump
41	—	Hose clamp
42	8507	Water pump housing gasket
43	6023	Timing pointer
44	6C315	Crankshaft position sensor
45	6059	Engine front cover
46	12270	Hold-down clamp
47	9A425	Intake manifold end gasket
48	9K461	Intake manifold (lower)
49	10884	Water temperature indicator sender unit
50	9A424	Intake manifold end seal
51	12A648	Engine coolant temperature sensor

52	8255	Water thermostat gasket
53	8575	Water thermostat
54	8592	Water hose connection
55	12A362	Camshaft synchronizer
56	8597	Water bypass tube
57	12A112	Camshaft position sensor
58	9439	Intake manifold gasket
59	9D424	Intake manifold heater inlet tube
60	9H486	Intake manifold upper gasket
61	9E933	EGR valve spacer gasket
62	9E933	Throttle body gasket
63	12029	Ignition coil
64	12A166	Ignition coil mounting bracket
65	6582	Valve cover (RH)
66	9430	Exhaust manifold (RH)
67	6763	Oil fill pipe
68	6766	Oil filler cap
69	6758	Closure hose
70	9F593	Fuel injector
71	18465	PCV heater hoses

Internal Components



Item	Part Number	Description
1	6049	Cylinder head
2	6010	Cylinder block
3	6C515	Valve tappet guide plate retainer
4	6500	Valve tappets
5	6266	Camshaft rear bearing cover
6	6A528	Rocker arm fulcrum
7	6564	Rocker arm
8	6500	Valve tappet
9	6K564	Tappet guide plate and retainer
10	6397	Bell housing location pin
11	6565	Push rod
12	6A588	Rocker arm fulcrum guide

13	6513	Valve spring
14	6A516	Valve spring rotator
15	6518	Valve spring retainer key
16	6518	Valve spring retainer key
17	6517	Valve spring retainer sleeve
18	6514	Valve spring retainer
19	6513	Valve spring
20	6A517	Valve stem seal
21	6049	Cylinder head
22	6507	Intake valve
23	6505	Exhaust valve
24	9278	Oil pressure sensor
25	6375	Flywheel
26	6A372	Engine rear plate
27	6701	Crankshaft rear oil seal
28	6303	Crankshaft
29	6A338	Crankshaft main bearing—lower (4 req'd)
30	6A339	Crankshaft thrust main bearing
31	6325	No. 5 main bearing cap
32	6327	No. 4 main bearing cap
33	6330	No. 3 main bearing cap
34	6334	No. 2 main bearing cap
35	6329	No. 1 main bearing cap
36	6210	Connecting rod cap
37	6306	Crankshaft sprocket
38	6316	Crankshaft damper assembly
39	6268	Timing chain/belt
40	388907	Crankshaft key
41	6200	Connecting rod
42	6337	Crankshaft thrust main bearing—upper
43	6333	Crankshaft main bearing—upper (4 req'd)
44	6161	Oil control spacer
45	6159	Oil control ring
46	6152	Compression ring
47	6150	Compression ring
48	6159	Oil control ring
49	6110	Piston
50	6135	Piston pin
51	6600	Oil pump

52	6625	Oil pump inlet tube gasket
53	6622	Oil pump screen cover and tube
54	6A618	Oil pump intermediate shaft
55	6261	No. 1 camshaft bearing
56	6262	No. 3 camshaft bearing
57	6270	No. 4 camshaft bearing
58	391269	Camshaft pin
59	6256	Camshaft sprocket
60	6269	Camshaft thrust plate
61	6267	No. 2 camshaft bearing
62	6263	No. 5 camshaft bearing
63	6250	Camshaft

Engine

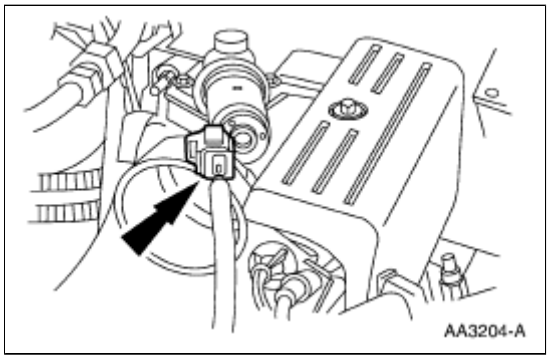
For mechanical concerns; for additional information, refer to Section 303-00 .

For driveability concerns; for additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

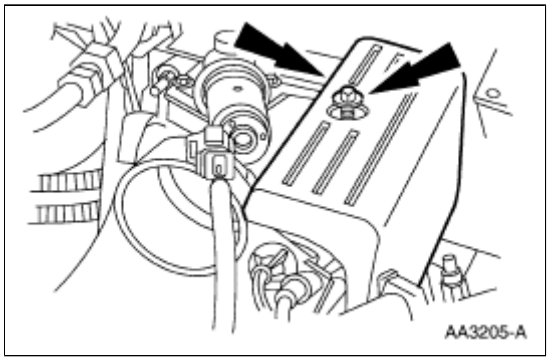
Valve Cover —RH

Removal

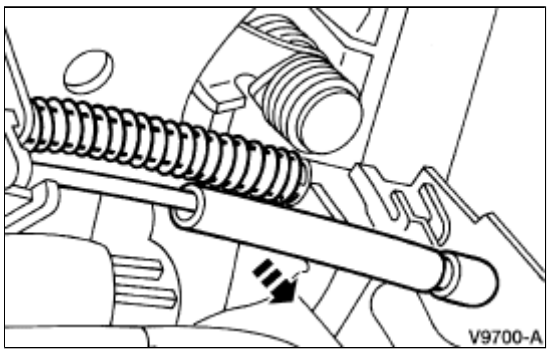
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Disconnect the idle air control (IAC) valve electrical connector.



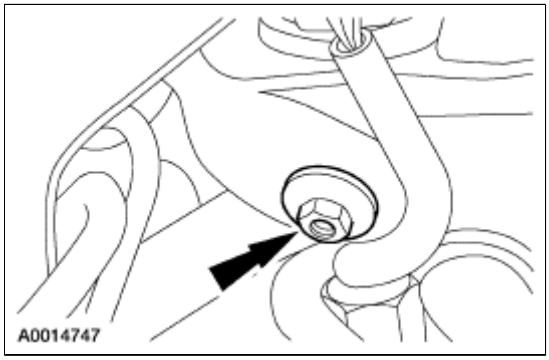
4. Remove the bolt and the accelerator control snow shield.



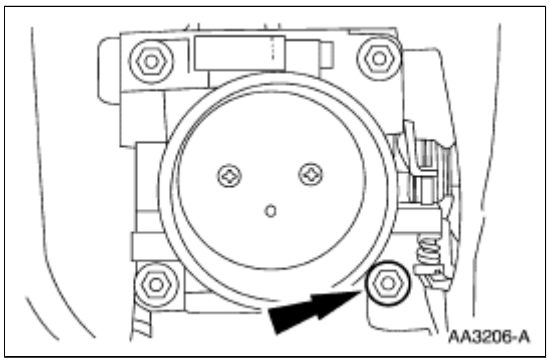
5. Disconnect the accelerator and speed control (if equipped) cables from the throttle linkage.



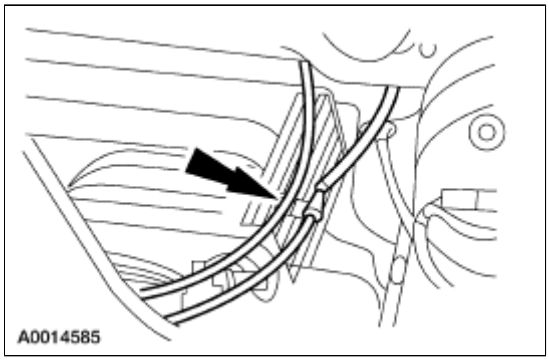
6. Remove the accelerator cable bracket nut.



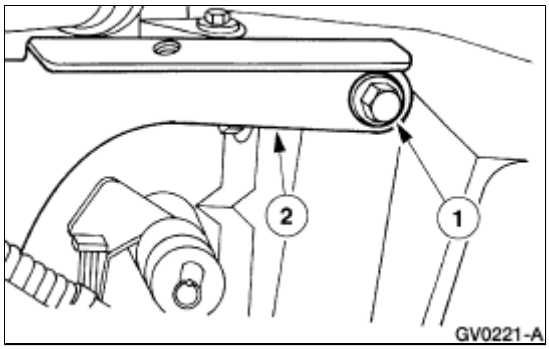
7. Remove the accelerator cable bracket lower nut.



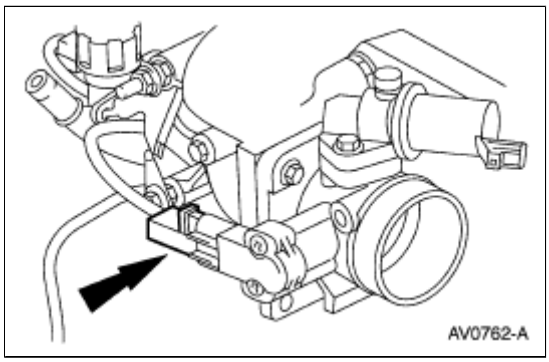
8. Remove the accelerator and speed control (if equipped) cables from the clip.



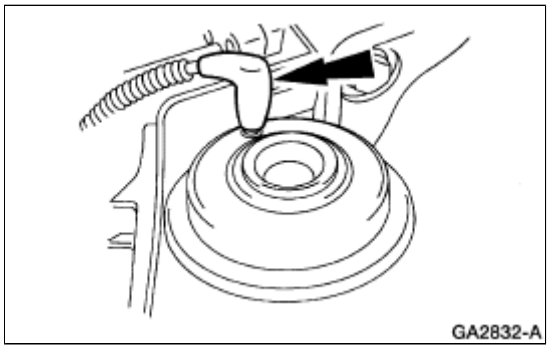
9. Remove the accelerator cable bracket.
    1. Remove the nut.
    2. Remove the accelerator cable bracket.



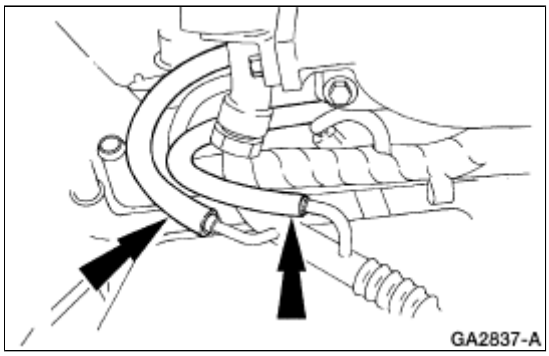
10. Disconnect the throttle position (TP) sensor electrical connector.



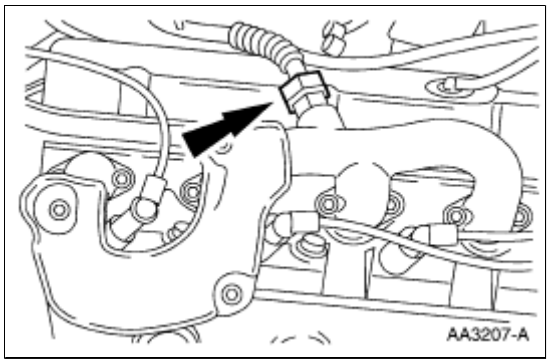
11. Remove the EGR vacuum connector.



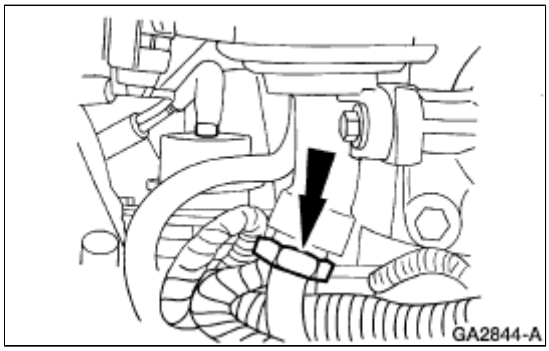
12. Disconnect the two pressure transducer hoses.



13. Disconnect the lower EGR valve-to-exhaust manifold tube fitting.

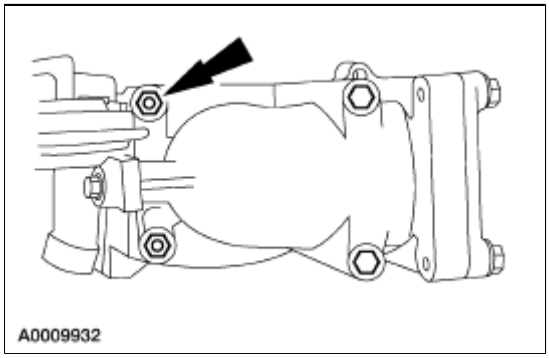


14. Disconnect the upper EGR valve-to-exhaust manifold tube fitting and remove the EGR valve to exhaust manifold tube.



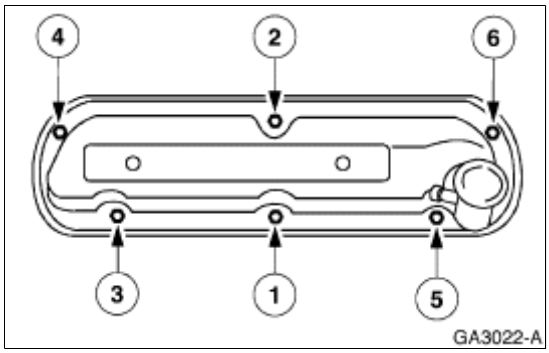
15. **NOTE:** Rear EGR spacer studs must be removed prior to EGR spacer removal. Use two nuts tightened against one another to remove the studs.

    Remove the EGR spacer bolts, nuts and the EGR spacer.



16. Disconnect the RH number 4 spark plug wire.

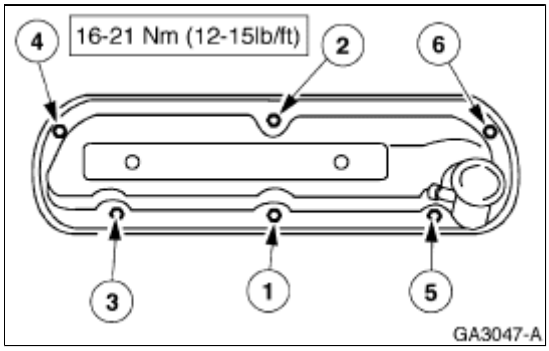
17. Remove the bolts and the RH valve cover.



Installation

1. **NOTE:** Make sure stamping and chamfered edges of the steel carrier in the new RH valve cover gasket are facing up.

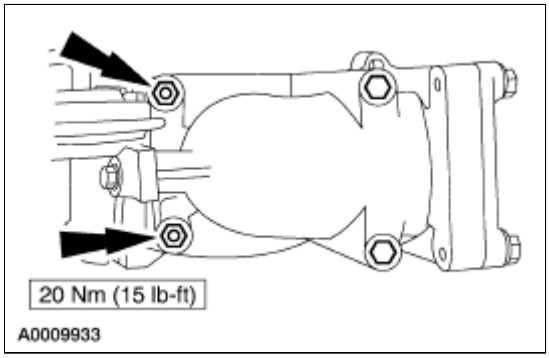
   Install RH valve cover.



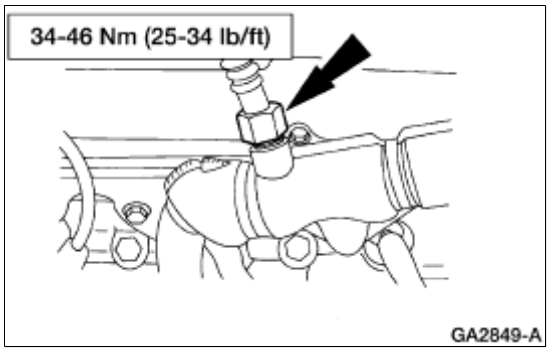
2. **CAUTION: Clean the EGR spacer and throttle body gasket surfaces with Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A and a Teflon® or hardwood scraper. Avoid the use of metal scraper or abrasive materials when removing old gasket material, or possible vacuum and EGR passage leaks may result.**

   On early models, install the EGR spacer gasket.

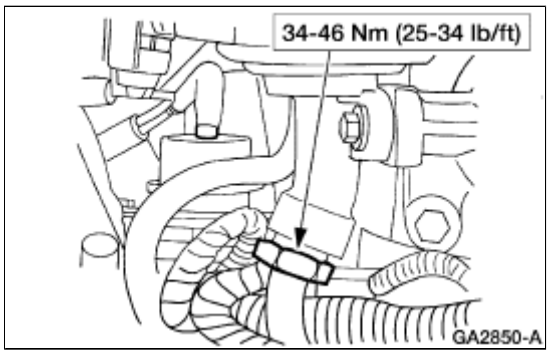
3. Install the EGR spacer, bolts, and the nuts.



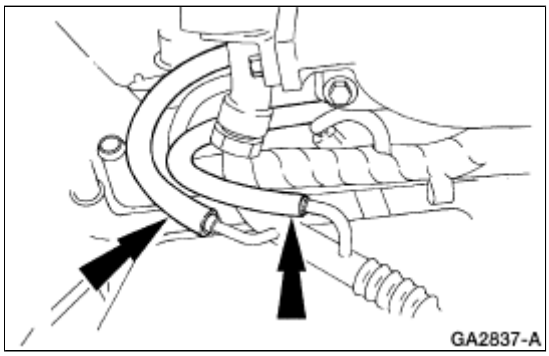
4. Connect the lower EGR valve-to-exhaust manifold tube nut.



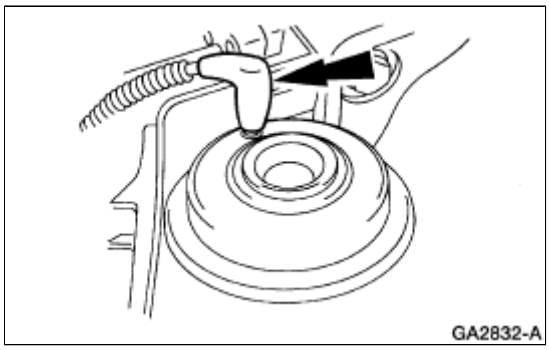
5. Connect the upper EGR valve-to-exhaust manifold tube nut.



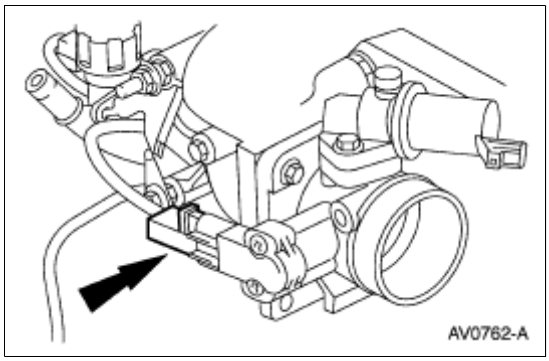
6. Connect the two EGR pressure transducer hoses.



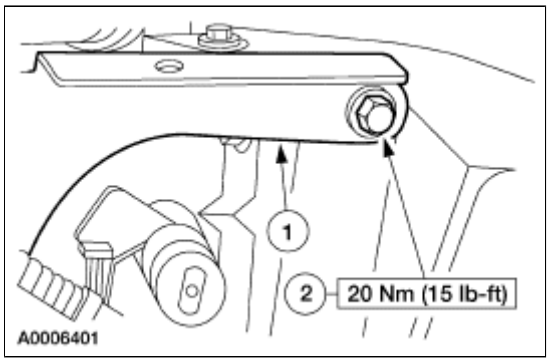
7. Connect the EGR valve vacuum connector.



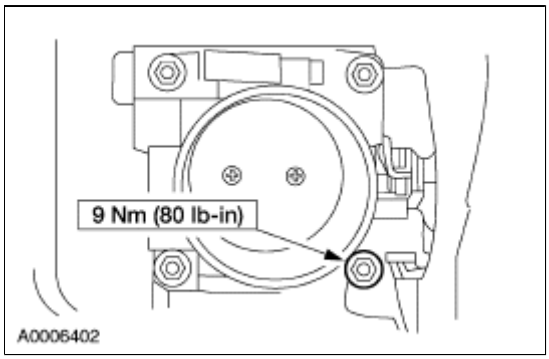
8. Connect the throttle position (TP) sensor electrical connector.



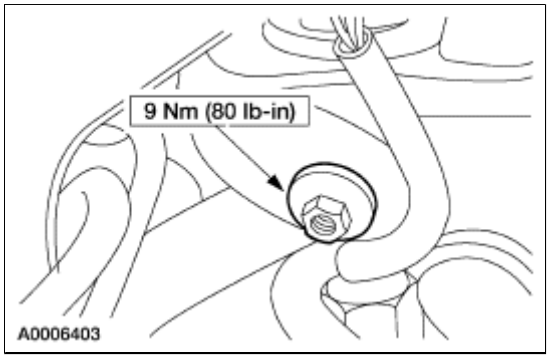
9. Install the accelerator cable bracket.
    1. Position the accelerator cable bracket.
    2. Install the bolt.



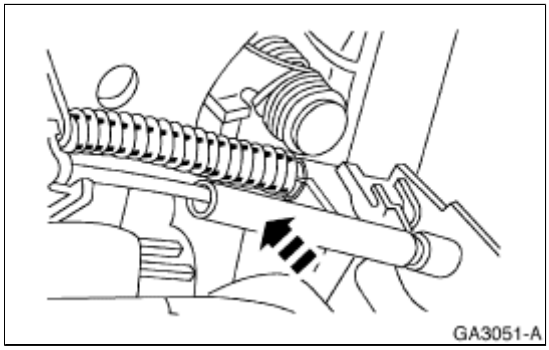
10. Install the accelerator cable bracket lower nut.



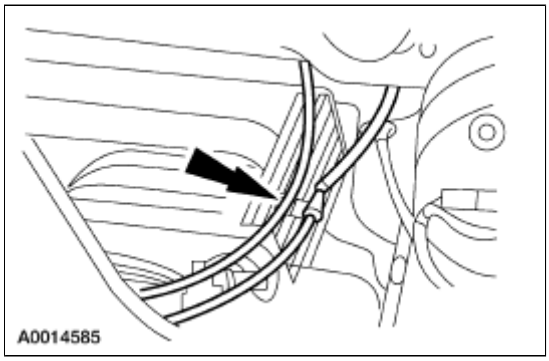
11. Install the accelerator cable bracket nut.



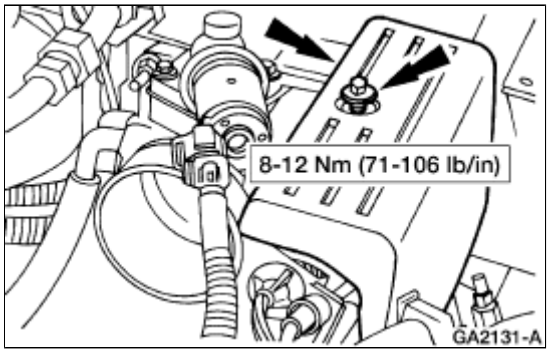
12. Connect the accelerator and speed control (if equipped) cables to the throttle linkage.



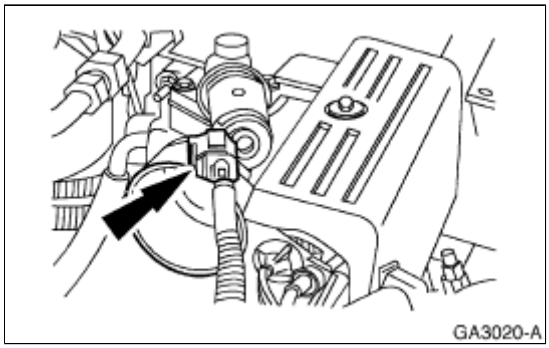
13. Position the accelerator and speed control (if equipped) cables into the clip.



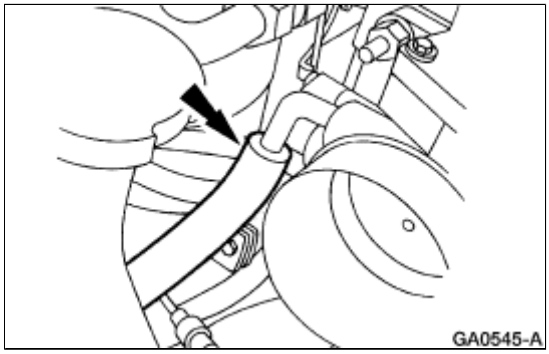
14. Install the accelerator control splash shield.



15. Connect the idle air control (IAC) valve electrical connector.



16. Connect the PCV hose to the throttle body.



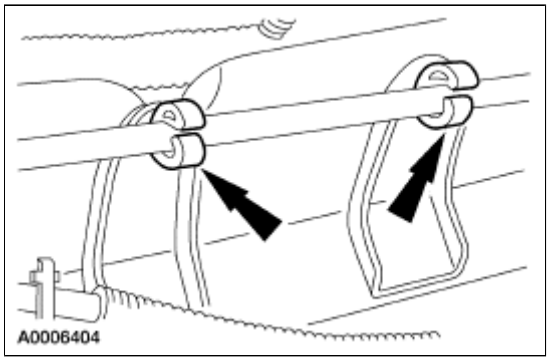
17. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

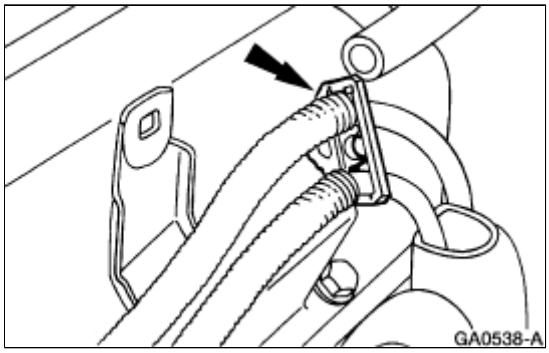
Valve Cover —LH

Removal

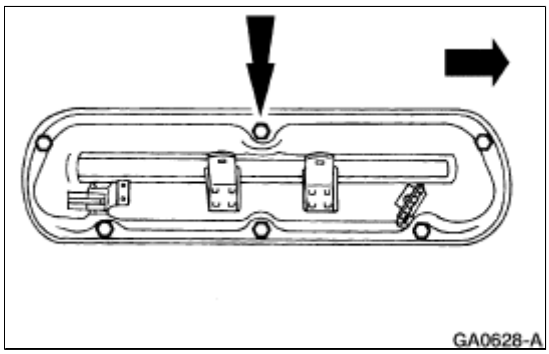
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.
2. Disconnect the fuel line. For additional information, refer to Section 310-00 .
3. Disconnect the fuel line from the LH valve cover and position aside.



4. Disconnect the spark plug wires from the LH valve cover.



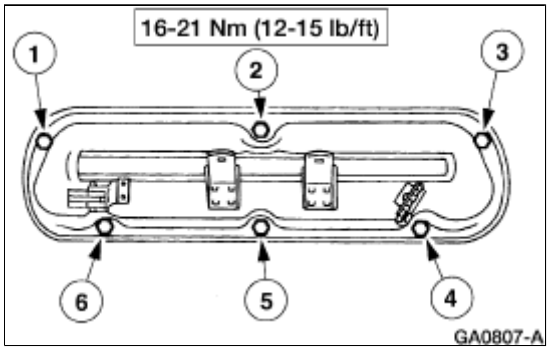
5. Remove the bolts and LH valve cover.



Installation

1. **NOTE:** Make sure the stamping and chamfered edges of the steel carrier in the new LH valve cover gasket are facing up.

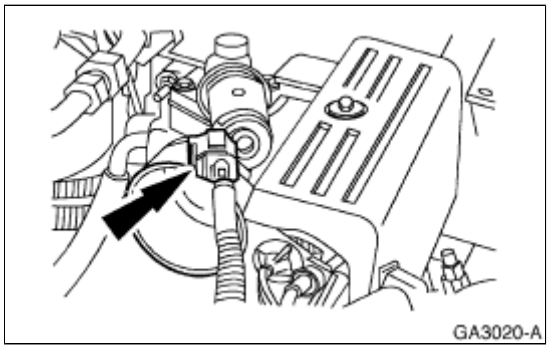
   To install, reverse the removal procedure.



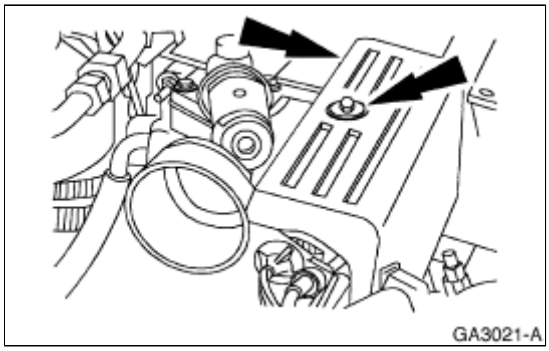
Intake Manifold —Upper

Removal

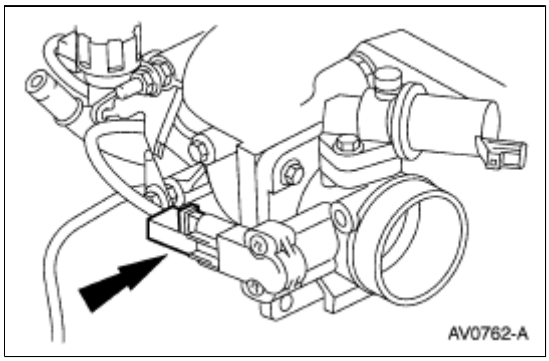
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Disconnect the idle air control (IAC) electrical connector.



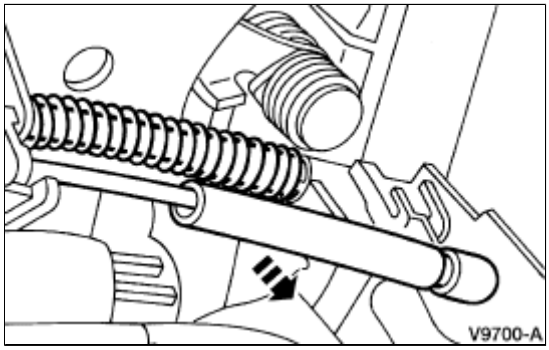
4. Remove the bolt and the accelerator control splash shield.



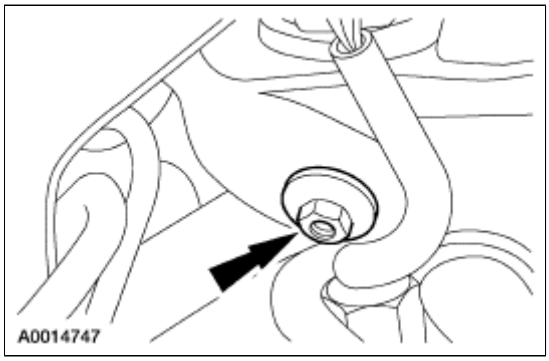
5. Disconnect the throttle position (TP) sensor electrical connector.



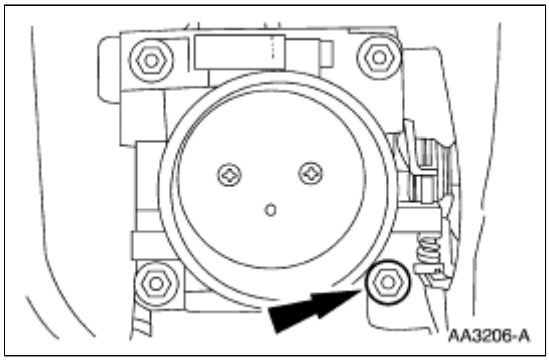
6. Disconnect the accelerator and speed control (if equipped) cables from the throttle linkage.



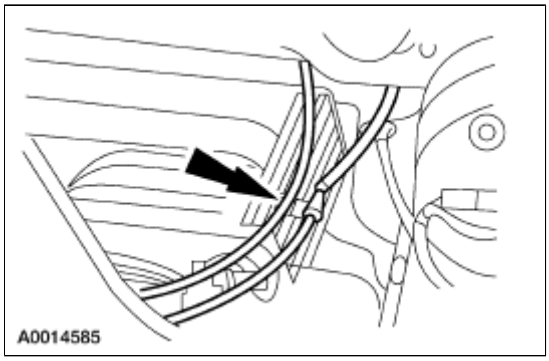
7. Remove the accelerator cable bracket nut.



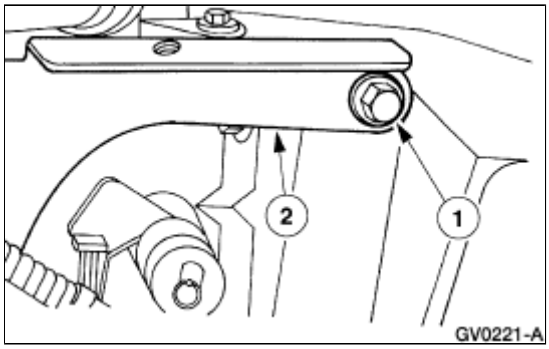
8. Remove the lower accelerator cable bracket nut.



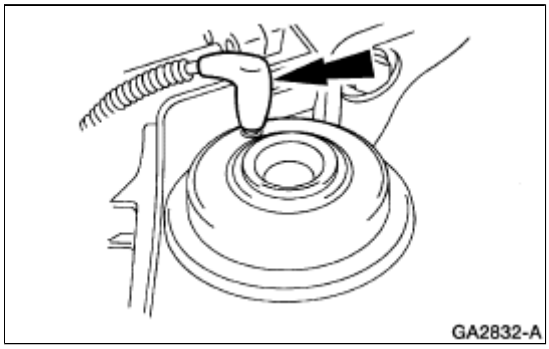
9. Remove the accelerator and speed control (if equipped) cables from the clip.



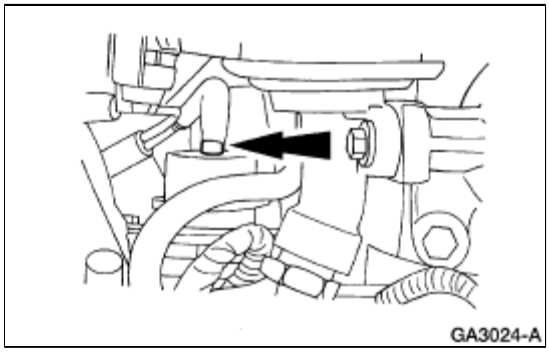
10. Remove the accelerator cable bracket.
    1. Remove the nut.
    2. Remove the accelerator cable bracket.



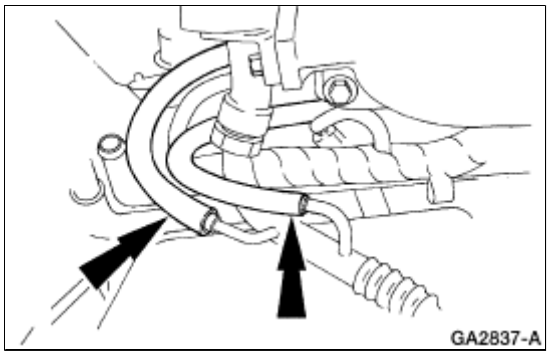
11. Disconnect the EGR valve vacuum connector.



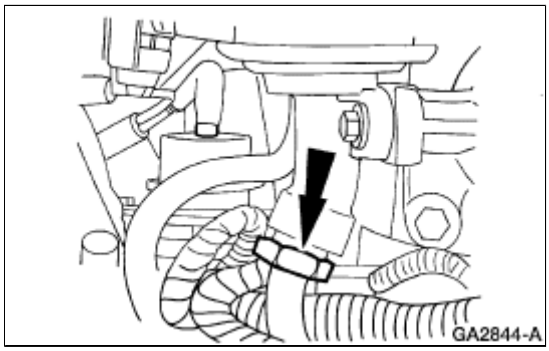
12. Disconnect the fuel pressure regulator vacuum connection.



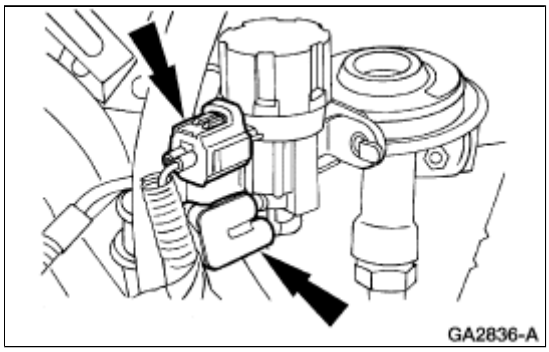
13. Disconnect the two pressure transducer hoses.



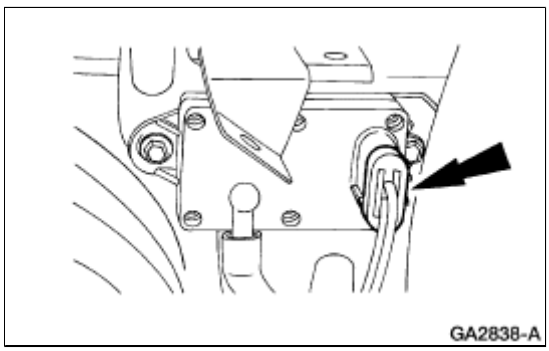
14. Disconnect the upper EGR valve-to-exhaust manifold tube fitting.



15. Disconnect the following connections:
    - Engine vacuum regulator (EVR) electrical connector
    - EVR vacuum connector

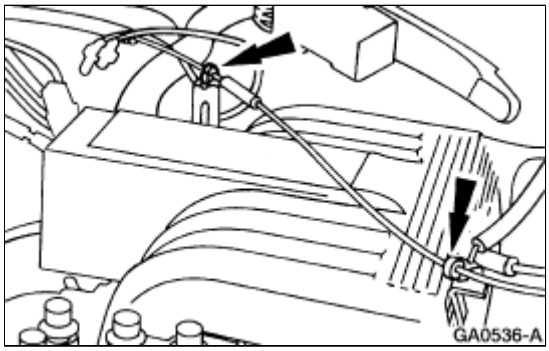


16. Disconnect the EGR backpressure transducer electrical connector.

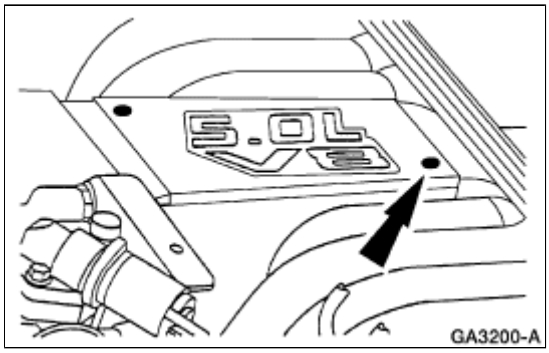


17. Remove the ignition coil bracket. For additional information, refer to Section 303-07C .

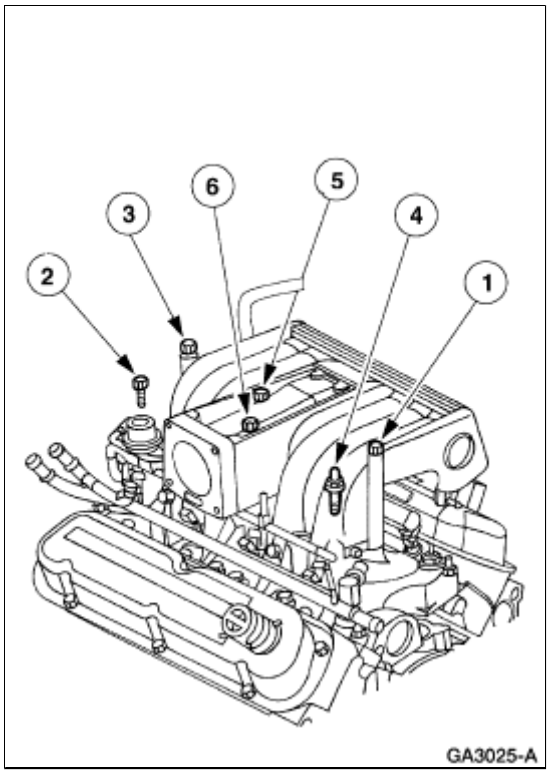
18. Disconnect the accelerator cable from the upper intake manifold clips.



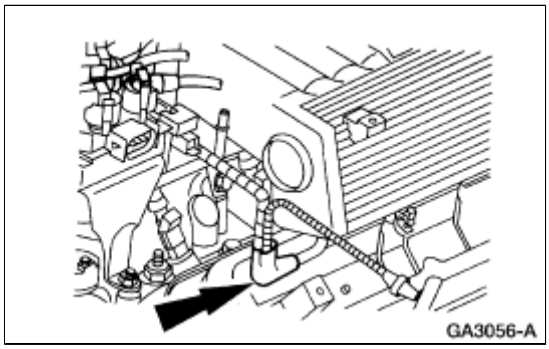
19. Remove the screws and the intake cover plate.



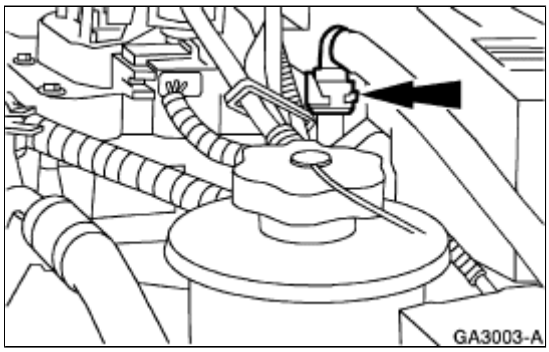
20. Remove the bolts in the sequence shown.



21. Disconnect the two vacuum connections from the front of the intake manifold.

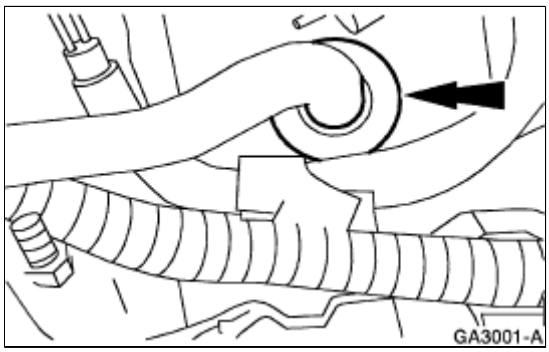


22. Disconnect the vapor management valve (VMV) purge line.



23. Disconnect the brake booster vacuum supply line at the LH rear upper intake connection.

24. Disconnect the positive crankcase ventilation (PCV) hose, and the two PCV heater hoses.



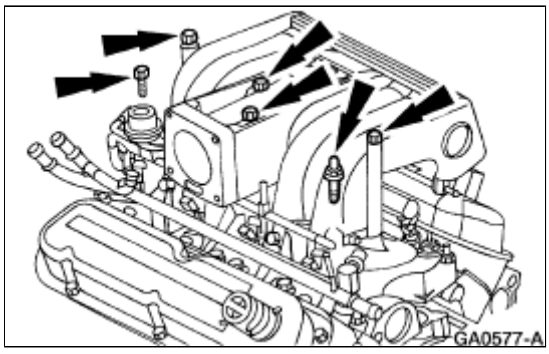
25. Remove the upper intake manifold and discard the old gasket.

Installation

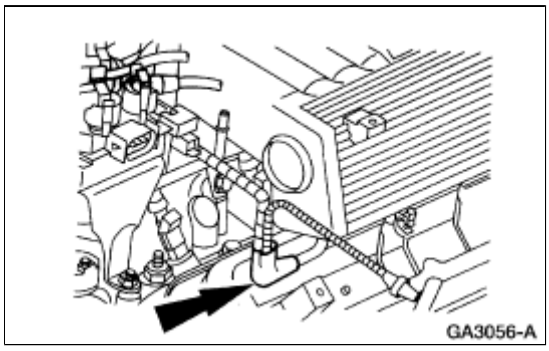
1. **NOTE:** Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A and a suitable plastic or wooden scraper to clean the upper and lower intake manifold gasket surfaces.

   Clean and inspect all surfaces, install new seals and gaskets.

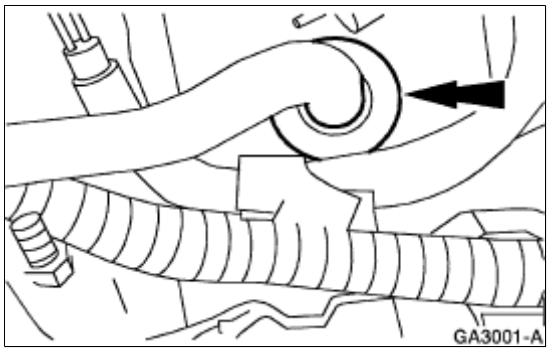
2. Position the upper intake manifold and gasket and start the bolts.



3. Connect the two upper intake vacuum connections.

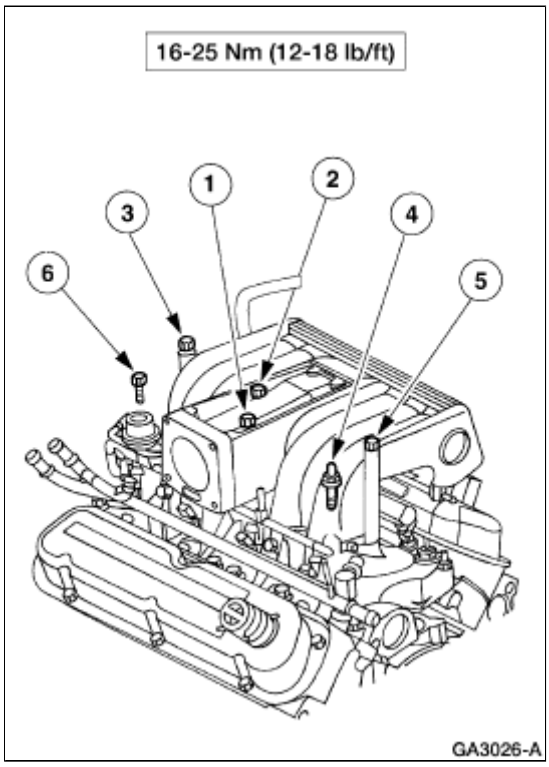


4. Connect the positive crankcase ventilation (PCV) tube, and the two PCV heater hoses.

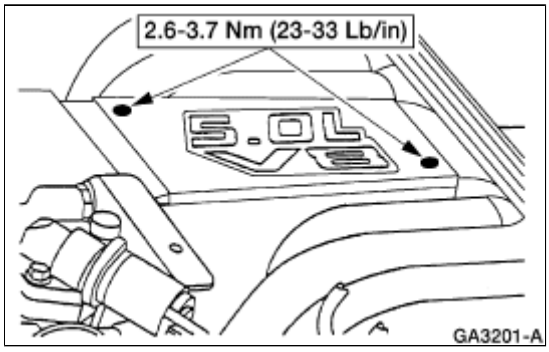


5. Connect the vacuum supply line to the brake booster at the LH rear upper intake connection.

6. Tighten the bolts in the sequence shown.

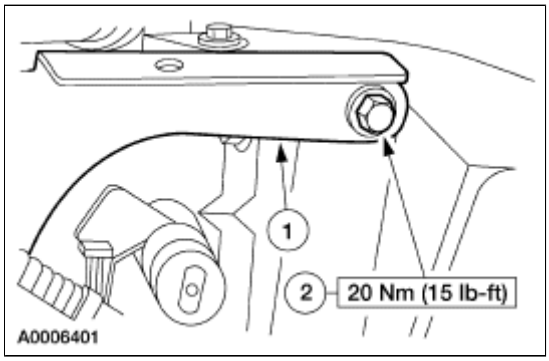


7. Install the upper intake manifold cover plate and tighten the screws.

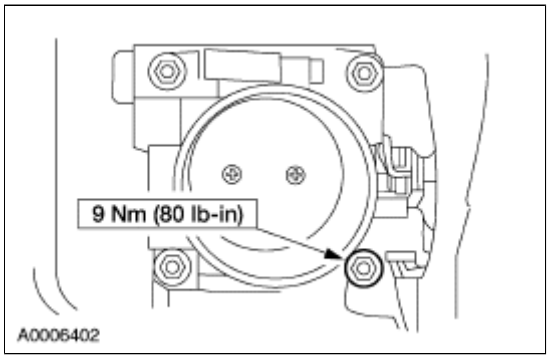


8. Install the accelerator cable bracket.

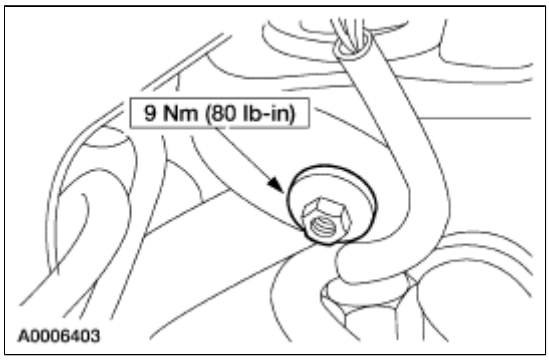
1. Position the accelerator cable bracket.
2. Install the bolt.



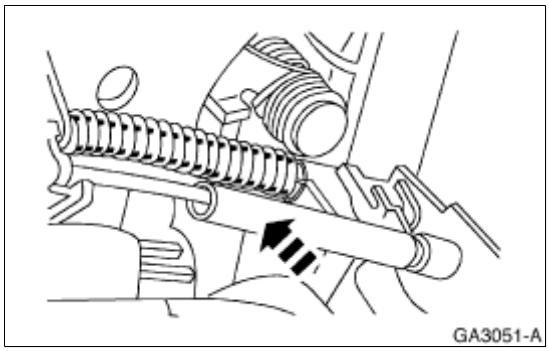
9. Install the lower accelerator cable bracket nut.



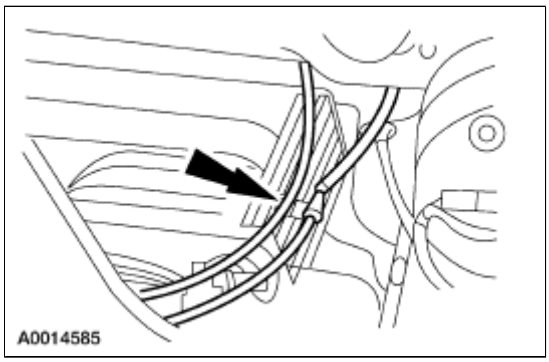
10. Install the accelerator cable bracket nut.



11. Connect the accelerator and speed control (if equipped) cables to the throttle linkage.

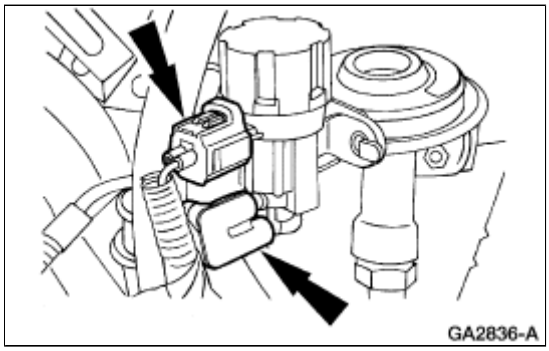


12. Position the accelerator and speed control (if equipped) cables into the clip.

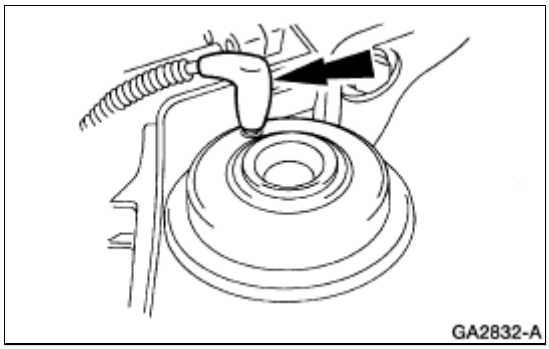


13. Install the ignition coils and the ignition coil bracket. For additional information, refer to Section 303-07C .

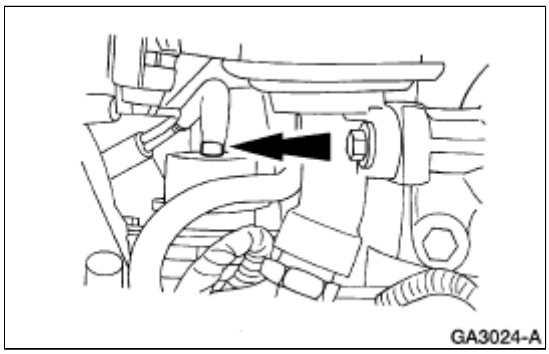
14. Connect the following connections:
    - Engine vacuum regulator (EVR) electrical connector
    - EVR vacuum connector



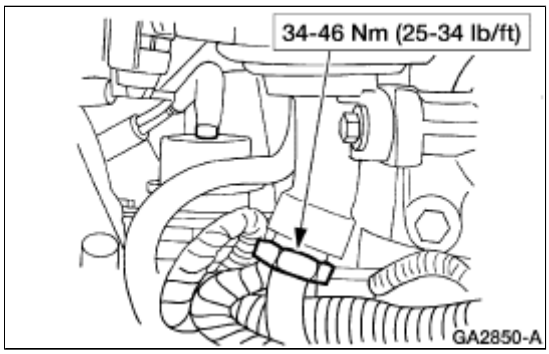
15. Connect the EGR valve vacuum connector.



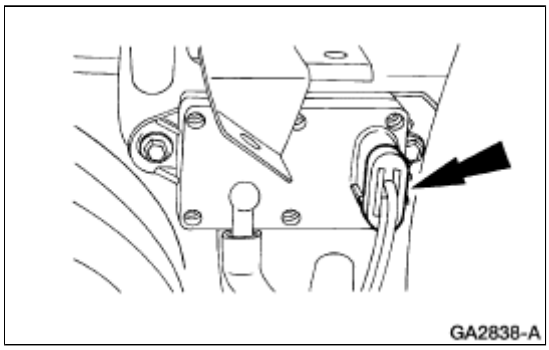
16. Connect the fuel pressure regulator vacuum connector.



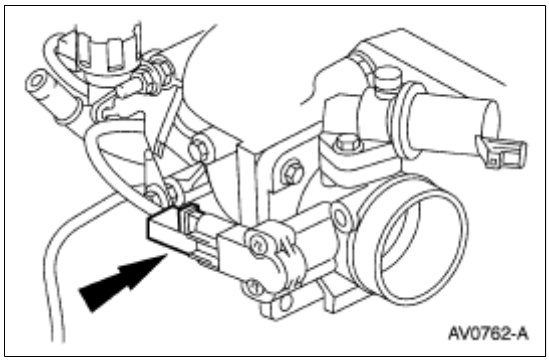
17. Connect the upper EGR valve-to-exhaust manifold tube connection.



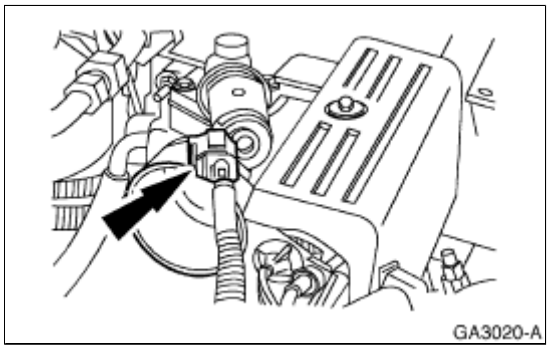
18. Connect the EGR backpressure transducer electrical connection.



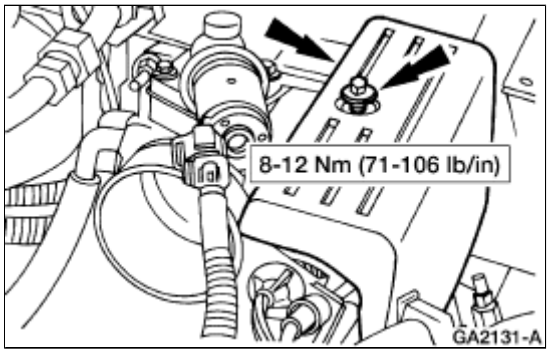
19. Connect the TP sensor electrical connector.



20. Connect the IAC electrical connector.



21. Install the accelerator control splash shield.



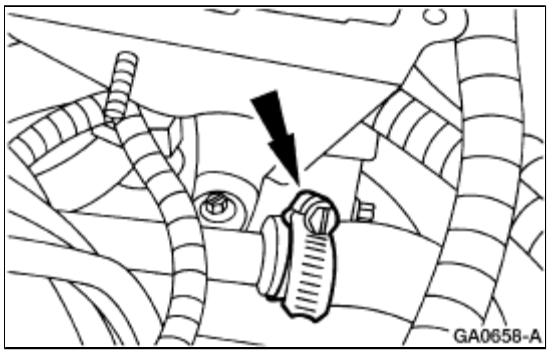
22. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

23. Connect the battery ground cable. For additional information, refer to Section 414-01 .

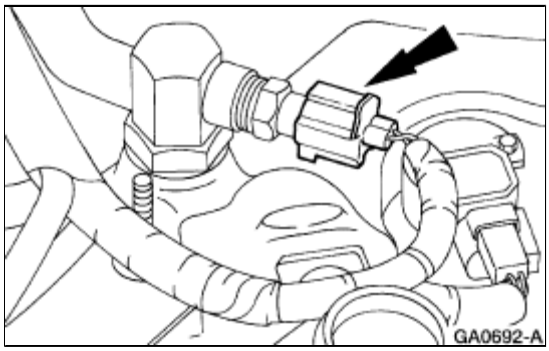
Intake Manifold —Lower

Removal

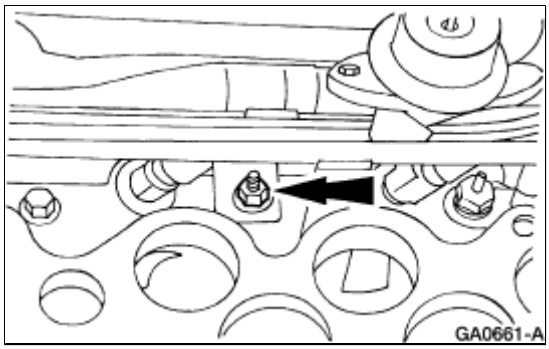
1. Drain the engine cooling system. For additional information, refer to Section 303-03 .
2. Disconnect the radiator overflow hose and position aside.
3. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.
4. Disconnect the water bypass hose from the water heater tube.



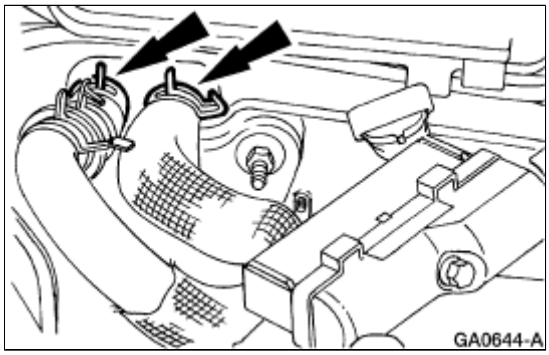
5. Disconnect the engine coolant temperature (ECT) electrical connector.



6. Remove the wire harness retainer nut.

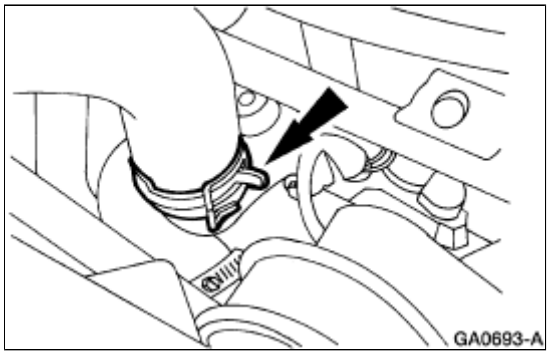


7. Disconnect the heater water hoses.

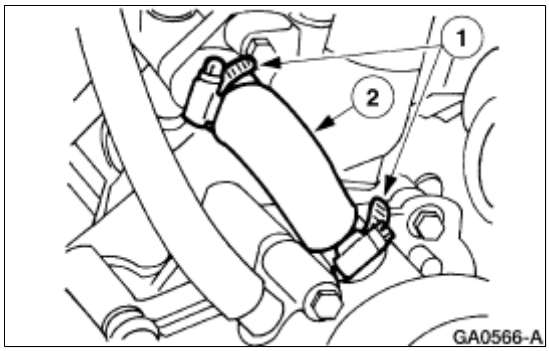


8. Disconnect the two PCV heater hoses from the water heater tube

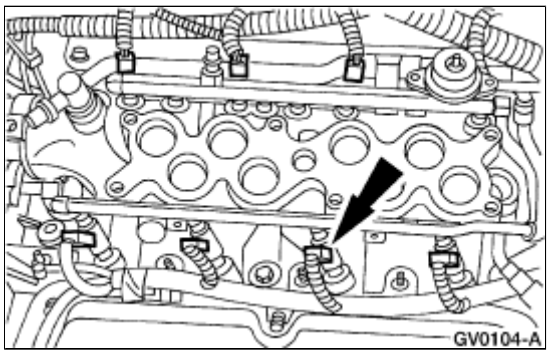
9. Disconnect the upper radiator hose.



10. Remove the water bypass hose.
    1. Loosen the water bypass hose clamps.
    2. Remove the water bypass hose.

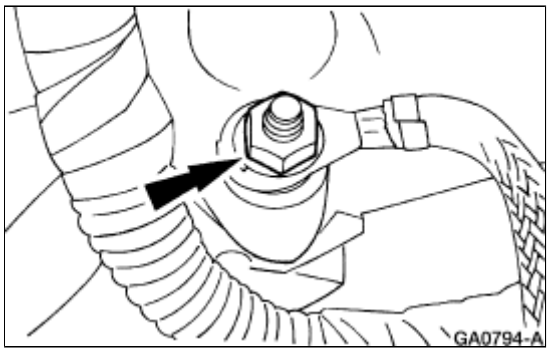


11. Disconnect the eight fuel injector electrical connectors.

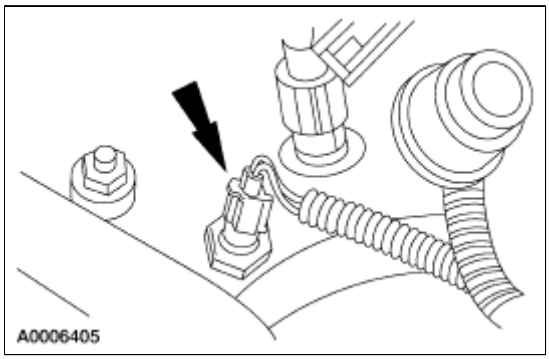


12. Disconnect the fuel line. For additional information, refer to Section 310-00 .

13. Disconnect the ground strap at the rear of the lower intake manifold.

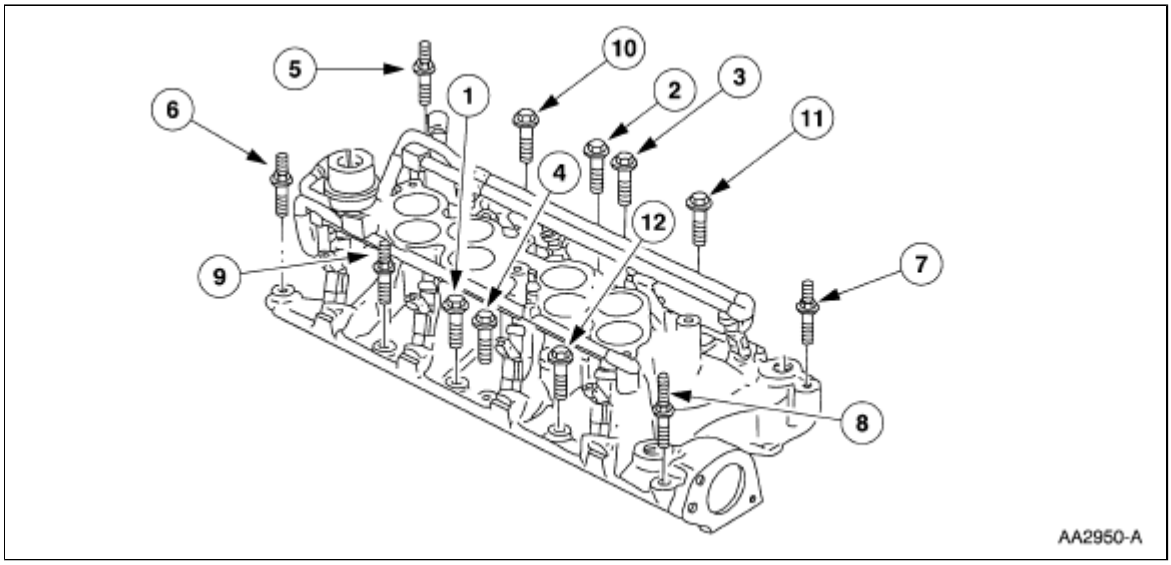


14. Disconnect the water temperature indicator sender electrical connector.

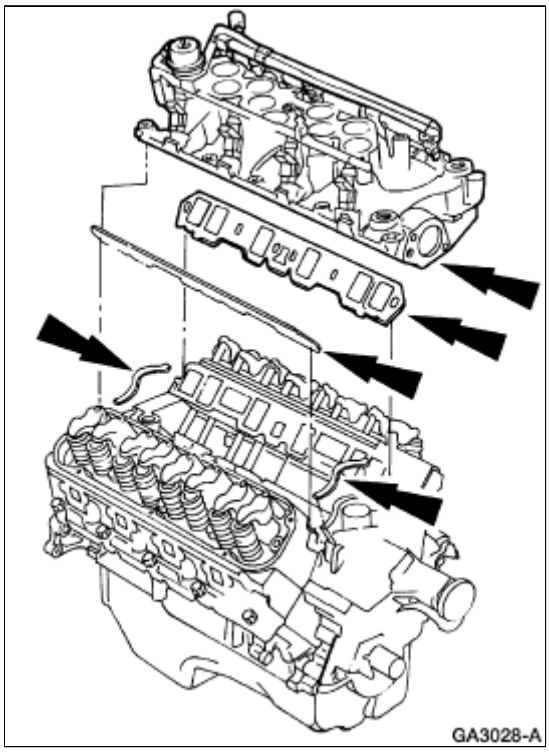


15. Remove the camshaft position (CMP) sensor and the camshaft synchronizer. For additional information, refer to Section 303-14 .

16. Remove the bolts.



17. Remove the lower intake manifold and discard the lower gasket.

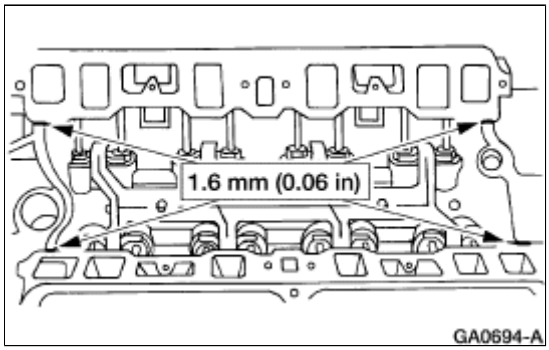


Installation

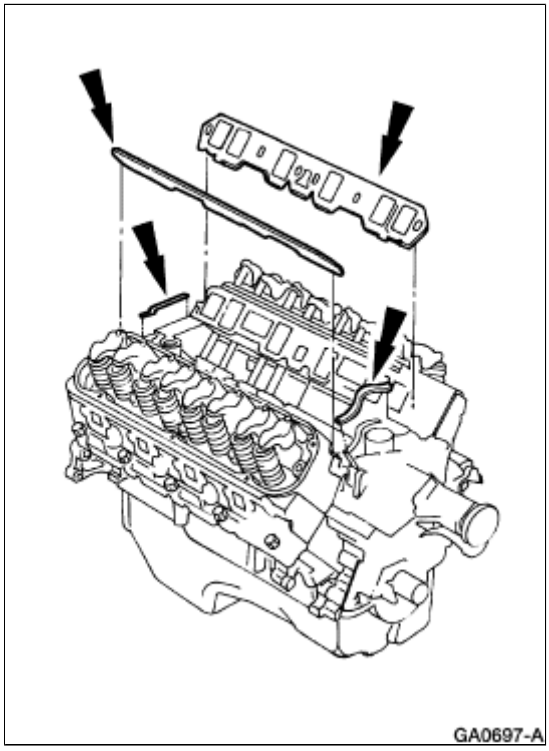
1. **NOTE:** Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A to clean the gasket surfaces of the lower intake manifold, cylinder heads, and the cylinder block.

Apply a 1.6mm (0.06) bead of sealer in the corners where the cylinder head and cylinder block meet.

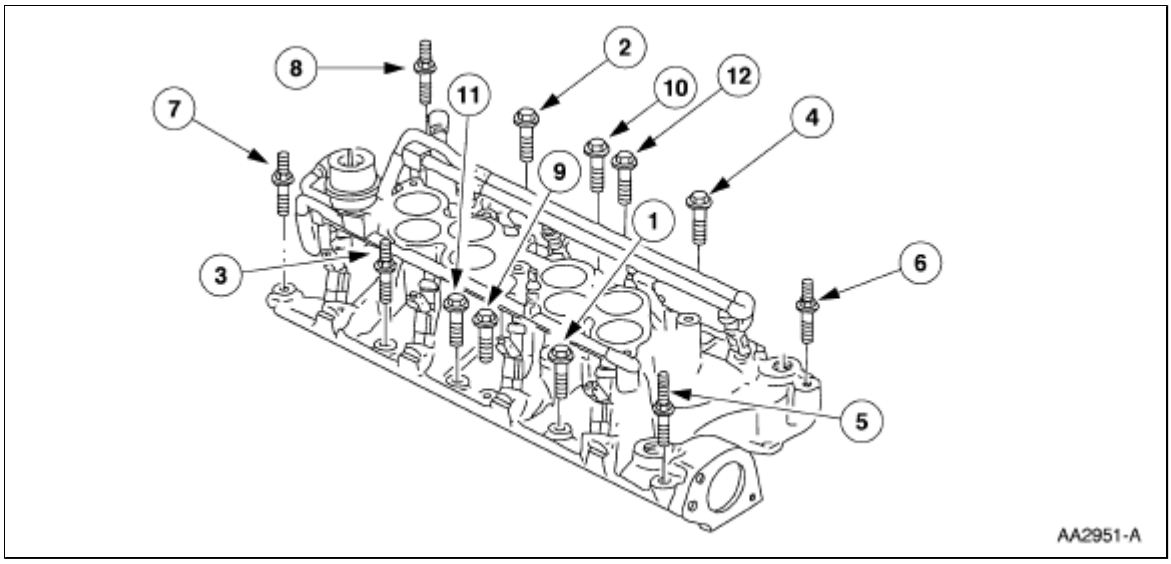
- Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



2. Position the four lower gaskets.
   - Install the intake manifold seal tabs to notch in the lower intake manifold gaskets.
   - Press firmly along the entire length of the intake manifold seal until silicone sealant is visible.



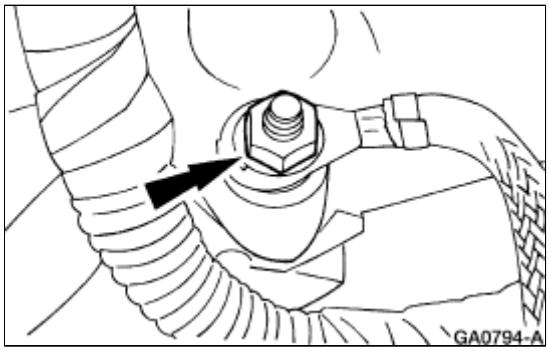
3. Position the lower intake manifold and start the bolts.



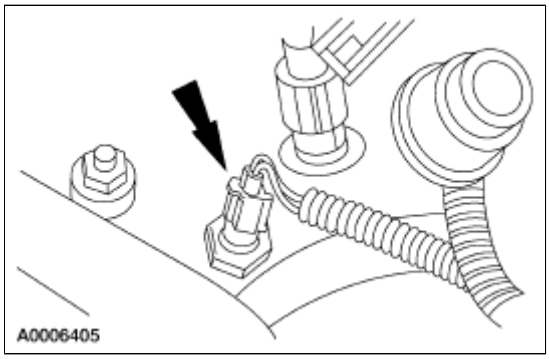
4. Tighten the lower intake manifold in two steps.
   - Step 1: Tighten to 10 Nm (89 lb-in).
   - Step 2: Tighten to 32 Nm (24 lb-ft).

5. Install the camshaft position (CMP) sensor and the camshaft synchronizer. For additional information, refer to Section 303-14 .

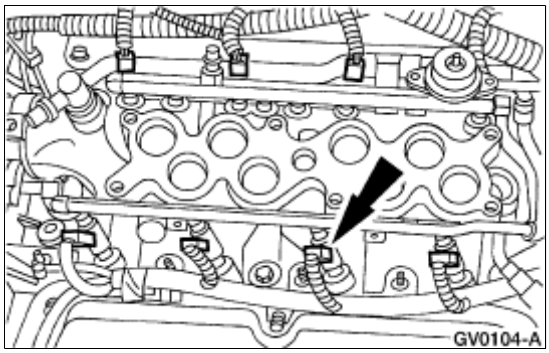
6. Connect the rear ground strap to the rear of the lower intake manifold.



7. Connect the water temperature indicator sender electrical connector.

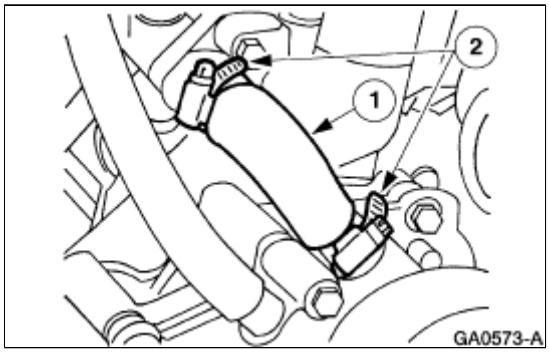


8. Connect the eight fuel injector electrical connectors.

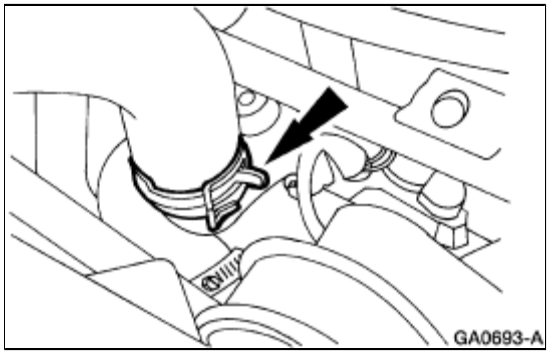


9. Reconnect the fuel line. For additional information, refer to Section 303-00 .

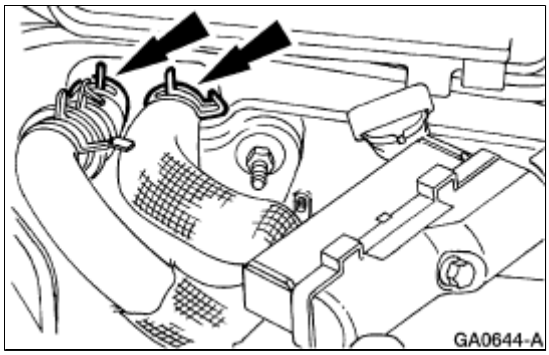
10. Install the water bypass hose.
    1. Position the water bypass hose.
    2. Install the two clamps.



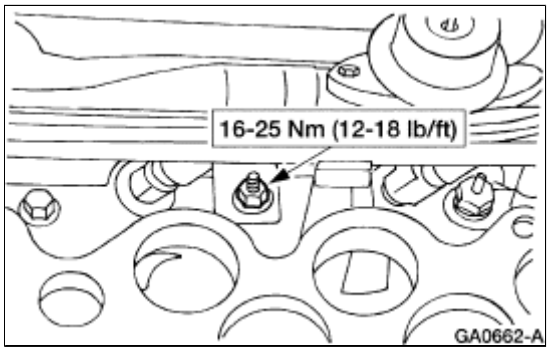
11. Connect the upper radiator hose.



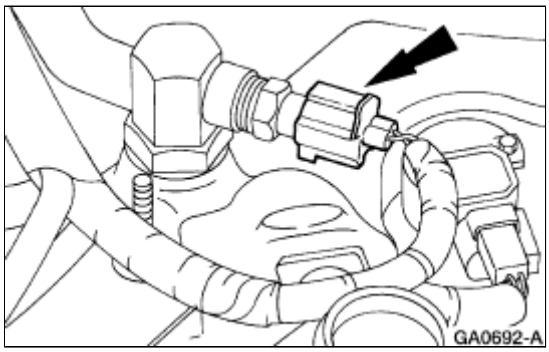
12. Connect the heater water hoses.



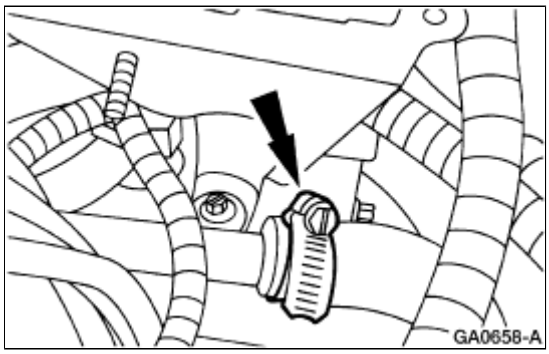
13. Install the wire harness retainer nut.



14. Connect the engine coolant temperature (ECT) electrical connector.



15. Connect the water heater bypass hose to the heater tube.



16. Connect the two PCV heater hoses to the heater tube.

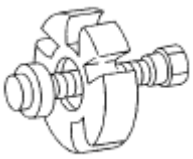
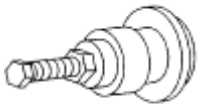
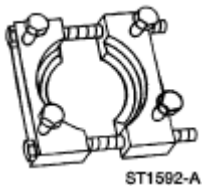
17. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

18. Connect the radiator overflow hose.

19. Fill the engine cooling system. For additional information, refer to Section 303-03 .

Crankshaft Pulley

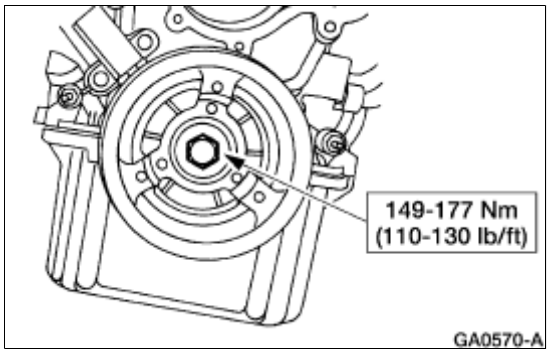
Special Tool(s)

 ST1286-A	Crankshaft Damper Remover 303-009 (T58P-6316-D)
 ST1328-A	Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)
 ST1592-A	Seal Remover 303-053 (T70P-6B070-B)
ST1378-A	Damper Puller Adapter 303-176 (T82L-6316-B)

Removal and Installation

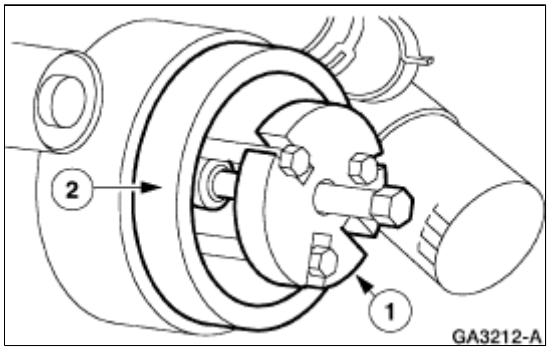
1. Remove the fan shroud. For additional information, refer to Section 303-03 .
2. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
3. **NOTE:** Use a suitable strap wrench to hold the crankshaft pulley (6312).

   Remove the bolt.

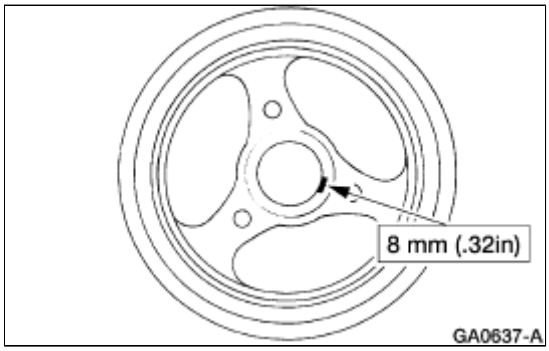


4. **NOTE:** The jackscrew from Damper Puller Adapter must be used with Crankshaft Damper Remover.

   Use Crankshaft Damper Remover to remove the crankshaft pulley.
   1. Install the Crankshaft Damper Remover.
   2. Remove the crankshaft pulley.



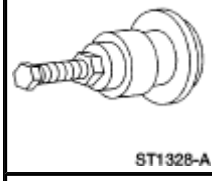
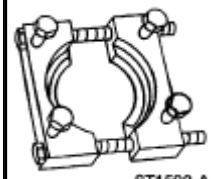
5. Apply silicone sealant to the woodruff key slot on the crankshaft pulley.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



6. To install, reverse the removal procedure.

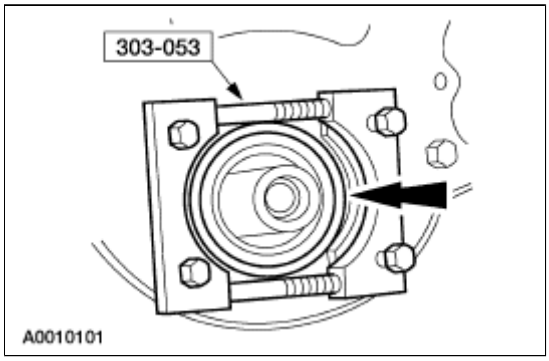
Crankshaft Front Oil Seal

Special Tool(s)

 ST1328-A	Crankshaft Seal Installer 303-335 (T88T-6701-A)
 ST1592-A	Seal Remover 303-053 (T70P-6B070-B)

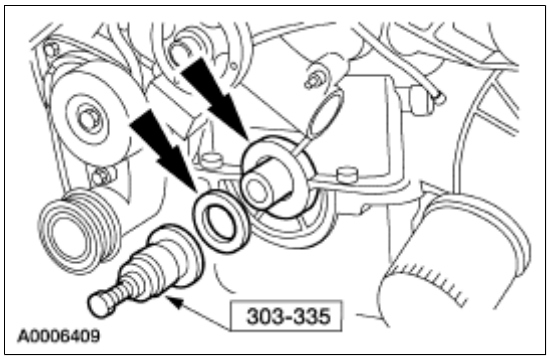
Removal

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
2. Use the special tool to remove the crankshaft front seal.



Installation

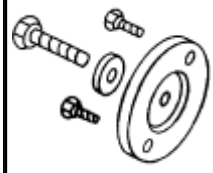
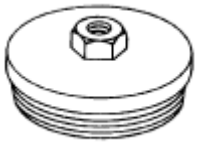
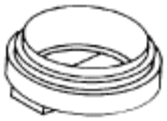
1. Install the crankshaft front seal using the special tool.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Crankshaft Rear Oil Seal

Special Tool(s)

ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1593-A	Rear Crank Shaft Adapter 303-S560 (T96T-6701-A)
 ST1382-A	Rear Crank Seal Remover 303-519 (T95P-6701-EH)
 ST1479-A	Rear Crank Seal Replacer 303-516 (T95P-6701-BH)
ST1594-A	Rear Crank Seal Replacer Spacer 303-561 (T96T-6701-B)

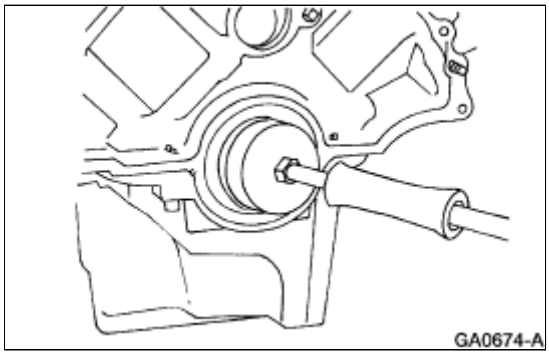
Removal

1. Remove the flywheel. For additional information, refer to Flywheel in this section.

2. **CAUTION: Avoid scratching or damaging the oil seal surfaces during removal of the crankshaft rear oil seal (6701).**

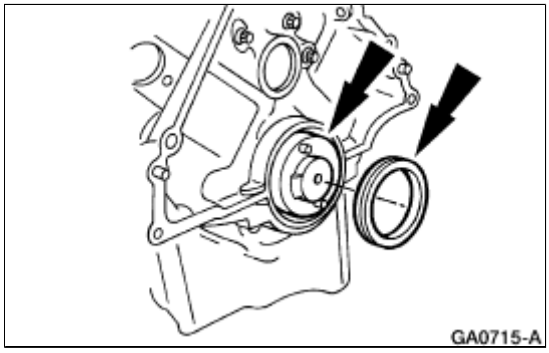
   NOTE: Be sure the crankshaft rear sealing surface is clean and free of any rust or corrosion. To clean the crankshaft rear sealing surface, use extra-fine emery cloth or extra-fine 0000 steel wool with Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A.

Use Rear Crankshaft Seal Remover and Impact Slide Hammer to remove the crankshaft rear main seal.

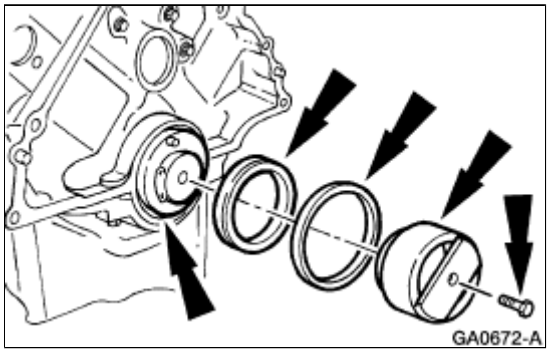


Installation

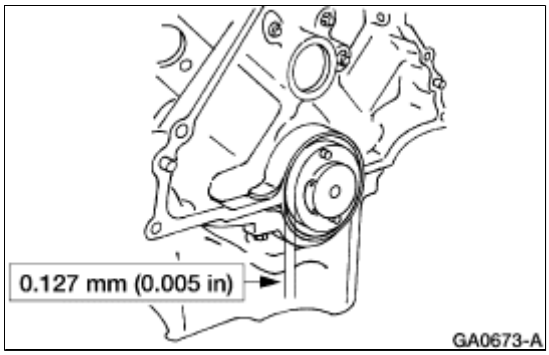
1. Lubricate the and crankshaft sealing surface.
    - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.



2. Position Rear Crank Adapter and use Rear Crank Seal Replacer Spacer and Rear Crank Seal Replacer to install the crankshaft rear oil seal.



3. Check that the crankshaft rear oil seal is within specification.

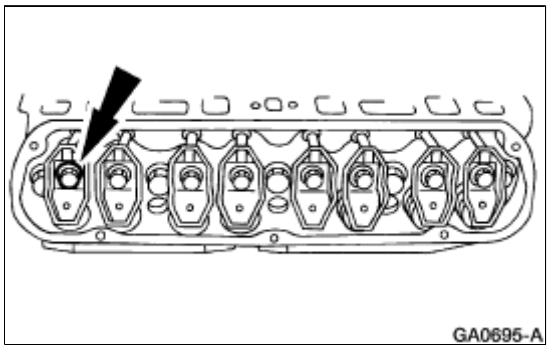


4. Install the flywheel.For additional information, refer to Flywheel in this section.

Valve Tappet

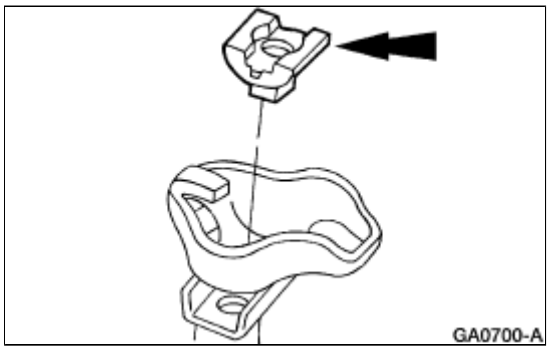
Removal

1. Remove the lower intake manifold (9424). For additional information, refer to Intake Manifold—Lower in this section.
2. Remove the valve covers (6582). For additional information, refer to Valve Cover—LH or Valve Cover—RH in this section.
3. Remove the bolts.

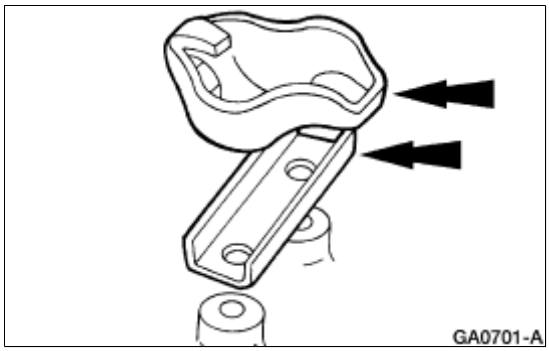


NOTE: Make sure to mark the rocker arms and the push rods so they will be installed in their original positions.

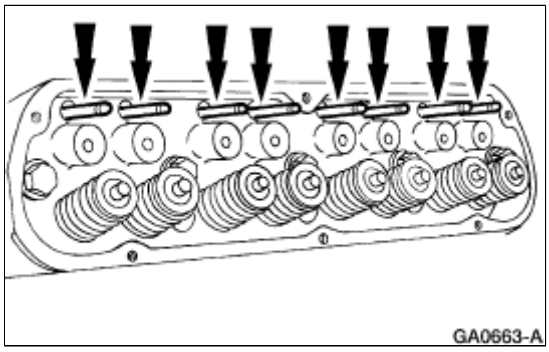
4. Remove the eight rocker arm seats (6A528).



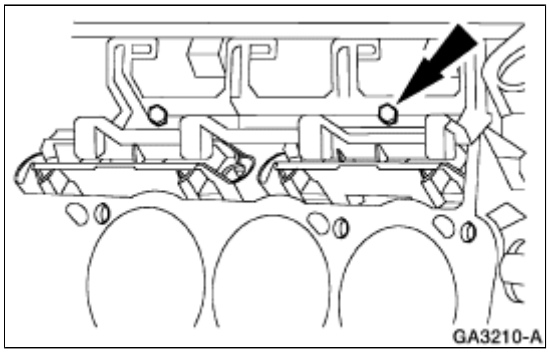
5. Remove the eight rocker arms (6564) and rocker arm fulcrum guides (6A588).



6. Remove the eight push rods (6565) and mark them so they can be reinstalled in their original positions.

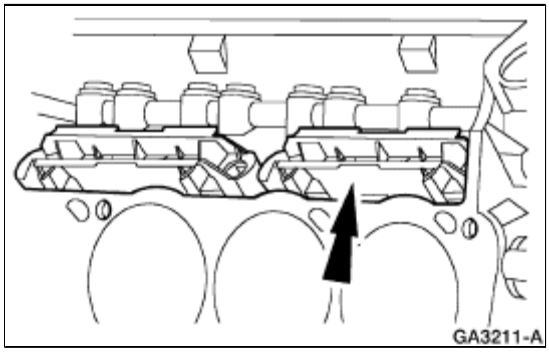


7. Remove the bolts and remove the valve tappet guide plate retainer.



8. **NOTE:** Mark the valve tappets so they can be reinstalled in their original positions.

   Remove the four valve tappet guides and the valve tappets using a valve tappet puller.

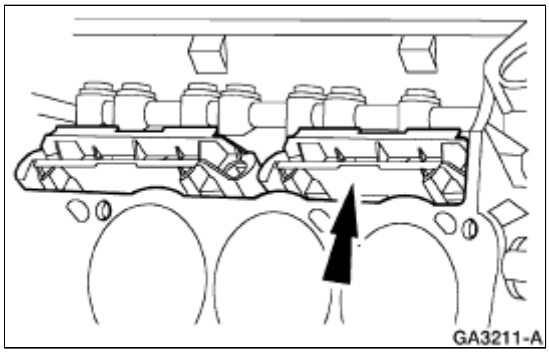


9. Inspect the valve tappets (6500). For additional information, refer to Section 303-00 .

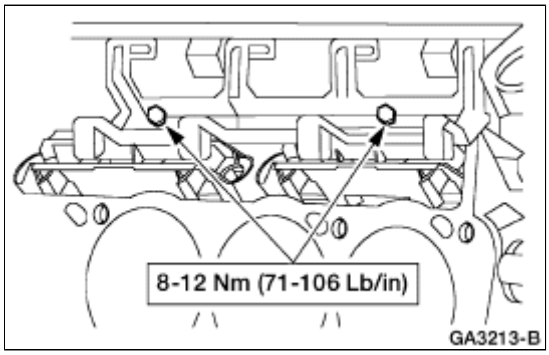
Installation

1. Lubricate the valve tappet bores before installing the valve tappets.
   - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

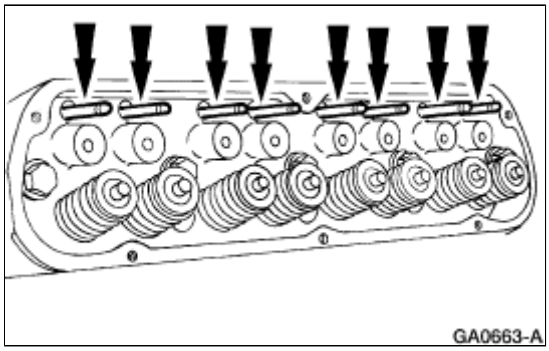
2. Install the valve tappets and the valve tappet guide plates in their original positions.



3. Position the valve tappet guide plate retainer and install the bolts.

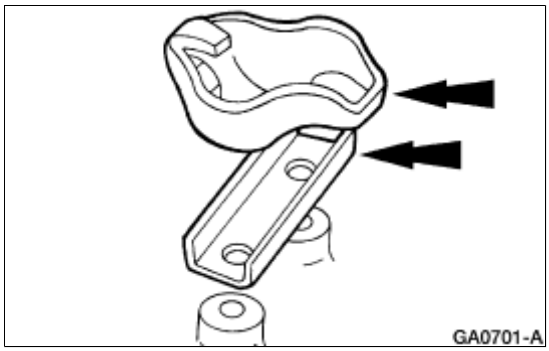


4. Install the push rods in the original location.

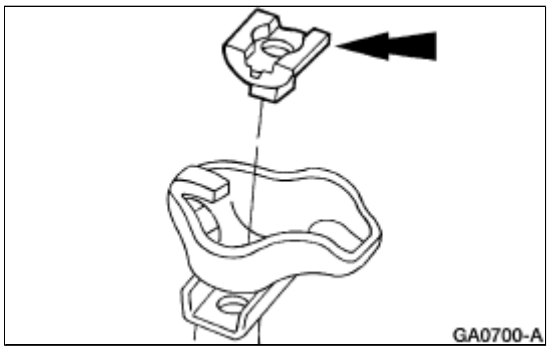


5. Apply engine oil to the top of the valve stem, rocker arm seats, and rocker arms.
   - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

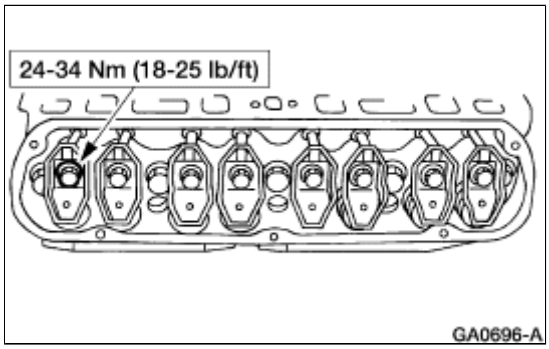
6. Install the eight rocker arms and rocker arm fulcrum guides.



7. Install the eight rocker arm seats.



8. Install the bolts.



9. Check the valve clearance. For additional information, refer to Section 303-00 .

10. Install the valve cover on the side that is being repaired. For additional information, refer to Valve Cover—RH and Valve Cover—LH in this section.

11. Install the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.

Valve Spring

Removal

1. Remove the rocker arm of the valve to be repaired. For additional information, refer to Valve Tappet in this section.

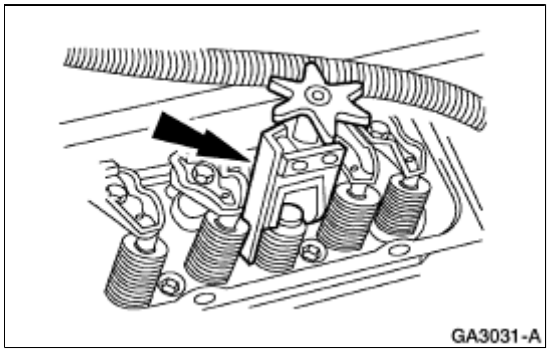
2. Position the piston at top dead center (TDC).

3. Remove the spark plugs. For additional information, refer to Section 303-07C .

4. **CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.**

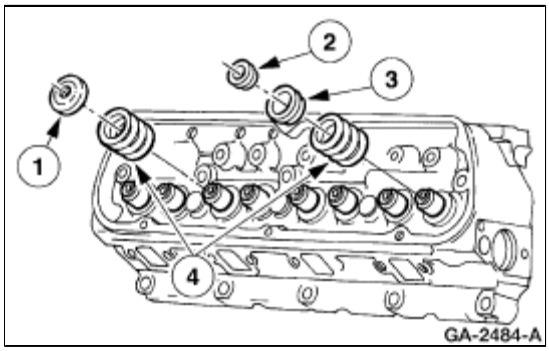
   Install compressed air in the cylinder to hold both valves in position.

5. Use a suitable valve spring compressor, remove the valve spring retainer key.



NOTE: Mark the location of the parts so they can be installed in their original positions.

6. Remove the valve springs.
   1. Remove the valve spring rotator (exhaust).
   2. Remove the valve spring retainer sleeve (intake).
   3. Remove the valve spring retainer (intake).
   4. Remove the valve springs.

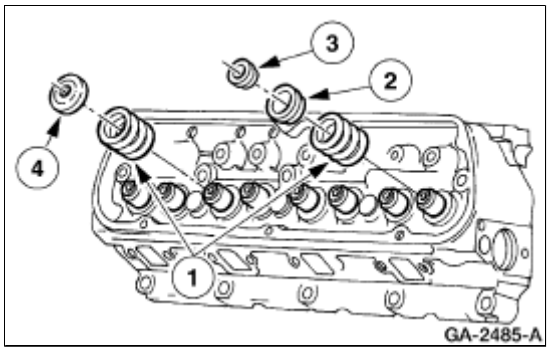


7. Check the valves and valve springs. For additional information, refer to Section 303-00 .

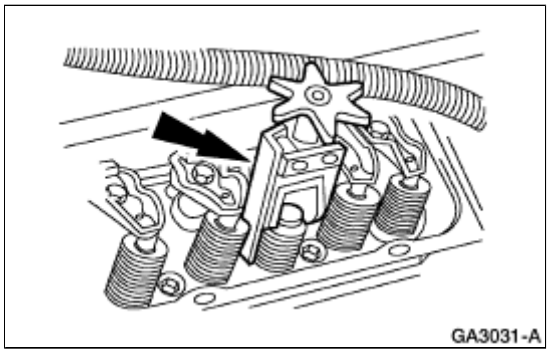
Installation

1. Lubricate the valve stem.
   - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

2. Install the valve springs.
   1. Install the valve springs.
   2. Install the valve spring retainer (intake).
   3. Install the valve spring retainer sleeve (intake).
   4. Install the valve spring rotator (exhaust).



3. Use a suitable valve spring compressor install the valve spring retainer keys.



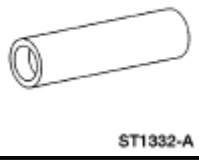
4. Remove the compressed air line.

5. Install the spark plugs. For additional information, refer to Section 303-07C .

6. Install the rocker arm. For additional information, refer to Valve Tappet in this section.

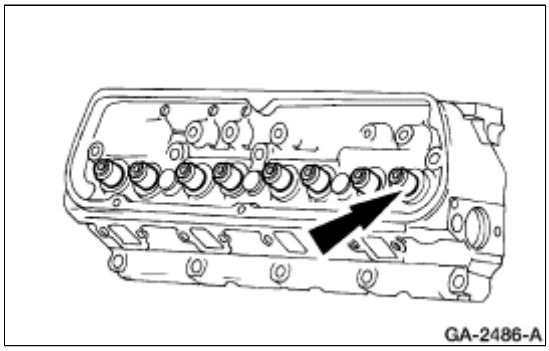
Valve Seal

Special Tool(s)

 ST1332-A	Valve Stem Seal Replacer 303-303 (T87L-6571-BH)

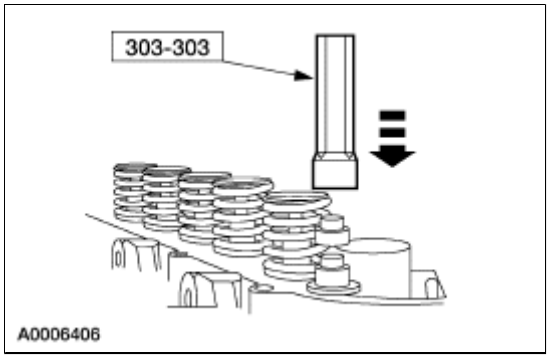
Removal

1. Remove the valve springs. For additional information, refer to Valve Spring in this section.
2. Remove the valve stem seals.



Installation

1. Use the special tool to install the valve stem seals.

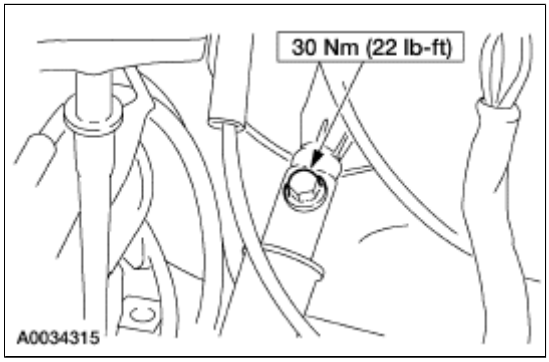


2. Install the valve springs.

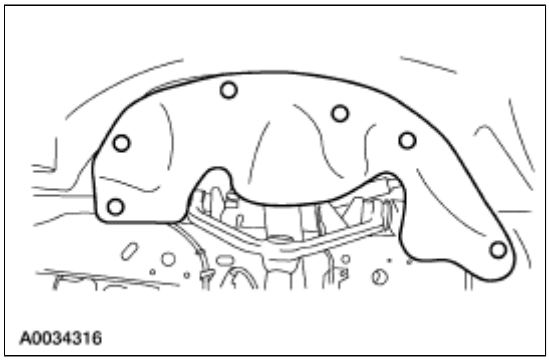
Exhaust Manifold —LH

Removal and Installation

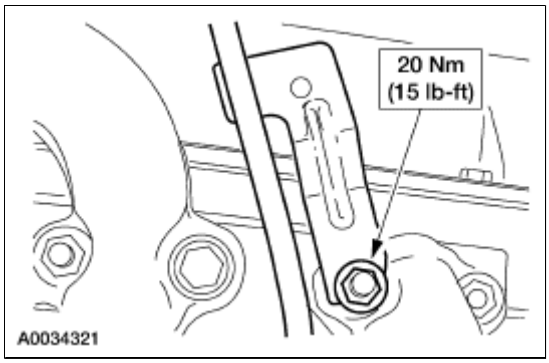
1. Position the front wheels in the straight-ahead position. Make sure the steering wheel is locked.
2. Remove the steering column intermediate shaft bolt.



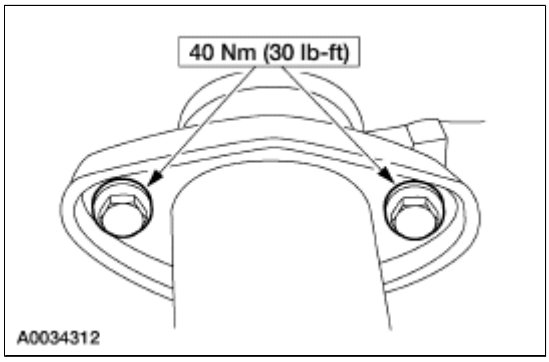
3. Remove the left front tire. For additional information, refer to Section 204-04 .
4. Remove the wheel well splash shield.



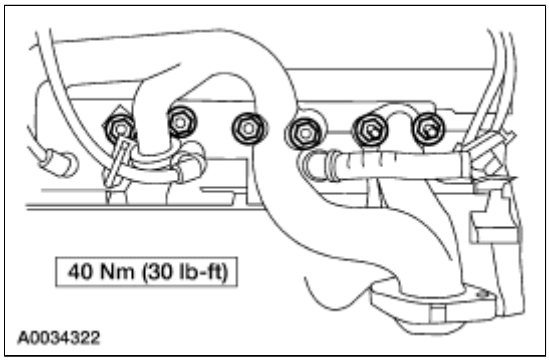
5. Remove the spark plug wires from left side spark plugs. For additional information, refer to Section 303-07C .
6. Remove the engine oil level indicator tube.



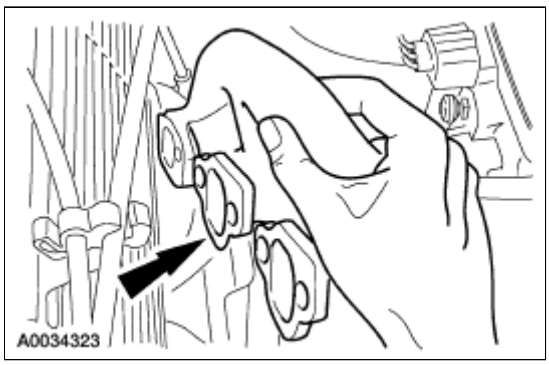
7. Remove the bolts.



8. Remove the bolts.



9. Remove the exhaust manifold and the gasket.

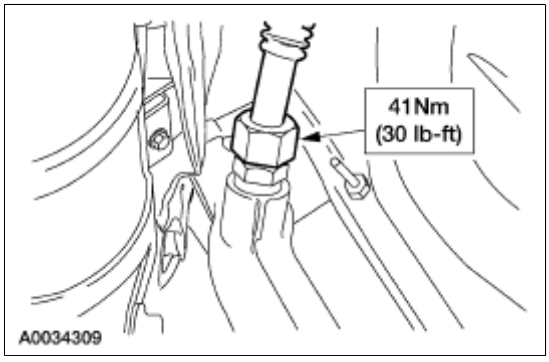


10. To install, reverse the removal procedure.
    - Install a new gasket.

Exhaust Manifold —RH

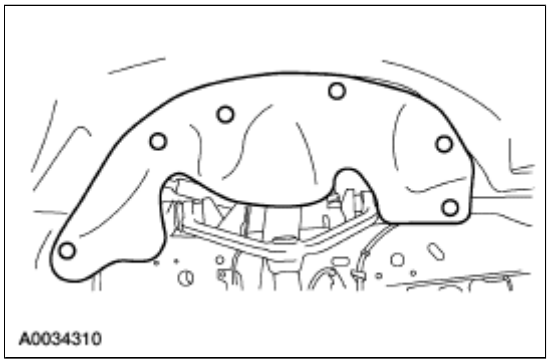
Removal and Installation

1. Disconnect the exhaust gas recirculation tube from the exhaust manifold.

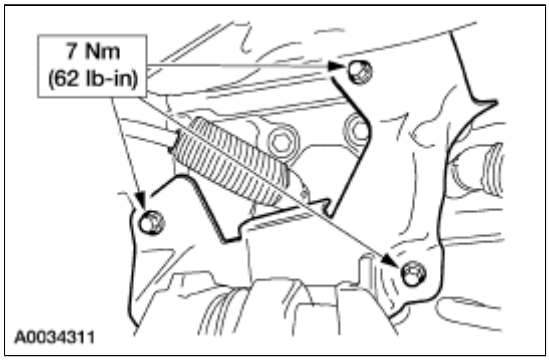


2. Remove the right front tire. For additional information, refer to Section 204-04 .

3. Remove the wheel well splash shield.

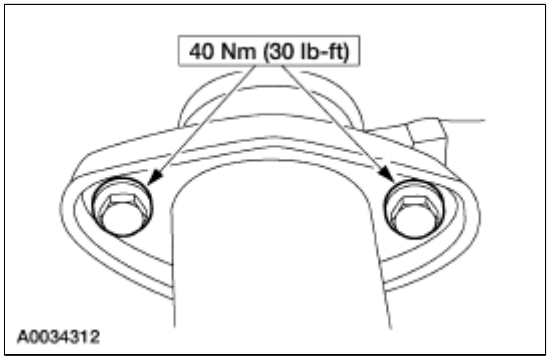


4. Remove the exhaust manifold heat shield.

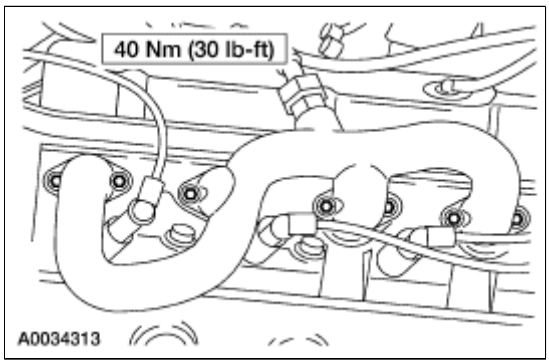


5. Remove the spark plug wires from the right side spark plugs. For additional information, refer to Section 303-07C .

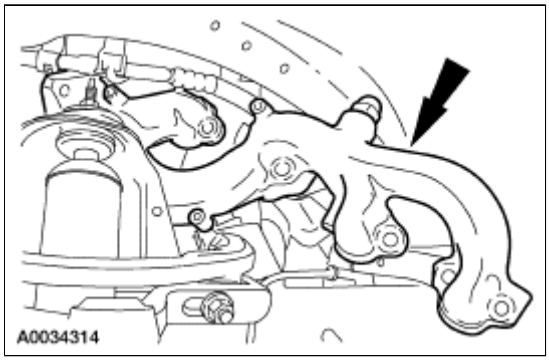
6. Remove the bolts.



7. Remove the bolts.



8. Remove the exhaust manifold and the gasket.

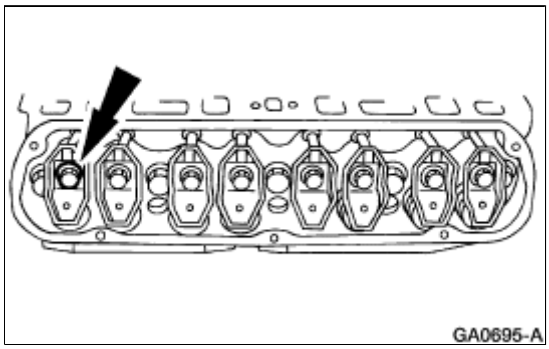


9. To install, reverse the removal procedure.
    - Install a new gasket.

Cylinder Head

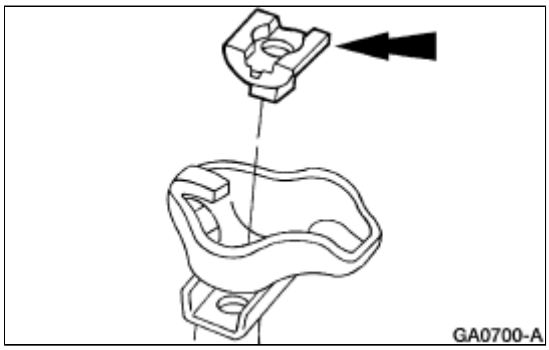
Removal

1. Remove the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.
2. Remove the valve covers. For additional information, refer to Valve Cover—LH or Valve Cover—RH in this section.
3. Remove the bolts.

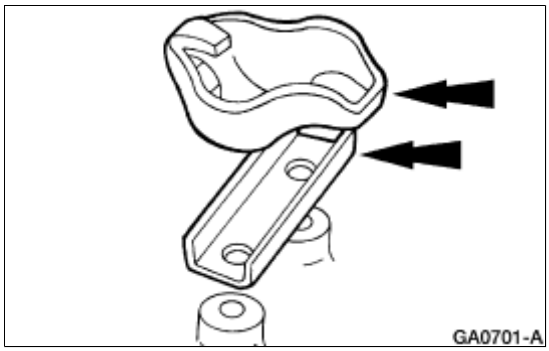


NOTE: Make sure to mark the rocker arms and the push rods so they will be installed in their original positions.

4. Remove the eight rocker arm fulcrums.

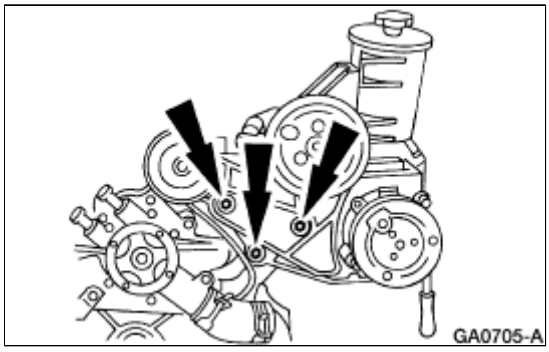


5. Remove the eight rocker arms and rocker arm fulcrum guides.

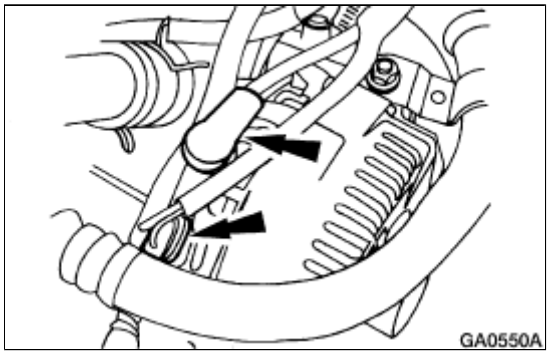


6. Remove the exhaust manifolds. For additional information, refer to Exhaust Manifold—LH or Exhaust Manifold—RH in this section.

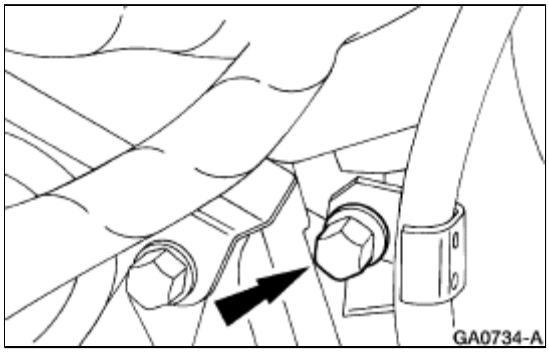
7. Remove the bolts and remove the bracket (RH only).



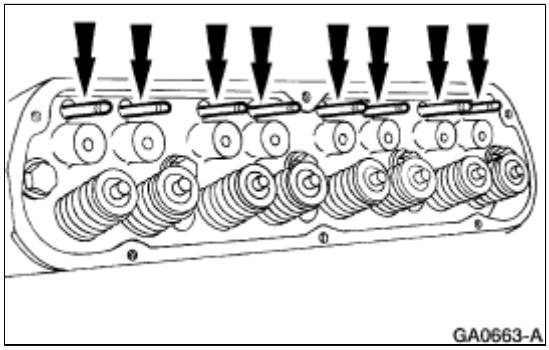
8. Disconnect the generator electrical connectors (RH only).



9. Remove the bolt retaining the transmission oil fill tube from the back of the RH cylinder head.

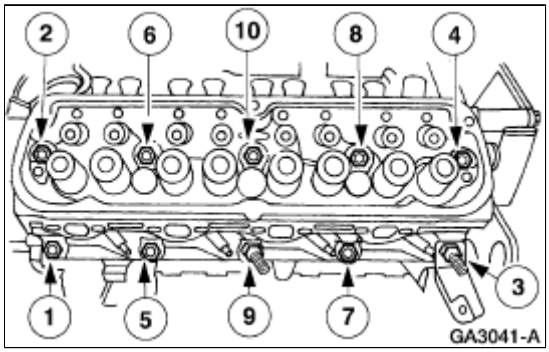


10. Remove the push rods and mark them so they can be installed in their original locations.



11. **NOTE:** Only the LH cylinder head is equipped with spark plug wire brackets.

    Remove the bolts in the indicated sequence and remove the cylinder head.
    - Discard the old bolts.



12. Clean and inspect the cylinder head surface. For additional information, refer to Section 303-00 .

Installation

1. **NOTE:** A specially treated composition gasket is used. Do not apply a sealer to a composition gasket.

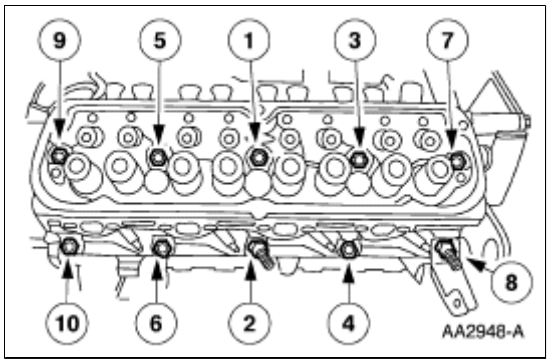
   Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A to clean the cylinder head, intake manifold, valve cover and head gasket surfaces.

2. Install the head gaskets.

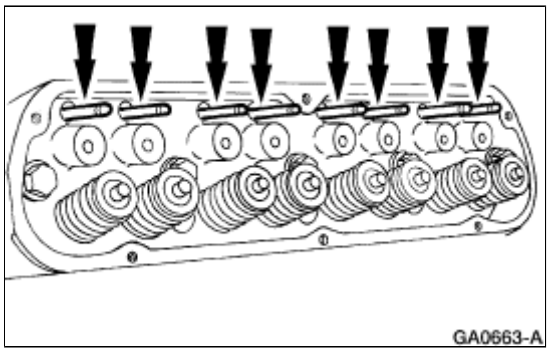
3. **NOTE:** Only the LH cylinder head is equipped with spark plug wire brackets.

   Install the cylinder head on the head gasket and loosely install the new bolts.

4. Tighten the bolts in three steps.
   - Step 1: Tighten to 40 Nm (30 lb-ft).
   - Step 2: Tighten to 68 Nm (50 lb-ft).
   - Step 3: Tighten an additional 90 degrees.

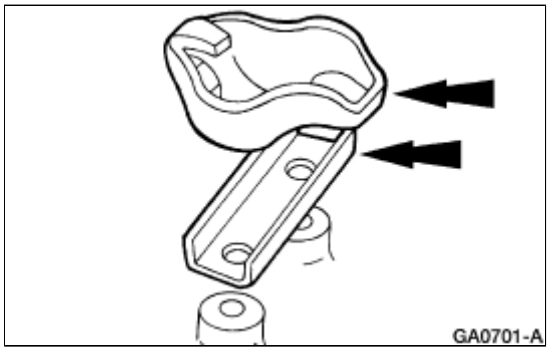


5. Lubricate and install the push rods in their original locations.
    - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

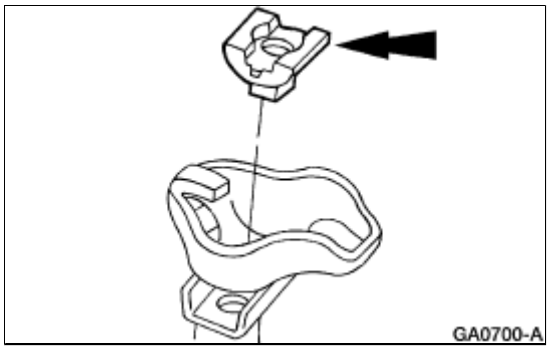


6. Apply engine oil to the top of the valve stem, rocker arm seats, and rocker arms.
    - Use Super Premium SAE 5W-30 Motor Oil XO5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

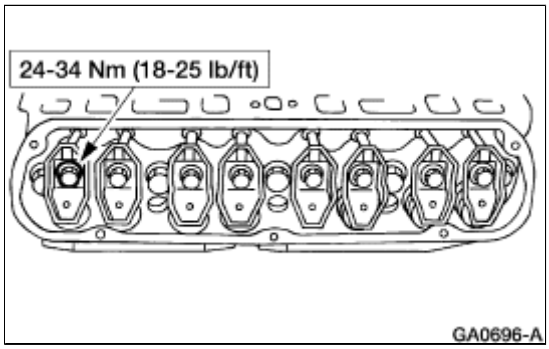
7. Install the eight rocker arms and rocker arm fulcrum guides.



8. Install the eight rocker arm fulcrums.



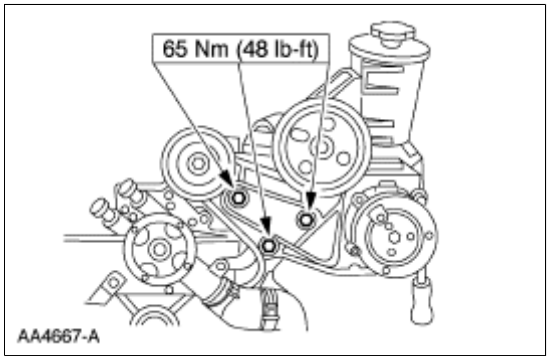
9. Install the bolts.



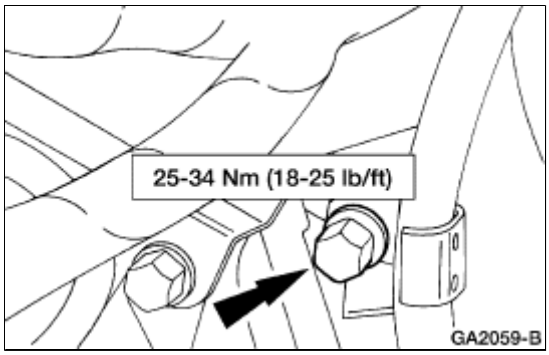
10. Check the valve clearance. For additional information, refer to Section 303-00 .

11. Install the valve cover on the side that is being repaired. For additional information, refer to Valve Cover—LH or Valve Cover—RH in this section.

12. Install the bracket and the bolts.

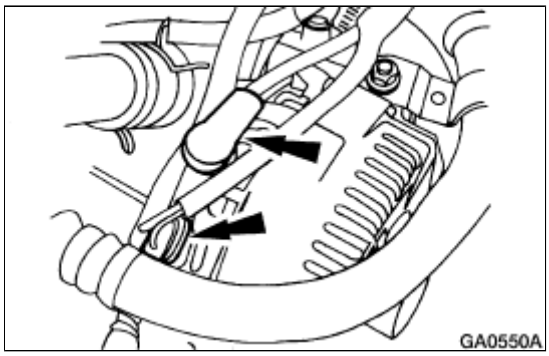


13. Install the bolt on the RH cylinder head.



14. Install the exhaust manifolds. For additional information, refer to Exhaust Manifold—LH or Exhaust Manifold—RH in this section.

15. Connect the generator electrical connectors (RH only).

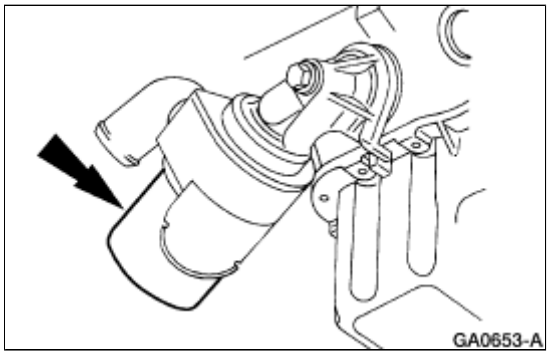


16. Install the lower intake manifold. For additional information, refer to Intake Manifold—Lower in this section.

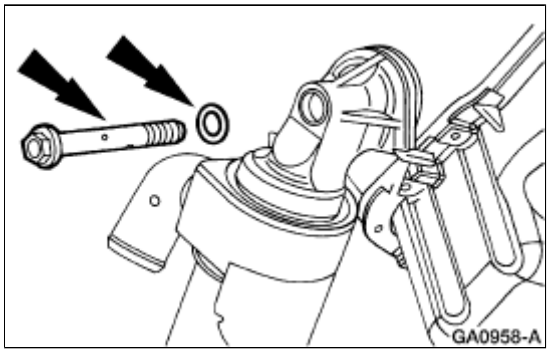
Oil Cooler

Removal

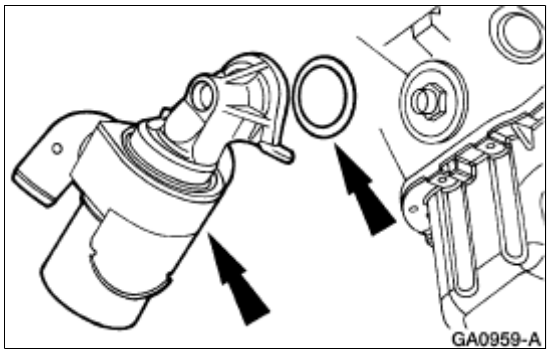
1. Remove the fan shroud. For additional information, refer to Section 303-03 .
2. Drain the engine cooling system. For additional information, refer to Section 303-03 .
3. Remove the oil filter (6731).



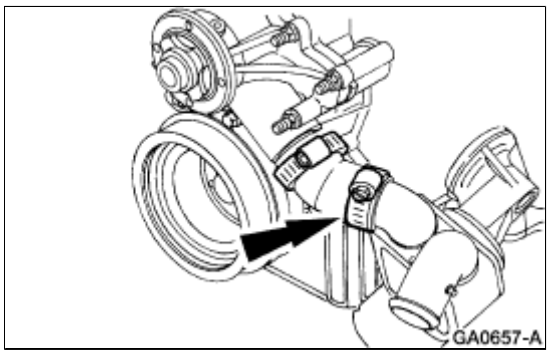
4. Disconnect the lower radiator hose from the oil cooler (6A642).
5. Remove the bolt and the O-ring.



6. Remove the oil cooler and the O-ring.



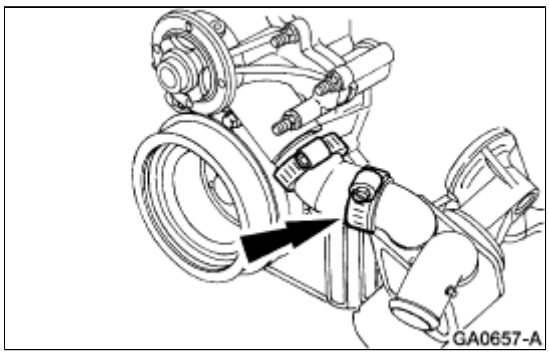
7. Disconnect the oil cooler from the water inlet hose.



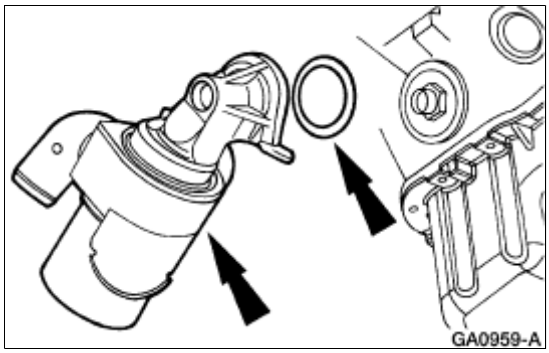
8. Clean and inspect the surfaces of the cylinder block (6010) and the oil cooler.

Installation

1. Connect the oil cooler to the water inlet hose.

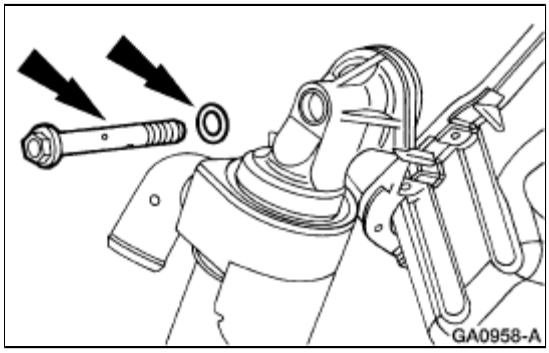


2. Position the oil cooler O-ring and install the oil cooler.

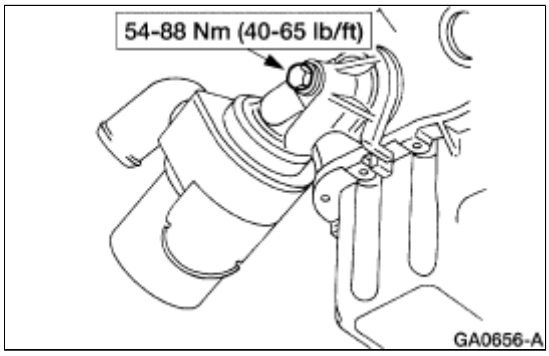


3. **CAUTION: Be sure to position the O-ring into the groove on the oil cooler. Failure to properly position the O-ring may crush the O-ring and cause an engine oil leak. Coat the O-ring with petroleum jelly to hold the O-ring in place during oil cooler bolt installation.**

   Install the bolt and O-ring.

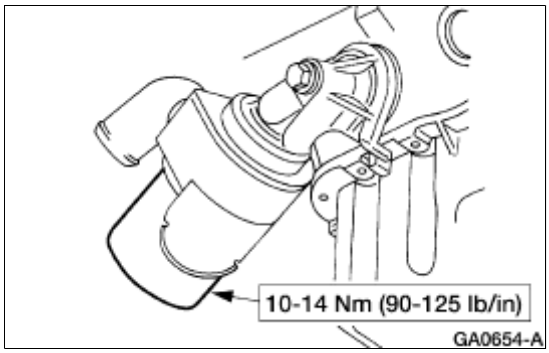


4. Tighten the bolt.



5. Connect the lower radiator hose (8286) to the oil cooler.

6. Install the oil bypass filter (6714).
   - Coat oil filter gasket with Motorcraft Super Premium 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specifications WSS-M2C153-G and API Certification Mark.



7. Fill the engine cooling system. For additional information, refer to Section 303-03 .

8. Install the fan shroud. For additional information, refer to Section 303-03 .

9. Start the engine and run for two minutes. Stop the engine and allow the oil to drain back into the pan. Check the oil level and add as required. The oil level should read between the MIN and MAX lines.
   - Use clean engine oil meeting Ford specifications WSS-M2C153-G.

Oil Pan

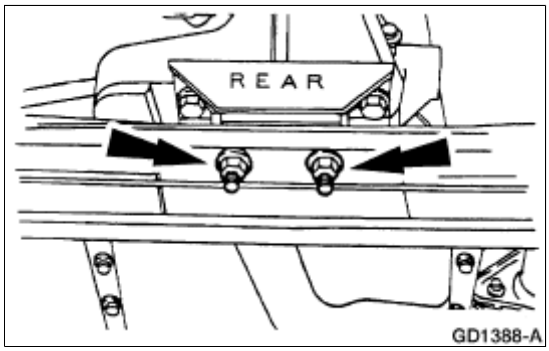
Special Tool(s)

ST2453-A	Axle Service Plugs Set 205-S358 (T95T-4850-A)
ST1130-A	High-Lift Transmission Jack 014-00942

Removal

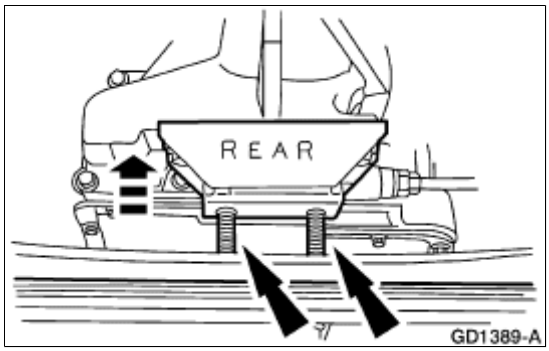
All vehicles

1. Disconnect battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the nuts.

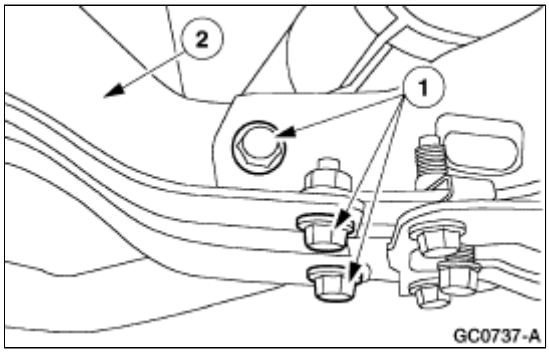


4. **CAUTION: Do not allow the transmission to hang freely.**

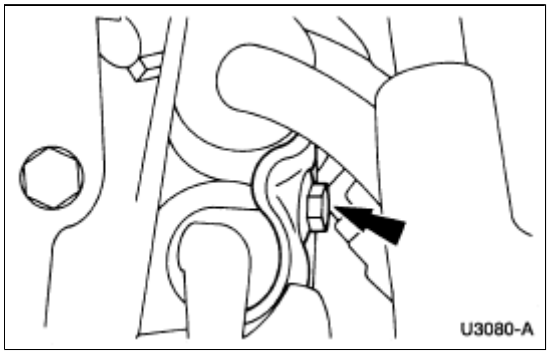
   Position the High-Lift Transmission Jack under the transmission.
   - Lift the transmission.



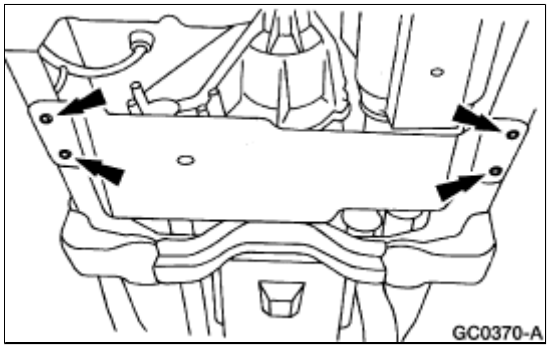
5. Remove the crossmember.
    1. Remove the six bolts.
    2. Remove the crossmember.



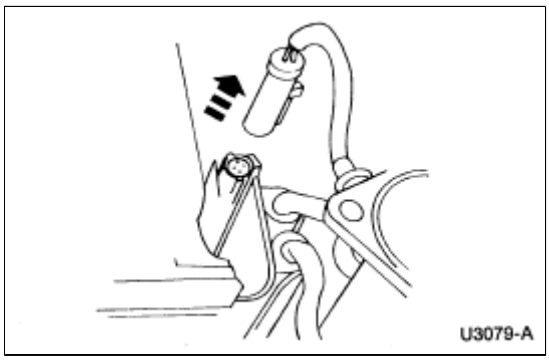
6. Remove the support insulator bracket.



7. Remove the transfer case skid plate, if equipped.

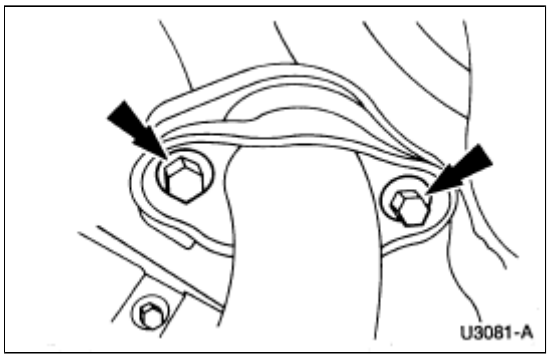


8. Disconnect the heated oxygen sensors (HO2S).

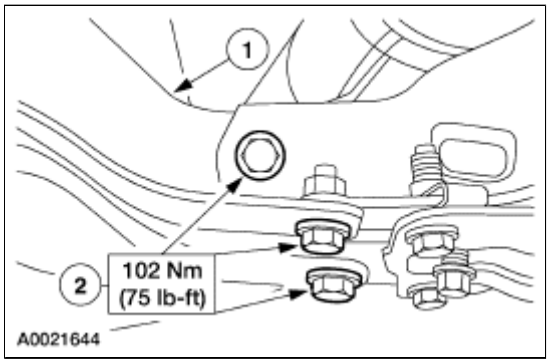


9. **NOTE:** The RH side is shown; the LH side is similar.

   Remove the three-way catalytic converters (TWC).



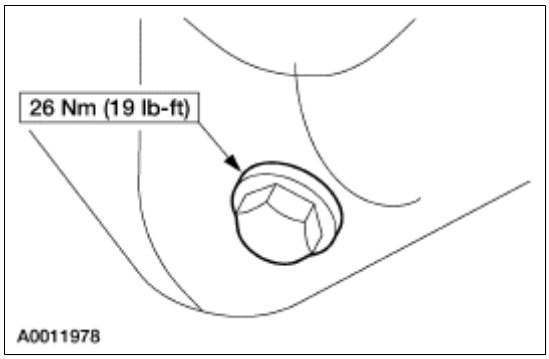
10. Install the crossmember.
    1. Position the crossmember.
    2. Install the six bolts.



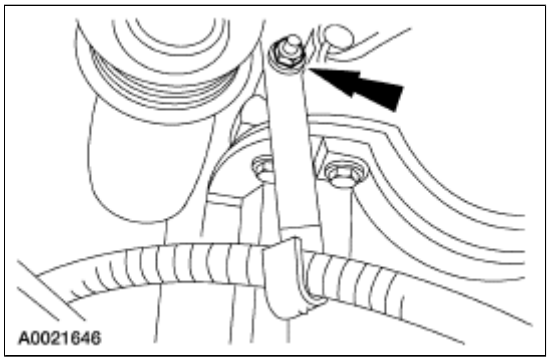
11. Lower the transmission onto the crossmember and position the High-Lift Transmission Jack aside.

12. **NOTE:** Place a suitable container under the oil pan.

    Drain the engine oil and reinstall the drain plug.



13. Remove the nut and position the bracket aside.



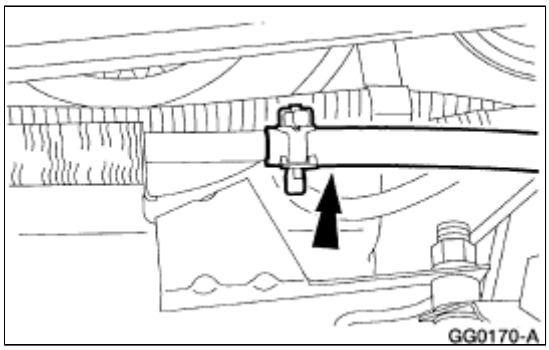
14. Lower the vehicle.

15. **NOTE:** Steering column must remain in the unlocked position.

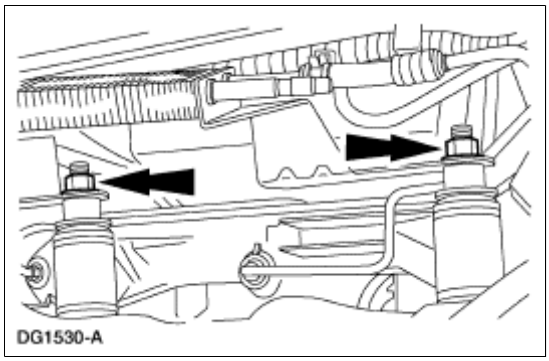
    Place the front wheels in the straight-ahead position.

16. Raise and support the vehicle.

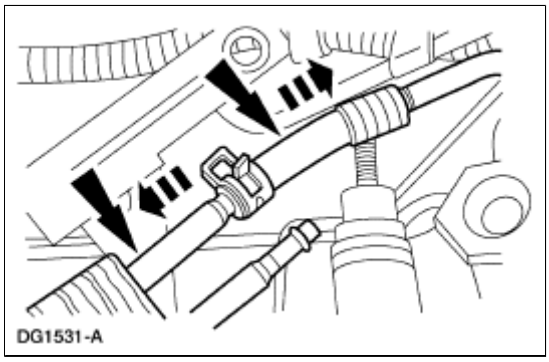
17. Disconnect the power steering return hose at the power steering fluid cooler.
    - Allow the system to drain.



18. Remove the power steering fluid cooler-to-crossmember nuts.



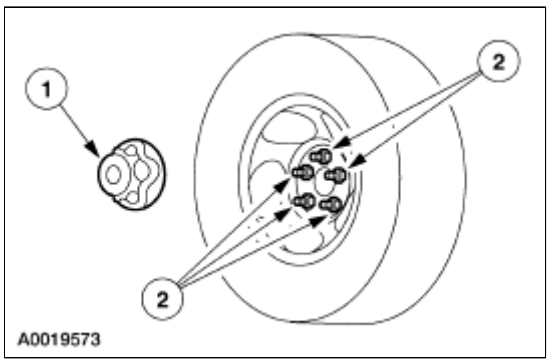
19. Disconnect the power steering return hose. Remove the power steering fluid cooler.



20. **CAUTION: Do not use heat to loosen a seized wheel nut. Heat can damage the wheel and wheel bearings.**

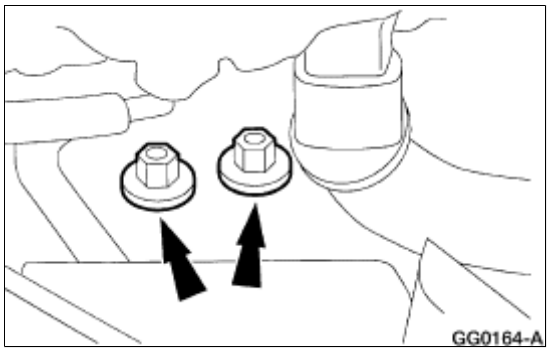
    NOTE: To avoid damage or scratching to the center cap, place face up when removed.

    Remove the front wheel and tire assemblies.
    1. If necessary, remove the center cap.
    2. Remove the nuts, and the wheel and tire assemblies.

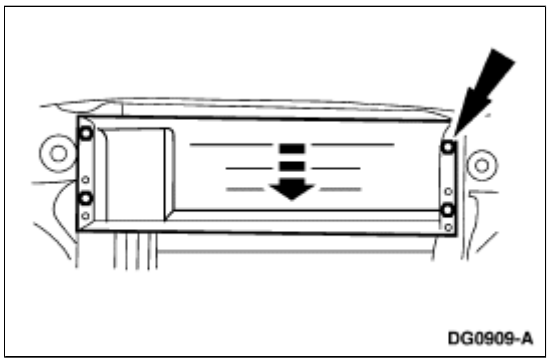


21. Remove the inner fender splash shields.

22. Remove the top motor mount nuts.

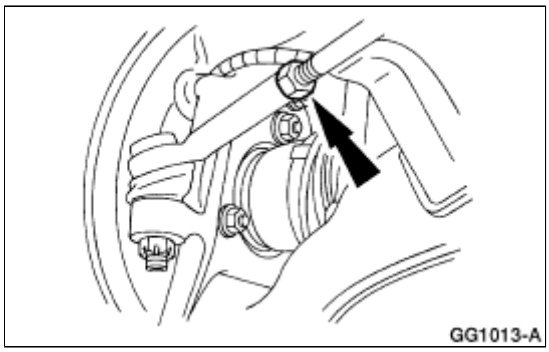


23. Remove the bolts and the radiator air deflector.

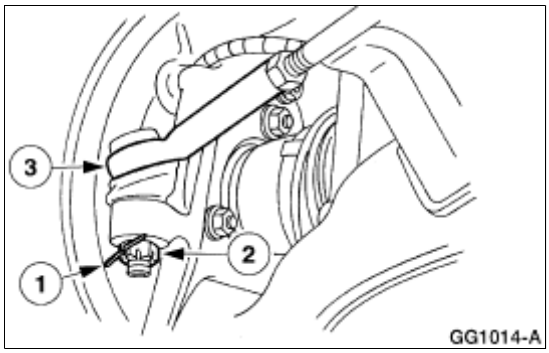


24. **NOTE:** LH tie-rod end shown, RH similar.

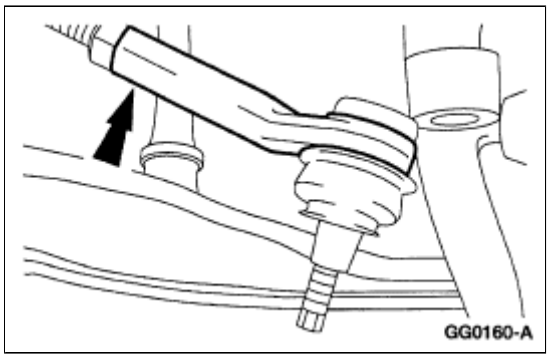
    Loosen the tie-rod end jam nuts.



25. Disconnect the tie-rod ends.
    1. Remove and discard the cotter pins.
    2. Remove the castellated nuts.
    3. Separate the tie-rod ends from the steering knuckles. Do not damage the tie-rod end seals.

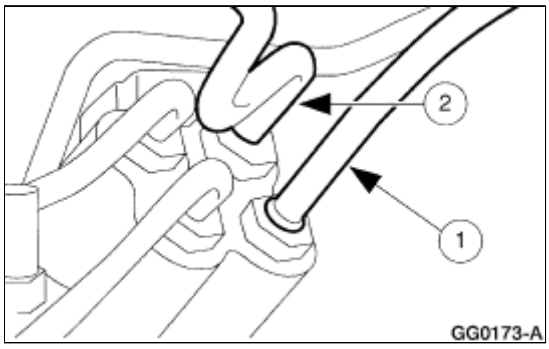


26. Remove the LH tie-rod end.
    - Count and record the number of turns required to remove the LH tie-rod end.



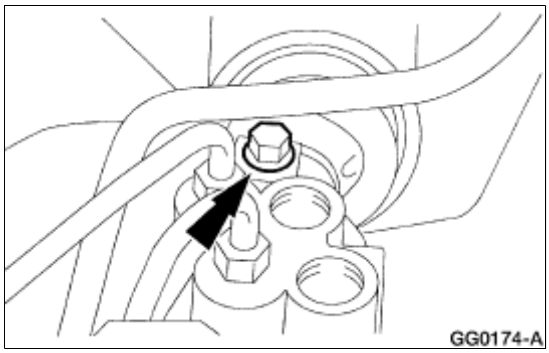
27. Remove the front stabilizer bar. For additional information, refer to Section 204-01A or Section 204-01B .
    - Mark the driver side end of the stabilizer bar for correct installation.

28. Disconnect the steering gear hoses.
    1. Disconnect the power steering pressure hose.
    2. Disconnect the power steering return hose.



29. Plug the ends of all fluid hoses removed and ports in the steering gear to prevent damage and entry of dirt.

30. Rotate the steering column shaft to access the intermediate shaft pinch bolt. Remove the pinch bolt.



31. Lower the vehicle.

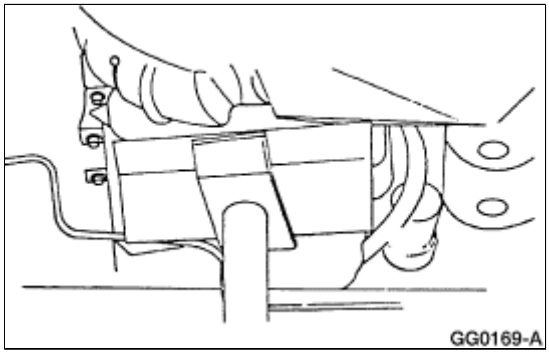
32. Turn the steering wheel back to the straight-ahead position. Turn the ignition key to the locked position.

33. Raise and support the vehicle.

34. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the air bag sliding contact will result.**

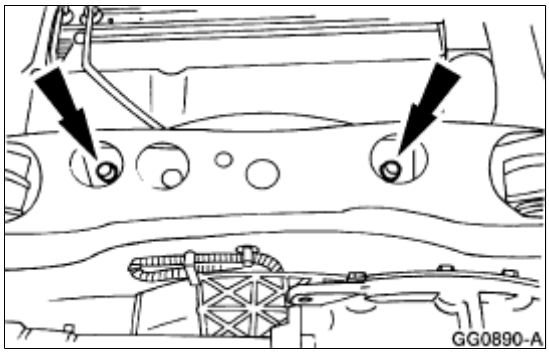
    Disconnect the intermediate shaft from the steering gear input shaft.

35. Raise the engine.
    - Position a block of wood between a screw jack and the bottom of the oil pan to avoid damaging the oil pan while raising the engine.

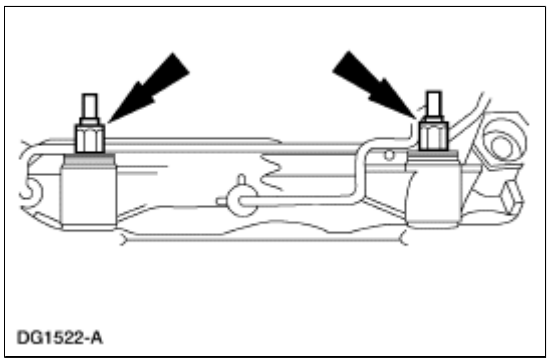


36. **CAUTION: Hold the tops of the steering gear-to-crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

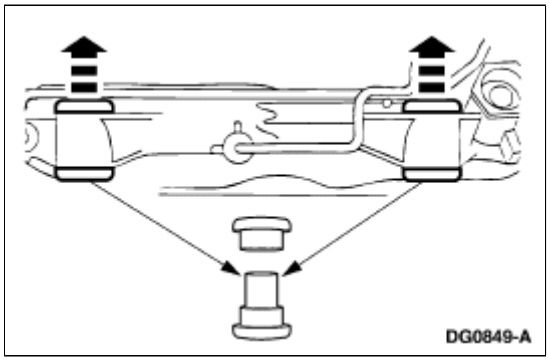
    Remove the nuts.



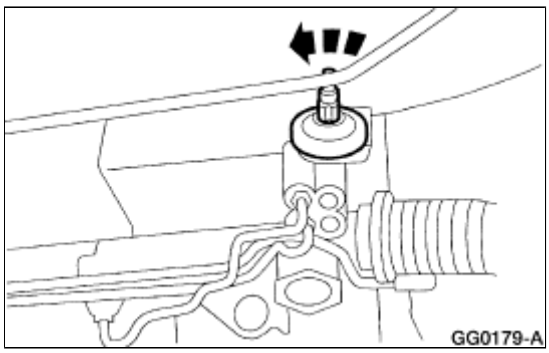
37. Remove the stud bolts and washers.



38. Remove the steering gear-to-crossmember insulator bushings.

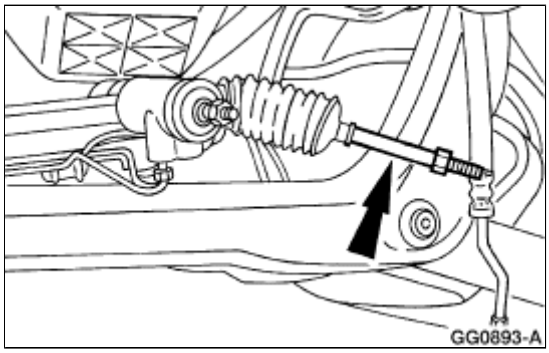


39. Turn the steering gear input shaft to the right until the stop is reached.

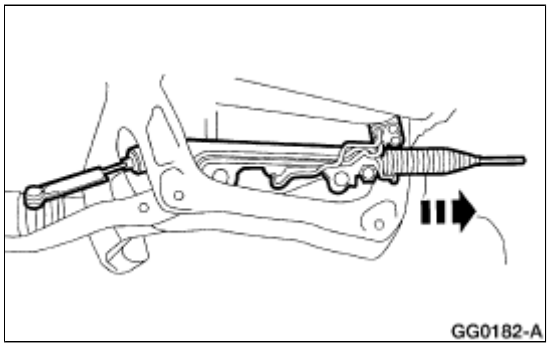


40. Move the steering gear as far to the RH side of the vehicle as possible.

41. Move the LH front wheel spindle tie-rod forward to clear the crossmember. Turn the steering gear input shaft to the left until the stop is reached.



42. Remove the steering gear from the vehicle.



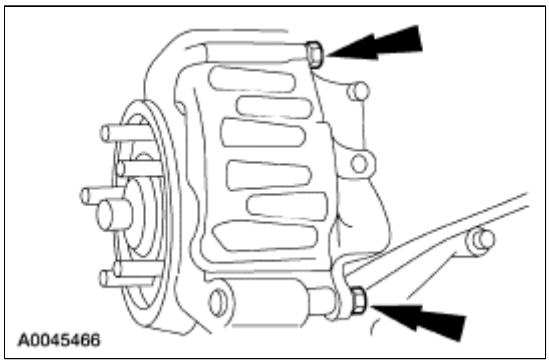
4x4 vehicles

43. **CAUTION: Do not allow the calipers to hang by the hoses.**

NOTE: Remove or tape the brake pads, to prevent them from falling out of the caliper guides.

NOTE: Install a wheel nut to secure each brake disc in place.

Remove the bolts and position both calipers aside.



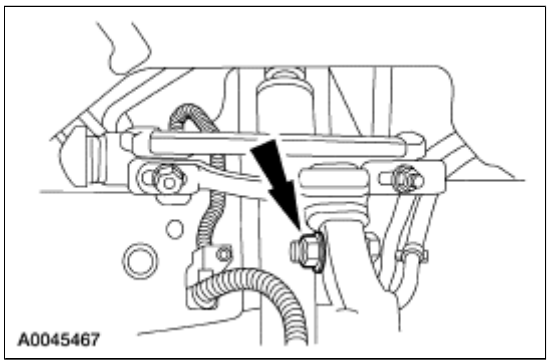
44. Unclip the left and right wheel anti-lock sensor wiring harnesses from the locators on the vehicle chassis, located above the stabilizer bar brackets.

45. **CAUTION: Do not allow the halfshafts to hang freely. It is possible to overextend and internally separate the inner CV joint.**

CAUTION: Take necessary precautions to protect the machined sealing surfaces on each axle.

Remove both pinch bolts and disconnect the upper ball joints.

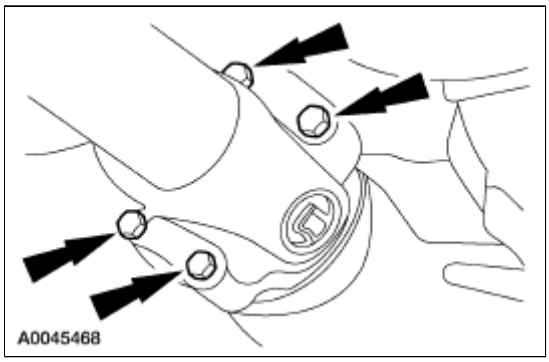
- Pull the RH halfshaft, with the wheel knuckle, away from the front axle until the halfshaft is out of the front axle.
- Pull the LH halfshaft, with the wheel knuckle, away from the front axle. The LH halfshaft cannot be removed from the front axle at this time.



46. **NOTE:** Tape the U-joint bearing caps to prevent them from falling off the U-joint.

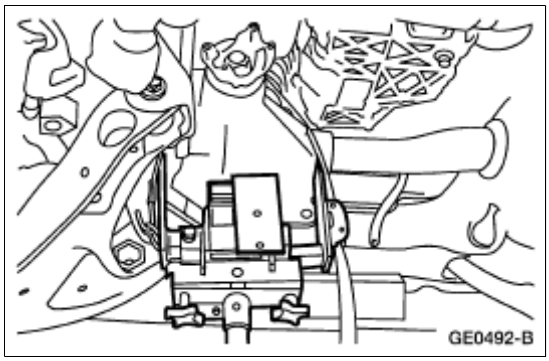
NOTE: Index-mark the front axle pinion flange to the front driveshaft.

Remove and discard the bolts and straps. Secure the driveshaft out of the way.

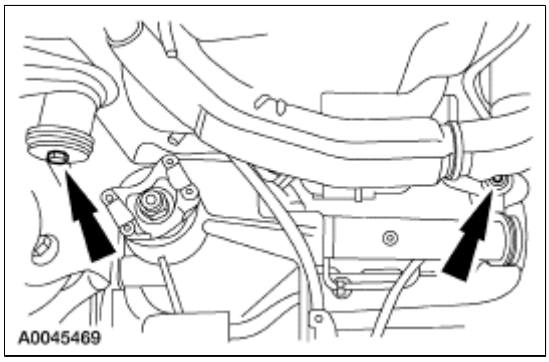


47. **NOTE:** Use the Axle Service Plugs Set T95T-4850-A to plug the axle openings.

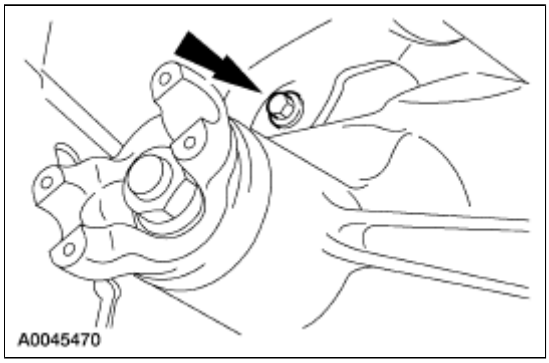
Secure the axle housing to a suitable lift.



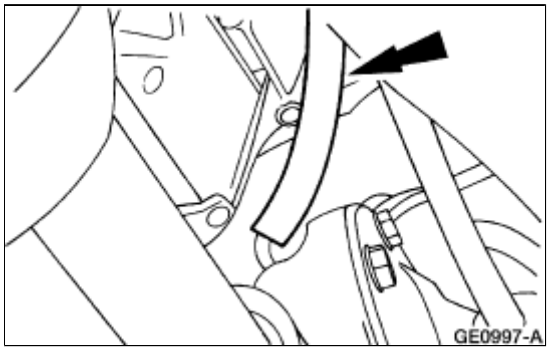
48. Remove and discard the bolts.



49. Remove the top front axle housing bolt, then lower the axle 25 mm (1 in) and move to the right 19 mm (0.75 in), guiding the LH axle halfshaft out of the axle.



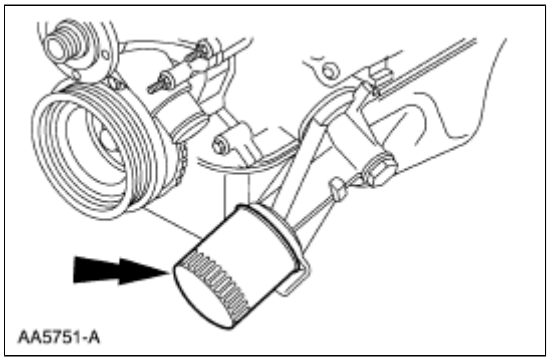
50. Disconnect the vent hose from the front axle housing.



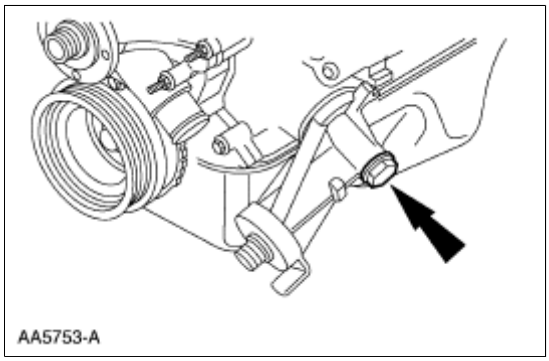
51. Lower the axle from the vehicle.

All vehicles

52. Remove the oil filter assembly.

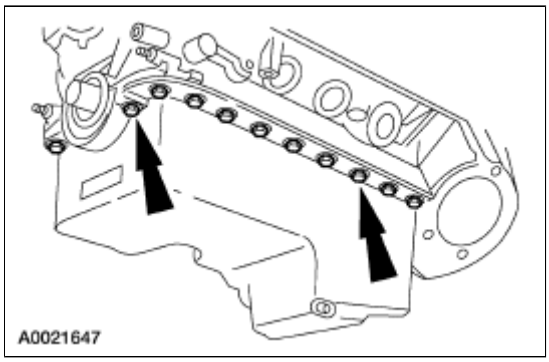


53. Position aside the oil bypass assembly.
    - Remove the bolt and the O-ring seal.

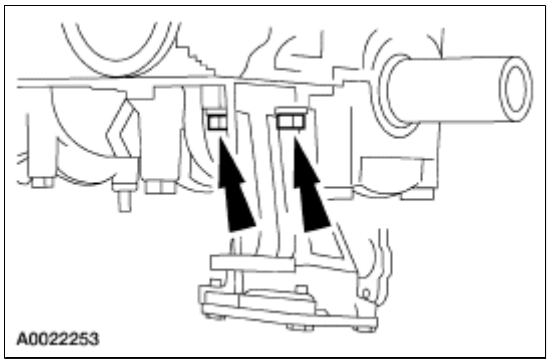


54. **NOTE:** Remove the oil pump and the oil pan as an assembly.

    Remove the bolts and lower the oil pan.



55. Remove the bolts, lower the oil pump into the oil pan, and remove the oil pan.

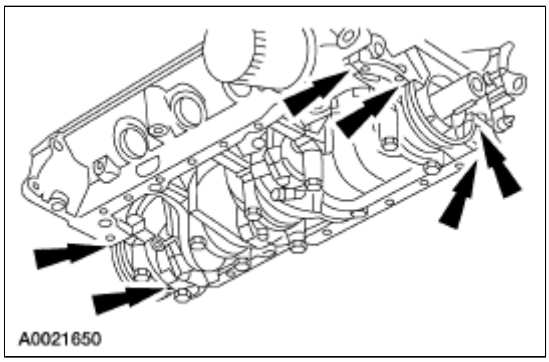


Installation

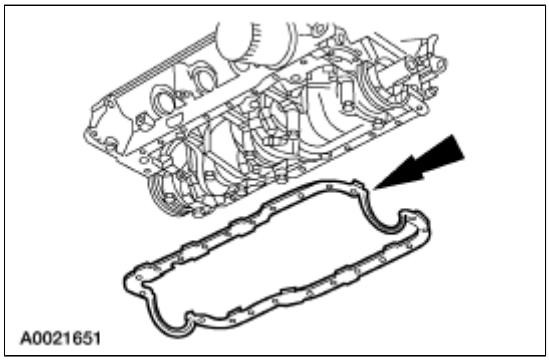
All vehicles

1. **NOTE:** The oil pan gasket must be installed within four minutes after applying the silicone.

   Apply sealant in the six positions shown.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.

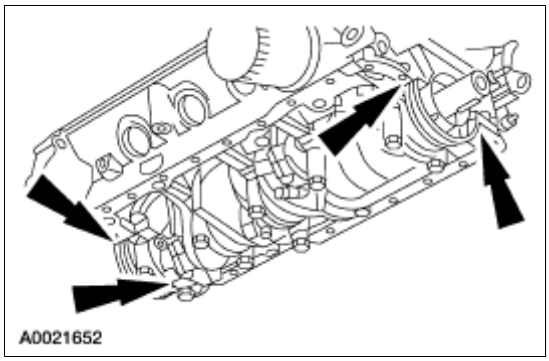


2. Install the oil pan gasket.



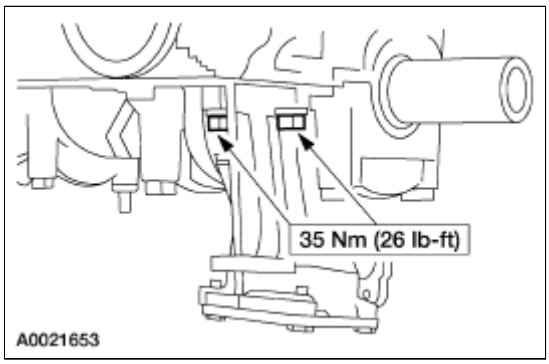
3. **NOTE:** The oil pan must be installed within four minutes after applying the silicone.

   Apply sealant in the four positions shown:
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.

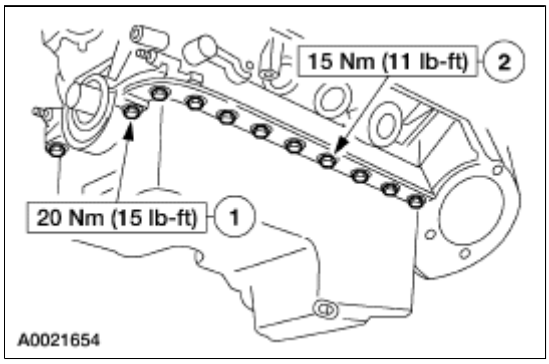


4. **NOTE:** The oil pan and the oil pump must be installed as an assembly.

   Install the oil pump.



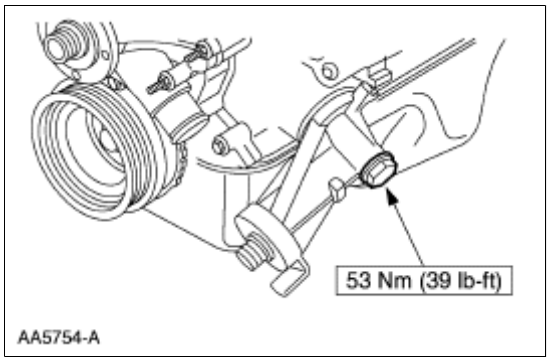
5. Install the oil pan and the reinforcement rails.
   1. Tighten the four end bolts.
   2. Tighten the remaining 18 bolts.



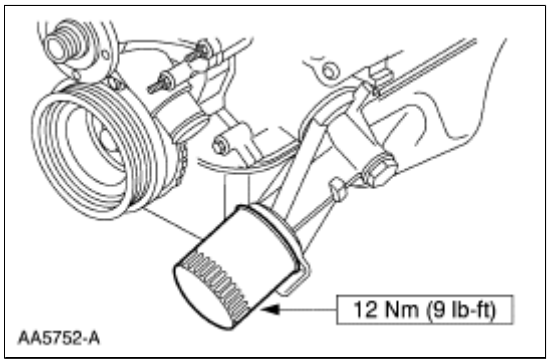
6. **CAUTION: Failure to properly position the O-ring seal can cause an engine oil leak.**

   NOTE: Coat the O-ring seal with petroleum jelly to hold the O-ring in place during installation.

   Install the oil bypass assembly.
   - Position the O-ring seal into the groove on the adapter.
   - Install the bolt.



7. Install the oil filter assembly.

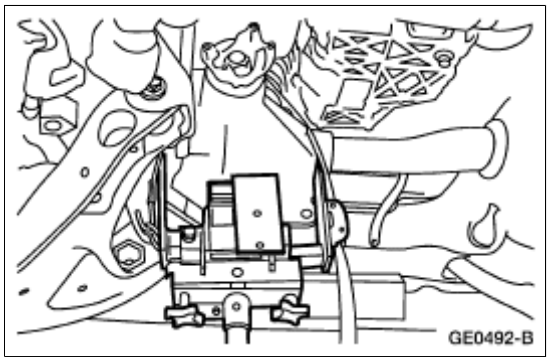


4x4 vehicles

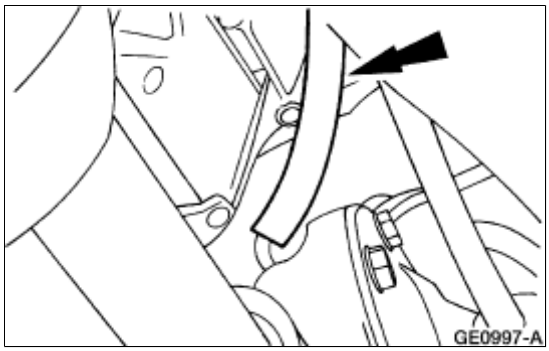
8. **NOTE:** Remove the plug set used to plug the axle openings.

   Secure the front axle housing to a suitable lift.

9. Position the front axle close to the installed position.



10. Connect the vent hose to the front axle.



11. **CAUTION: A new circlip must be installed on the end of the halfshaft.**

    NOTE: LH halfshaft will not fully seat into the front axle at this time.

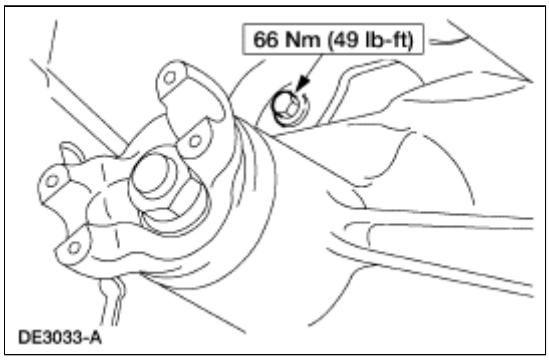
    Guide the LH halfshaft into the front axle.

12. Raise the front axle to the fully installed position.

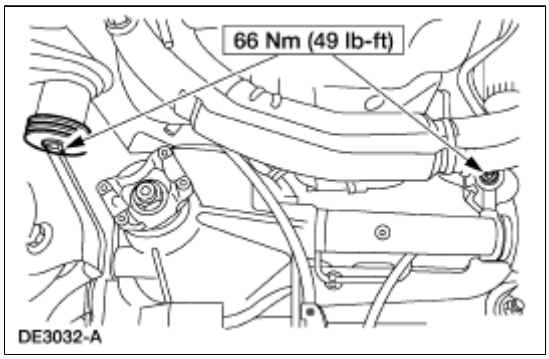
13. **CAUTION: Make sure the halfshaft circlip fully seats.**

    Completely install the LH halfshaft.

14. Install the front axle housing top bolt.



15. Using new bolts, install the remaining front axle housing bolts.

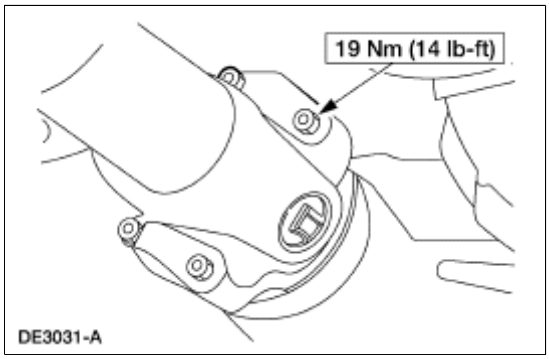


16. **CAUTION: A new circlip must be installed on the end of the halfshaft.**

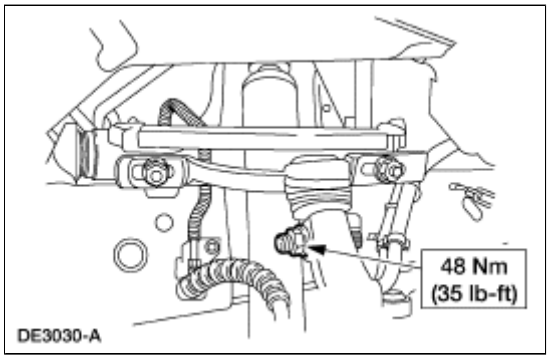
    CAUTION: Make sure the halfshaft circlip fully seats.

    Install the RH halfshaft.

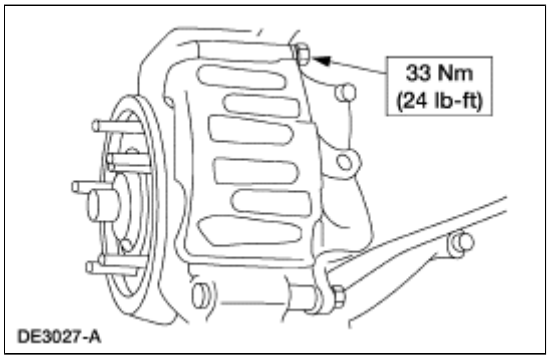
17. Using new bolts, install the front driveshaft.



18. Connect the upper ball joints and install the pinch bolts.

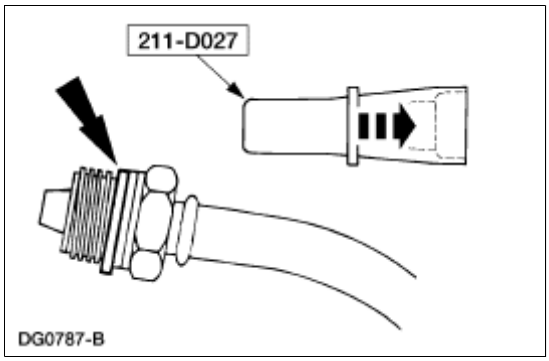


19. Install both front calipers.



All vehicles

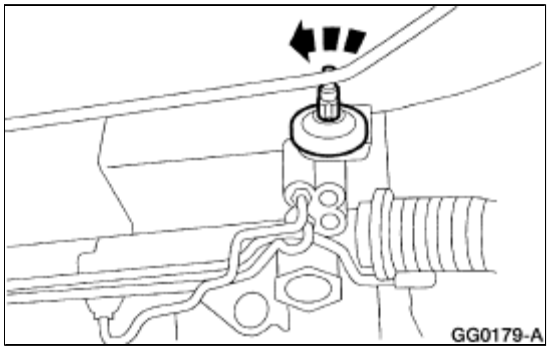
20. Using the special tool, install new seals on the power steering return hose and the power steering pressure hose.



21. **NOTE:** Make sure the steering gear input shaft is turned to the left until the stop is reached.

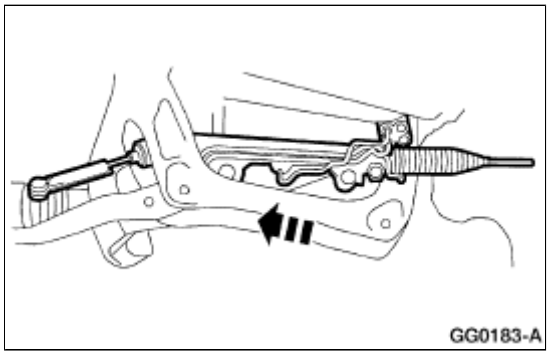
    NOTE: Handle the steering gear with caution to avoid damage to fluid transfer tubes and to avoid dimples in the tie-rod boots.

    Turn the steering gear input shaft to the right until the stop is reached. Note the number of turns required.

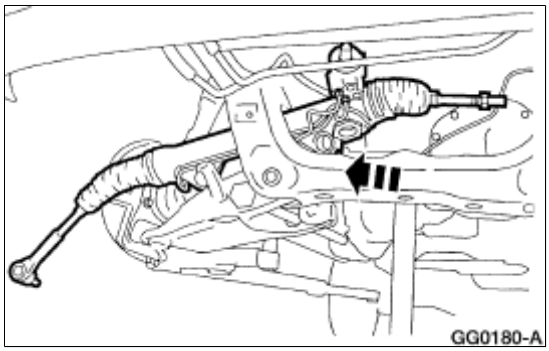


22. **NOTE:** Make sure the steering gear control valve housing is turned toward the front of the vehicle.

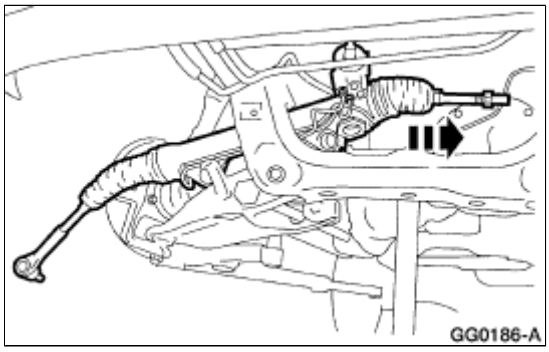
    Install the steering gear into the RH opening of the crossmember.



23. Move the steering gear as far to the RH side of the vehicle as possible.

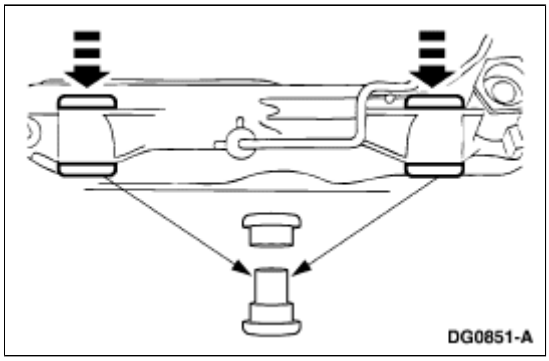


24. Move the LH front wheel spindle tie-rod into the opening in the crossmember and move the steering gear into position.



25. To place the steering gear in the straight ahead position, turn the steering gear input shaft to the left by half the number of turns recorded previously.

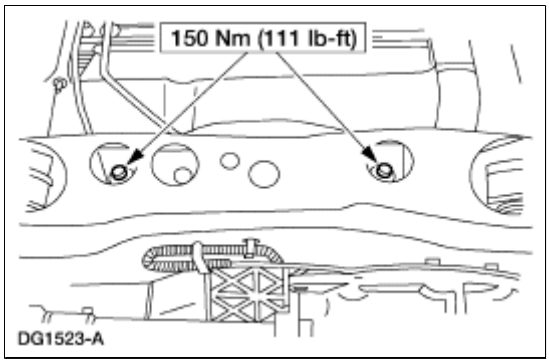
26. Install the steering gear-to-crossmember insulator bushings as shown.
    - The large end of the metal sleeve must be positioned downward.
    - Check that the mounting surfaces on the crossmember are clean and free of debris.



27. Install the steering gear-to-crossmember washers and stud bolts.
    - For additional information on correct mounting hardware orientation, refer to Section 211-02 .

28. **CAUTION: Hold the tops of the steering gear-to-crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

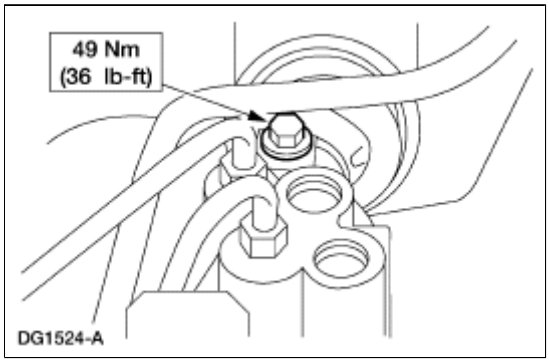
    Install the nuts.



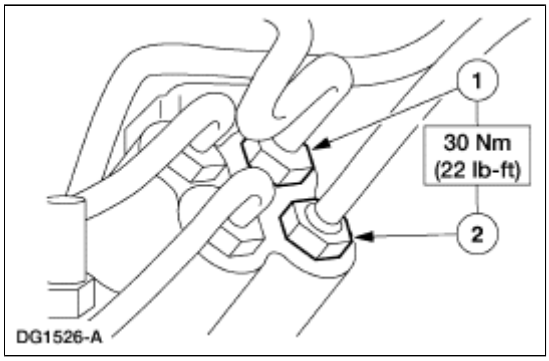
29. Lower the engine.

30. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the clockspring will result.**

    Connect the intermediate shaft to the steering gear input shaft. Install the pinch bolt.

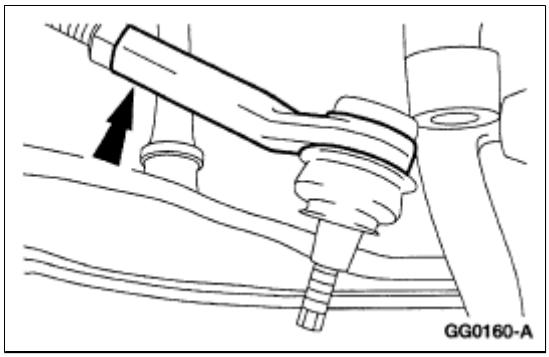


31. Connect the steering gear hoses.
    - Connect the power steering return hose.
    - Connect the power steering pressure hose.

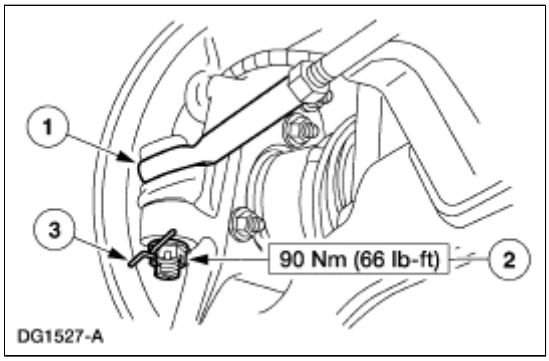


32. Install the front stabilizer bar. For additional information, refer to Section 204-01A or Section 204-01B .
    - Position the front stabilizer bar as noted during removal.

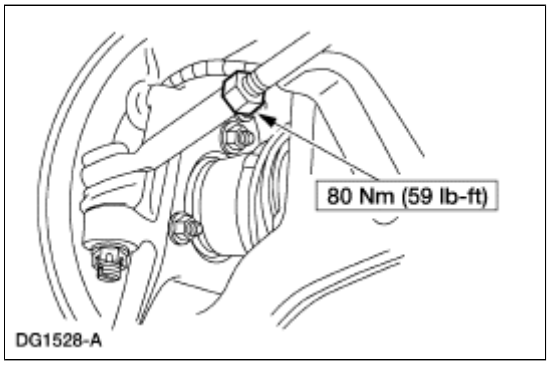
33. Install the tie-rod end.
    - Rotate the tie-rod end the number of turns recorded during removal.



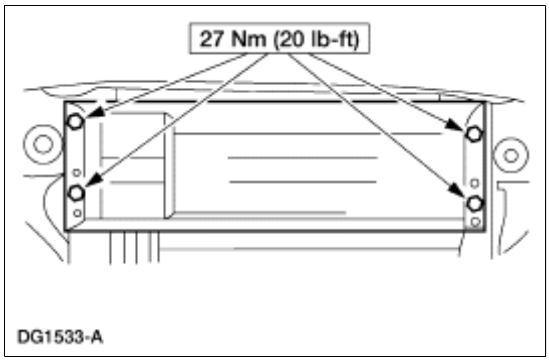
34. Connect the tie-rod ends to the steering knuckles.
    1. Position the tie-rod ends to the steering knuckles.
    2. Install the castellated nuts.
    3. Install the new cotter pins.
    - Check that the brake dust shields are not bent and are not in contact with the outer tie-rod boot seals.



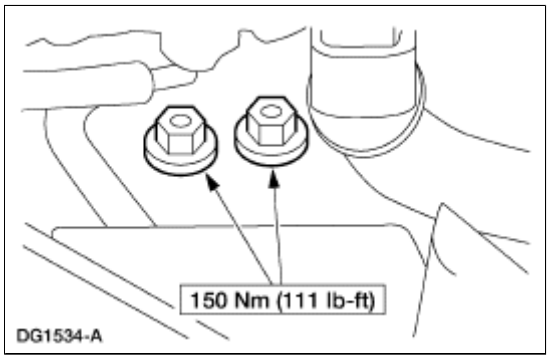
35. Tighten the LH tie-rod end jam nut.



36. Install the radiator air deflector.



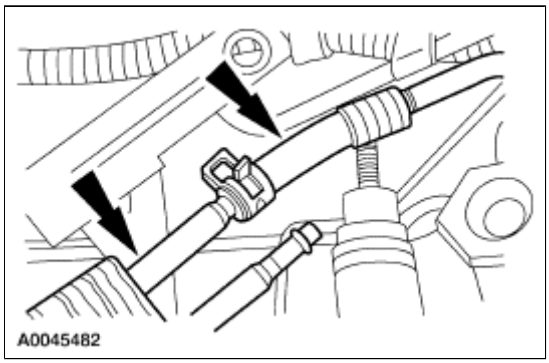
37. Install the top engine mount nuts.



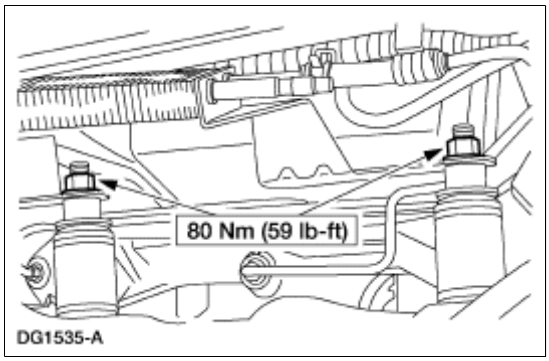
38. Install the inner fender splash shields.

39. Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

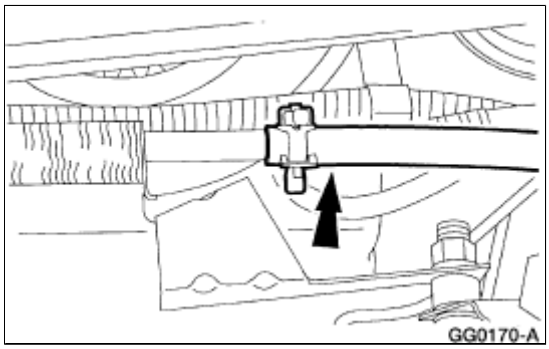
40. Install the power steering fluid cooler and connect the power steering return hose.



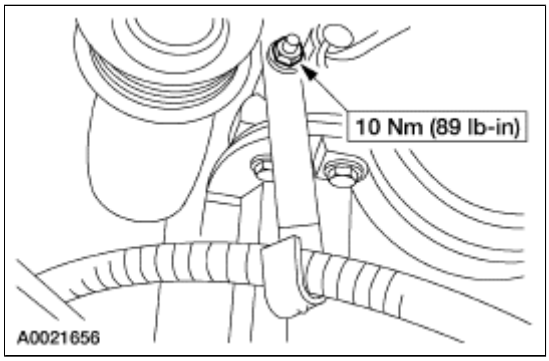
41. Install the power steering fluid cooler crossmember nuts.



42. Connect the power steering return hose.



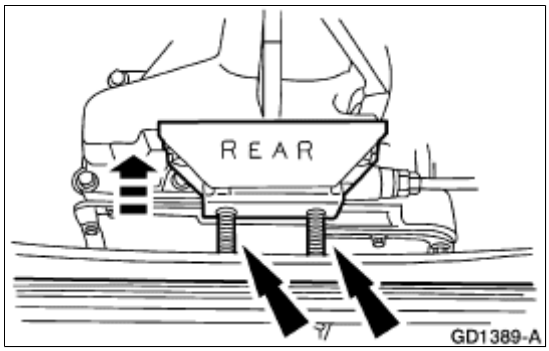
43. Install the wire harness and bracket.



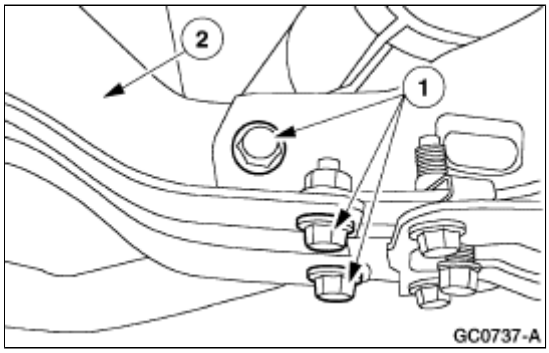
44. **CAUTION: Do not allow the transmission to hang freely.**

Position the High-Lift Transmission Jack under the transmission.

- Lift the transmission.

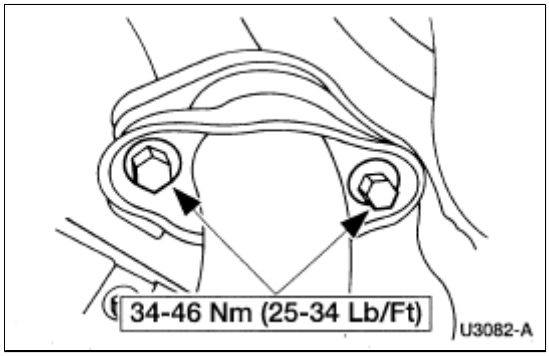


45. Remove the crossmember.
    1. Remove the six bolts.
    2. Remove the crossmember.

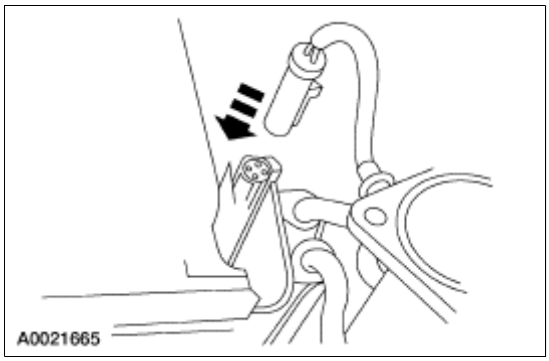


46. **NOTE:** The RH side is shown; the LH side is similar.

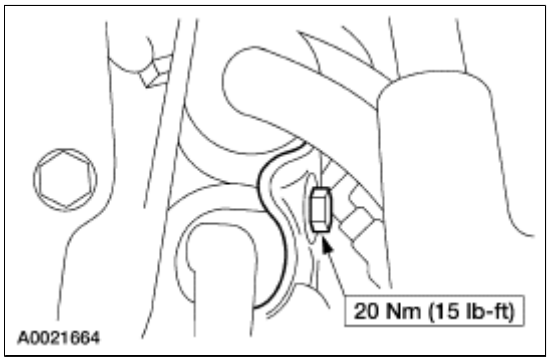
    Install the three-way catalytic converter (TWC).



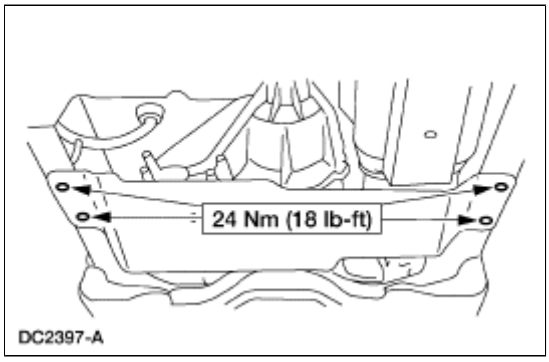
47. Connect the heated oxygen sensors (HO2S).



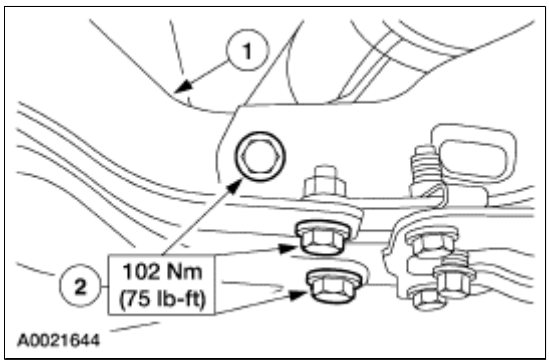
48. Install the support insulator bracket.



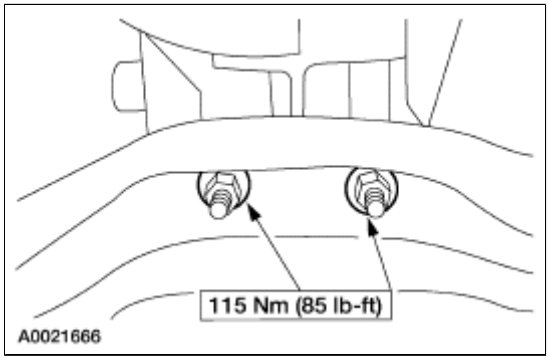
49. Install the transfer case skid plate, if equipped.



50. Install the crossmember.
    1. Position the crossmember.
    2. Install the six bolts.



51. Lower the transmission onto the crossmember and install the nuts.



52. Position the High-Lift Transmission Jack aside.

53. Lower the vehicle.

54. Fill the engine crankcase with clean oil meeting Ford specification WSS-M2C153-G.

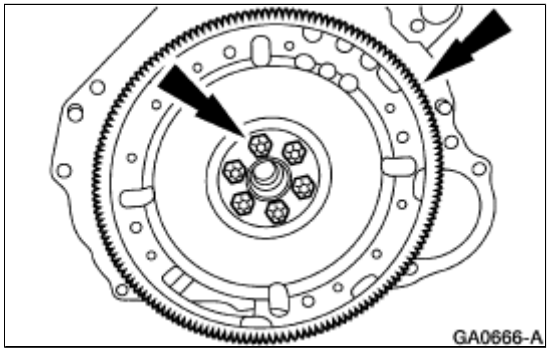
55. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .

56. Connect the battery ground cable.

Flywheel

Removal

1. Remove the transmission. For additional information, refer to Section 307-01B .
2. Remove and discard the bolts. Remove the flywheel.

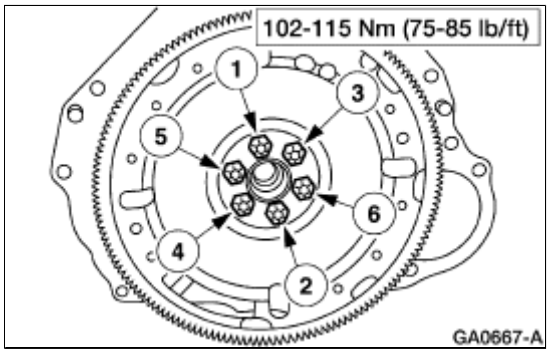


3. Clean and inspect the flywheel. For additional information, refer to Section 303-00 .

Installation

1. **NOTE:** Sealant must be removed from the bolt holes prior to reassembly.

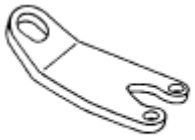
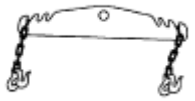
   Position the flywheel and install new bolts.



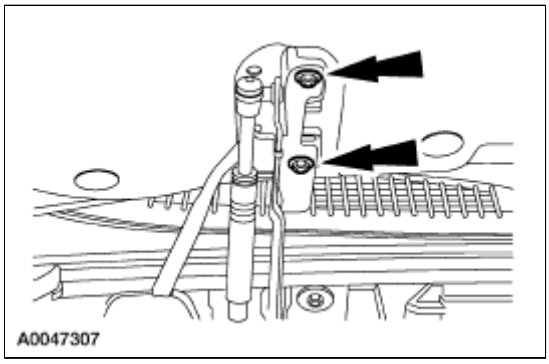
2. Install the transmission. For additional information, refer to Section 307-01B .

Engine

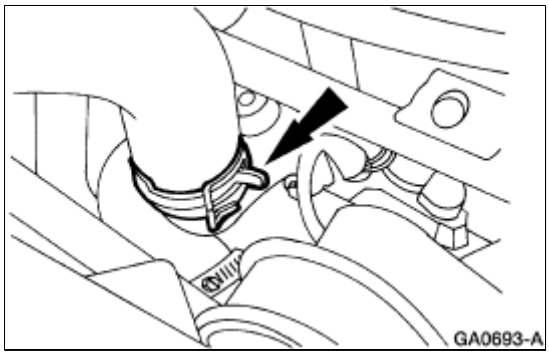
Special Tool(s)

 ST1621-A	5.0L Lifting Bracket 303-D096 (D94P-6001-B) or equivalent
ST2352-A	Spring Lock Coupling Disconnect Tool Set 412-039 (T84L-19623-B
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

1. Remove the hood.



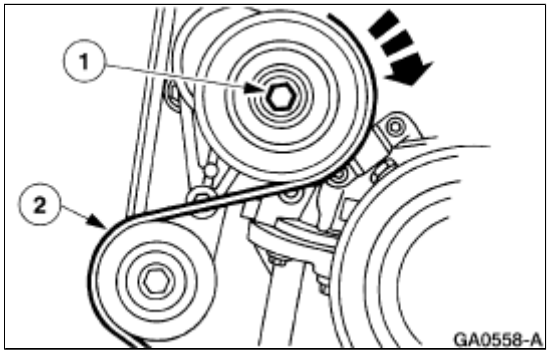
2. Remove the battery. For additional information, refer to Section 414-01 .
3. Drain the engine cooling system. For additional information, refer to Section 303-03 .
4. Disconnect the upper radiator hose.



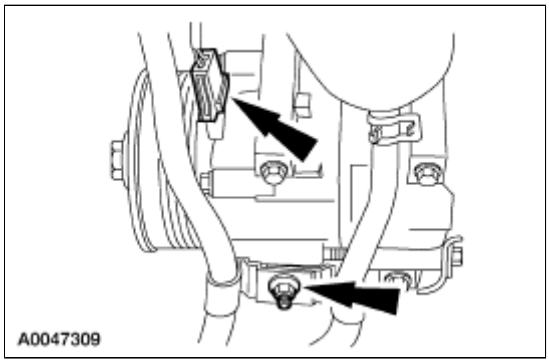
5. Remove the fan shroud. For additional information, refer to Section 303-03 .

6. Discharge and recover the air conditioning system. For additional information, refer to Section 412-00 .

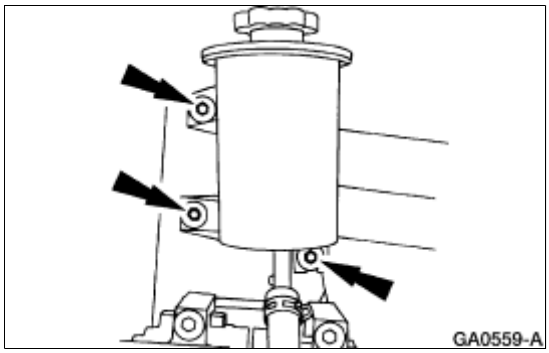
7. Remove the drive belt.
   1. Rotate the drive belt tensioner clockwise.
   2. Remove the drive belt.



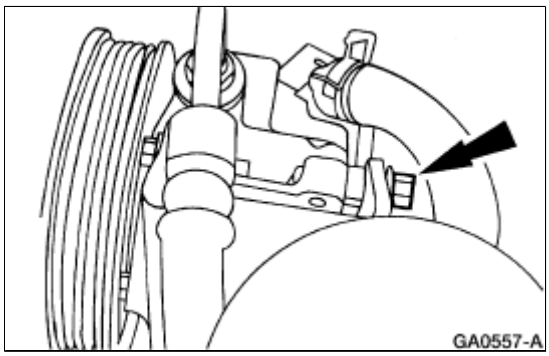
8. Disconnect the A/C clutch electrical connector and remove the power steering hose clamp.



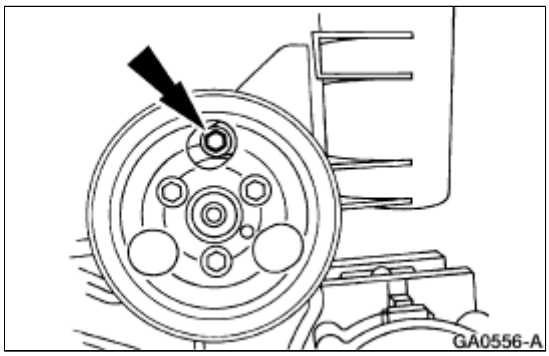
9. Remove the bolts and position the power steering reservoir aside.



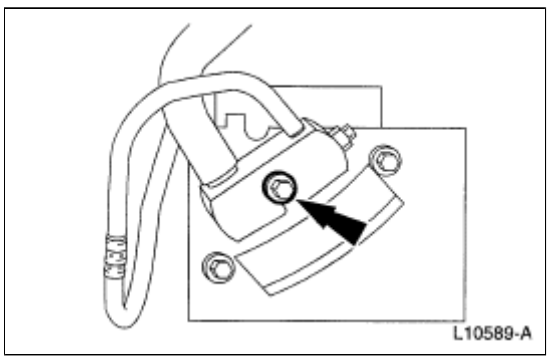
10. Remove the rear power steering pump bolt.



11. Remove the three bolts and position the power steering pump aside.

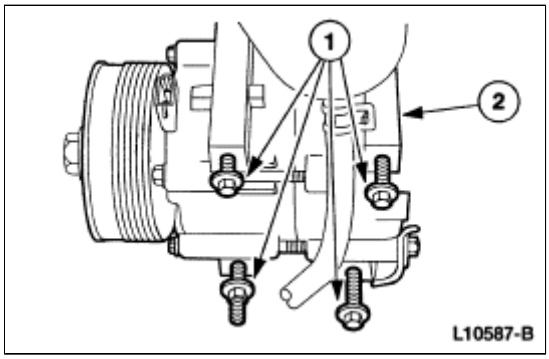


12. Remove the A/C manifold from the A/C compressor.

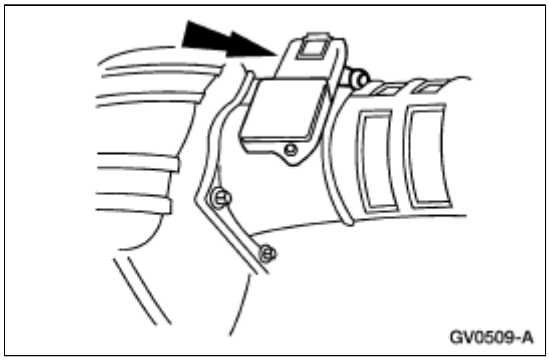


13. Remove the A/C compressor.

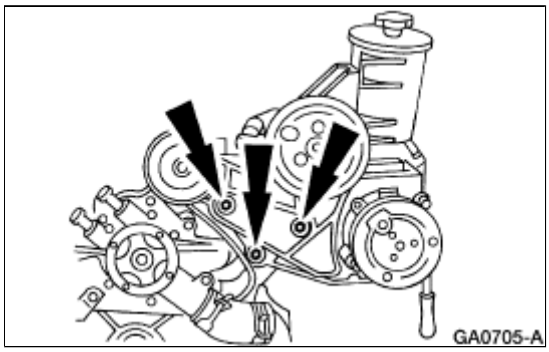
1. Remove the bolts.
2. Lift out the A/C compressor.



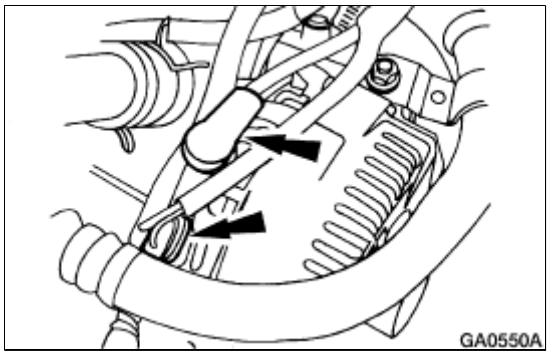
14. Disconnect the mass airflow (MAF) sensor electrical connector.



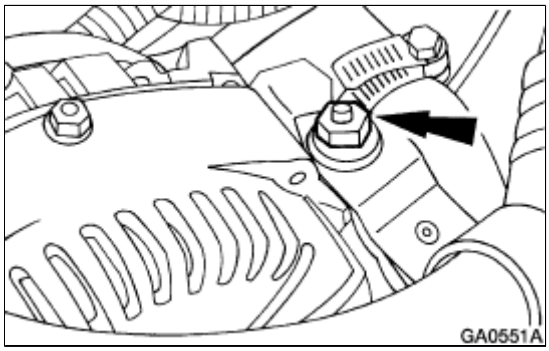
15. Remove the bolts and remove the bracket.



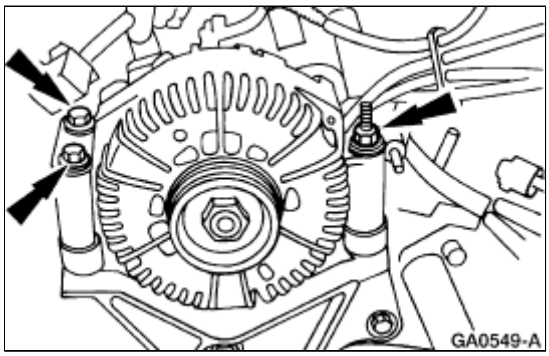
16. Disconnect the generator electrical connections.



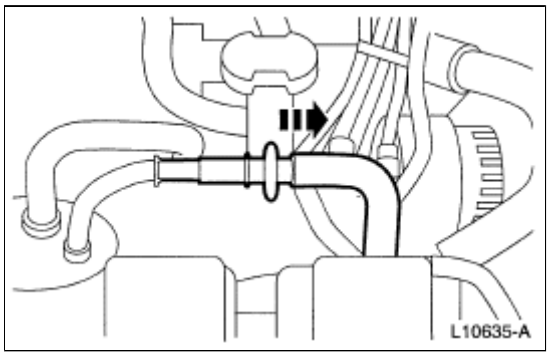
17. Remove the nut on the generator stud.



18. Remove the bolts and remove the generator.

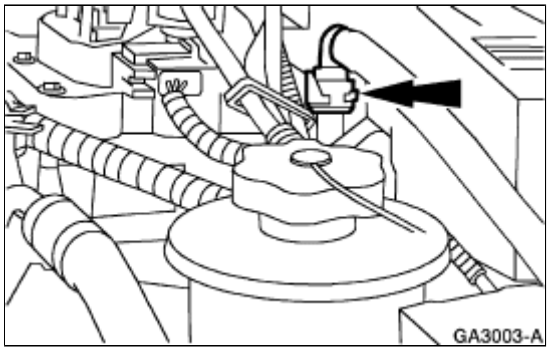


19. Using special tool 412-039, disconnect the A/C manifold and tube spring lock coupling from the suction accumulator/drier.

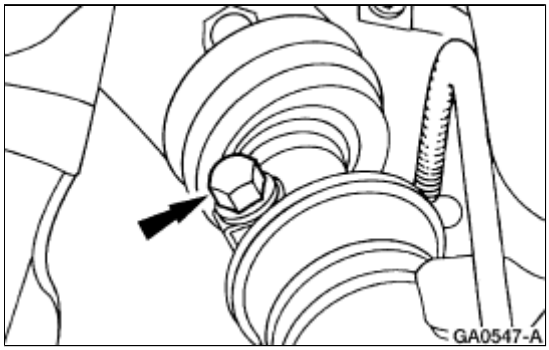


20. Disconnect the fuel lines at the spring lock couplings. For additional information, refer to Section 310-00 .

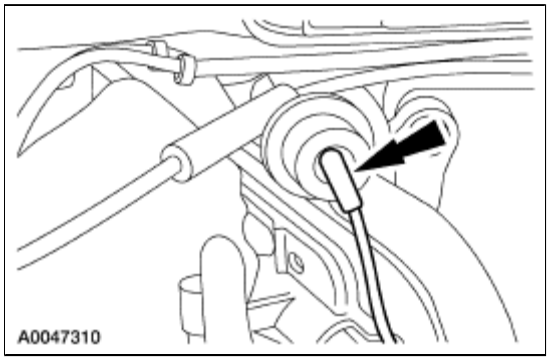
21. Disconnect the evaporative emissions (EVAP) canister purge solenoid hose.



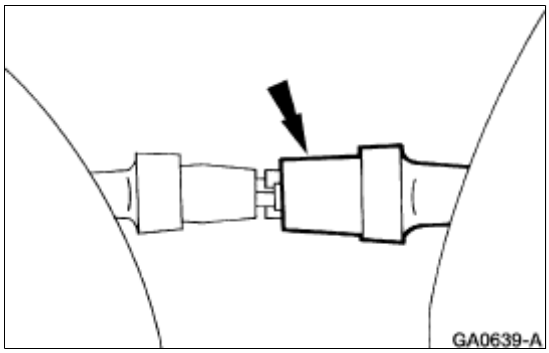
22. Remove the bolt and position the lower steering column shaft aside.



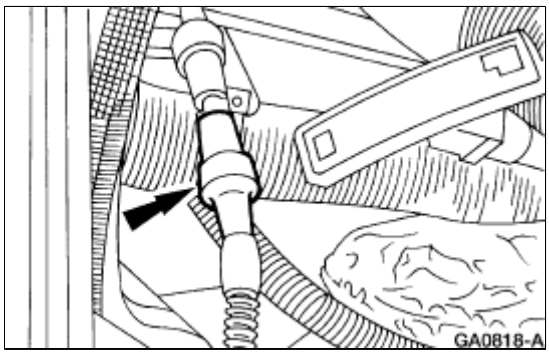
23. Disconnect the heater control valve vacuum hose.



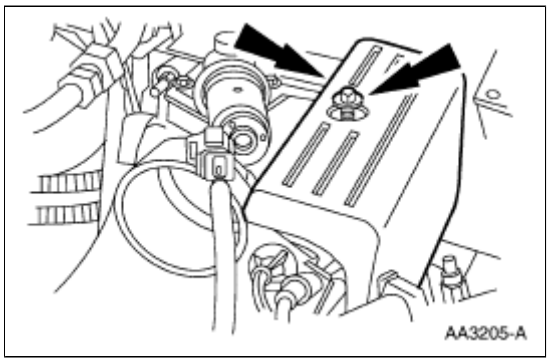
24. Disconnect the RH vacuum connection.



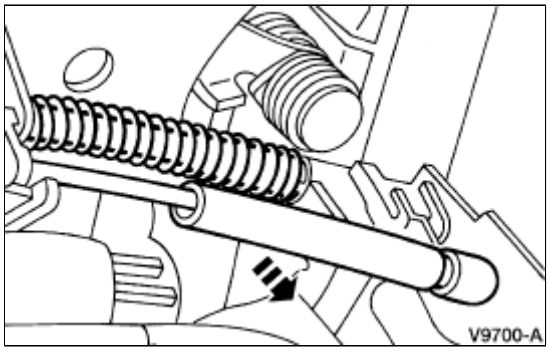
25. Disconnect the LH vacuum connection.



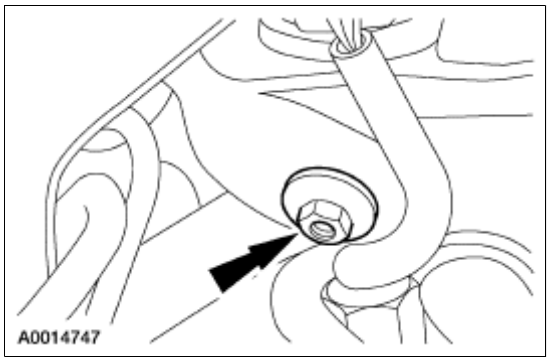
26. Remove the accelerator control snow shield.



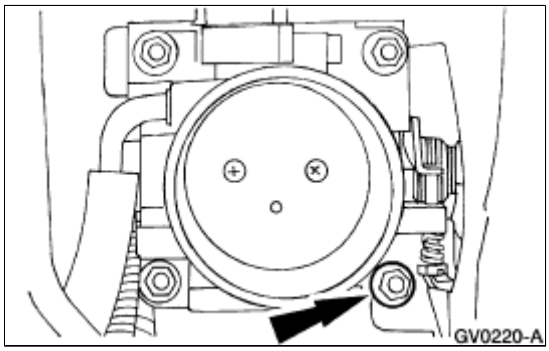
27. Disconnect the accelerator and the speed control cables from the throttle linkage.



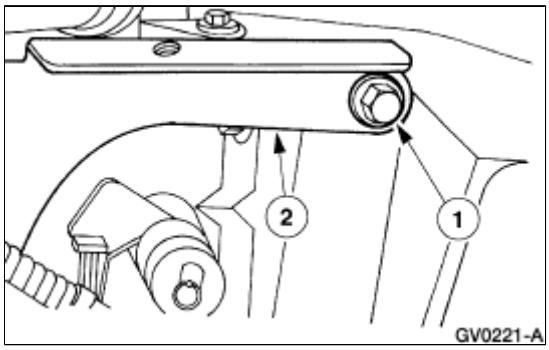
28. Remove the accelerator cable bracket nut.



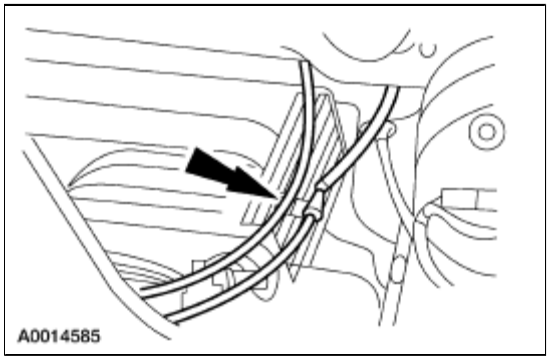
29. Remove the lower accelerator cable bracket nut.



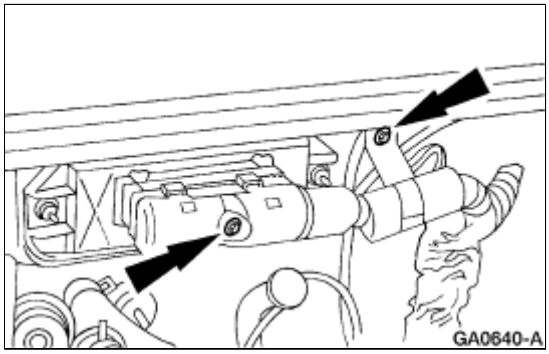
30. Remove the accelerator cable bracket.
    1. Remove the nut.
    2. Remove the accelerator cable bracket.



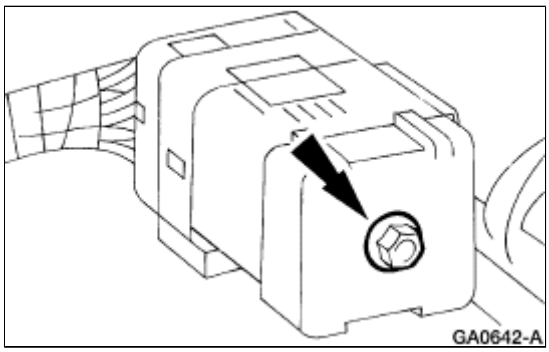
31. Remove the accelerator and the speed control cables from the clip.



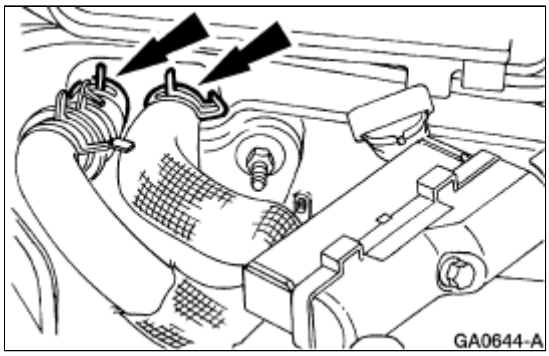
32. Disconnect the powertrain control module (PCM) connector and the body ground connector.



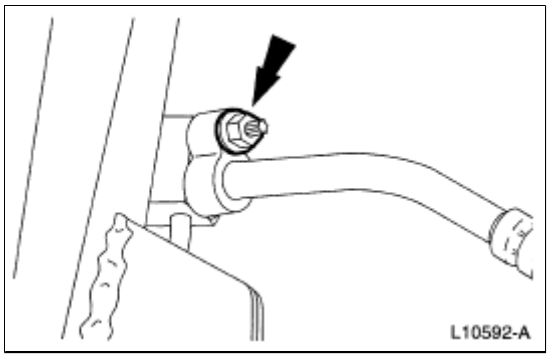
33. Disconnect the engine bulkhead connector.



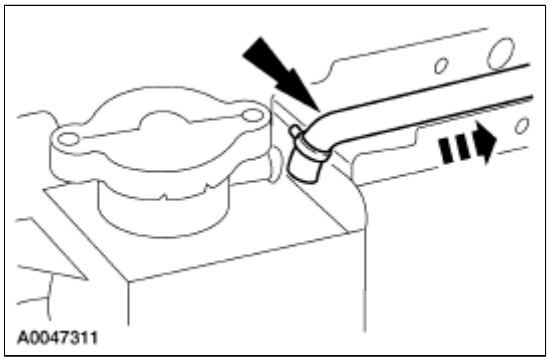
34. Disconnect the heater water hoses.



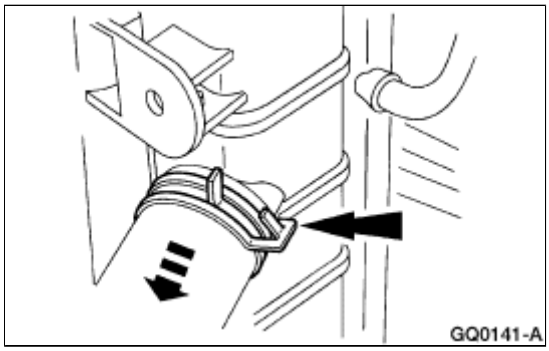
35. Disconnect the A/C manifold and tube, and the condenser to the evaporator tube, from the A/C condenser.



36. Disconnect the radiator overflow hose from the radiator filler neck.

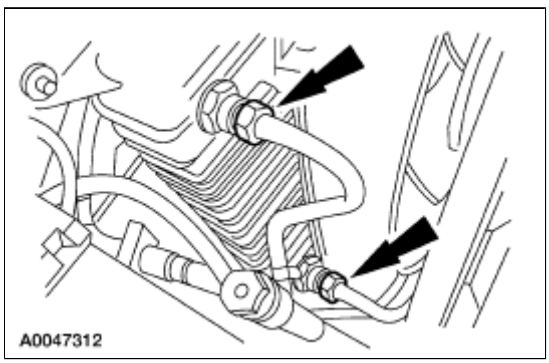


37. Disconnect the upper radiator hose from the radiator.

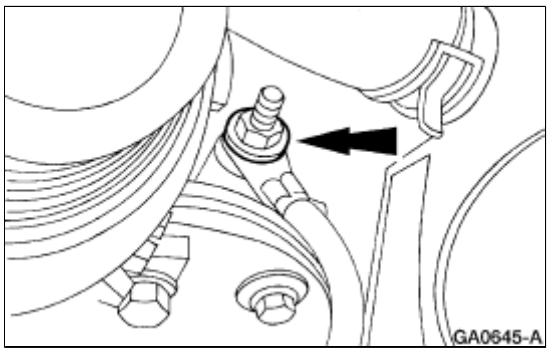


38. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

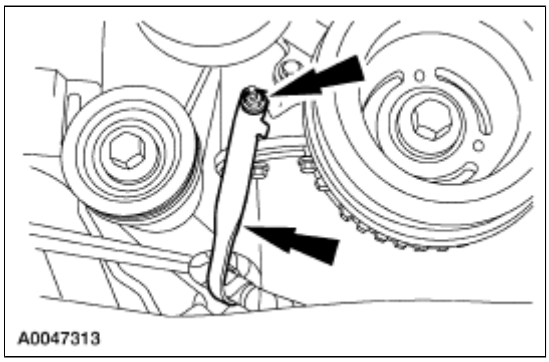
    Disconnect the transmission cooling tubes.



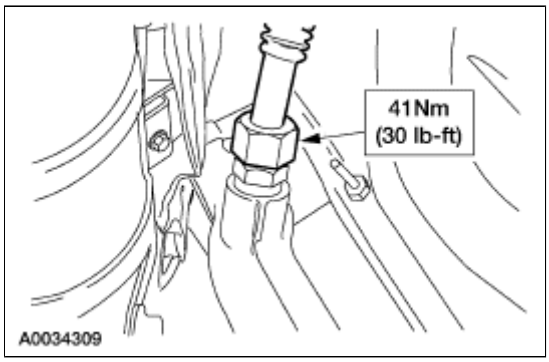
39. Disconnect the ground cable from the engine front cover.



40. Remove the wiring brace from the engine front cover.

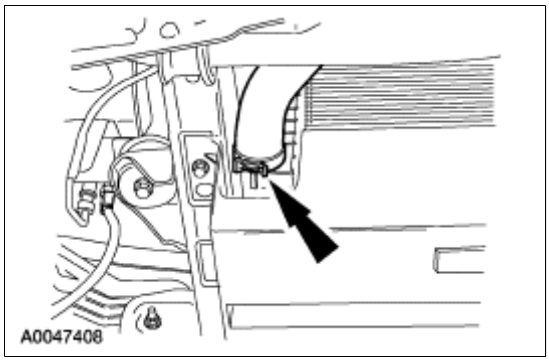


41. Disconnect the exhaust gas recirculation (EGR) tube from the exhaust manifold.

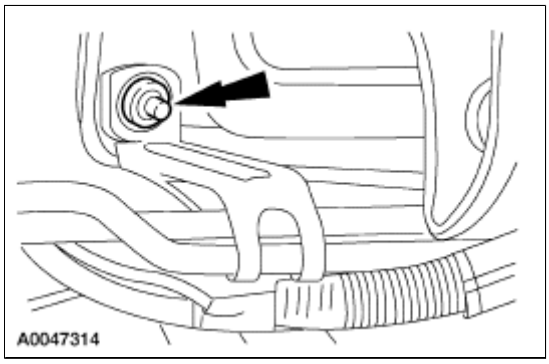


42. Raise and support the vehicle. For additional information, refer to Section 100-02 .

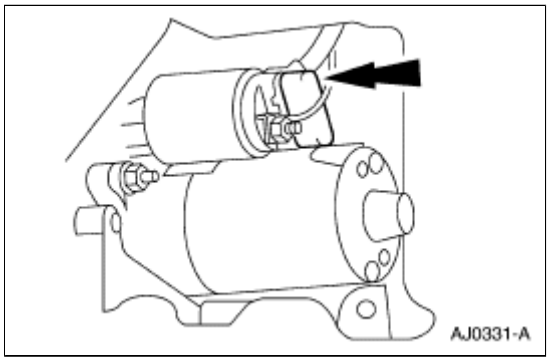
43. Disconnect the lower radiator hose from the radiator.



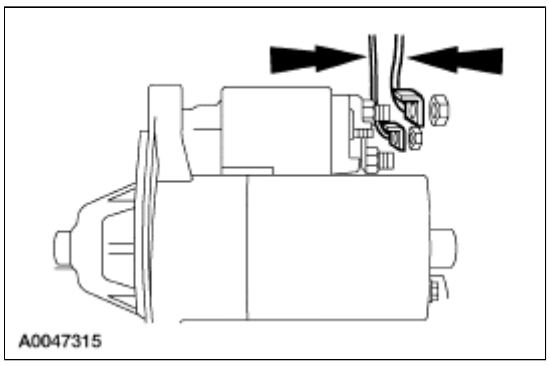
44. Remove the transmission cooler tubes brace from the RH engine mount.



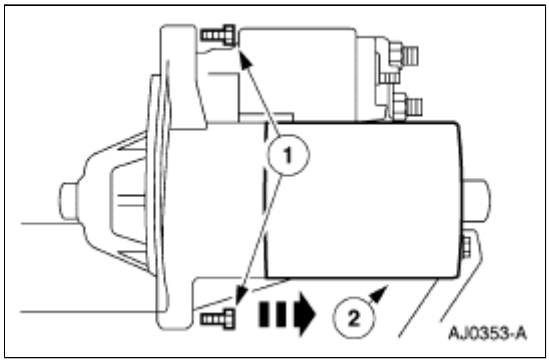
45. Remove the starter motor solenoid terminal cover.



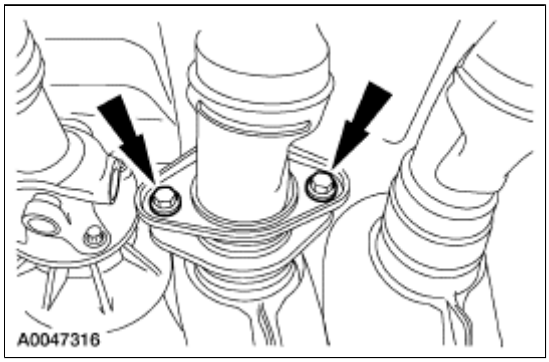
46. Disconnect the wiring from the starter motor solenoid.



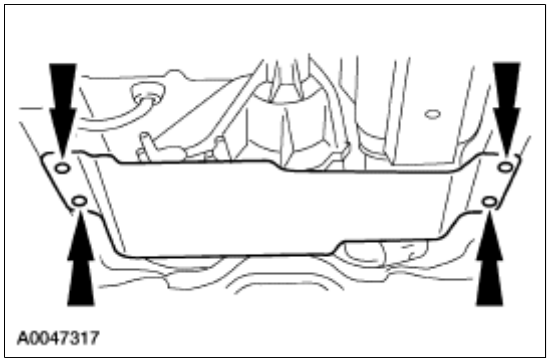
47. Remove the starter motor.
    1. Remove the bolts.
    2. Remove the starter motor.



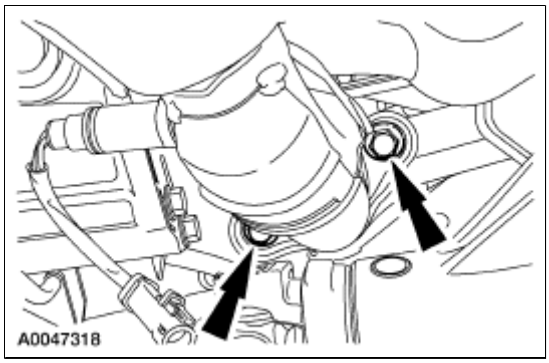
48. Remove the bolts from the muffler to the catalytic converter.



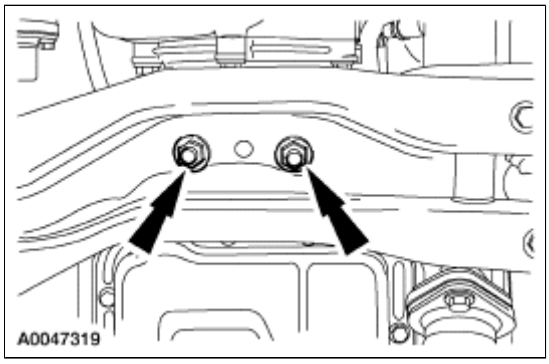
49. If equipped, remove the bolts and the skid plate.



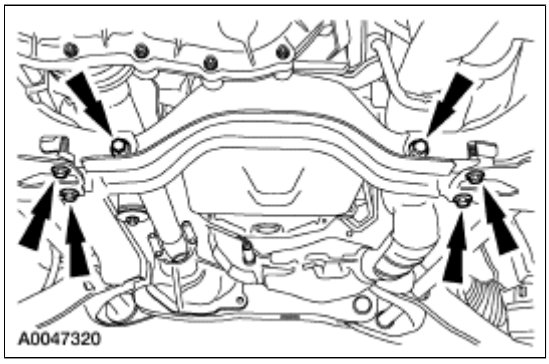
50. Remove the bolts.



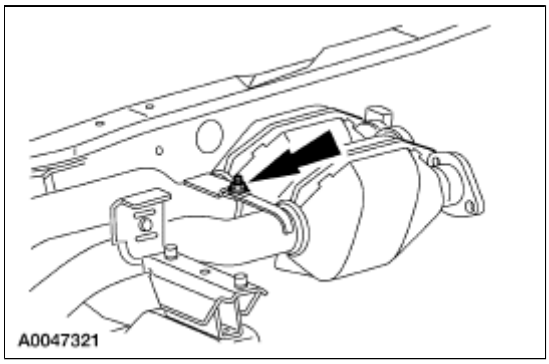
51. Remove the nuts.
    - Position a suitable transmission jack under the transmission.



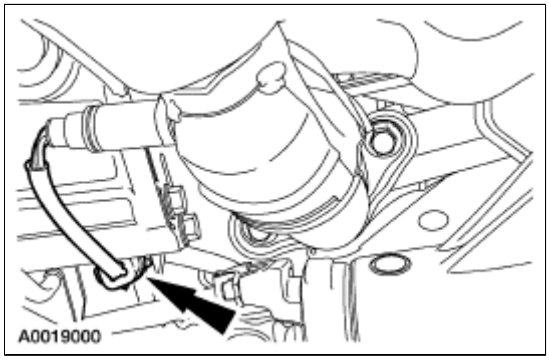
52. Remove the bolts and the transmission crossmember.



53. Remove the nut.

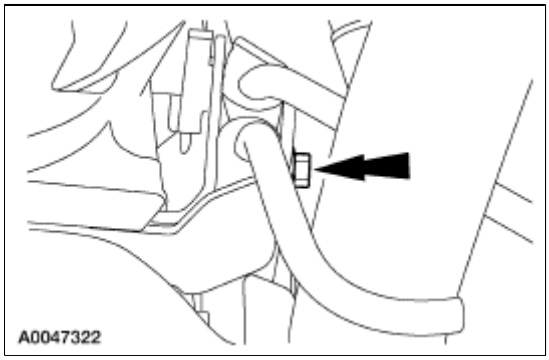


54. Disconnect the LH heated oxygen sensor and the catalyst monitor sensor.

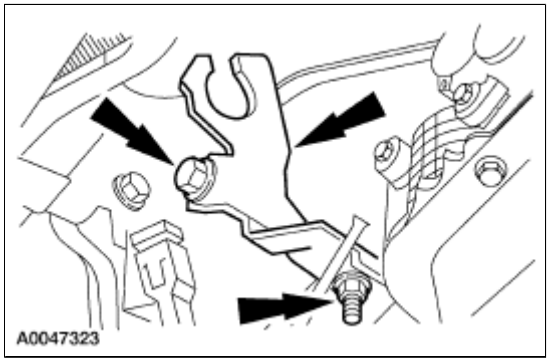


55. **CAUTION: Disconnect the RH oxygen sensor while lowering the three-way catalytic converter.**

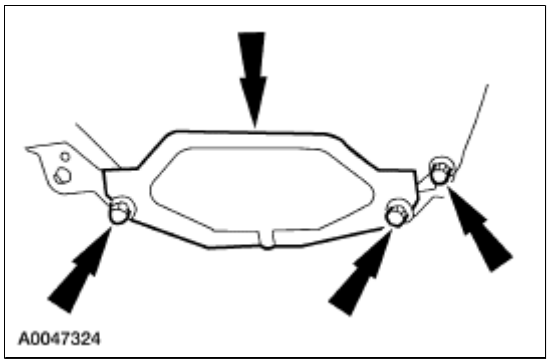
Remove the bolt and the three-way catalytic converter (TWC).



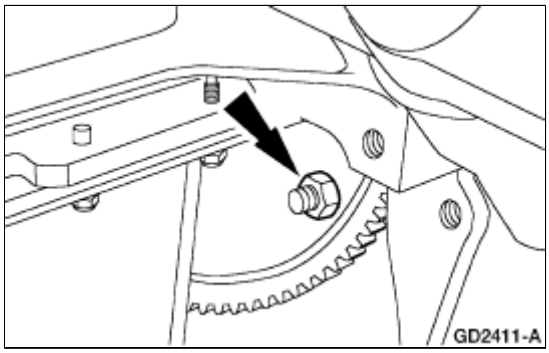
56. Remove the retainers and position the transmission cable and bracket aside.



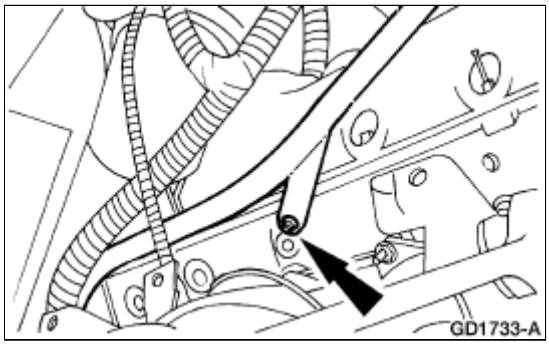
57. Remove the transmission inspection cover.



58. Remove the torque converter retaining nuts.

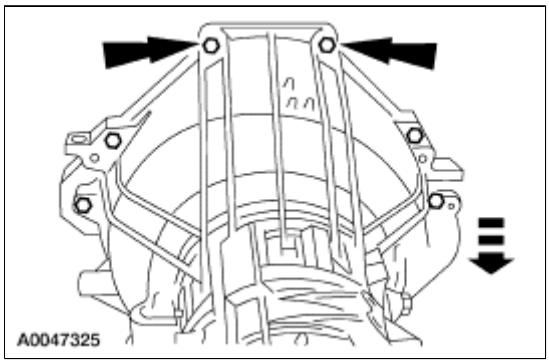


59. Remove the transmission fluid level indicator tube retaining bolt and position the indicator tube aside.

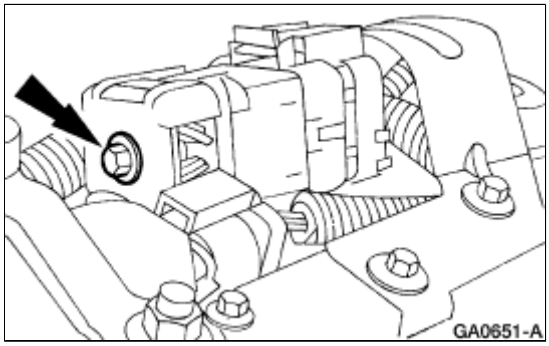


60. **NOTE:** Lower the transmission to access the upper bolts.

    Remove the transmission-to-engine upper bolts.

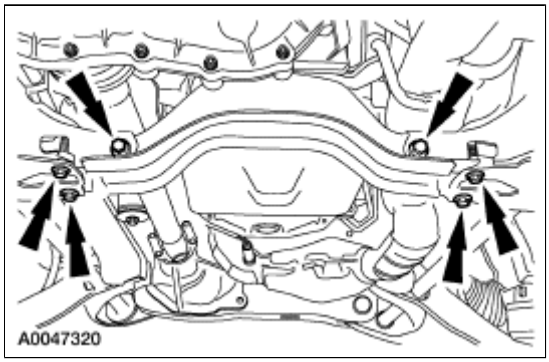


61. Disconnect the transmission bulkhead connector.

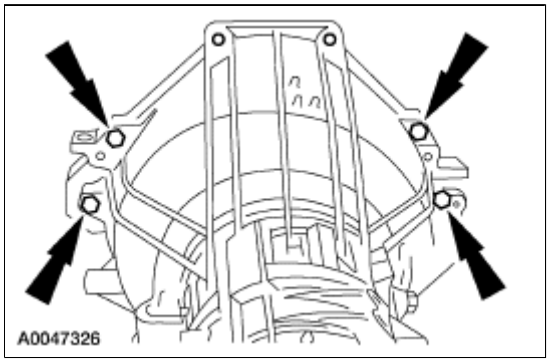


62. If equipped, disconnect the low oil level sensor electrical connector .

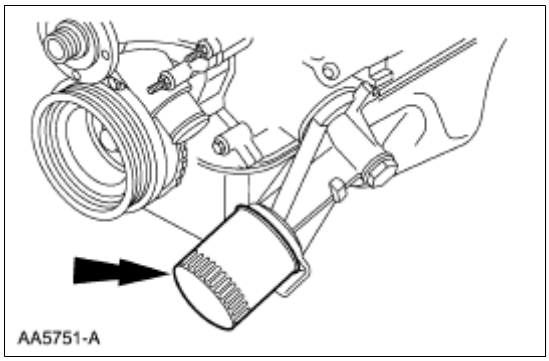
63. Raise the transmission and install the crossmember. Install the retaining nuts on the transmission mount. Tighten all retainers securely.



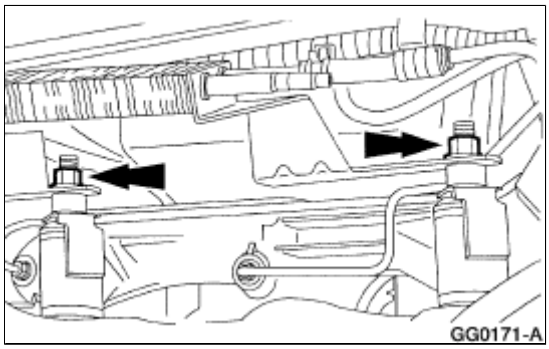
64. Remove the remaining transmission-to-engine bolts. Remove the transmission jack.



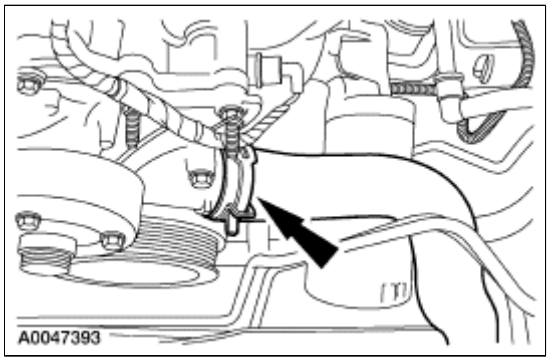
65. Remove the oil bypass filter.



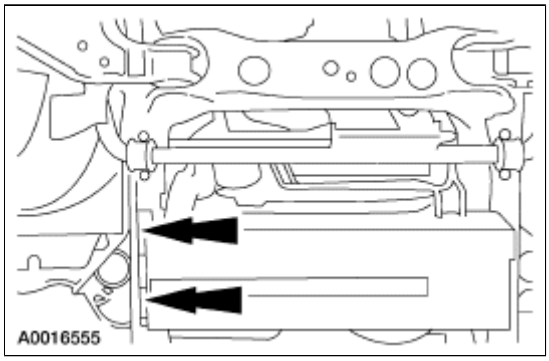
66. Remove the nuts and position the power steering cooler aside.



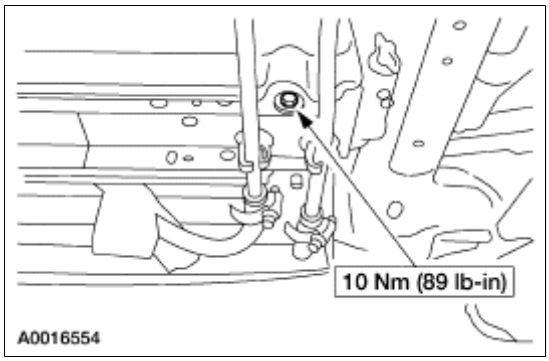
67. Remove the lower radiator hose from the water pump.



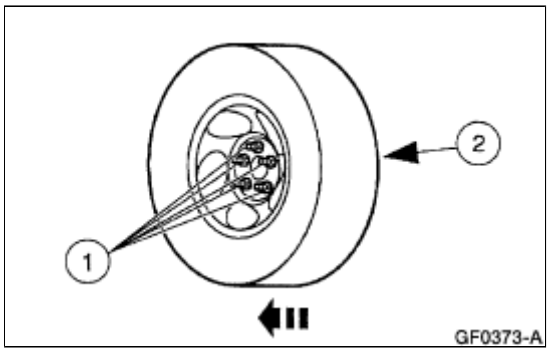
68. Remove the air deflector.



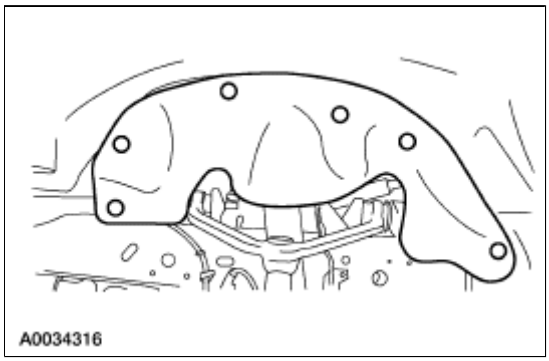
69. Remove the bolt.



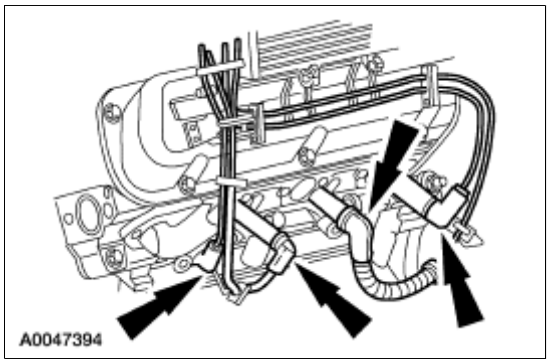
70. Remove the left front wheel and tire assembly.
    1. Remove the wheel nuts.
    2. Remove the wheel and tire assembly, using a side-to-side rocking motion.



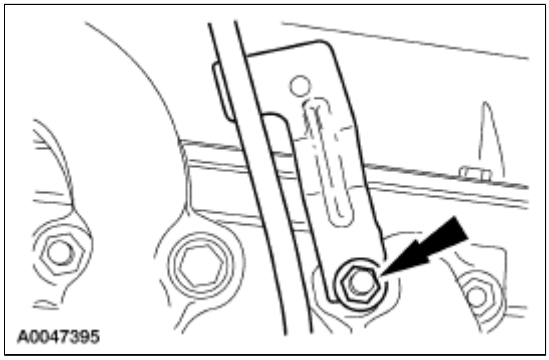
71. Remove the left front wheel well splash shield.



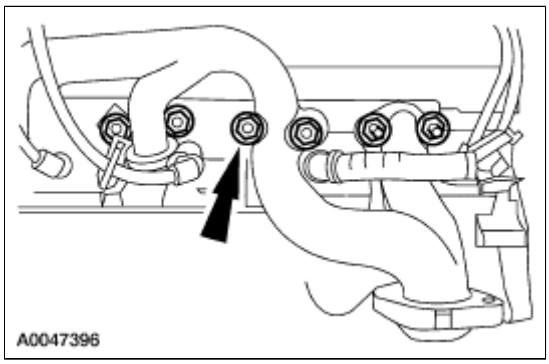
72. Disconnect the spark plug wires from the LH spark plugs.



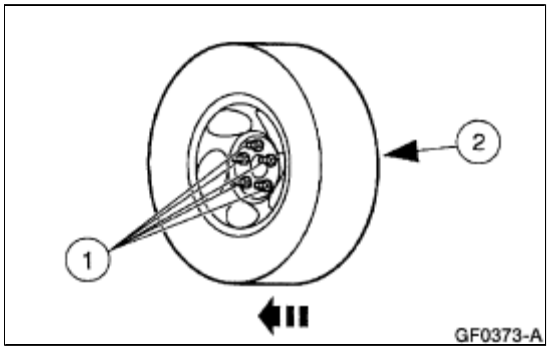
73. Remove the engine oil fluid level indicator tube.



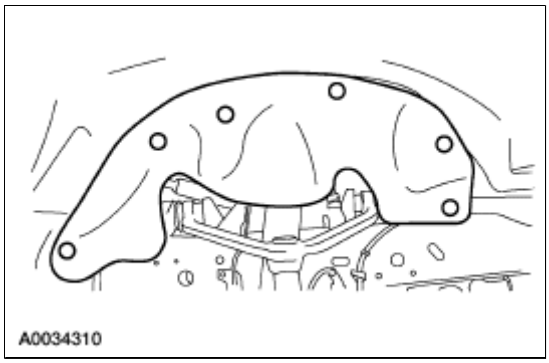
74. Remove all the LH exhaust manifold retainers.



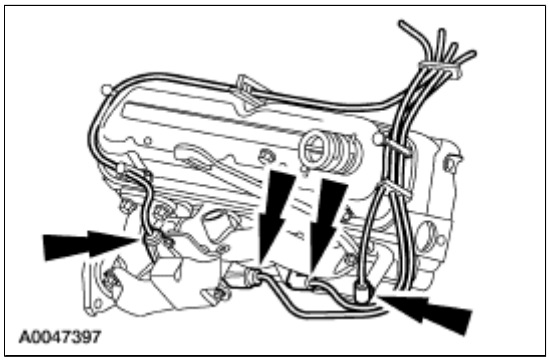
75. Remove the right front wheel and tire assembly.
    1. Remove the wheel nuts.
    2. Remove the wheel and tire assembly, using a side-to-side rocking motion.



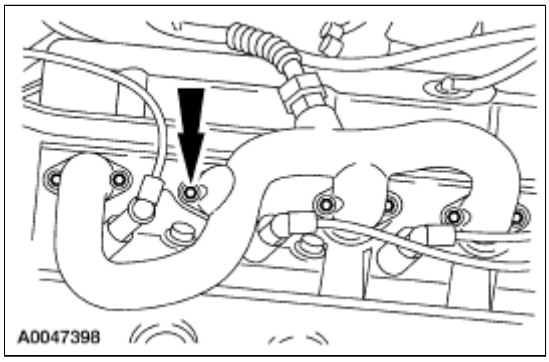
76. Remove the right side wheel well splash shield.



77. Disconnect the spark plug wires from the RH spark plugs.

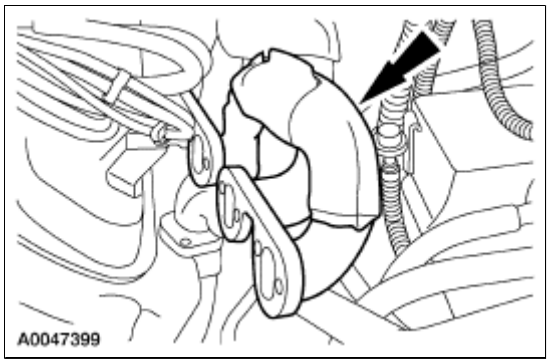


78. Remove all the RH exhaust manifold retainers.

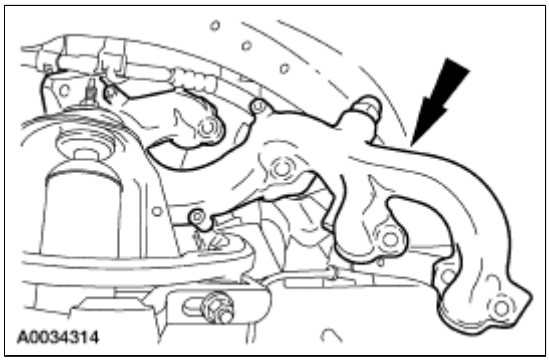


79. Lower the vehicle.

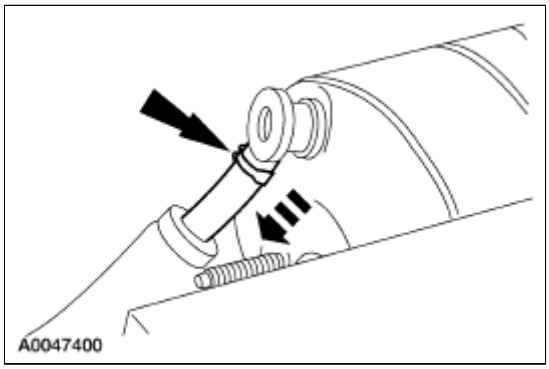
80. Remove the left side exhaust manifold and gasket.



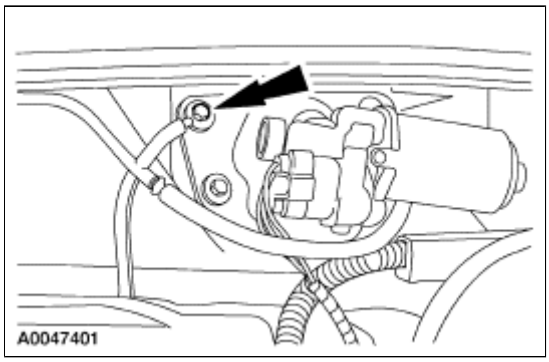
81. Remove the right side exhaust manifold and gasket.



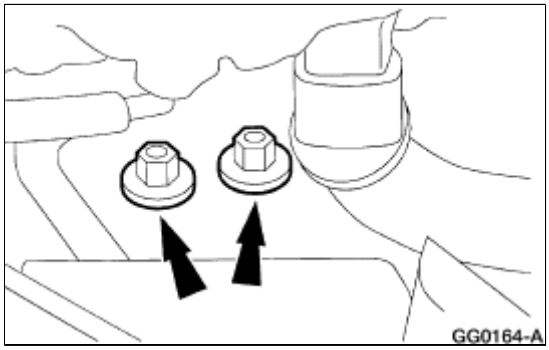
82. Disconnect the vacuum hose at the brake booster.



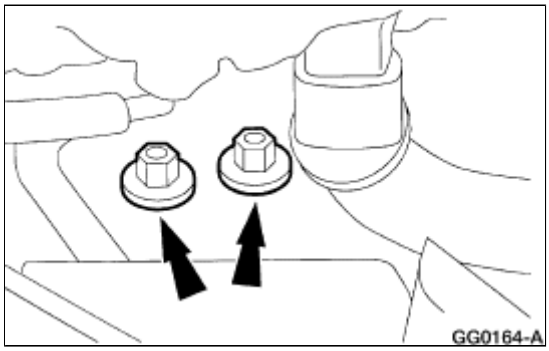
83. Remove the engine ground strap from the bulkhead.



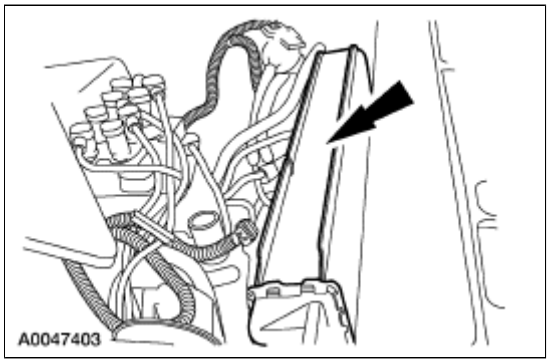
84. Remove the LH motor mount nuts.



85. Remove the RH motor mount nuts.

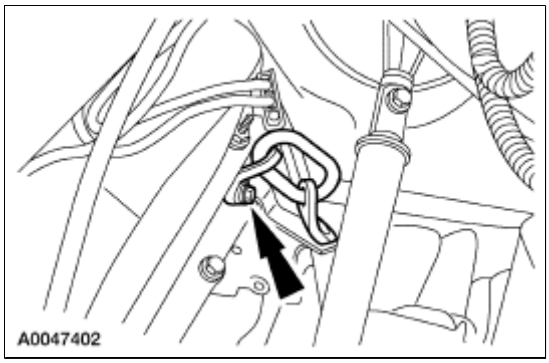


86. Remove the radiator and condenser assembly.

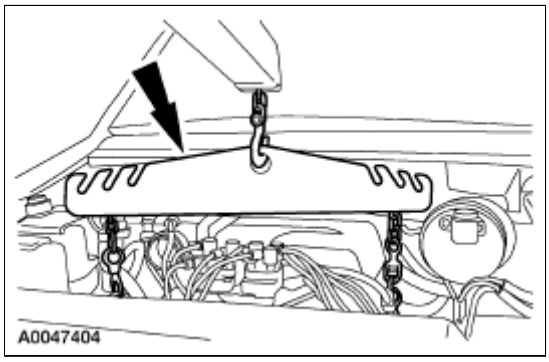


87. **NOTE:** The lifting brackets should be installed on the exhaust manifold stud bolts for the No. 1 and No. 8 cylinders.

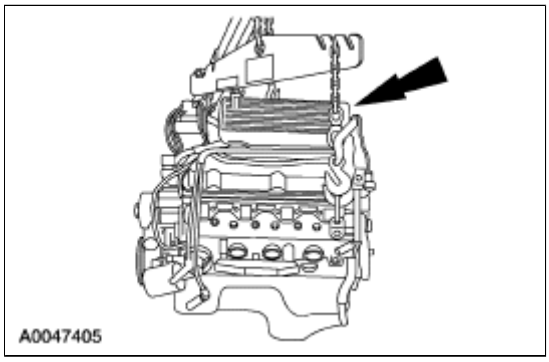
    Install the lifting brackets.



88. Install the spreader bar on the lifting brackets.

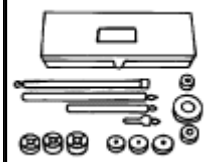
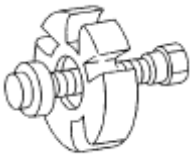
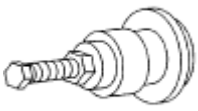
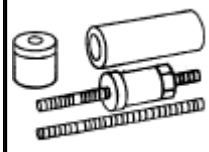
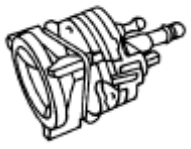
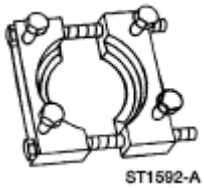


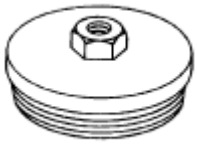
89. Remove the engine.



Engine

Special Tool(s)

 ST1381-A	Camshaft Bearing Service Set 303-017 (T65L-6250-A)
 ST1286-A	Crankshaft Damper Remover 303-009 (T58P-6316-D)
 ST1328-A	Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)
ST2435-A	Syncro Positioning Tool 303-630
 ST1591-A	Damper Replacer 303-008 (T52L-6306-AEE)
 ST1276-A	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)
 ST1592-A	Seal Remover 303-053 (T70P-6B070-B)

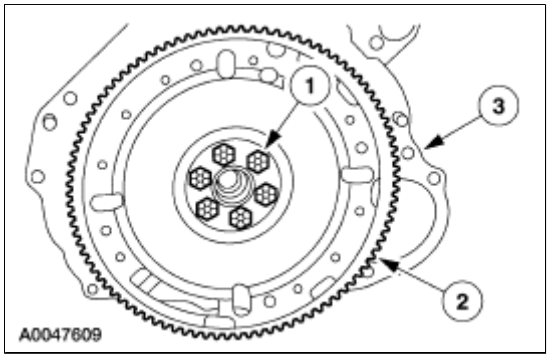
ST1187-A	Impact Hammer 307-005 (T59L-100-B)
 ST1382-A	Rear Crank Seal Remover 303-519 (T95P-6701-EH)
ST1378-A	Damper Puller Adapter 303-176 (T82L-6316-B)

Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Pipe Sealant with Teflon XW7Z-19554-AA or equivalent	WSK-M2G350-A2

Disassembly

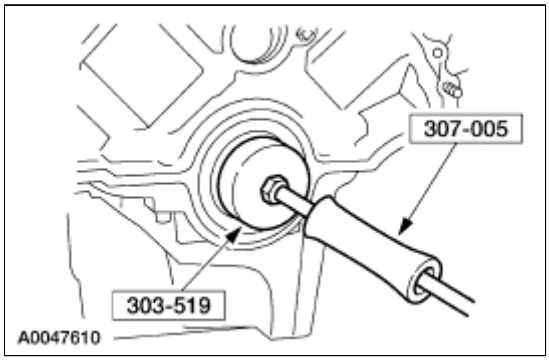
1. Remove the flywheel and the spacer plate.
    1. Remove and discard the flywheel bolts.
    2. Remove the flywheel.
    3. Remove the spacer plate.



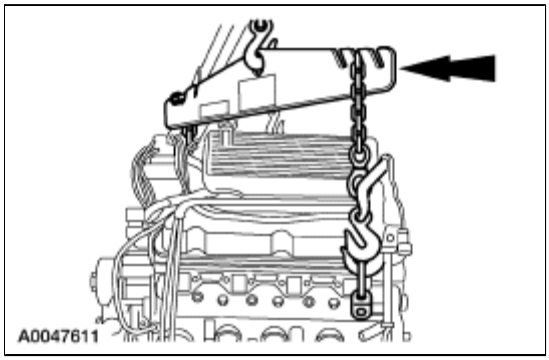
2. **CAUTION: Avoid scratching or damaging the oil seal surfaces during removal of the crankshaft rear oil seal.**

NOTE: Be sure the crankshaft rear sealing surface is clean and free of any rust or corrosion. To clean the crankshaft rear sealing surface, use extra-fine emery cloth or extra-fine 0000 steel wool with metal surface cleaner.

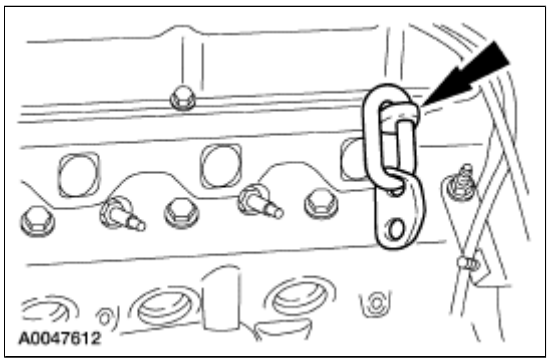
Using the special tools, remove the crankshaft rear main seal.



3. Mount the engine on a suitable engine stand and remove the spreader bar.

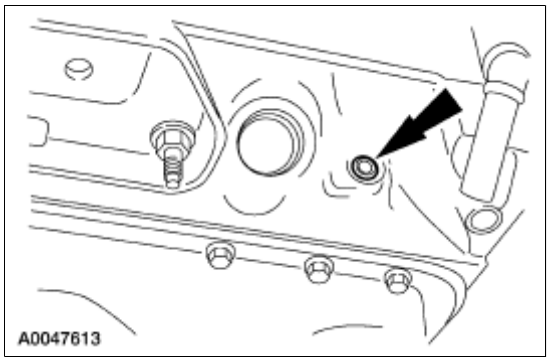


4. Remove the engine lifting brackets.

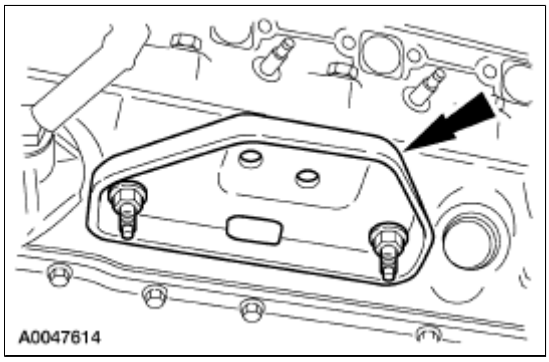


5. **NOTE:** If the cylinder block is to be reused, use thread sealer when installing the cylinder block coolant drain plugs.

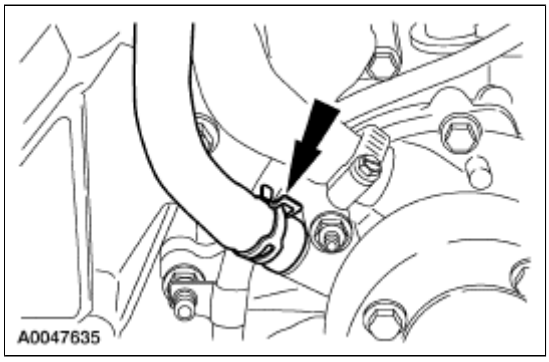
   Remove both the RH and the LH cylinder block coolant drain plugs.



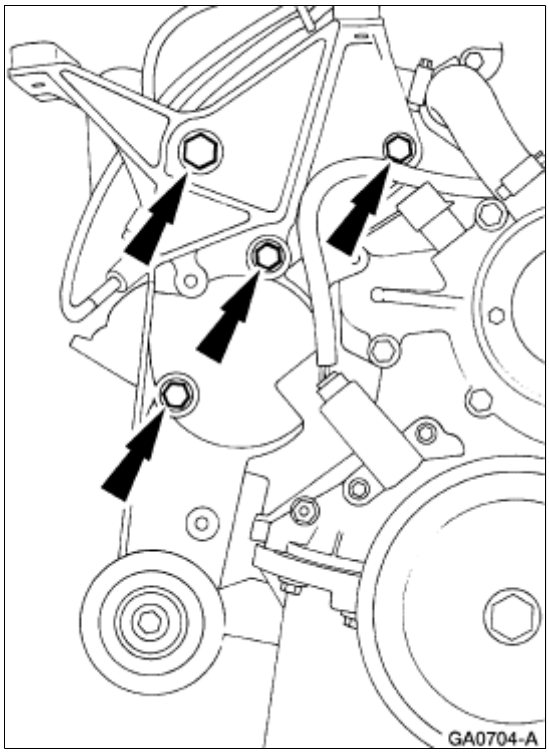
6. Remove both the RH and the LH engine mount brackets.



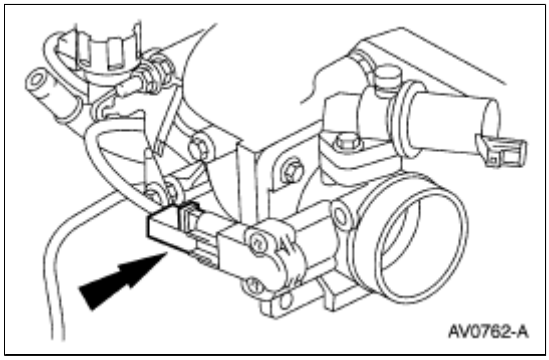
7. Disconnect the heater hose from the water pump.



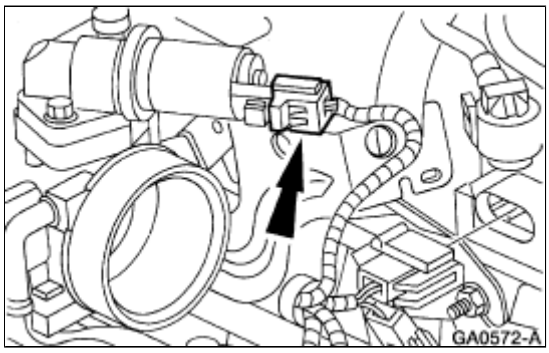
8. Remove the bolts and remove the generator mounting bracket.



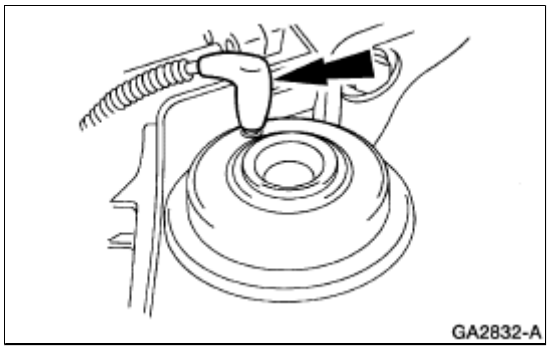
9. Disconnect the throttle position (TP) sensor electrical connector.



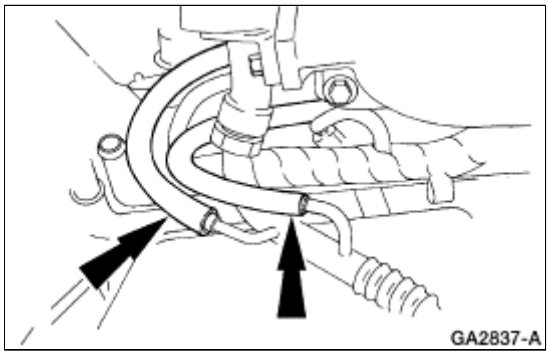
10. Disconnect the idle air control (IAC) solenoid electrical connector.



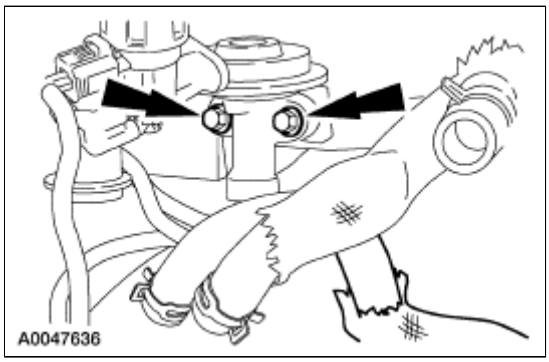
11. Remove the exhaust gas recirculation (EGR) valve vacuum hose.



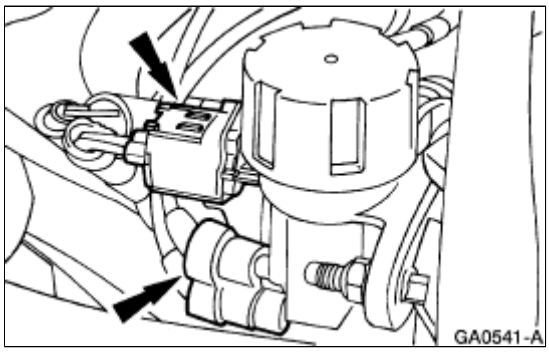
12. Disconnect the EGR backpressure transducer hoses.



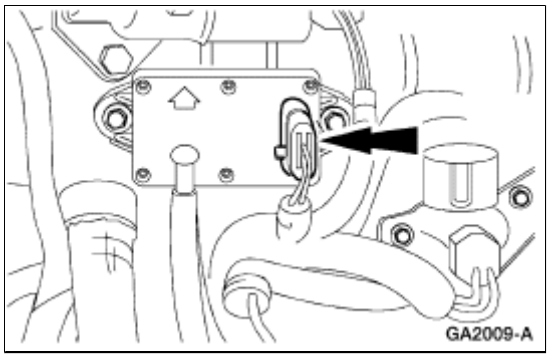
13. Remove the EGR valve and the EGR tube as an assembly.



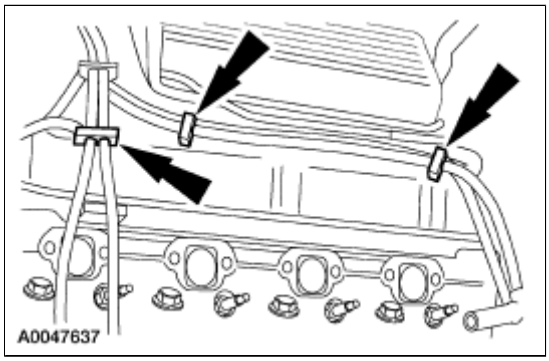
14. Disconnect the EGR vacuum regulator solenoid vacuum and electrical connections.



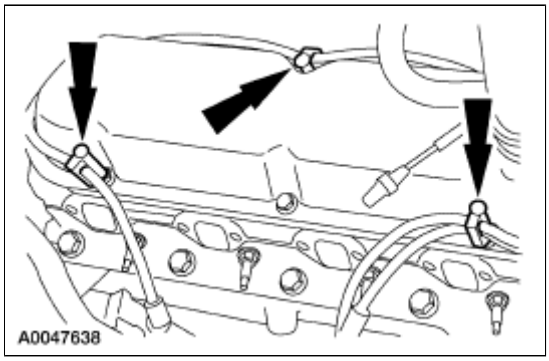
15. Disconnect the EGR backpressure transducer electrical connector.



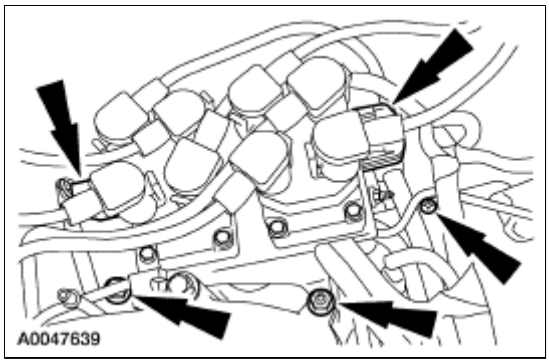
16. Disconnect the LH spark plug wire retainers from the valve cover. Position the spark plug wires aside.



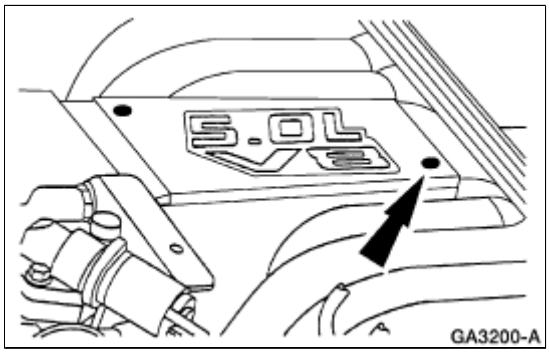
17. Disconnect the RH spark plug wire retainers from the valve cover. Position the spark plug wires aside.



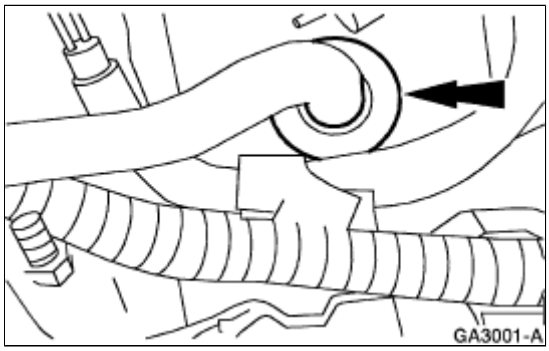
18. Remove the ignition coils and the mounting bracket as an assembly.
    - Disconnect the coils.
    - Remove the mounting bracket retainers.



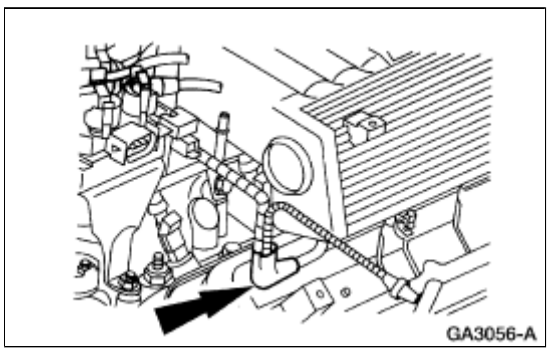
19. Remove the screws and the intake cover plate.



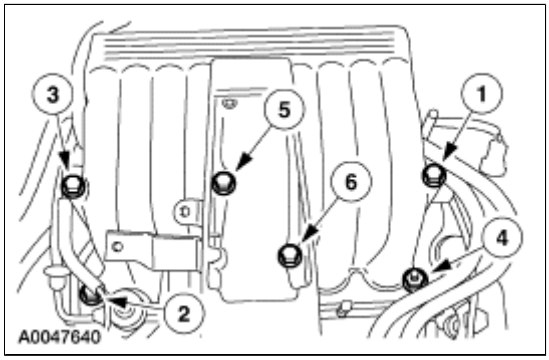
20. Disconnect the positive crankcase ventilation (PCV) hose.



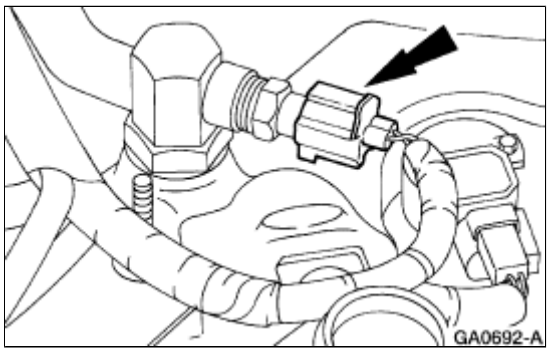
21. Disconnect the two evaporative emissions (EVAP) canister purge solenoid connections and the two PCV heater hoses.



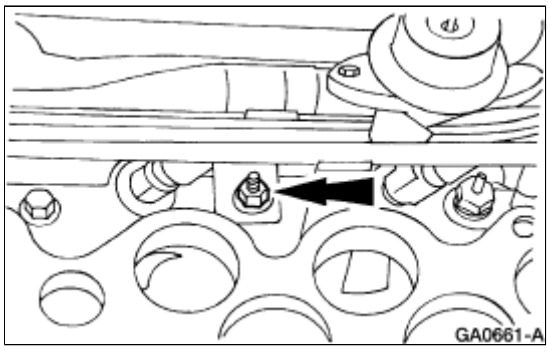
22. Remove the bolts in the sequence shown. Remove the upper intake manifold and gasket.



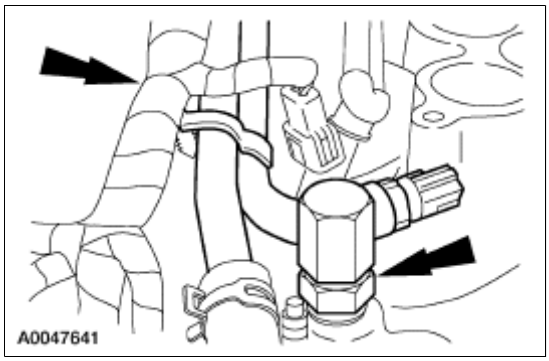
23. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



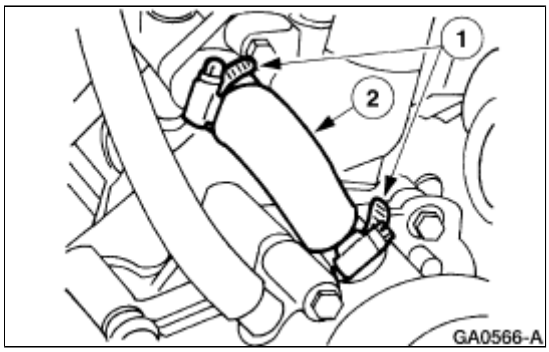
24. Remove the water heater tube retaining nut.



25. Remove the water heater tube from the lower intake manifold.
    - Release the retaining nut from the intake manifold.
    - Position the wiring harness aside.

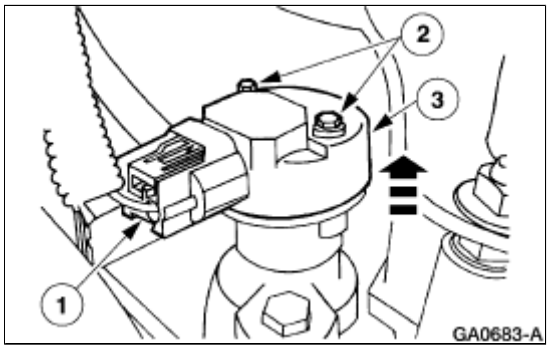


26. Remove the water bypass hose.
    1. Loosen the hose clamps.
    2. Remove the water bypass hose.

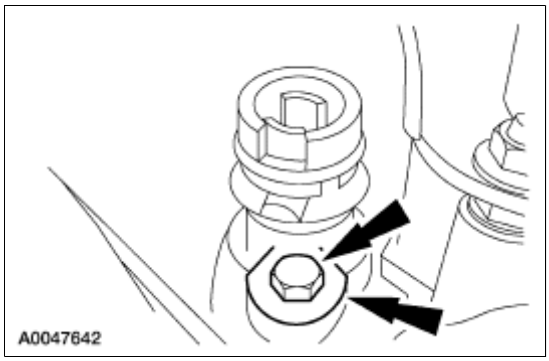


27. **NOTE:** Prior to the removal of the camshaft position (CMP) sensor, set the No. 1 cylinder to top dead center (TDC) of the compression stroke. Then note the position of the CMP sensor electrical connector. Installation procedures require that the electrical connector be located in the same position.

    Remove the CMP sensor.
    1. Disconnect the CMP electrical connector.
    2. Remove the screws.
    3. Remove the CMP sensor.

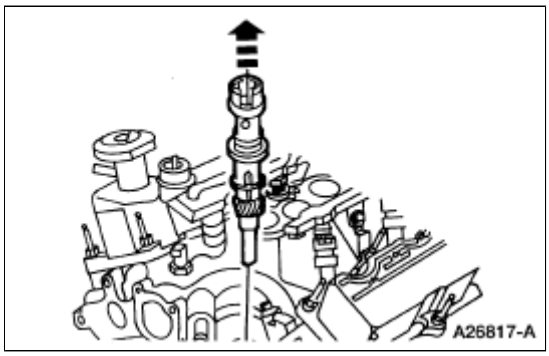


28. Remove the camshaft synchronizer hold-down bolt and clamp.

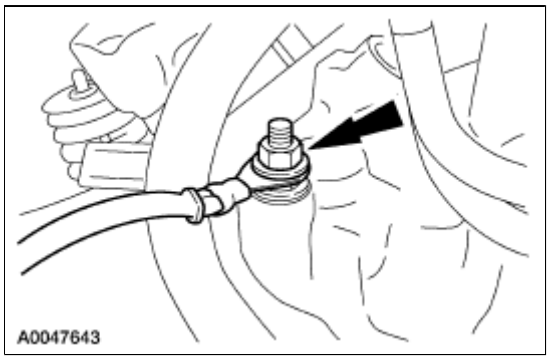


29. **NOTE:** The oil pump driveshaft might come out with the camshaft synchronizer. If so, retrieve the oil pump driveshaft before proceeding.

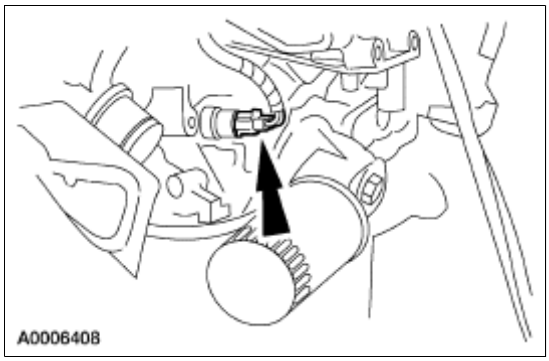
    Remove the camshaft synchronizer.



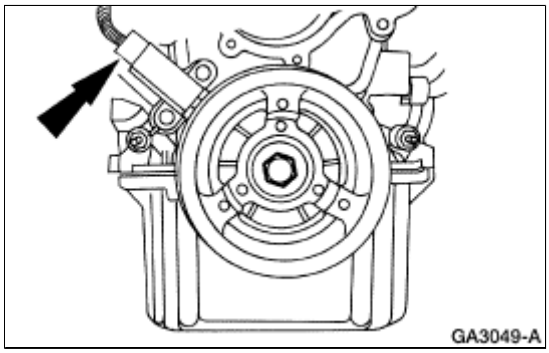
30. Remove the engine ground strap from the lower intake manifold.



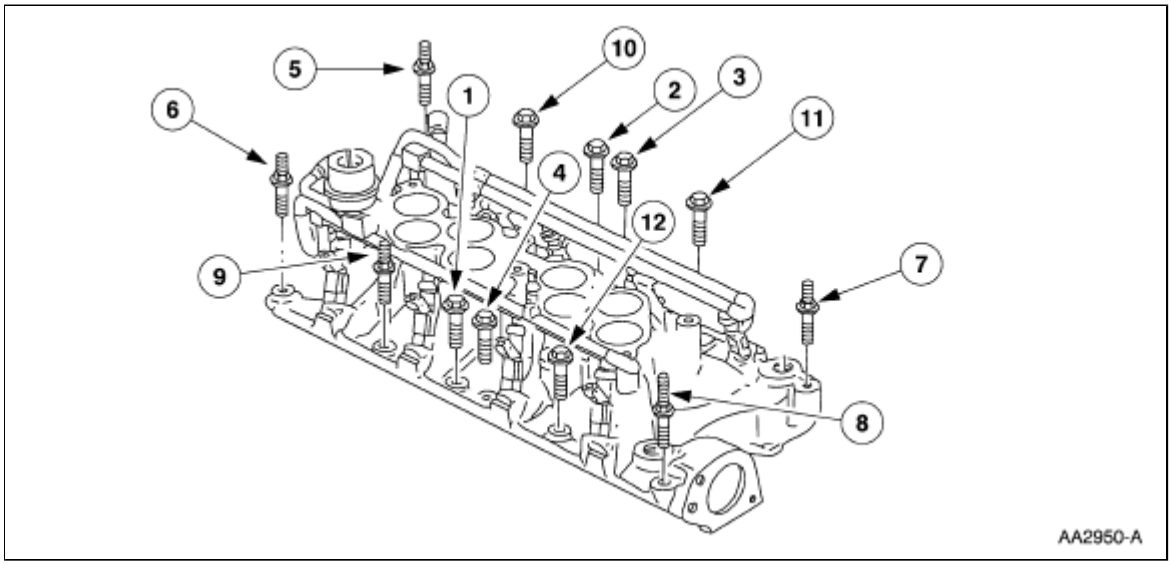
31. Disconnect the oil pressure sensor electrical connector.



32. Disconnect the crankshaft position (CKP) sensor electrical connector.

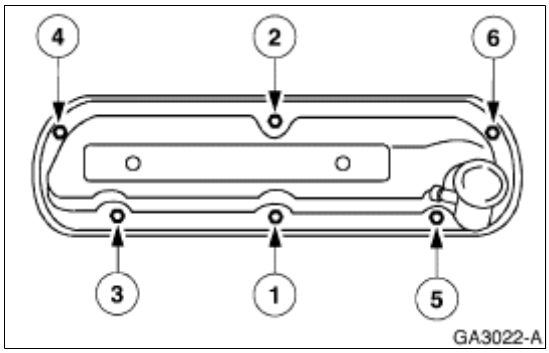


33. Remove the bolts in the sequence shown.

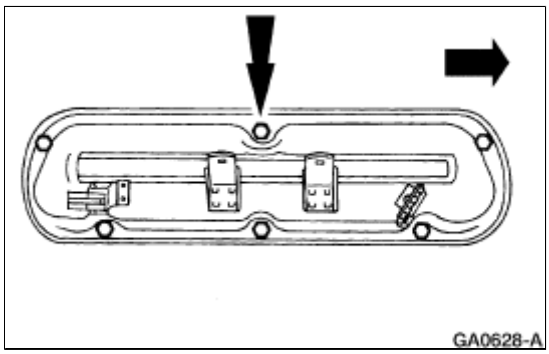


34. Remove the lower intake manifold and discard the gasket.

35. Remove the bolts and the RH valve cover.



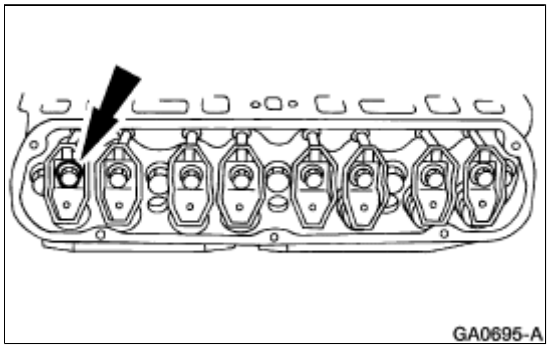
36. Remove the bolts and the LH valve cover.



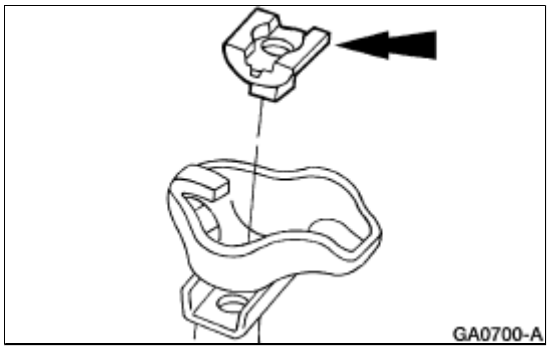
37. **NOTE:** Mark the rocker arms to make sure that they will be reinstalled in their original positions.

    NOTE: RH shown; LH similar.

    Remove the bolts from each side.

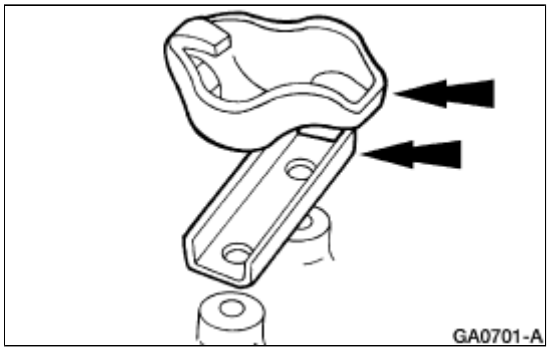


38. Remove the eight rocker arm fulcrums from each side.



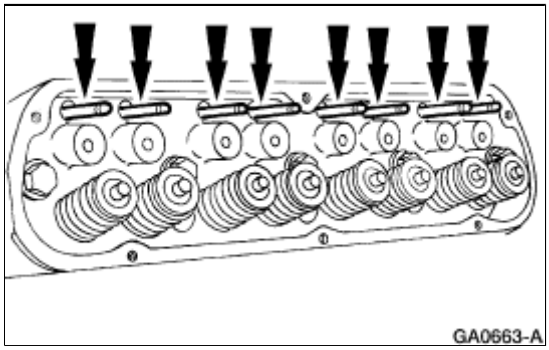
39. **NOTE:** If reusing the rocker arms, clean and inspect all of the components. For additional information, refer to Section 303-00 .

    Remove the rocker arms and the rocker arm fulcrum guides from each side.

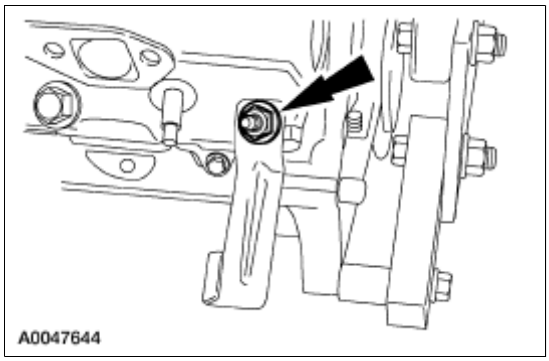


40. **NOTE:** Mark all push rods to make sure that they will be installed in their original positions.

    Remove all of the push rods.

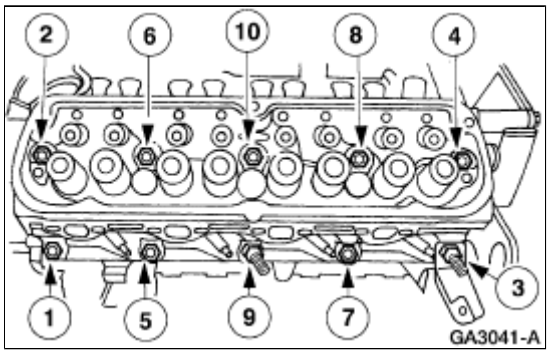


41. Remove the spark plug wire retaining bracket from the LH cylinder head.

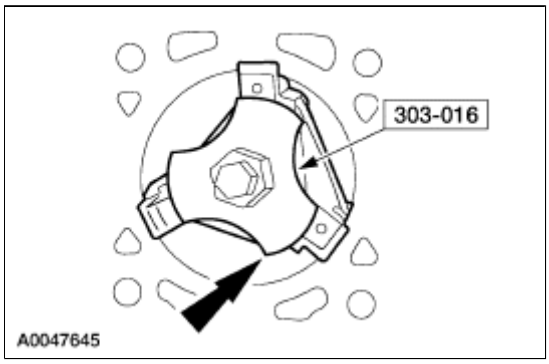


42. **NOTE:** If reusing the cylinder heads, refer to Section 303-00 .

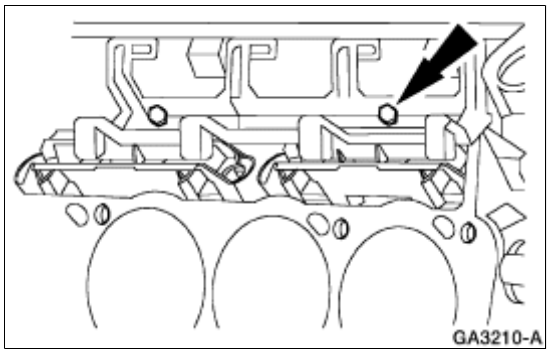
    Remove the bolts in the indicated sequence and remove the cylinder head from each side.
    - Discard the old bolts.



43. Using the special tool, remove the ridge off the top of the eight cylinder bores.



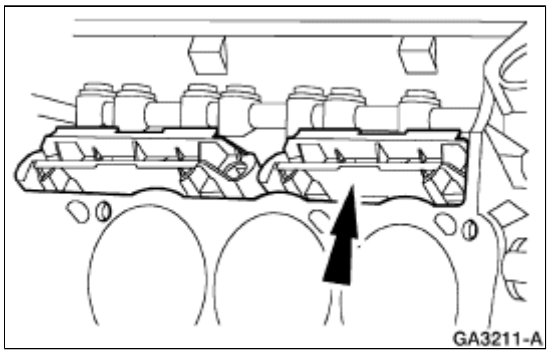
44. Remove the bolts and remove the valve tappet guide plate retainer.



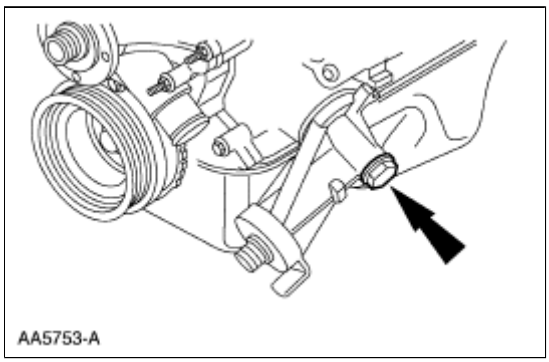
45. **NOTE:** If reusing the valve tappets, refer to Section 303-00 .

    NOTE: Mark the valve tappets so they can be reinstalled in their original positions.

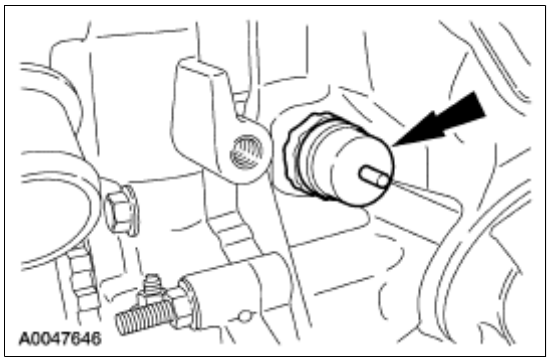
    Remove the four valve tappet guide plates and the valve tappets using a valve tappet puller.



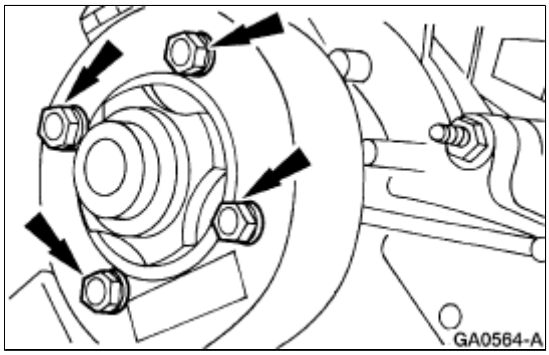
46. Remove the oil filter adapter bolt and the O-ring seal.



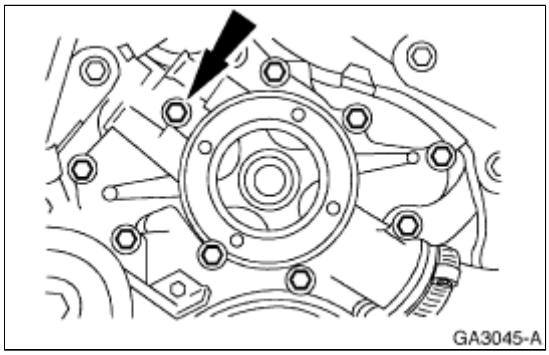
47. Remove the oil pressure sending unit.



48. Remove the water pump pulley.

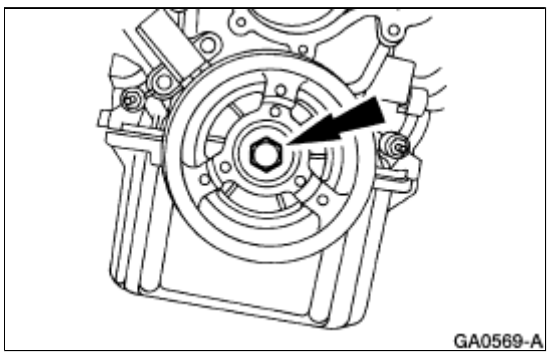


49. Remove the water pump.



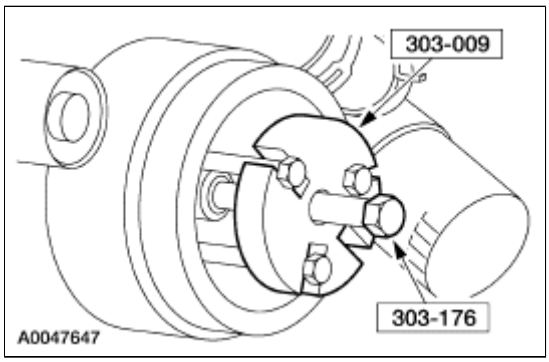
50. **NOTE:** Use a suitable strap wrench to hold the crankshaft pulley.

    Remove the bolt.

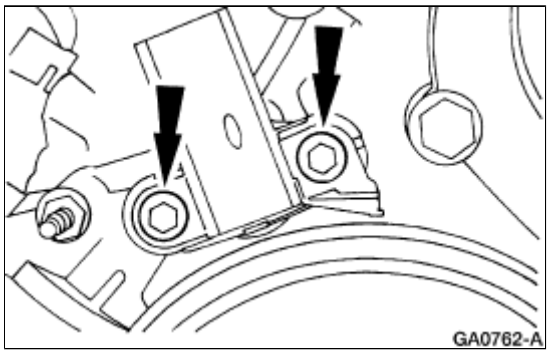


51. **NOTE:** The jackscrew from special tool 303-176 must be added to special tool 303-009.

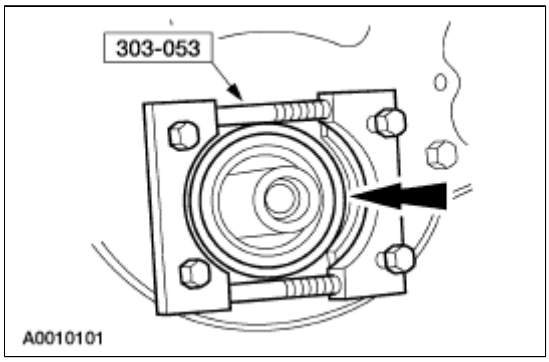
    Using the special tools, remove the crankshaft pulley.



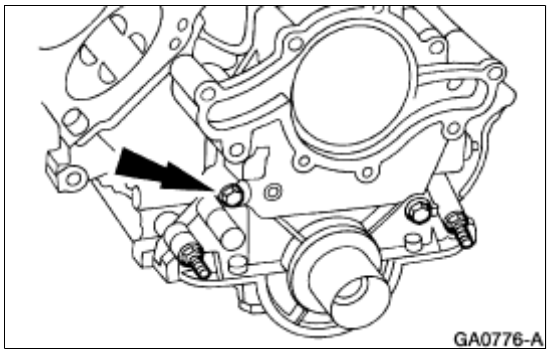
52. Remove the CKP sensor and timing pointer.



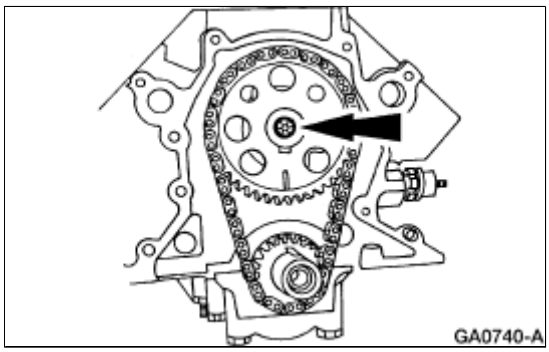
53. Using the special tool, remove the crankshaft front seal.



54. Remove the bolts and studs and the engine front cover.
    - Discard the old engine front cover gasket.

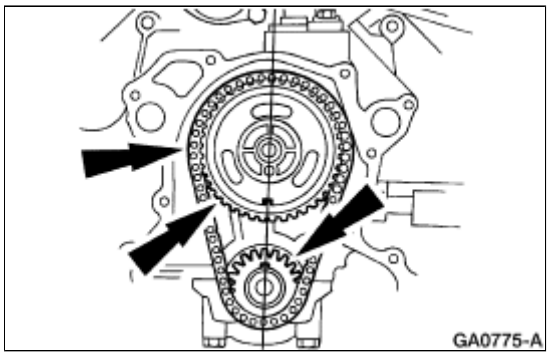


55. Remove the bolt.

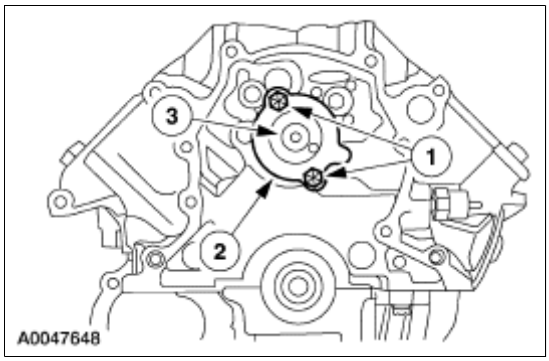


56. **NOTE:** If reusing timing drive components, refer to Section 303-00 .

    Remove the camshaft sprocket, crankshaft sprocket and the timing chain at the same time.

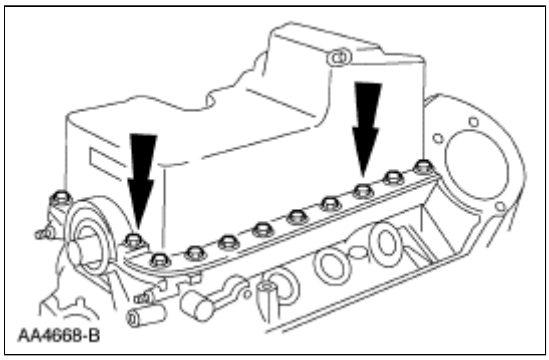


57. Remove the camshaft.
    1. Remove the bolts.
    2. Remove the end plate.
    3. Remove the camshaft.



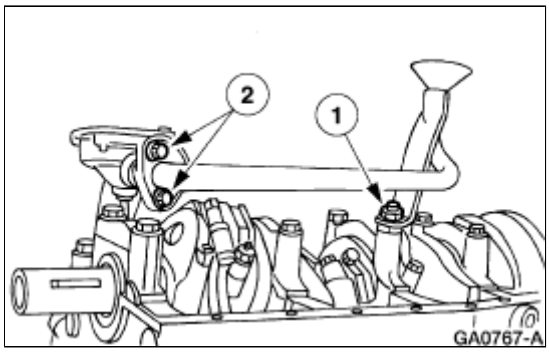
58. Rotate the engine on the engine stand.

59. Remove the 22 bolts, reinforcements rails and the oil pan.
    - Discard the old oil pan gasket.



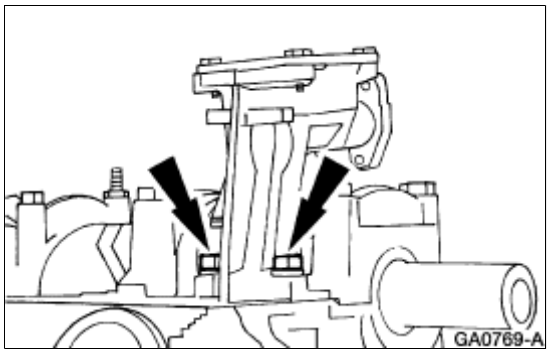
60. **NOTE:** Use metal surface cleaner and a suitable plastic or wooden scraper to clean sealing surfaces. All sealing surfaces must be clean.

    Remove the oil pump screen cover and tube.
    1. Remove the nut.
    2. Remove the bolts.

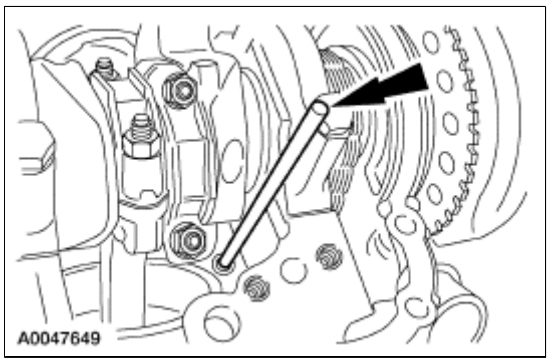


61. **NOTE:** If reusing the oil pump, refer to Section 303-00 .

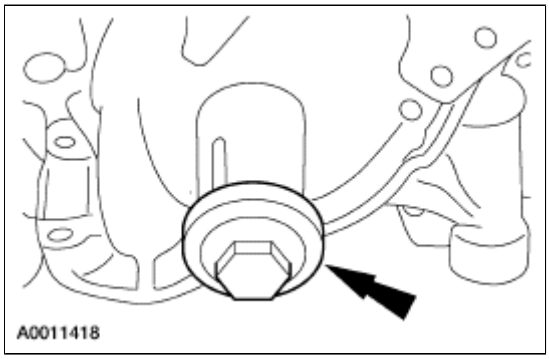
    Remove the bolts and the oil pump.



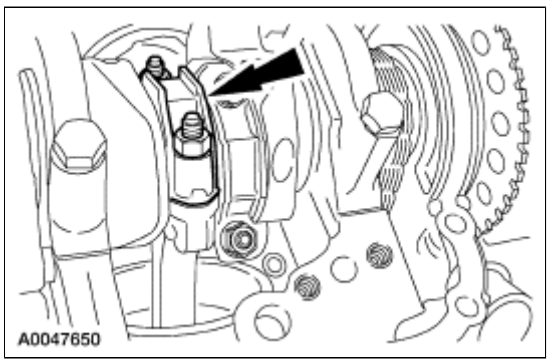
62. Remove the oil pump drive.



63. Install the crankshaft pulley bolt.



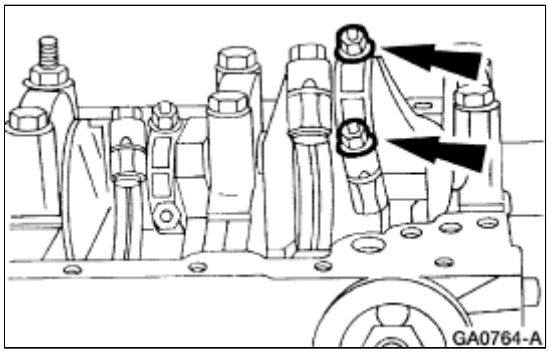
64. Turn the crankshaft until the connecting rod cap being removed is in the downward position.



65. **NOTE:** If reusing the connecting rods, refer to Section 303-00 .

NOTE: Mark the connecting rod caps so they can be reinstalled in their original positions.

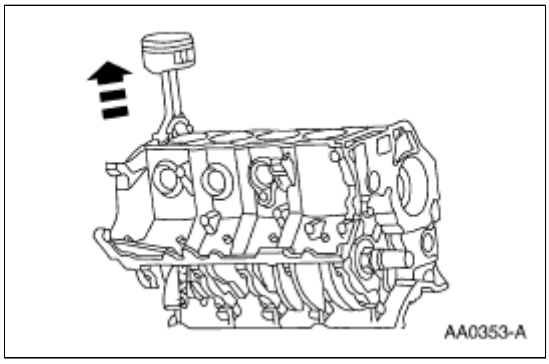
Remove the 16 nuts and the eight connecting rod caps.



66. **CAUTION: Place rubber hoses over the connecting rod studs to protect the crankshaft journals and the cylinder walls from being damaged.**

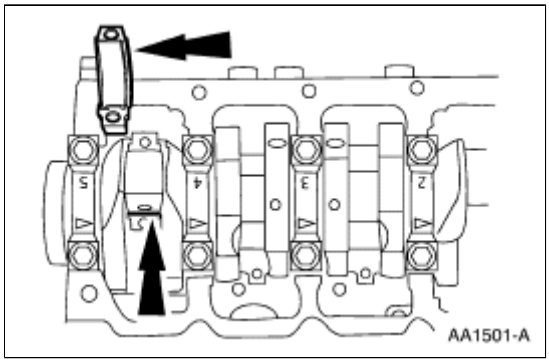
NOTE: If reusing the piston and the connecting rod assembly, refer to Section 303-00 .

Push the piston and connecting rod assembly out of the top of the cylinder.



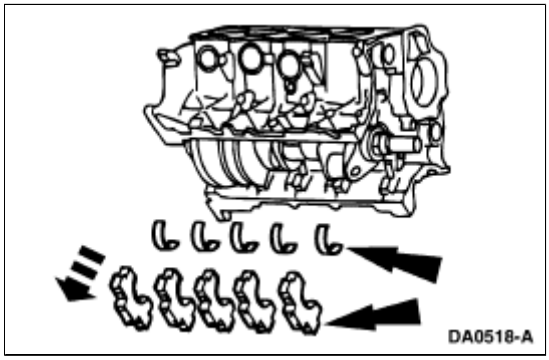
67. **NOTE:** If reusing the connecting rod bearings, refer to Section 303-00 .

Remove the connecting rod bearings from the connecting rod caps and from the connecting rods.



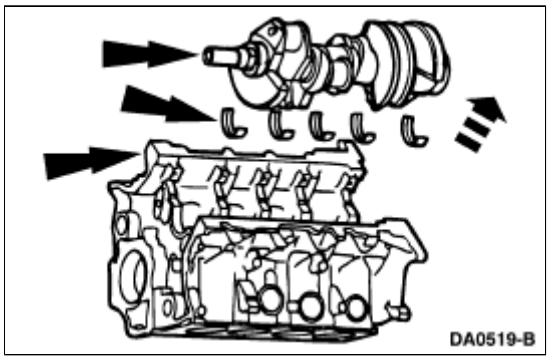
68. **NOTE:** If reusing the crankshaft main bearing caps, refer to Section 303-00 .

Remove the five main bearing caps and the lower crankshaft main bearings.

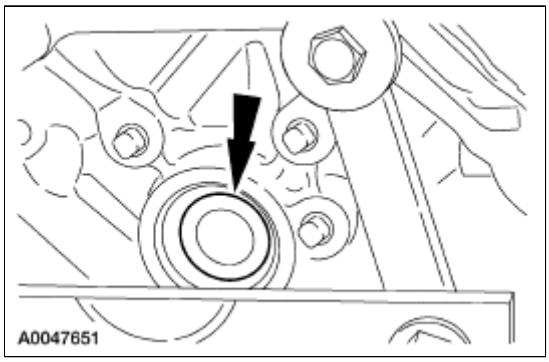


69. **NOTE:** If reusing the crankshaft, refer to Section 303-00 .

Remove the crankshaft and the upper crankshaft main bearings from the cylinder block.

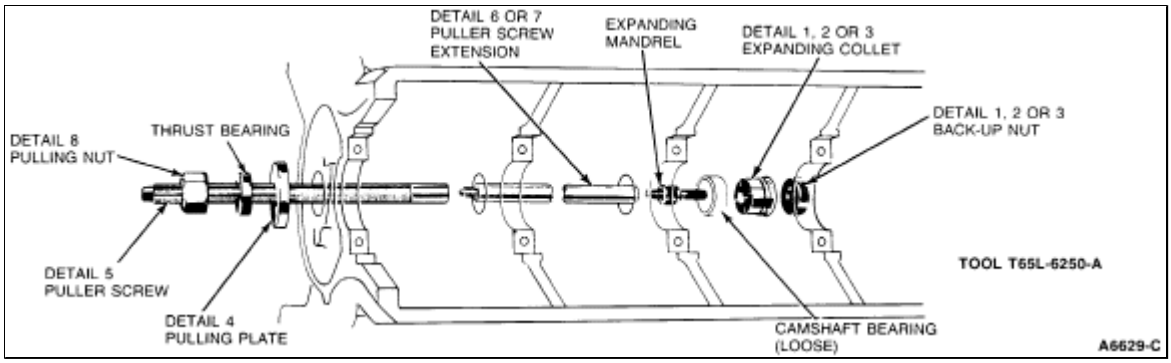


70. Remove the camshaft rear plug.



71. **NOTE:** If reusing the camshaft bearings, refer to Section 303-00 .

Using special tool, remove the camshaft bearings.



72. If reusing the engine block, refer to Section 303-00 .

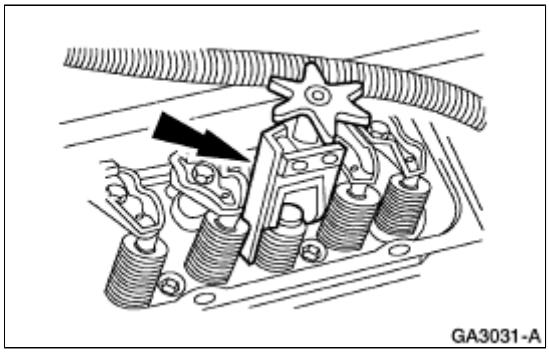
Cylinder Head

Special Tool(s)

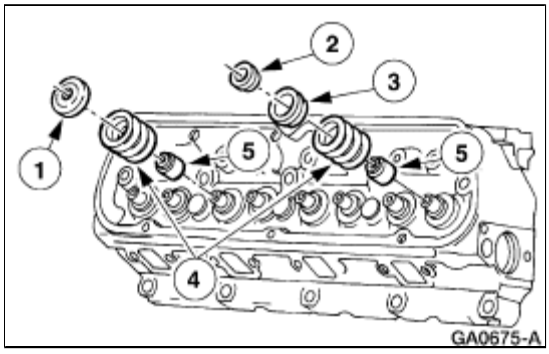
ST2131-A	Valve Stem Seal Replacer 303-303 (T87L-6571-BH)

Disassembly

1. Use a suitable valve spring compressor on the valve spring to be removed. Compress the valve spring and remove the valve spring retainer key.

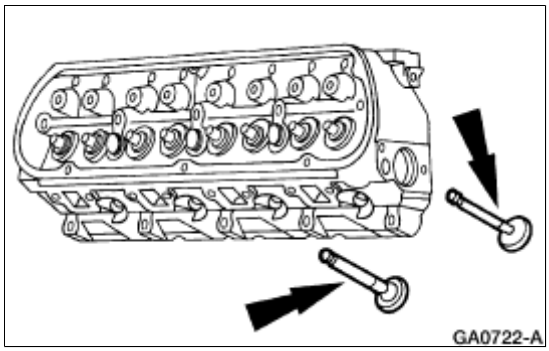

GA3031-A

2. Remove the valve springs and valve stem seals.
    1. Remove the valve spring rotator (exhaust).
    2. Remove the valve spring retainer sleeve (intake).
    3. Remove the valve spring retainer (intake).
    4. Remove the valve springs.
    5. Remove the valve stem seals.



GA0675-A

3. Remove the valve from the cylinder head.

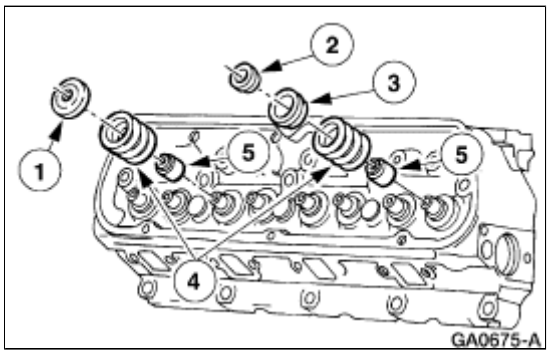


4. Inspect the valves and valve springs. For additional information, refer to Section 303-00 .

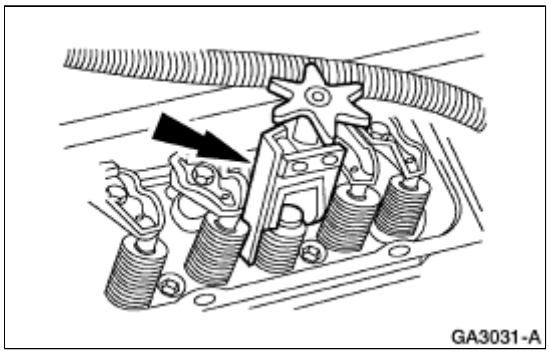
Assembly

1. Lubricate and install the valve in the location from which it was removed.
   - Use Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

2. Install the valve springs and valve stem seals.
   1. Install the valve stem seals.
   2. Install the valve springs.
   3. Install the valve spring retainers (intake).
   4. Install the valve spring retainer sleeve (intake).
   5. Install the valve spring rotator (exhaust).



3. Use a suitable valve spring compressor on the valve spring to be installed. Compress the valve spring and install the valve spring retainer keys.



4. Inspect the valve springs. For additional information, refer to Section 303-00 .

Piston

Special Tool(s)

ST1400-A	Pin Remover/Replacer 303-S024 (T68P-6135-A)

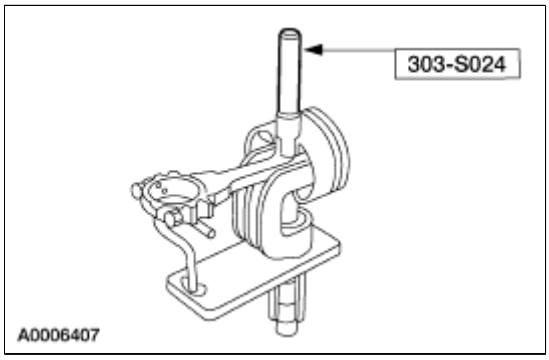
Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

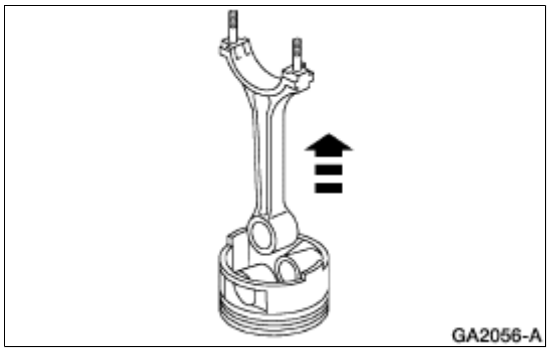
Disassembly

1. **NOTE:** The piston pin bore of a connecting rod and the diameter of the pin must be within specification. Refer to the general specifications in this section.

   Use the special tool to press the piston pin out of the connecting rod and piston assembly.

2. Remove the connecting rod from the piston.



3. Remove the piston rings from the pistons.

4. Clean and inspect the connecting rod and the piston. For additional information, refer to Section 303-00 .

Assembly

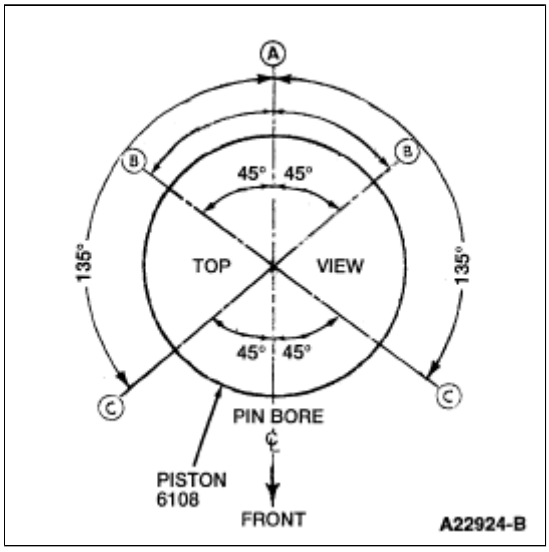
NOTE: For RH piston assemblies, the identification notch on the piston and the connecting rod must face in the same direction. For LH assemblies, they must face in the opposite direction.

If installing new connecting rods, use the large chamfered side of the connecting rod bearing bore for direction identification.

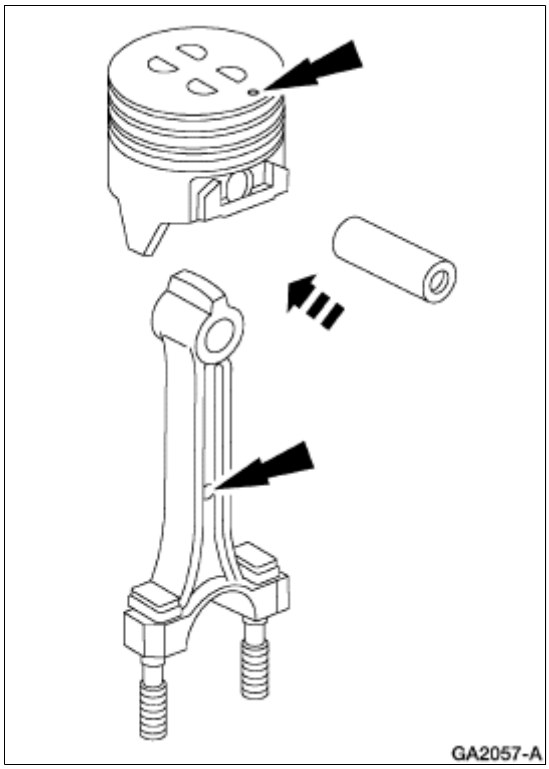
1. Install piston rings using a piston ring installation tool of the correct size.

2. Oil the piston rings and pistons with clean engine oil.

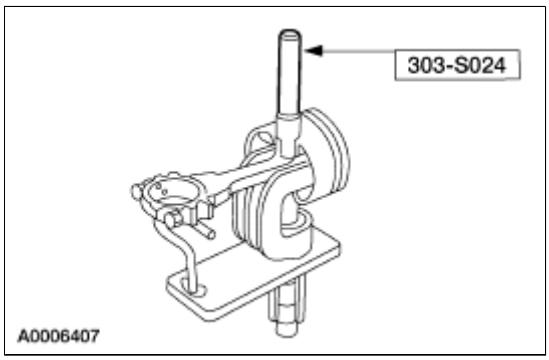
3. Make sure the ring gaps (oil spacer-A, oil ring-B, and compression ring-C are properly spaced around the circumference of the piston.



4. Lubricate the piston pin and piston pin bore with clean engine oil, and position the piston pin in the piston pin bore.

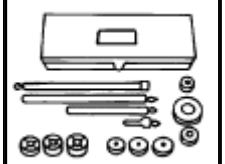
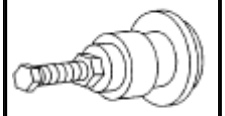
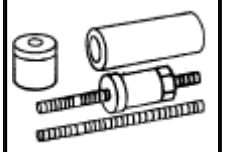
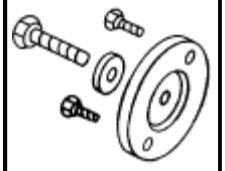
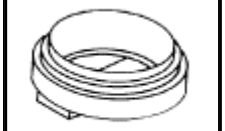
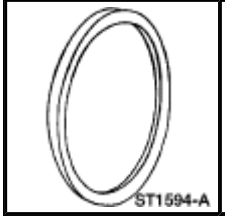
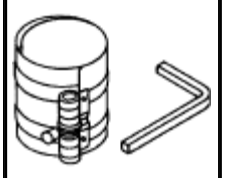


5. Use the special tool to press the piston pin into the piston and connecting rod.



Engine

Special Tool(s)

 ST1381-A	Camshaft Bearing Service Set 303-017 (T65L-6250-A)
 ST1328-A	Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)
 ST1591-A	Damper Replacer 303-008 (T52L-6306-AEE)
 ST1593-A	Rear Crankshaft Adapter 303-S560 (T96T-6701-A)
 ST1479-A	Rear Crank Seal Replacer 303-516 (T95P-6701-BH)
 ST1594-A	Rear Crank Seal Replacer Spacer 303-561 (T96T-6701-B)
	Piston Ring Compressor 303-D032 (D81L-6002-C)

Material

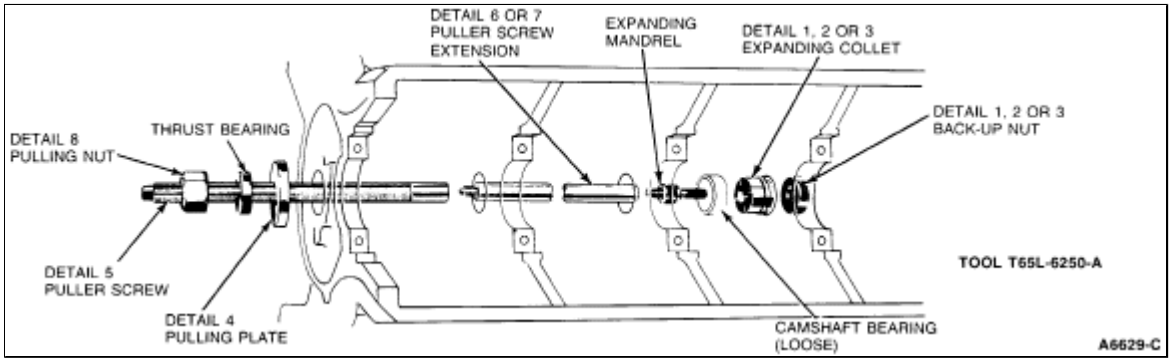
Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Pipe Sealant with Teflon XW7Z-19554-AA or equivalent	WSK-M2G350-A2

NOTE: If reusing the cylinder block, inspect all the core plugs. For additional information, refer to Section 303-00 .

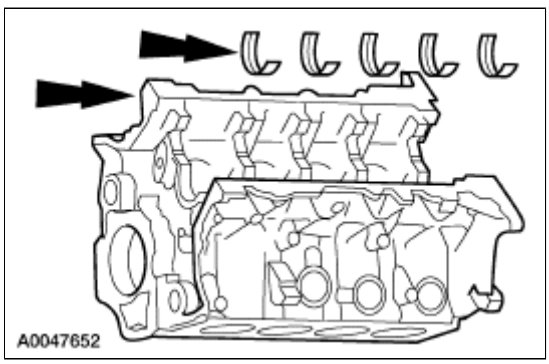
NOTE: Before engine assembly, use metal surface cleaner and a suitable plastic or wooden scraper to clean the sealing surfaces. All of the sealing surfaces must be clean. Make sure the coolant and the oil passages are clear.

1. **NOTE:** Make sure the oil hole in the camshaft bearing is in line with the oil port in the block.

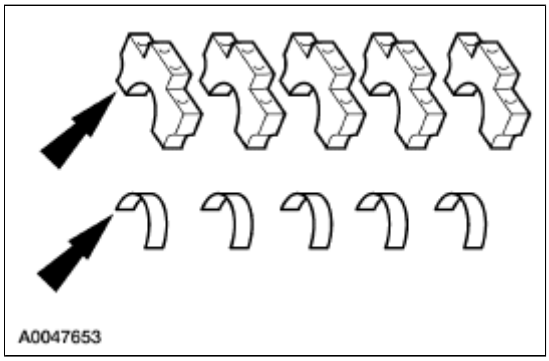
   Lubricate the camshaft bearings with clean engine oil. Use special tool to install the camshaft bearings.



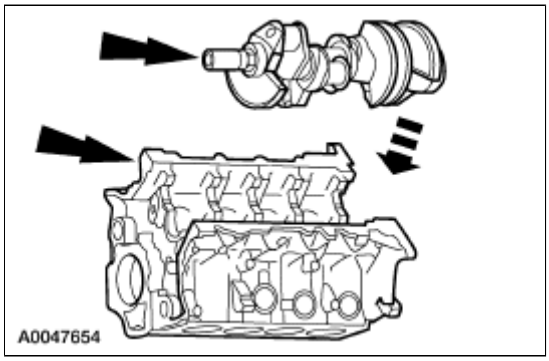
2. Lubricate the crankshaft upper main bearings with clean engine oil and install the upper main bearings in the cylinder block.



3. Lubricate the crankshaft lower main bearings with clean engine oil and install the lower main bearings in the crankshaft main bearing caps.



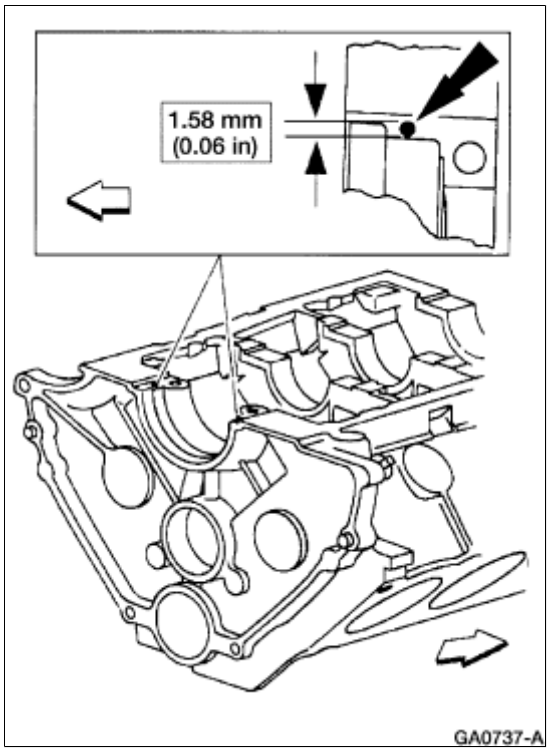
4. Install the crankshaft.



5. The crankshaft main bearings are precision selective fit. Inspect the bearing clearance. For additional information, refer to Section 303-00 .

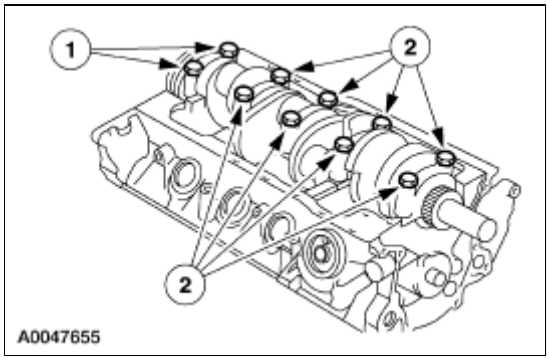
6. **NOTE:** If the rear main bearing cap is not installed within four minutes, remove the sealant and reapply.

   Using metal surface cleaner, clean the rear main bearing cap sealing area thoroughly and apply silicone gasket and sealant to the rear main bearing cap and to the cylinder block prating line.

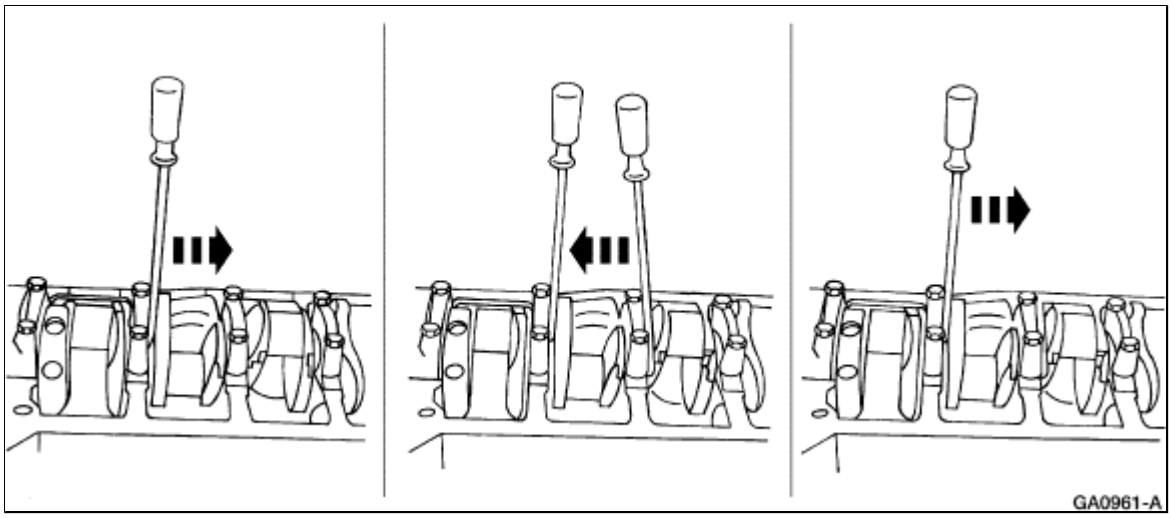


7. **NOTE:** Prior to installing the main bearing caps, lubricate the bearing surface with clean engine oil.

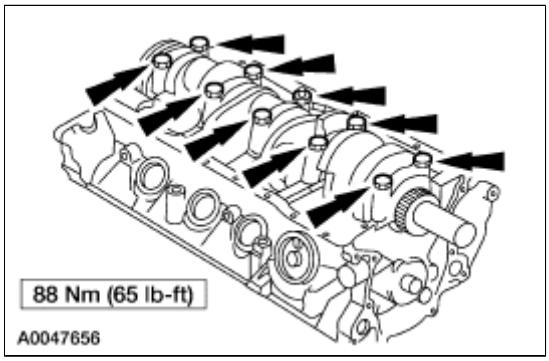
   Install the main bearing caps and start the bolts.
   1. Install the rear main bearing cap.
   2. Install the remaining main bearing caps.



8. Seat the thrust bearing while tightening the main bearing caps.



9. Tighten the bolts.

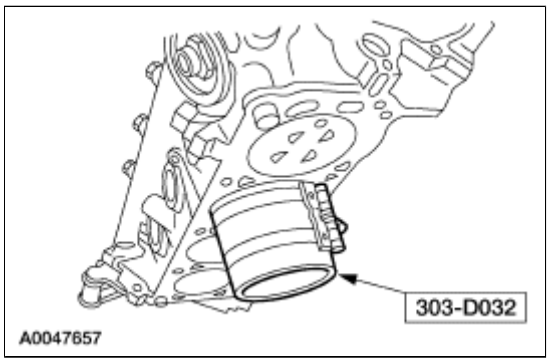


10. Make sure the piston rings are properly spaced. For additional information, refer to Piston in this section.

11. **NOTE:** Prior to piston installation, lubricate the cylinder bores with clean engine oil.

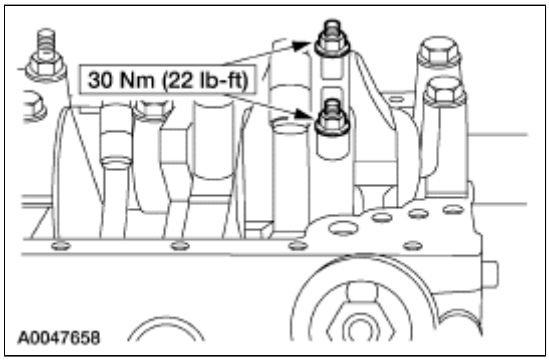
    NOTE: Position the piston with the identification notch in the piston head toward the front of the cylinder block.

    Using the special tool, install the pistons.

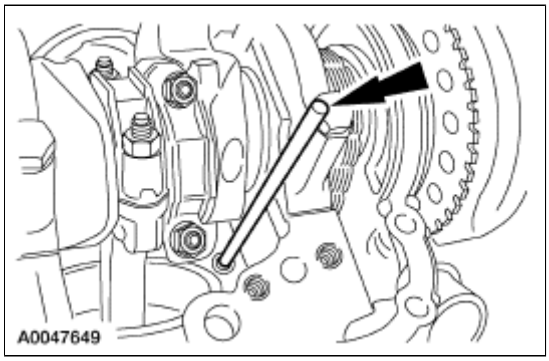


12. Check the clearance of each connecting rod bearing. For additional information, refer to Section 303-00 .

13. Lubricate the connecting rod bearings with clean engine oil and install the connecting rod caps and the nuts.

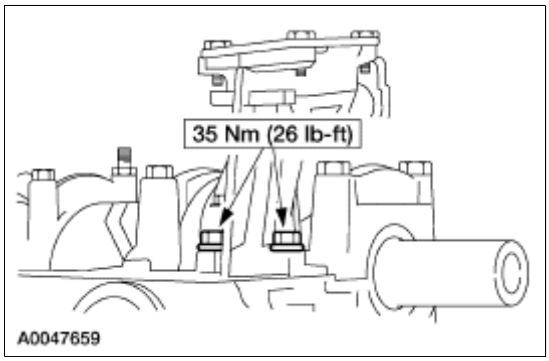


14. Install the oil pump driveshaft.

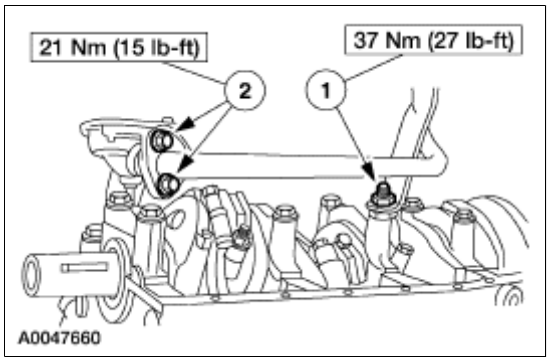


15. **NOTE:** Prime the oil pump prior to installation.

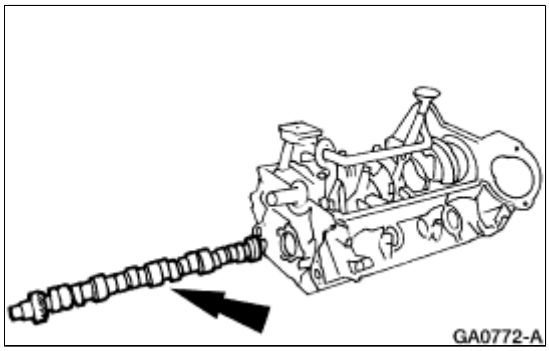
    Position the oil pump and install the bolts.



16. Install the oil pump screen cover and tube.
    1. Install the nut.
    2. Position the gasket and install the bolts.

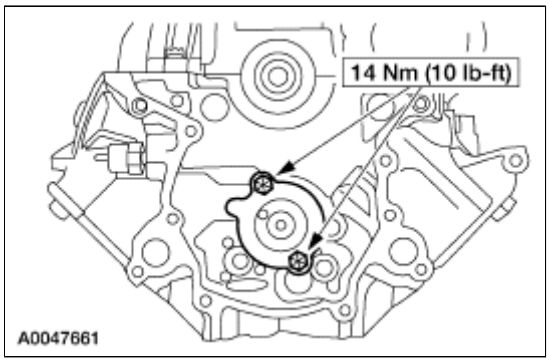


17. Lubricate the camshaft with clean engine oil and install the camshaft into the cylinder block.

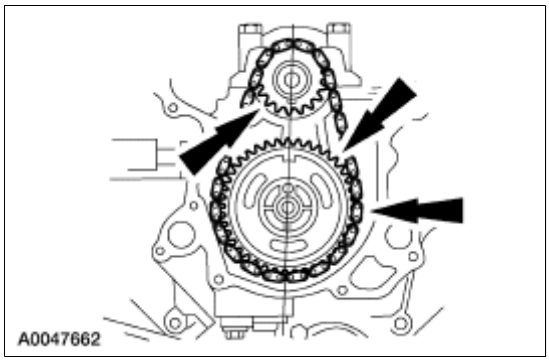


18. **NOTE:** The oil groove must face the rear of the engine.

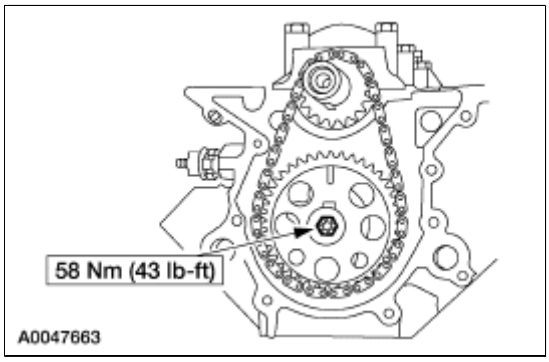
    Lubricate the camshaft thrust plate with clean engine oil. Install the camshaft thrust plate.



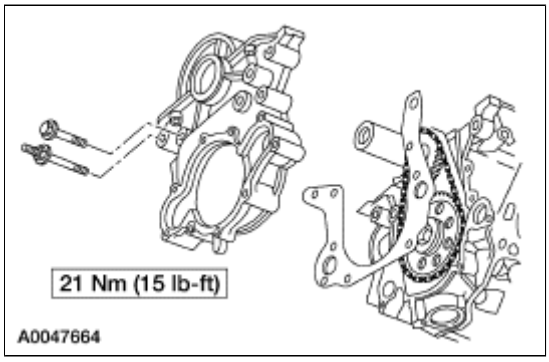
19. Position the crankshaft sprocket, the camshaft sprocket, and the timing chain while aligning the timing marks.



20. Lubricate the timing chain and sprockets with clean engine oil. Install the bolt.

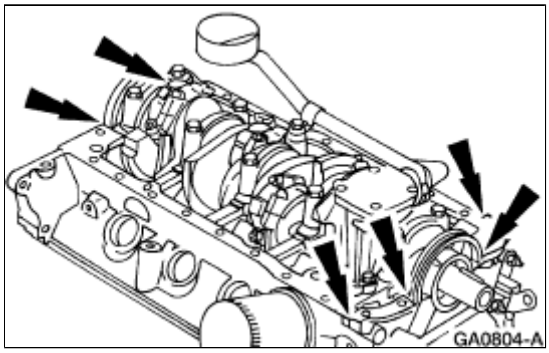


21. Position the lower engine front cover and the engine front cover gasket, and install the four bolts.

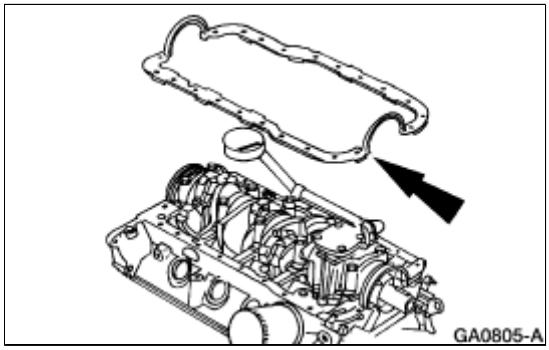


22. **NOTE:** The oil pan gasket must be installed within four minutes after applying the silicone.

    Apply silicone gasket and sealant in six positions.

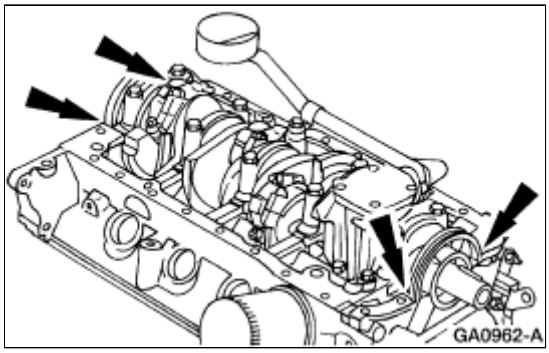


23. Install the oil pan gasket.

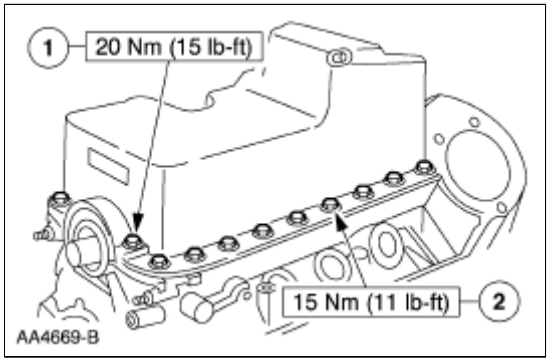


24. **NOTE:** The oil pan must be installed within four minutes after applying the silicone.

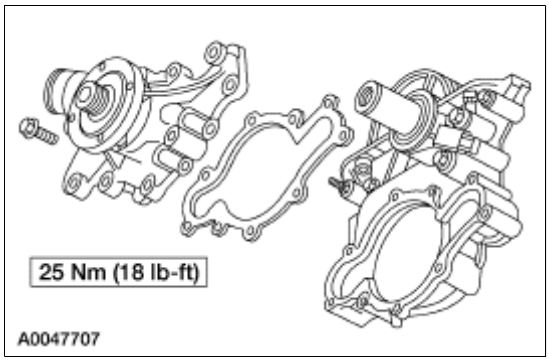
    Apply silicone gasket and sealant in four positions.



25. Position the oil pan, the reinforcement rails and install the 22 bolts.
    1. Tighten the four end bolts.
    2. Tighten the remaining 18 bolts.

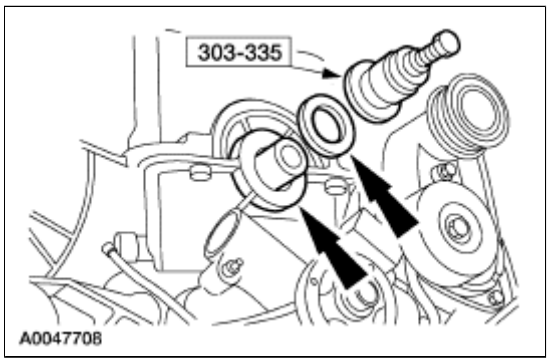


26. Install a new water pump housing gasket and the water pump.

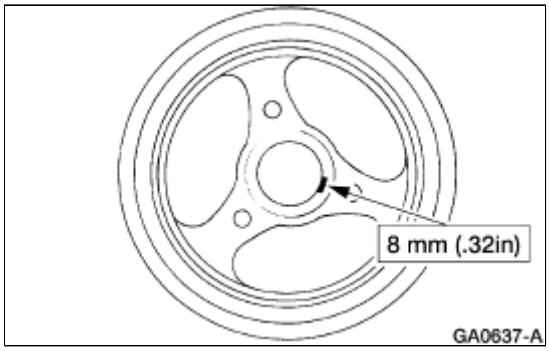


27. **NOTE:** Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.

    Using the special tool, install the crankshaft front oil seal.

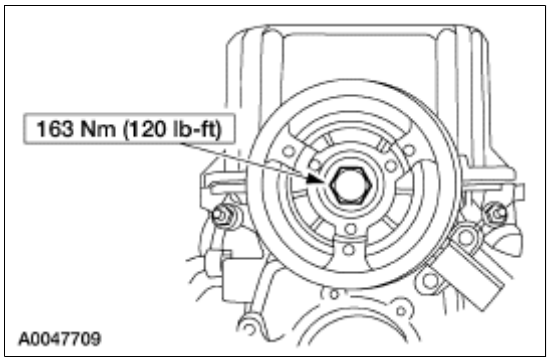


28. Apply silicone gasket and sealant to the woodruff key slot on the crankshaft pulley.



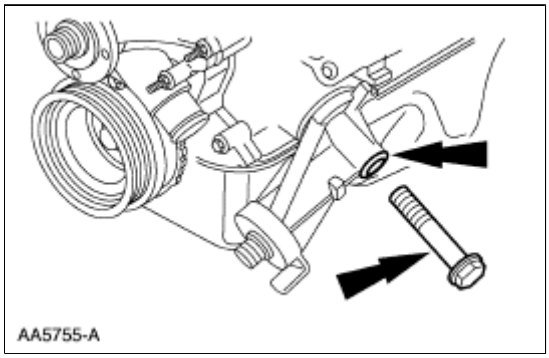
29. **NOTE:** Use a suitable strap wrench to hold the crankshaft pulley.

    Position the crankshaft pulley and install the bolt.

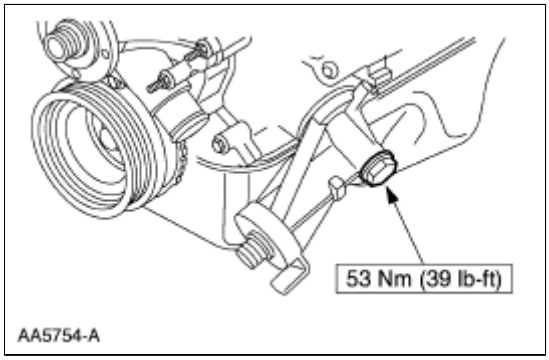


30. **CAUTION: Be sure to position the O-ring seal into the groove on the adapter. Failure to properly position the O-ring seal may cause an engine oil leak. Coat the O-ring seal with petroleum jelly to hold the O-ring seal in place during bolt installation.**

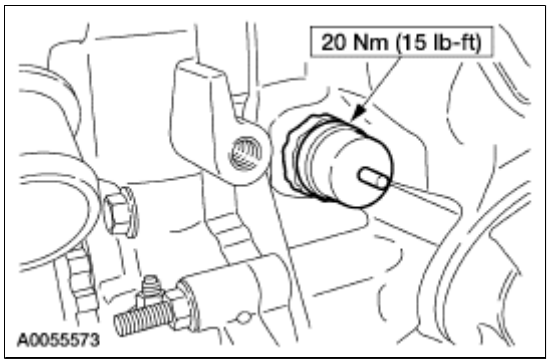
    Install the bolt and O-ring seal.



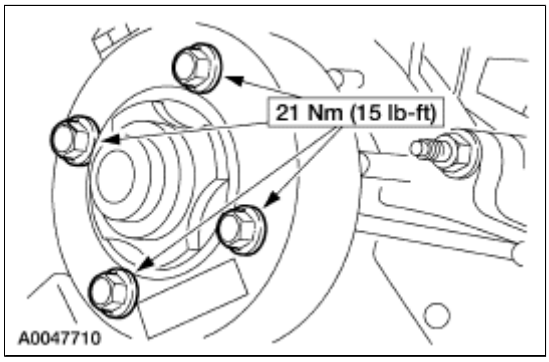
31. Tighten the bolt.



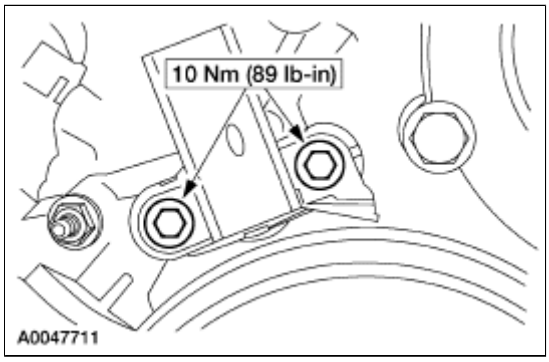
32. Install the oil pressure switch.



33. Position the water pump pulley and install the bolts.

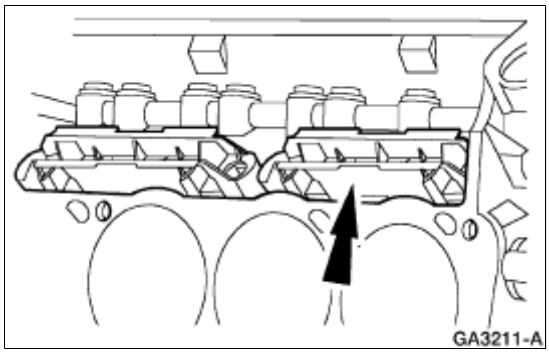


34. Position the crankshaft position sensor (CKP), timing pointer, and install the bolts.

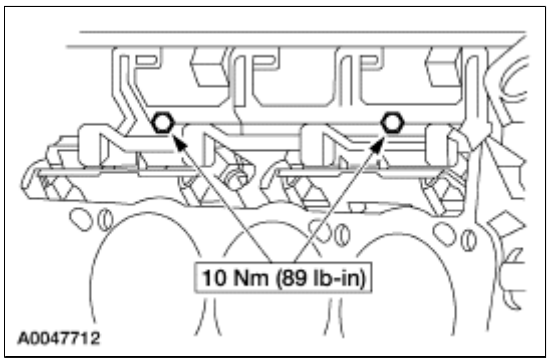


35. Rotate the engine on the engine stand.

36. Lubricate the valve tappet bores with clean engine oil. Install the valve tappets and the valve tappet guide plates in their original positions.



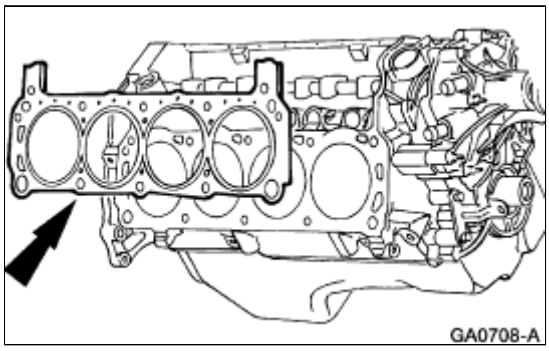
37. Position the valve tappet guide plate retainer and install the bolts.



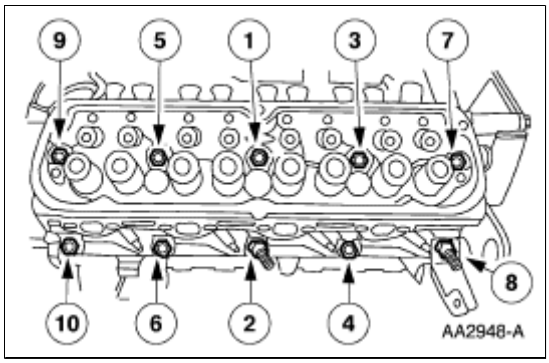
38. **NOTE:** The RH is shown; the LH is similar.

    NOTE: A specially treated composition gasket is used. Do not apply sealer to a composition gasket.

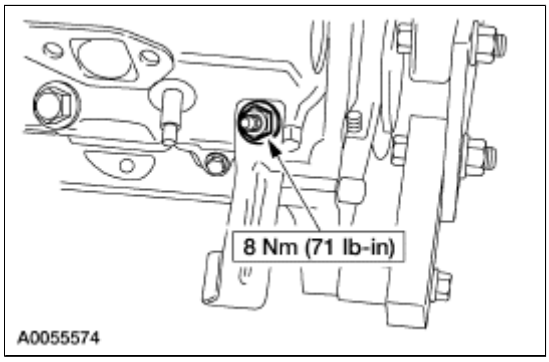
    Position the head gasket over the two dowel pins.



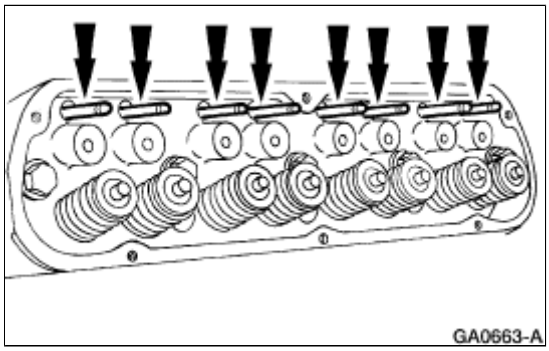
39. Install the cylinder head and install the ten new bolts in three steps.
    - Step 1: Tighten to 40 Nm (30 lb-ft).
    - Step 2: Tighten to 68 Nm (50 lb-ft).
    - Step 3: Rotate an additional 90 degrees.



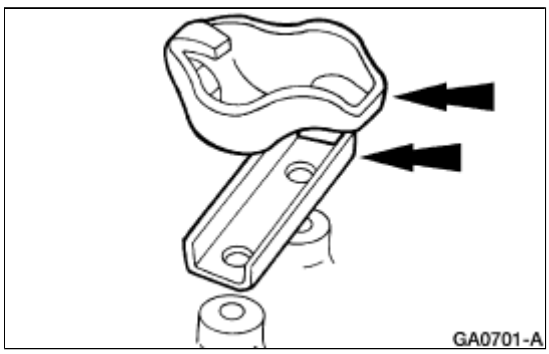
40. Install the spark plug wire bracket on the left cylinder head.



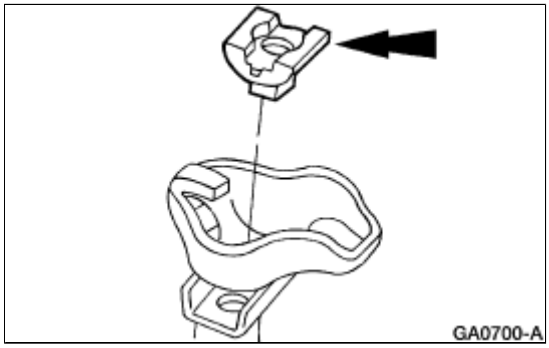
41. Install the push rods in their original positions.



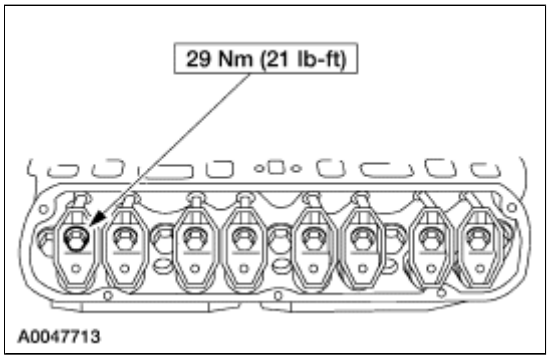
42. Lubricate the rocker arms and the fulcrum guides with clean engine oil. Install the rocker arms and the rocker arm fulcrum guides.



43. Install the eight rocker arm fulcrums.



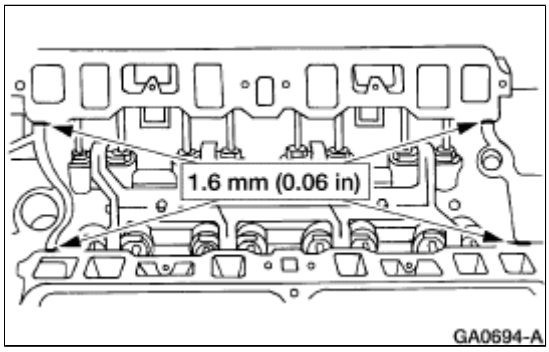
44. Install the bolts.



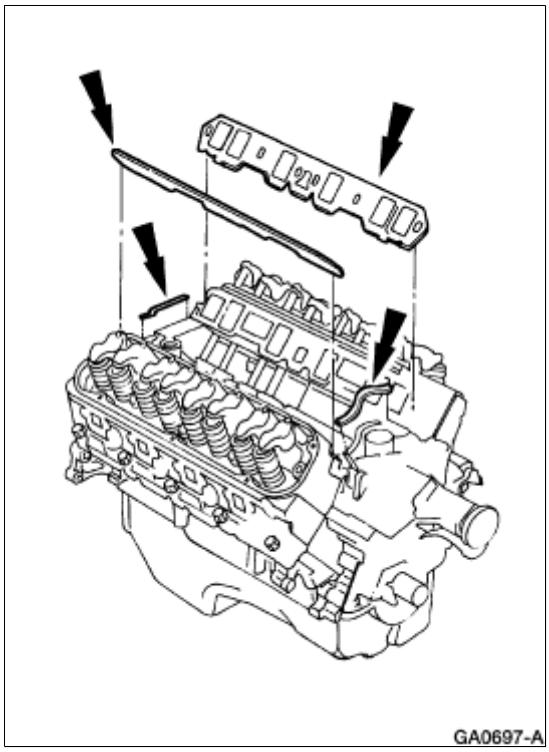
45. **NOTE:** Use metal surface cleaner to clean the gasket surfaces of the lower intake manifold, cylinder heads and cylinder block.

    NOTE: The lower intake manifold must be installed within four minutes after applying the silicone.

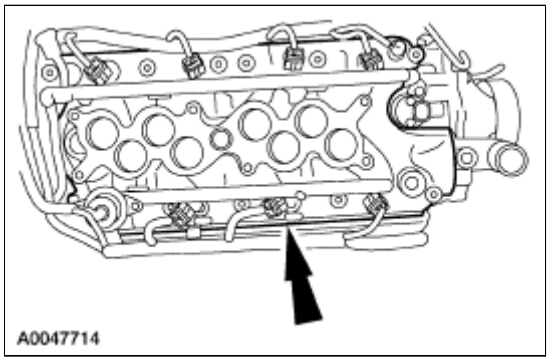
    Apply silicone gasket and sealant in the corners where the cylinder head and the cylinder block meet.



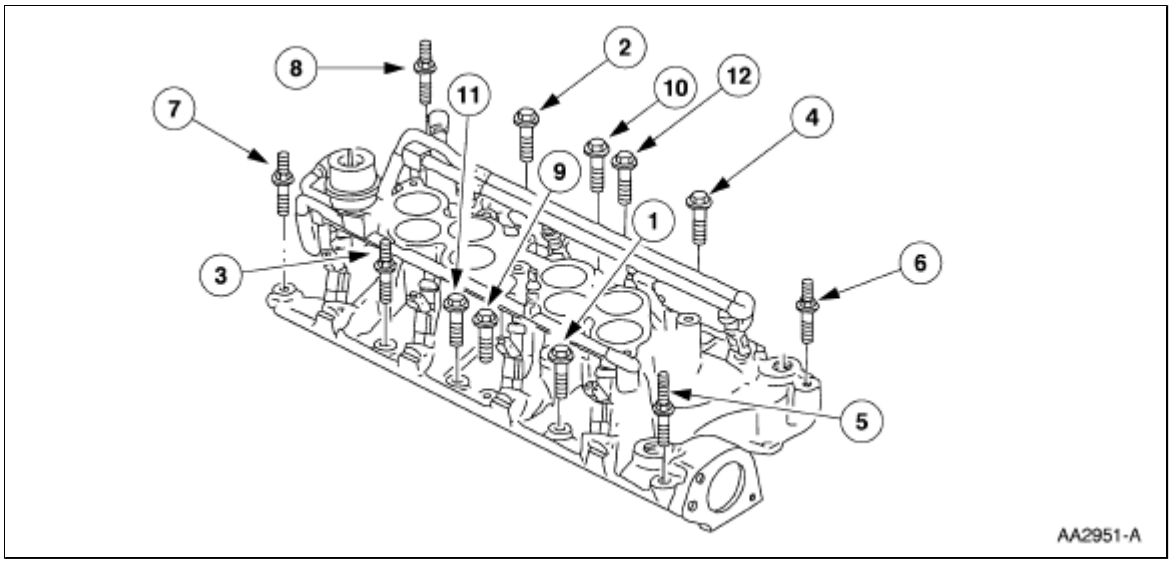
46. Position the four lower intake manifold gaskets.
    - Install the intake manifold seal tabs into the notch in the lower intake manifold gaskets.
    - Press firmly along the entire length of the intake manifold seal until the silicone sealant is visible.



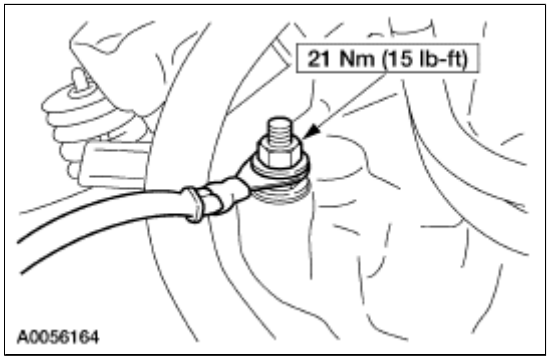
47. Install the lower intake manifold.



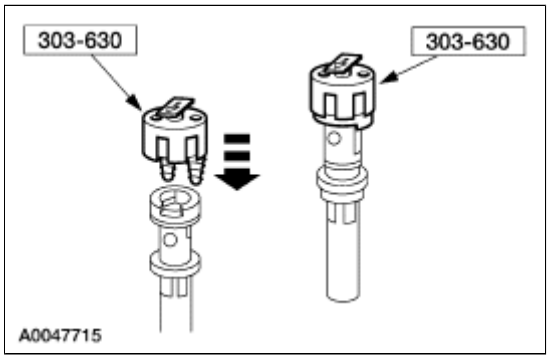
48. Tighten the twelve bolts in two steps.
    - Step 1: Tighten to 10 Nm (89 lb-in).
    - Step 2: Tighten to 32 Nm (24 lb-ft).



49. Install the ground strap on the intake manifold.



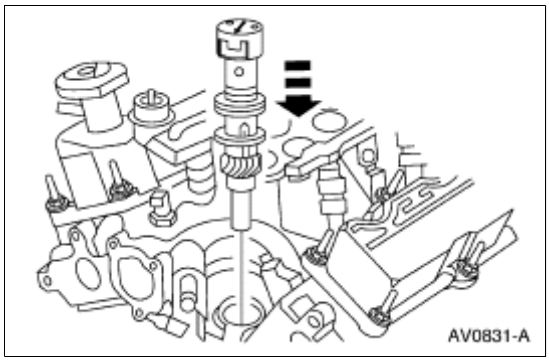
50. Install the special tool, aligning the tabs and the notches with those on the camshaft synchronizer.



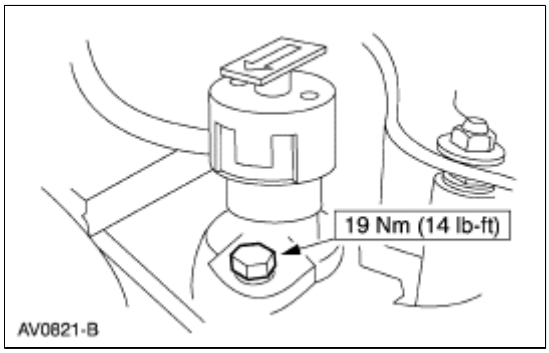
51. **NOTE:** When installing the camshaft synchronizer into the cylinder block, make sure that the arrow on the special tool is pointing toward the front of the vehicle, on a line that is parallel to the center line of the crankshaft.

    NOTE: The synchronizer will rotate slightly as the synchronizer gear engages the camshaft gear. When the synchronizer is fully installed, the arrow on the special tool should point to the position of the electrical connector.

    Install the camshaft synchronizer.

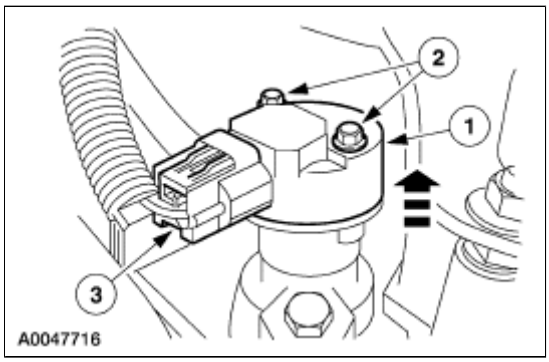


52. Position the clamp and install the bolt.

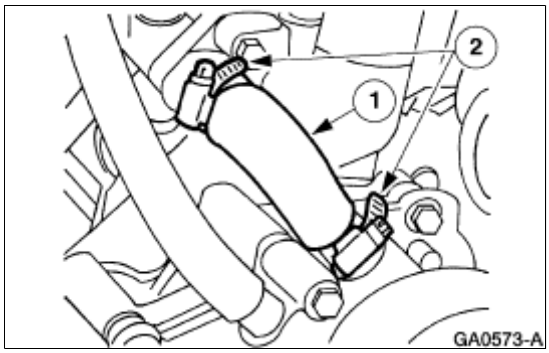


53. Remove the special tool.

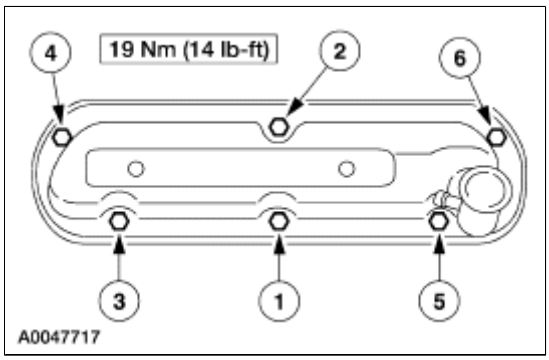
54. Install the camshaft position (CMP) sensor.
    1. Install the CMP sensor.
    2. Install the screws.
    3. Connect the CMP electrical connector.



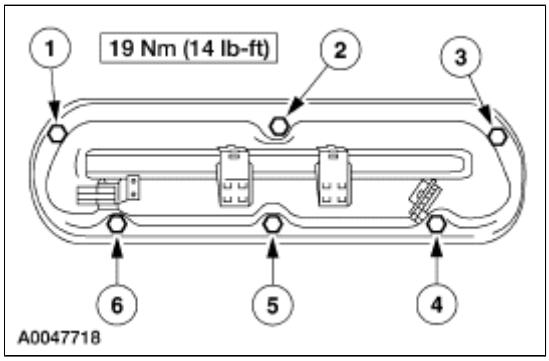
55. Install the water bypass tube.
    1. Position the water bypass tube.
    2. Install the clamps.



56. Position the RH valve cover and gasket and install the bolts.

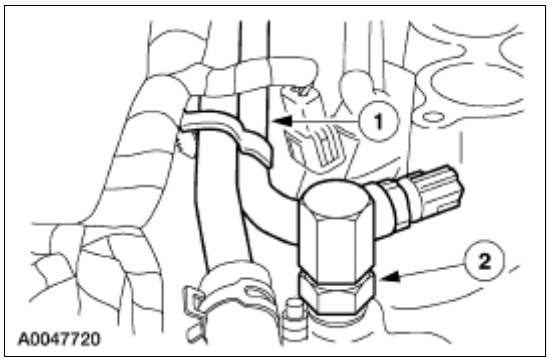


57. Position the LH valve cover and gasket, and install the bolts.

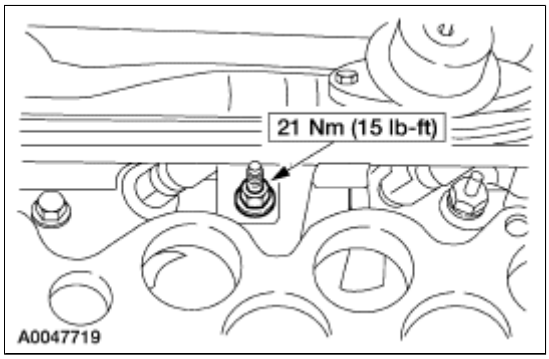


58. **NOTE:** Apply pipe sealant to pipe threads prior to installation.

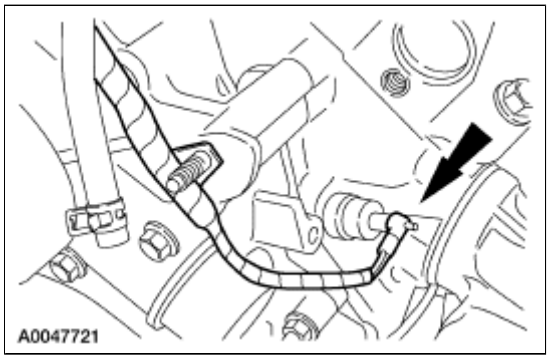
Install the water heater tube on the lower intake manifold.
1. Install the water pipe and position the wiring harness.
2. Tighten the nut on the water pipe.



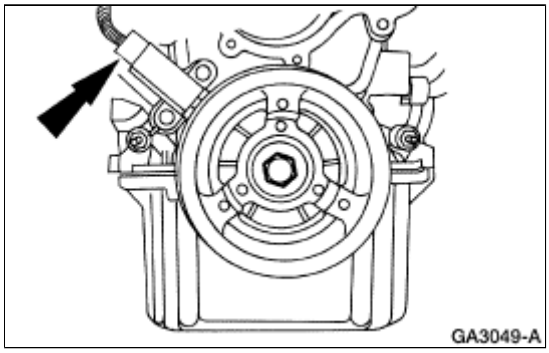
59. Install the heater tube retaining nut.



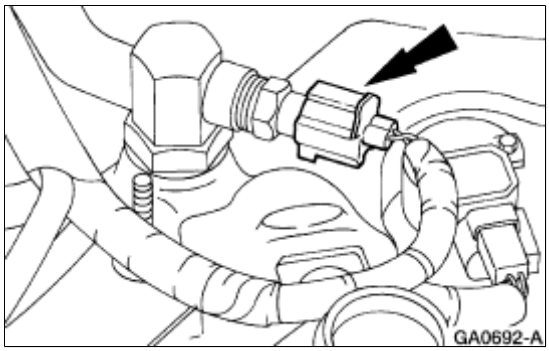
60. Position the engine sensor control wiring and connect the oil pressure sensor electrical connector.



61. Connect the crankshaft position sensor electrical connector.

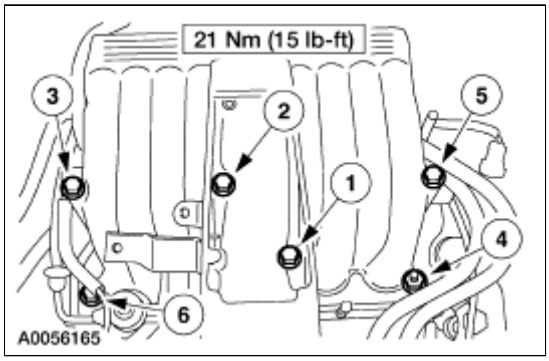


62. Connect the engine coolant temperature (ECT) electrical connector.

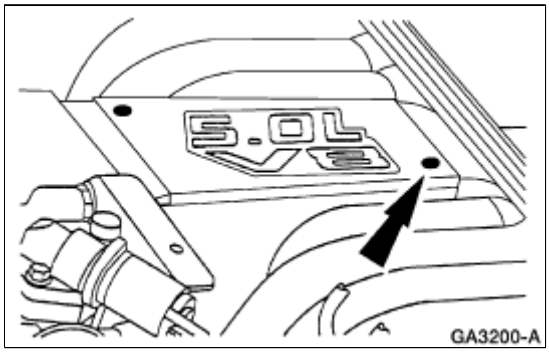


63. **NOTE:** Clean and inspect all the surfaces.

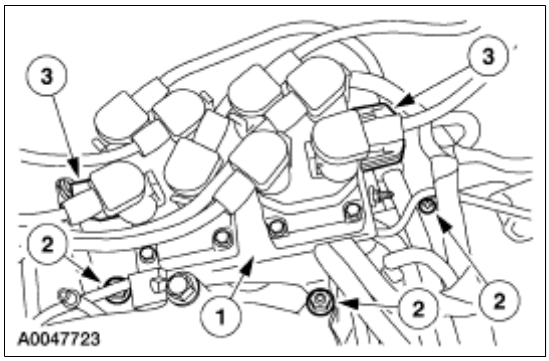
    Install new seals and gaskets. Position the upper intake manifold and install the bolts in the sequence shown.



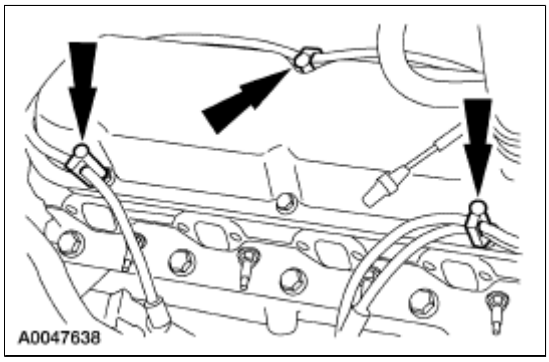
64. Install the upper intake manifold cover plate.



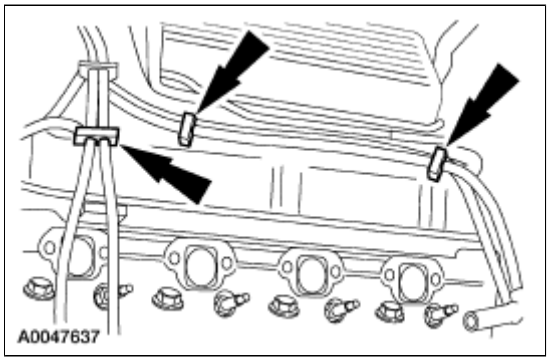
65. Install the ignition coils and bracket assembly.
    1. Install the ignition coils and bracket assembly.
    2. Install the three retainers.
    3. Connect the ignition coils electrical connectors.



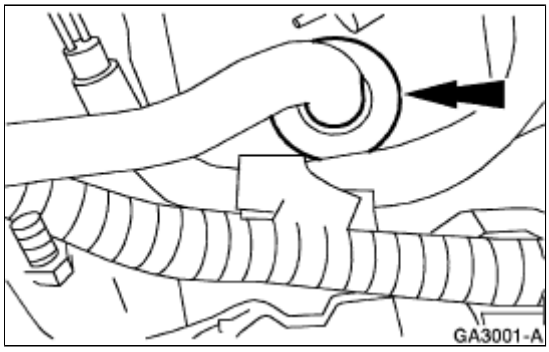
66. Connect the RH spark plug wire retainers to the valve cover.



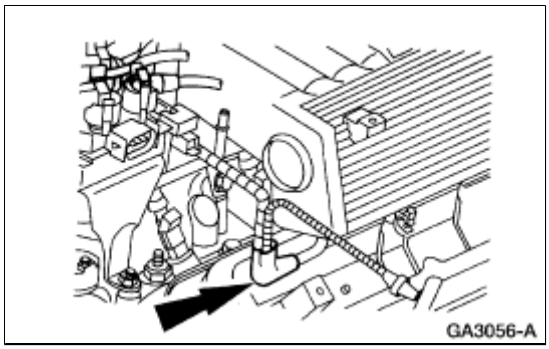
67. Connect the LH spark plug wire retainers to the valve cover.



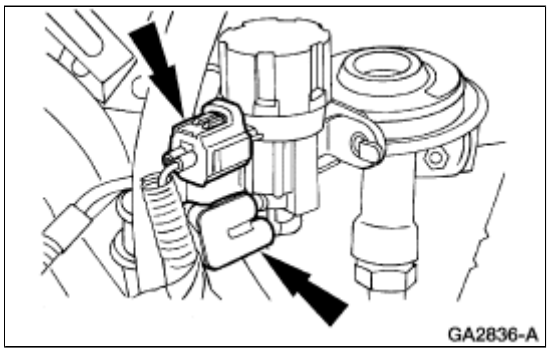
68. Connect the positive crankcase ventilation (PCV) hose to the intake manifold.



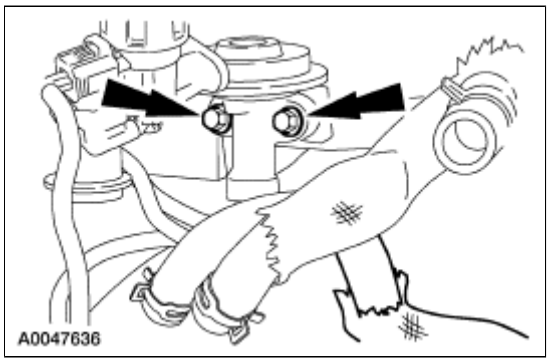
69. Connect the two upper intake vacuum connections and the two PCV heater hoses.



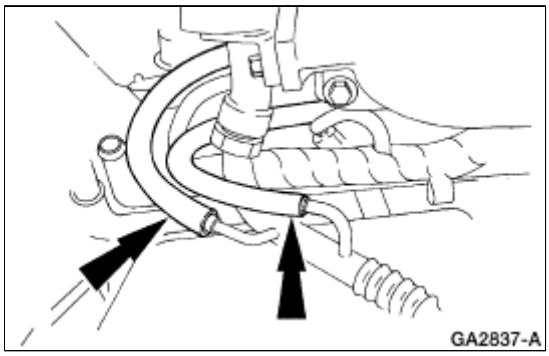
70. Connect the exhaust gas recirculation (EGR) vacuum regulator solenoid electrical and vacuum connections.



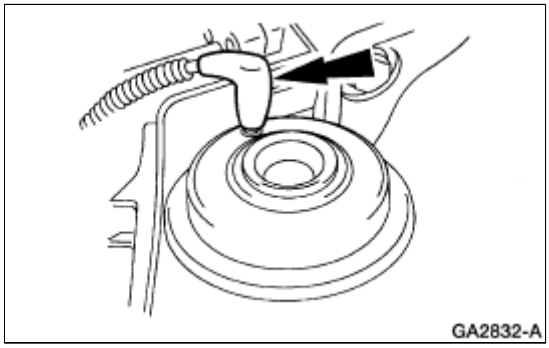
71. Install the EGR valve and tube assembly. Install the retainers hand-tight only.



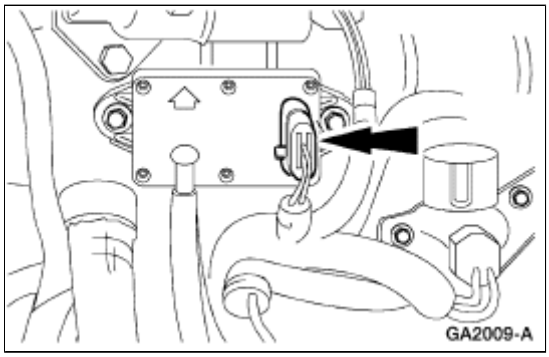
72. Connect the two pressure transducer hoses.



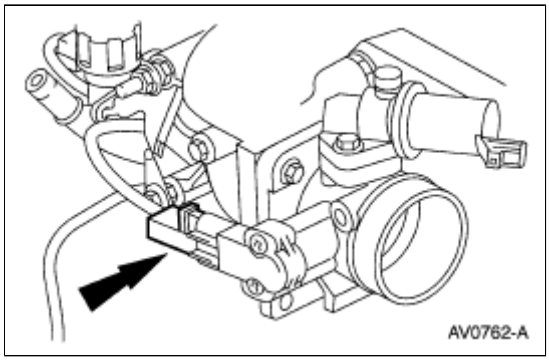
73. Connect the EGR valve vacuum connector.



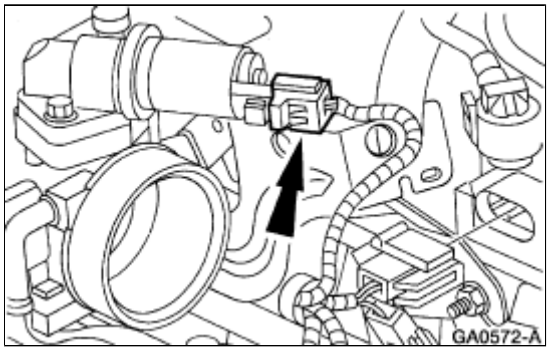
74. Connect the EGR backpressure transducer electrical connector.



75. Connect the throttle position (TP) sensor electrical connector.

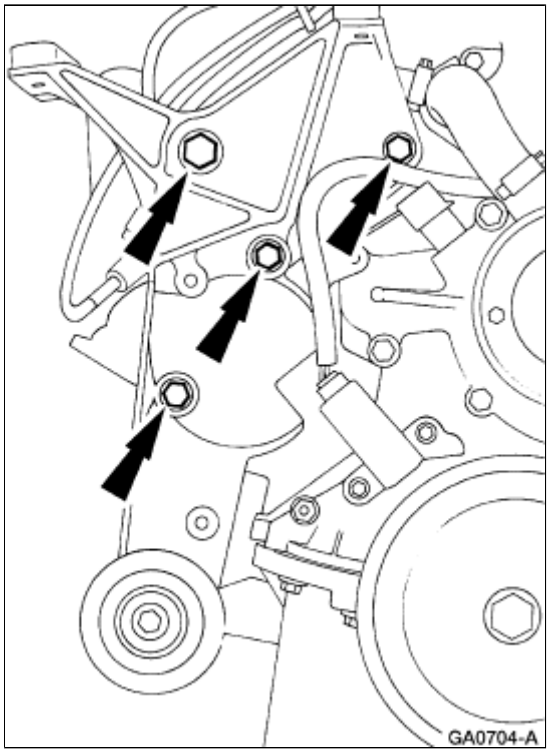


76. Connect the idle air control (IAC) bypass electrical connector.



77. **CAUTION: These bolts require special torque values. Correct tightening is necessary to prevent excessive accessory drive vibrations.**

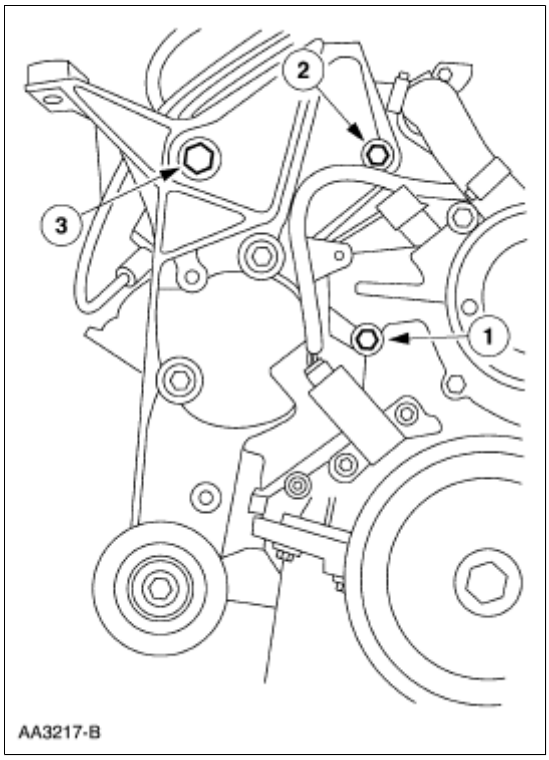
Position the generator bracket and install the bolts (RH only).



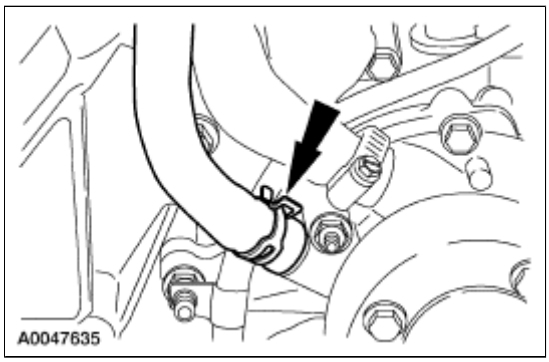
78. **NOTE:** Tighten the generator bracket in two steps.

Tighten the bolts in the sequence shown (RH only).

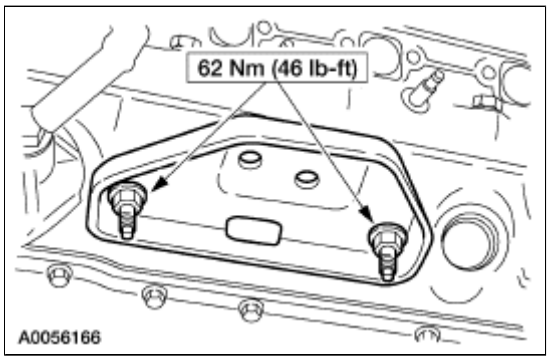
- Step 1: Tighten bolts 1 and 2 to 35 Nm (26 lb-ft).
- Step 2: Tighten bolt 3 to 65 Nm (48 lb-ft).



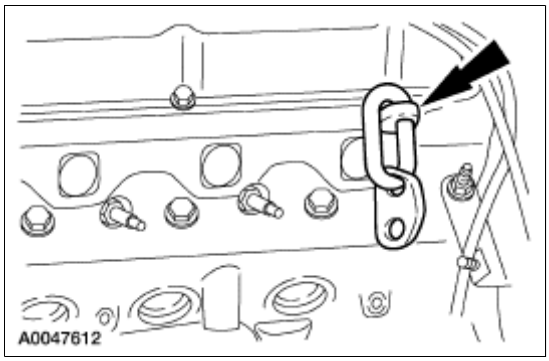
79. Connect the heater hose to the water pump.



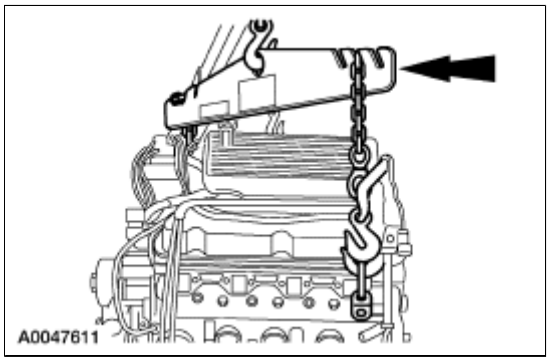
80. Install the RH and LH engine mount brackets.



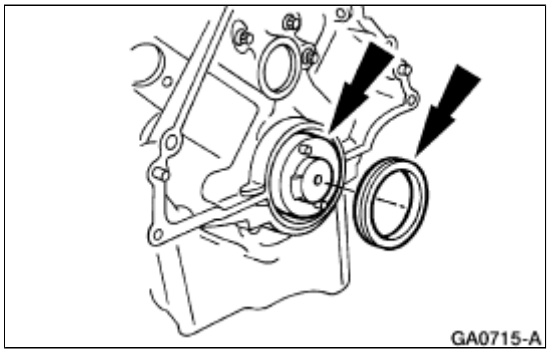
81. Install the engine lifting brackets.



82. Attach the spreader bar to the engine. Remove the engine from the engine stand.

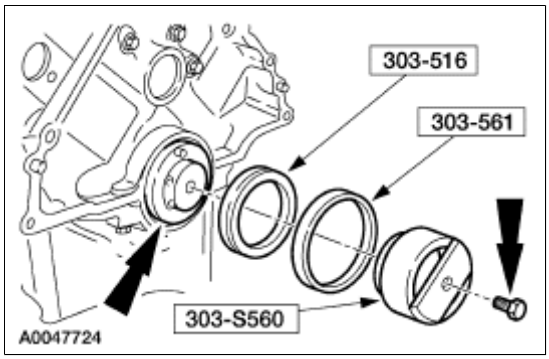


83. Lubricate the crankshaft rear oil seal and the crankshaft sealing surface with clean engine oil.

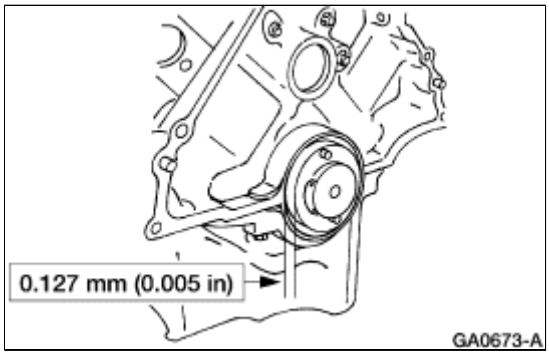


84. **NOTE:** Be sure the crankshaft rear sealing surface is clean and free of any rust or corrosion. To clean the crankshaft rear sealing surface, use extra-fine emery cloth or extra-fine 0000 steel wool with metal surface cleaner.

    Using the special tools, install the crankshaft rear oil seal.



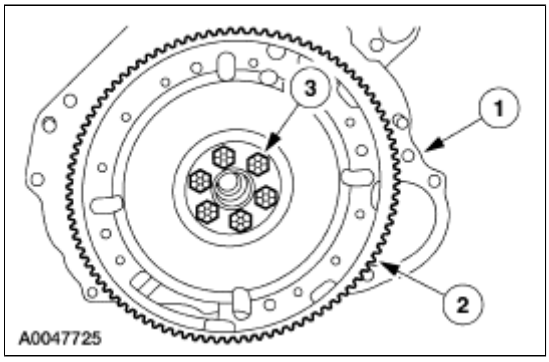
85. Check that the crankshaft rear oil seal is within specification.



86. Install the camshaft rear plug.

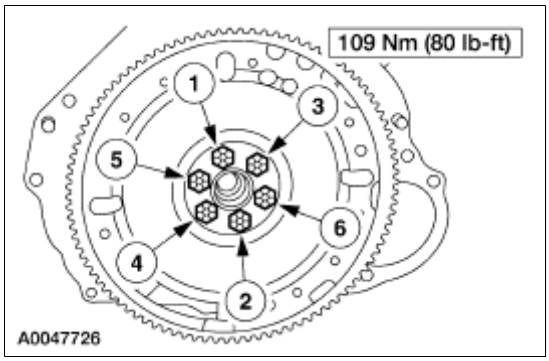
87. **NOTE:** Install new flywheel mounting bolts.

    Install the spacer plate and the flywheel.
    1. Install the spacer plate.
    2. Install the flywheel.
    3. Install the bolts.



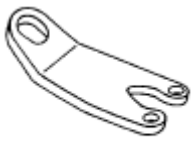
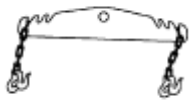
88. **NOTE:** Sealant must be removed from the bolt holes prior to reassembly.

    Tighten flywheel bolts in sequence shown.


109 Nm (80 lb-ft)
1
3
5
6
4
2
A0047726

Engine

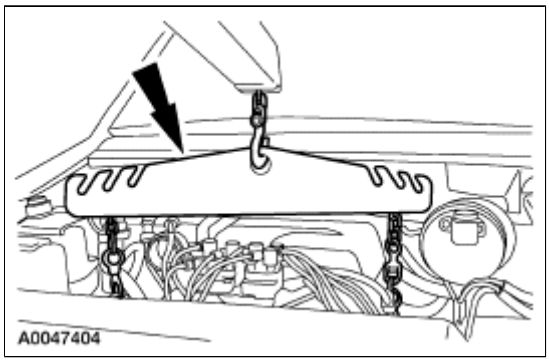
Special Tool(s)

 ST1621-A	5.0L Lifting Bracket 303-D096 (D94P-6001-B) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

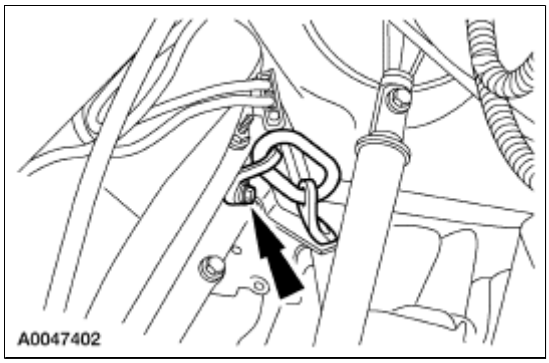
Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

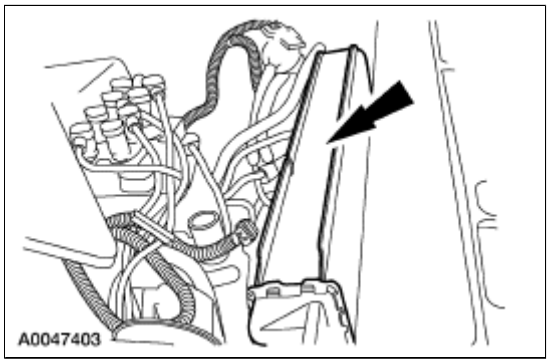
1. Position the engine in the vehicle.
2. Remove the spreader bar.



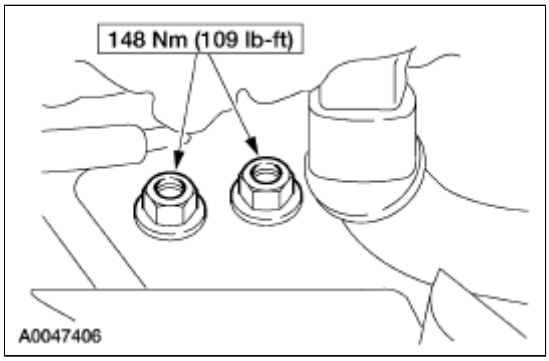
3. Remove the engine lifting brackets.



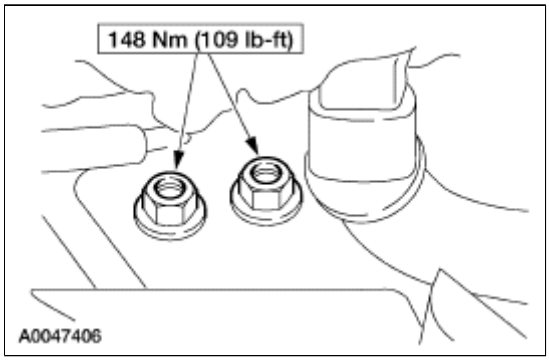
4. Install the radiator and the condenser assembly.



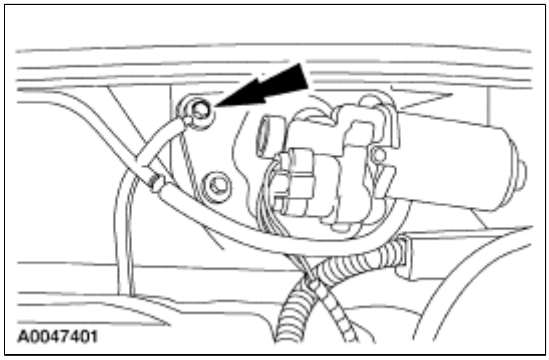
5. Install the RH motor mount nuts.



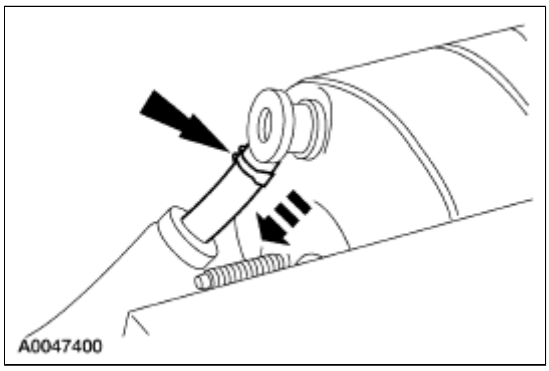
6. Install the LH motor mount nuts.



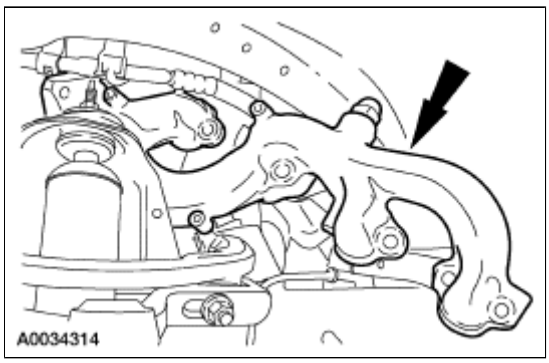
7. Install the engine ground strap at the bulkhead.



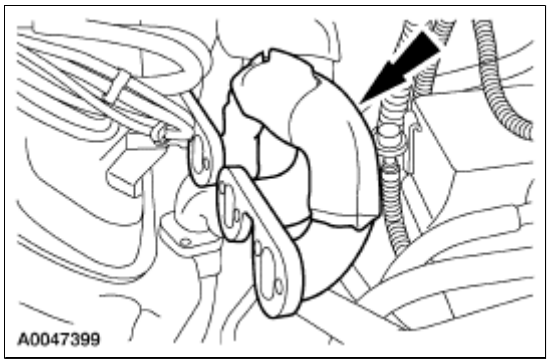
8. Connect the vacuum hose to the brake booster.



9. Install the RH exhaust manifold and gasket.

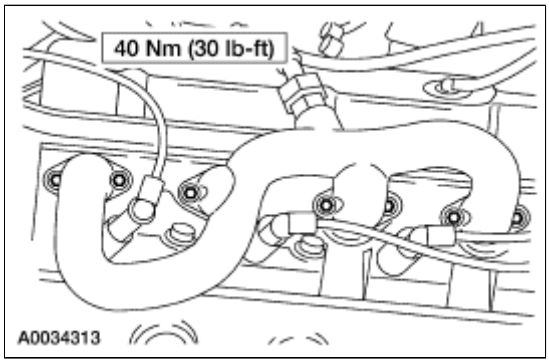


10. Install the left exhaust manifold and gasket.

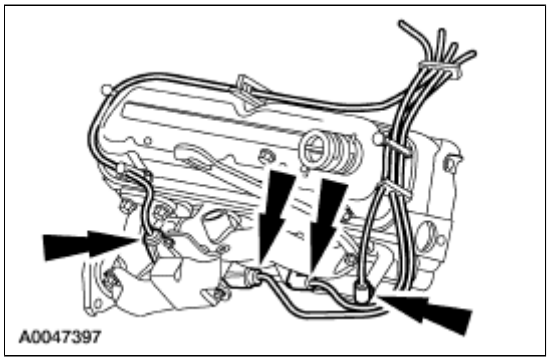


11. Raise and support the vehicle. For additional information, refer to Section 100-02 .

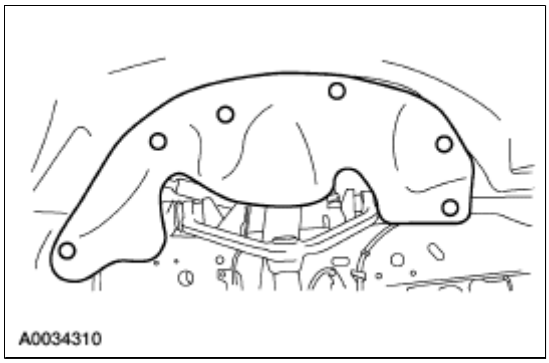
12. Install RH exhaust manifold retainers.



13. Connect the spark plug wires to the RH spark plugs.



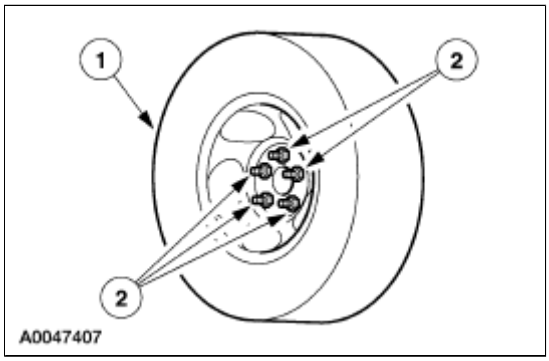
14. Install the right side wheel well splash shield.



15. **WARNING: Whenever a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to come off while the vehicle is in motion, causing loss of control. Failure to follow these instructions can result in personal injury.**

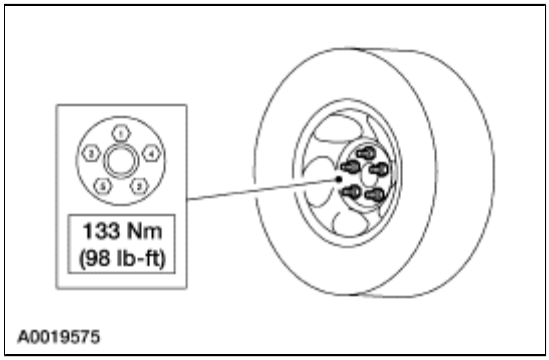
    Clean the right front wheel hub mounting surface and the wheel pilot.

16. Install the right front tire and wheel assembly.
    1. Position the tire and wheel assembly.
    2. Install the wheel nuts, then lower the vehicle.



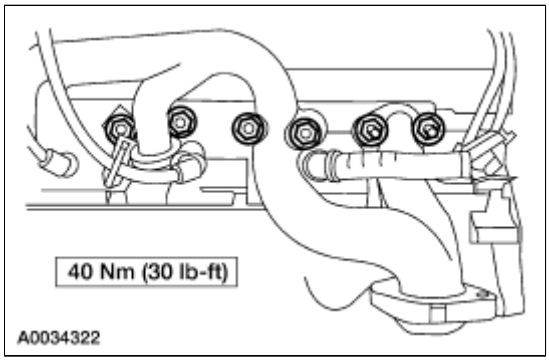
17. **CAUTION: Failure to tighten the wheel nuts in a star pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

    Tighten the wheel nuts in the sequence shown.

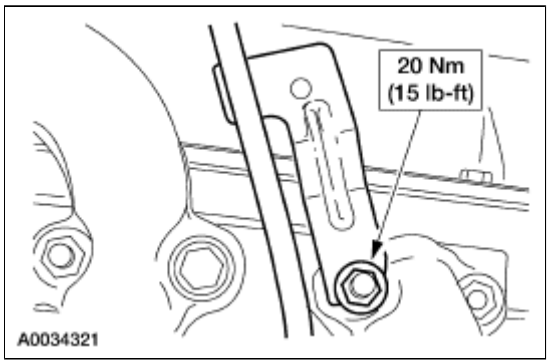


18. Install the center cap.

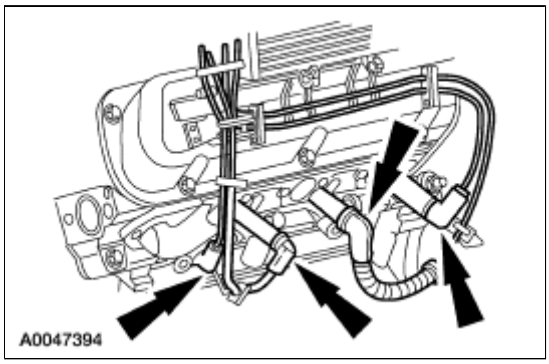
19. Install the LH exhaust manifold retainers.



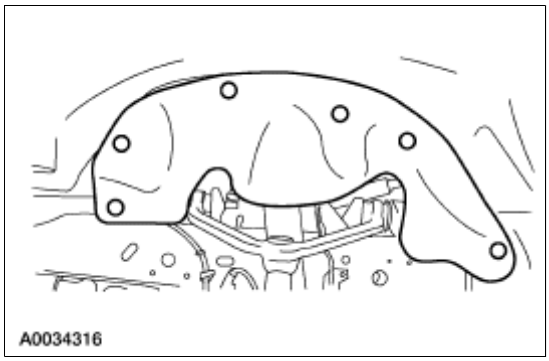
20. Install the engine fluid level indicator tube.



21. Connect the spark plug wires to the LH spark plugs.



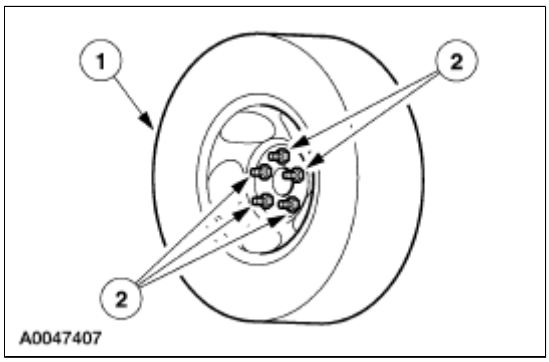
22. Install the left front wheel well splash shield.



23. **WARNING: Whenever a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to come off while the vehicle is in motion, causing loss of control. Failure to follow these instructions can result in personal injury.**

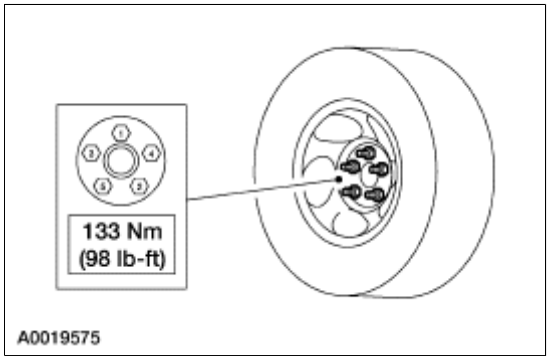
    Clean the left front wheel hub mounting surface and the wheel pilot.

24. Install the left front tire and wheel assembly.
    1. Position the tire and wheel assembly.
    2. Install the wheel nuts, then lower the vehicle.



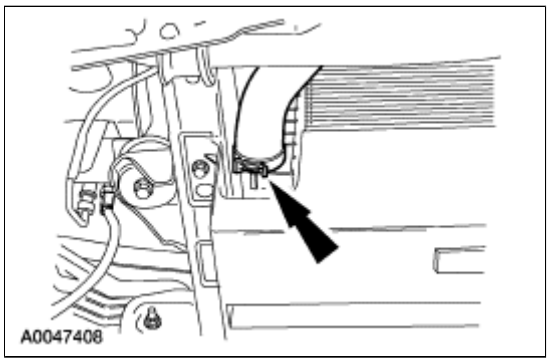
25. **CAUTION: Failure to tighten the wheel nuts in a star pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

    Tighten the wheel nuts in the sequence shown.

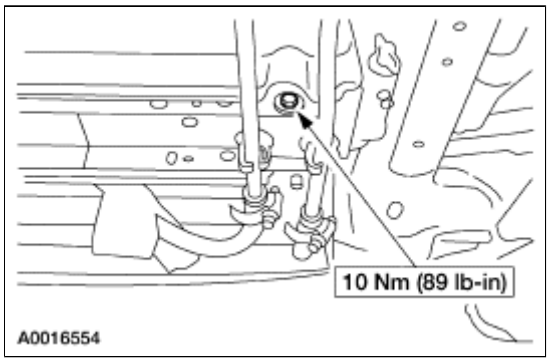


26. Install the center cap.

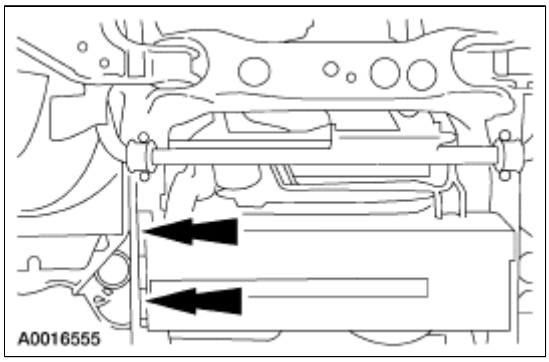
27. Connect the lower radiator hose to the radiator.



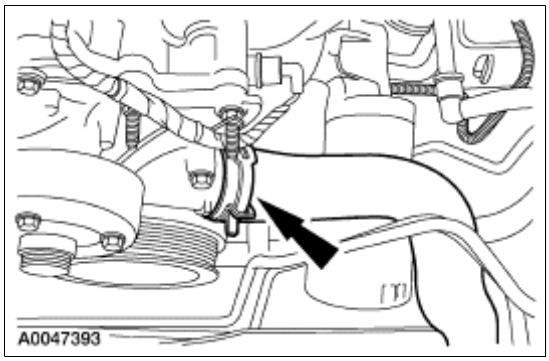
28. Install the bolt.



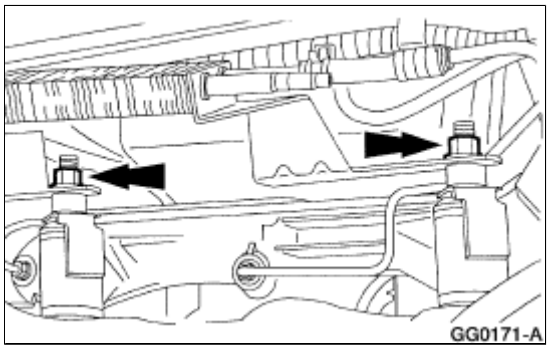
29. Install the air deflector.



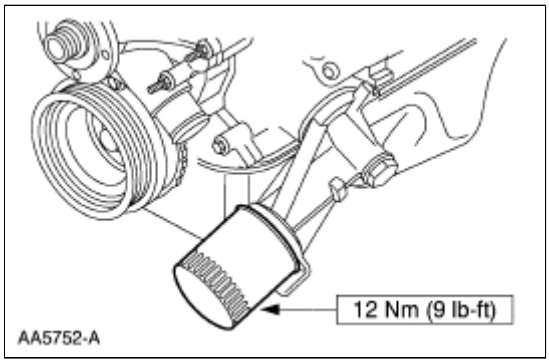
30. Connect the lower radiator hose to the water pump.



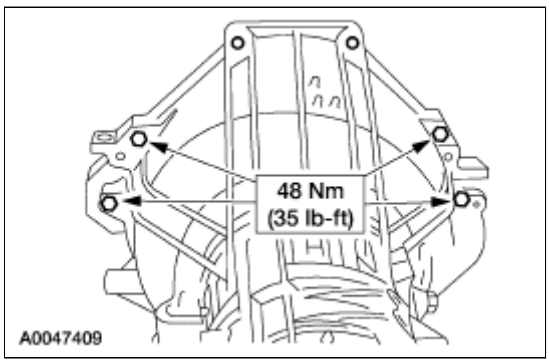
31. Install the power steering cooler.



32. Install the oil bypass filter.

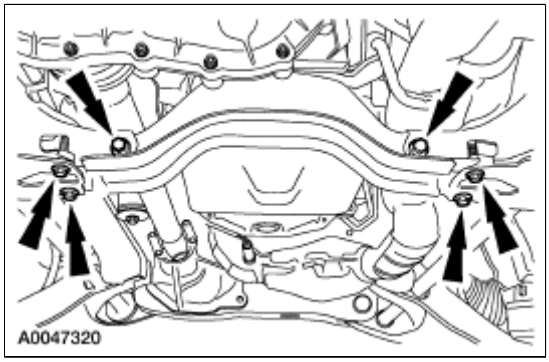


33. Install transmission-to-engine lower bolts.



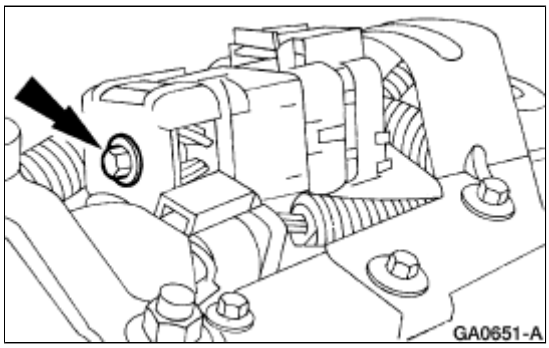
34. Remove the transmission mount retaining nuts. Using an adjustable jack, raise the transmission

slightly. Remove the crossmember and lower the transmission.

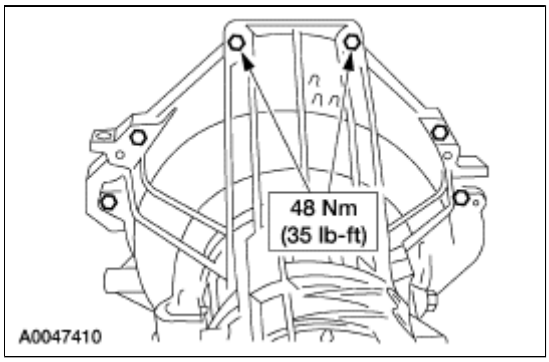


35. If equipped, connect the low oil level sensor electrical connector.

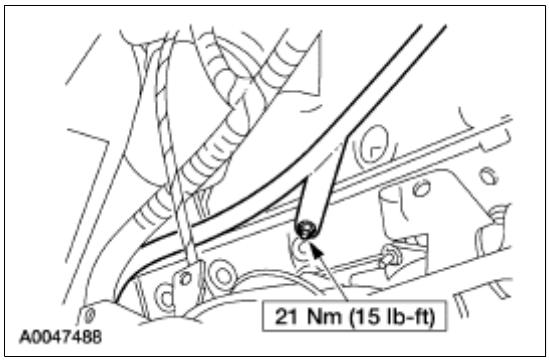
36. Connect the transmission bulkhead connector.



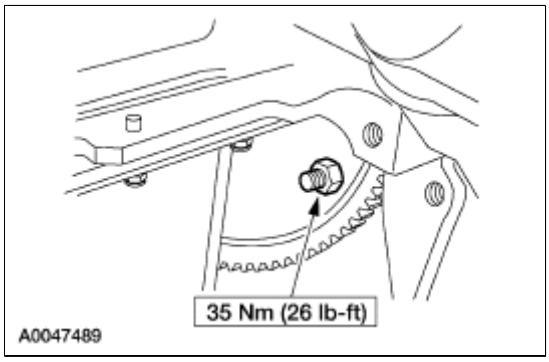
37. Install the transmission-to-engine upper bolts and raise the transmission to the installed position.



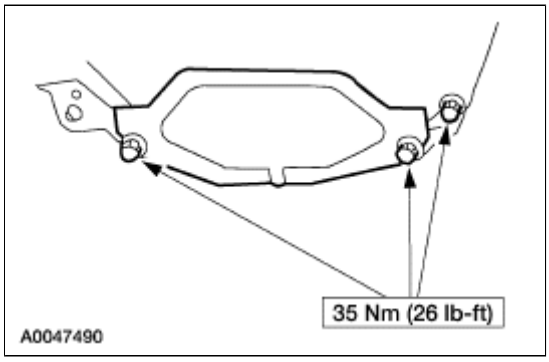
38. Install the transmission fluid level indicator tube.



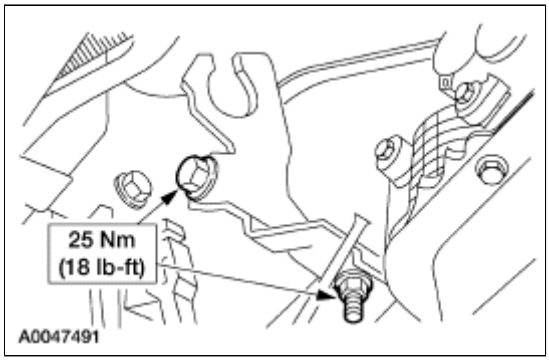
39. Install the torque converter retaining nuts.



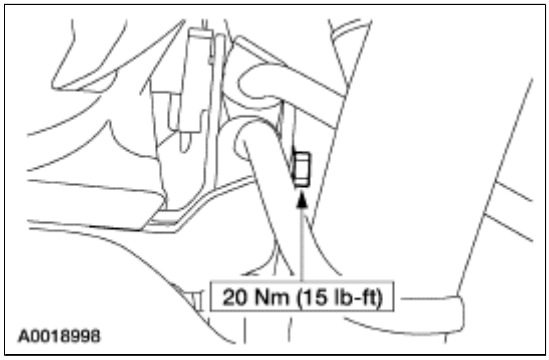
40. Install the transmission inspection cover.



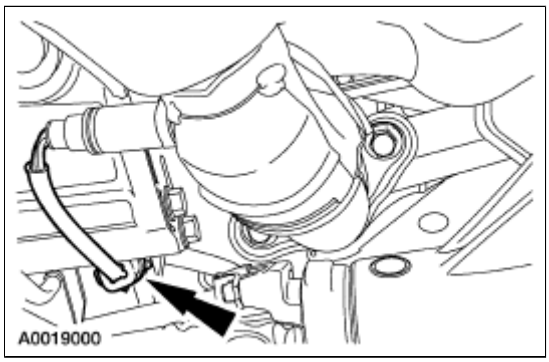
41. Install the transmission cable bracket.



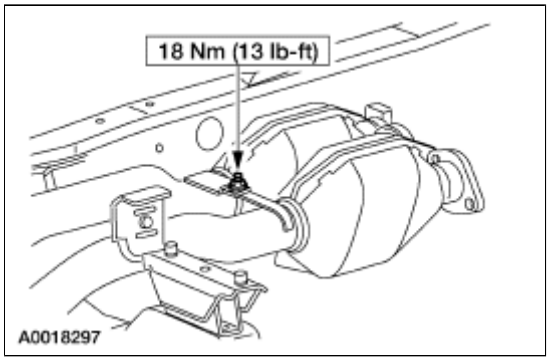
42. Install the bolt and the three-way catalytic converter (TWC).



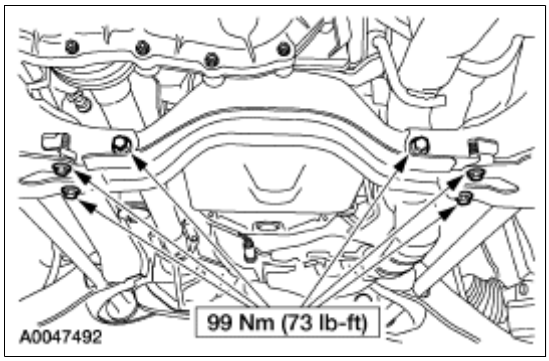
43. Connect the electrical connectors for the heated oxygen sensors and the catalyst monitor sensors.



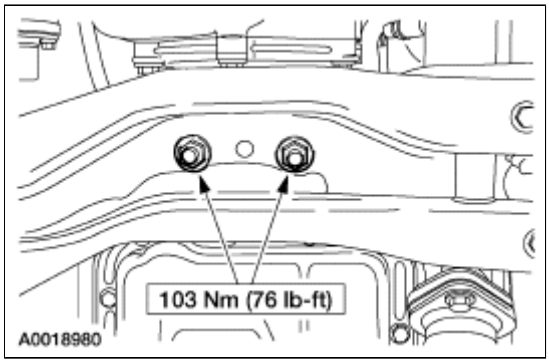
44. Install the nut.



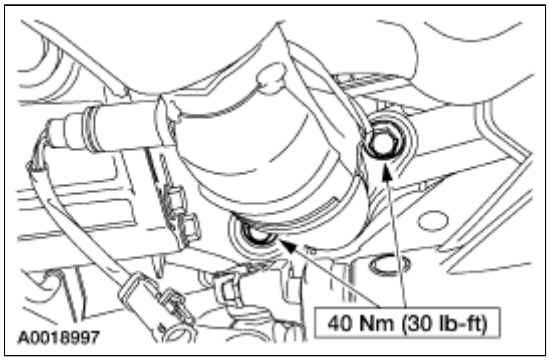
45. Install the transmission crossmember.



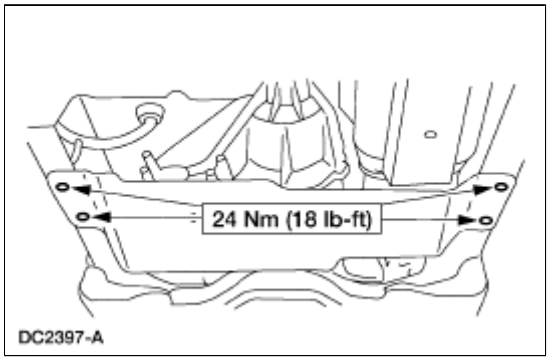
46. Install the nuts.
    - Remove the transmission jack.



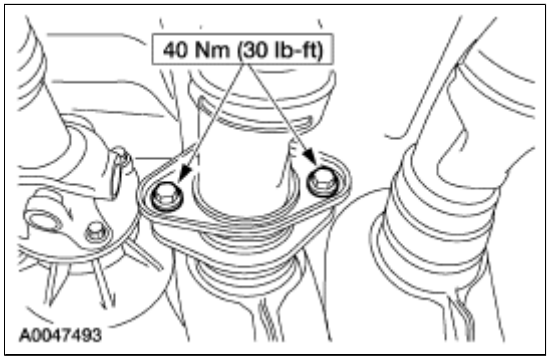
47. Install the bolts for the RH and the LH catalytic converters.



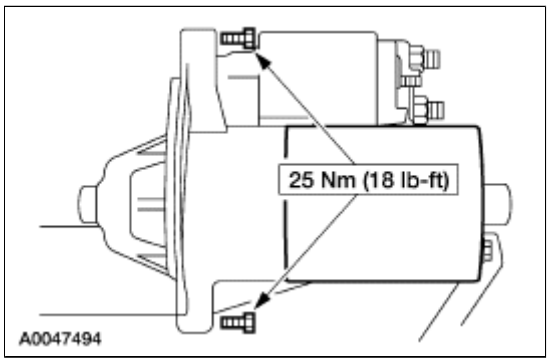
48. If equipped, install the skid plate.



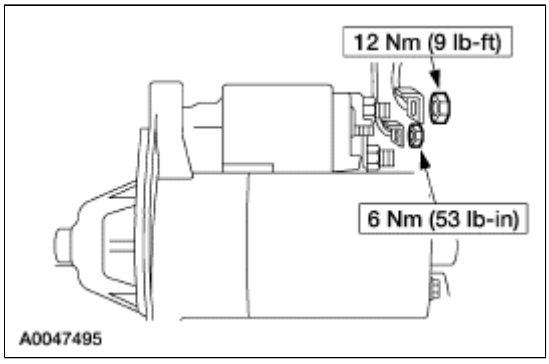
49. Install the bolts from the muffler to the catalytic converter.



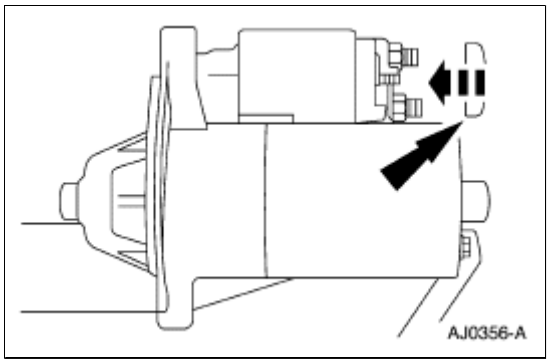
50. Position the starter motor and install the bolts.



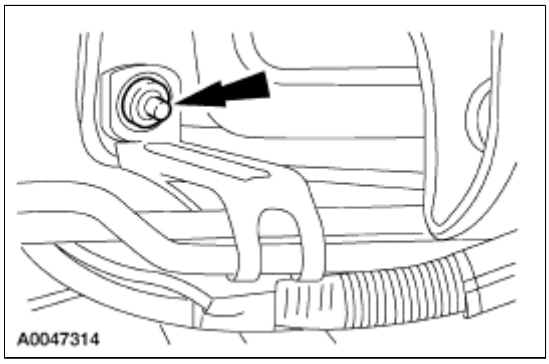
51. Connect the starter motor solenoid wiring.



52. Install the starter motor solenoid terminal cover.

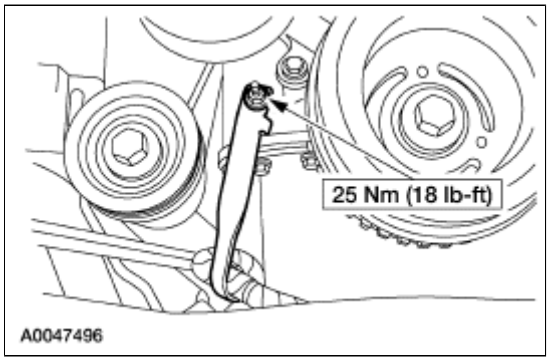


53. Install the transmission cooler tubes brace to the RH engine mount.



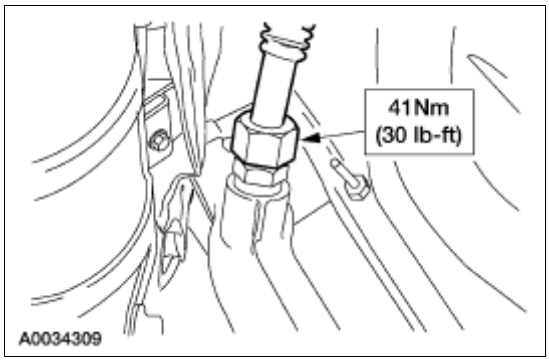
54. Lower the vehicle.

55. Install the wiring brace to the engine front cover.

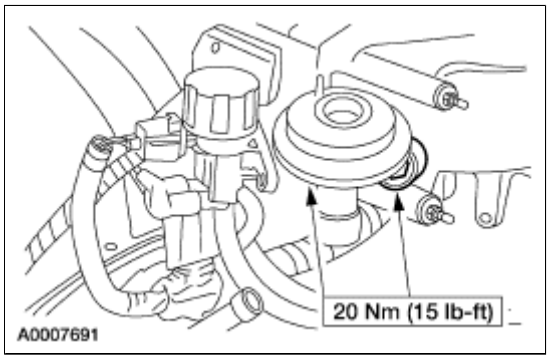


56. **NOTE:** If engine has been disassembled it will be necessary to tighten the EGR valve after connecting the tube to the exhaust manifold.

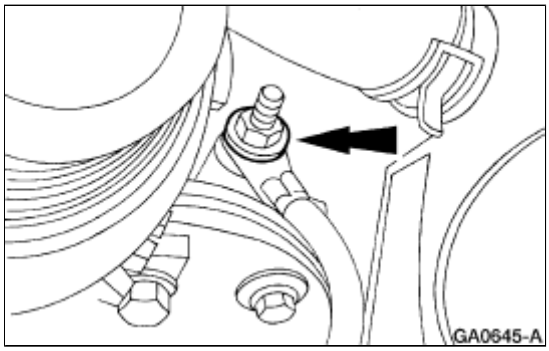
    Connect the exhaust gas recirculation (EGR) tube to the exhaust manifold.



57. Tighten the bolts.

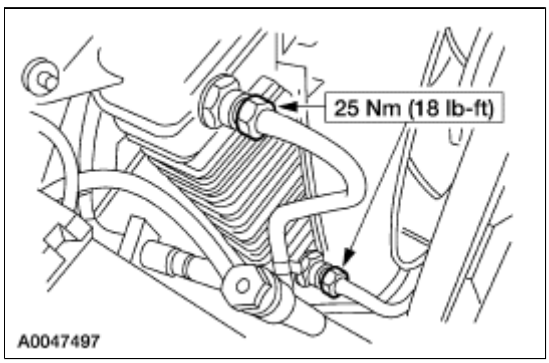


58. Connect the ground cable to the engine front cover.

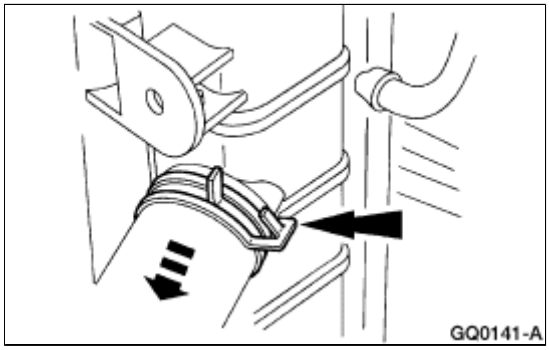


59. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

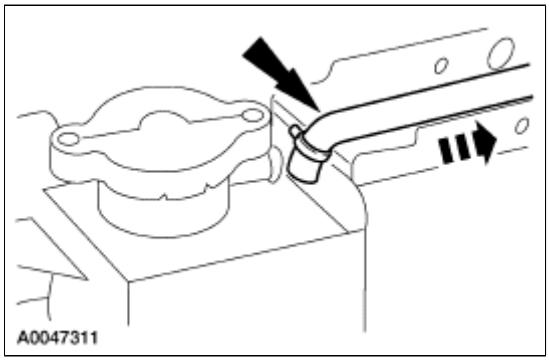
    Connect the two transmission cooling tubes.



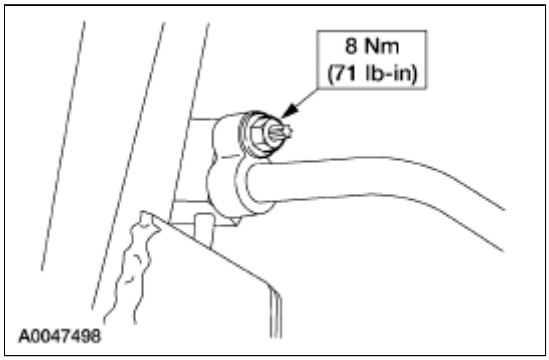
60. Connect the upper radiator hose.



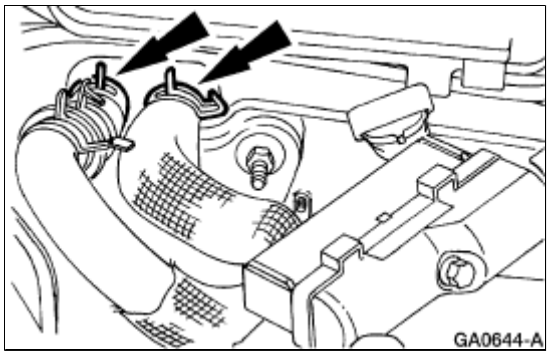
61. Connect the coolant overflow hose.



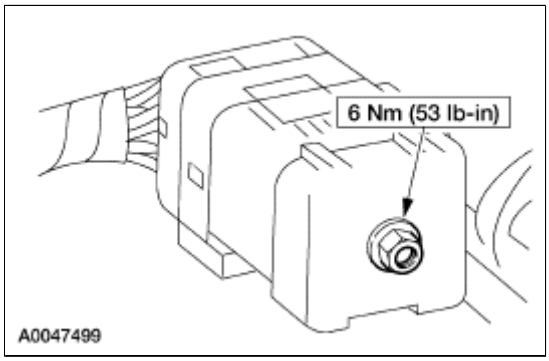
62. Connect the A/C manifold and tube, and the condenser-to-evaporator tube, to the A/C condenser core.



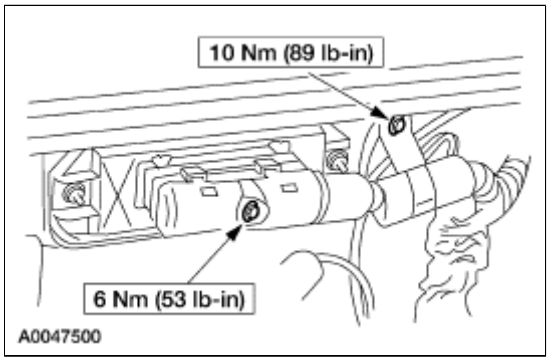
63. Connect the heater water hoses.



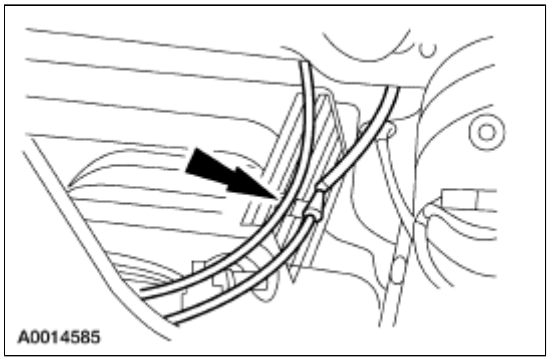
64. Connect the engine bulkhead connector.



65. Connect the powertrain control module (PCM) connector and the body ground connector.

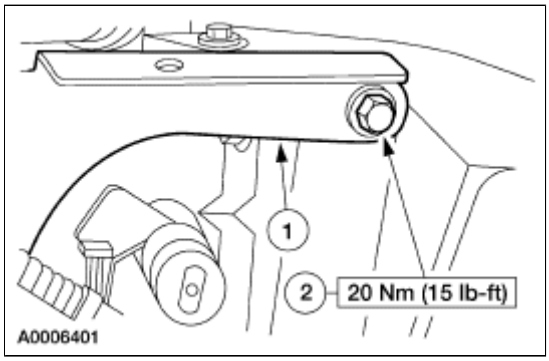


66. Install the accelerator and speed control cables to the clip.

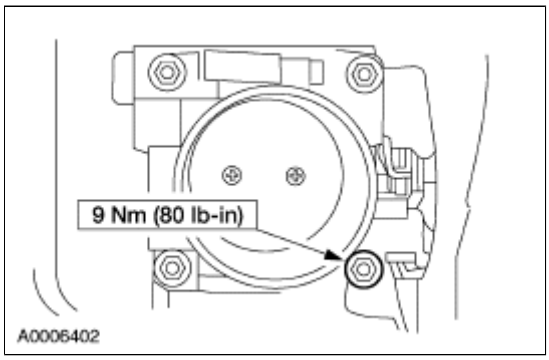


67. Install the accelerator cable bracket.

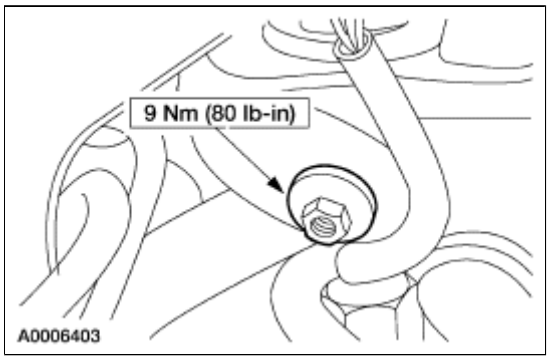
1. Install the bracket.
2. Install the bolt.



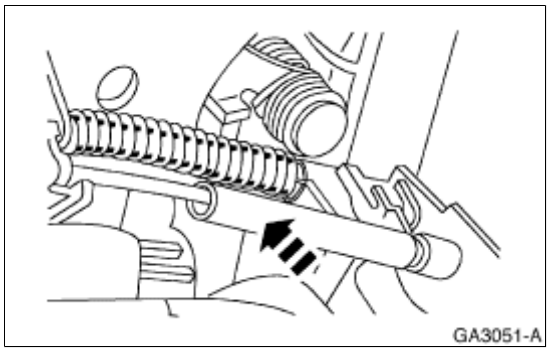
68. Install the lower accelerator cable bracket nut.



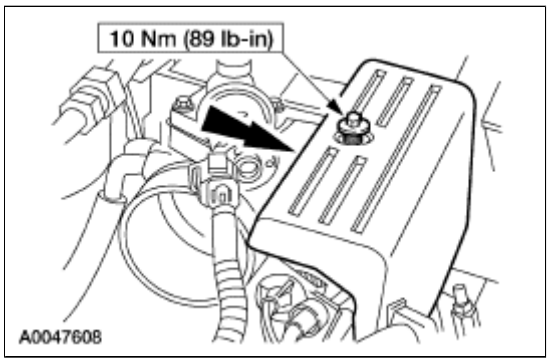
69. Install the accelerator cable bracket nut.



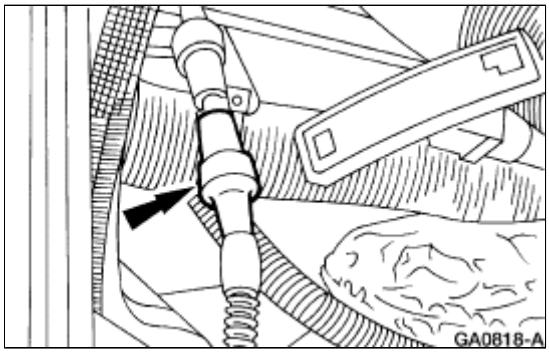
70. Connect the accelerator and speed control cables to the throttle linkage.



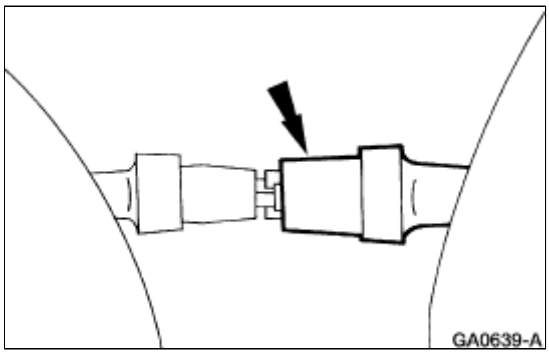
71. Install the accelerator control snow shield.



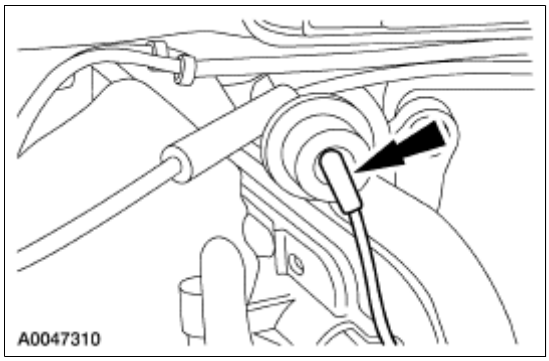
72. Connect the LH vacuum connection.



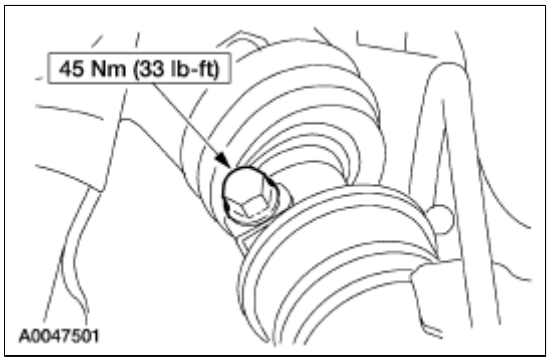
73. Connect the RH vacuum connection.



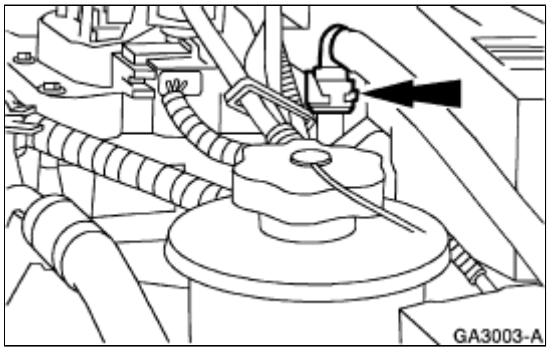
74. Connect the vacuum tube to the heater control valve.



75. Position the lower steering column shaft and install the bolt.

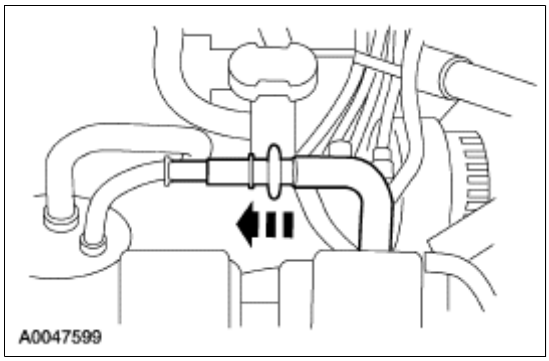


76. Connect the evaporative emissions (EVAP) canister purge solenoid vapor hose.

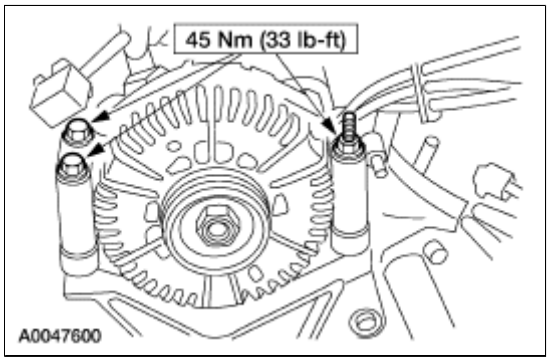


77. Connect the fuel lines at the spring lock couplings. For additional information, refer to Section 310-00 .

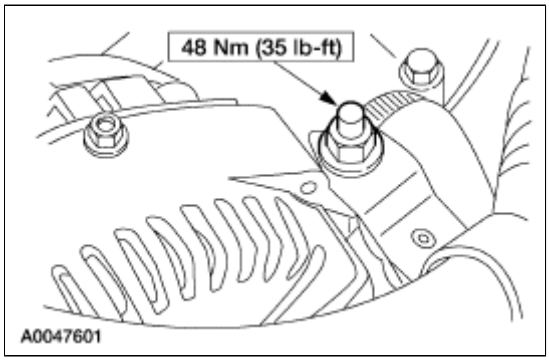
78. Connect the A/C manifold and tube spring lock coupling to the suction accumulator/drier.



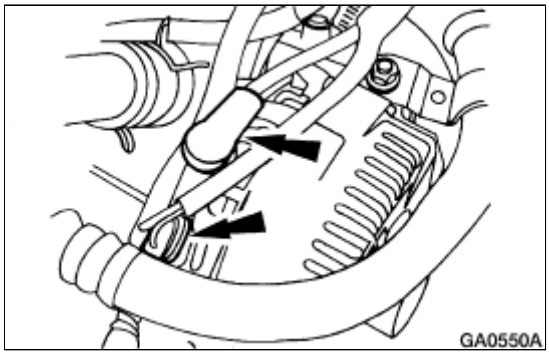
79. Install the generator.



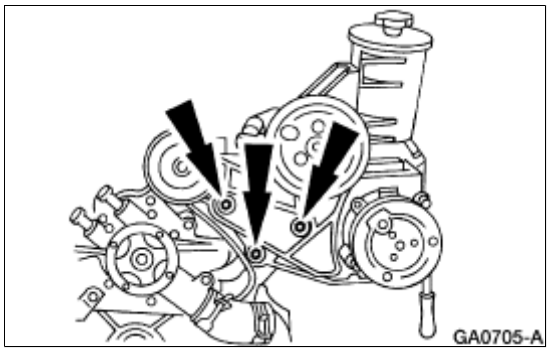
80. Install the nut on the generator stud.



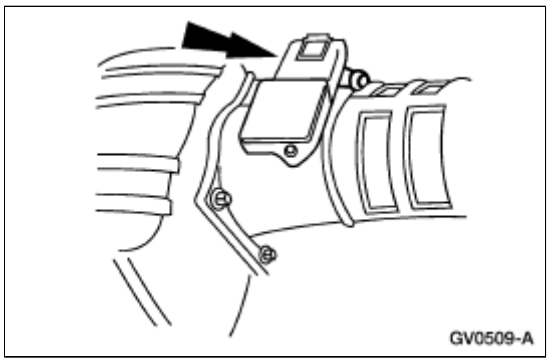
81. Connect the generator electrical connectors.



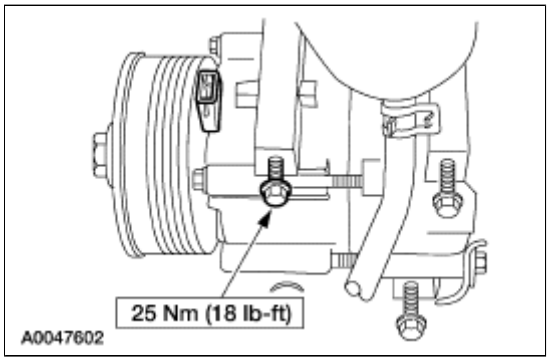
82. Install the bracket and the bolts.



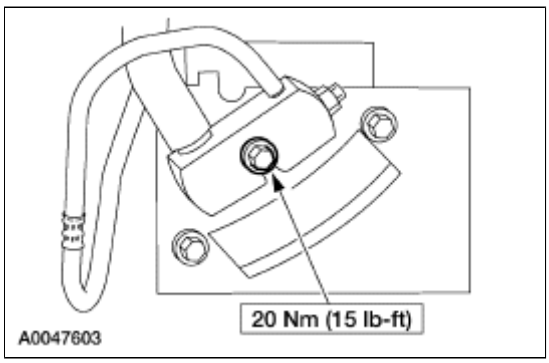
83. Connect the mass airflow (MAF) sensor electrical connector.



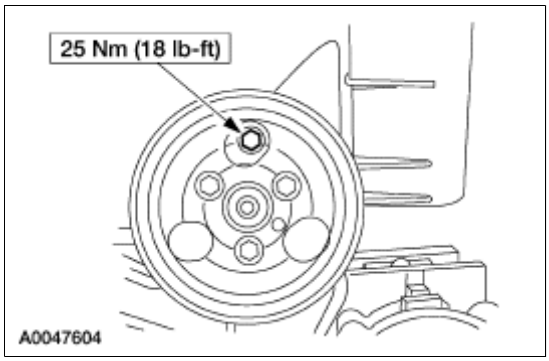
84. Install the A/C compressor.



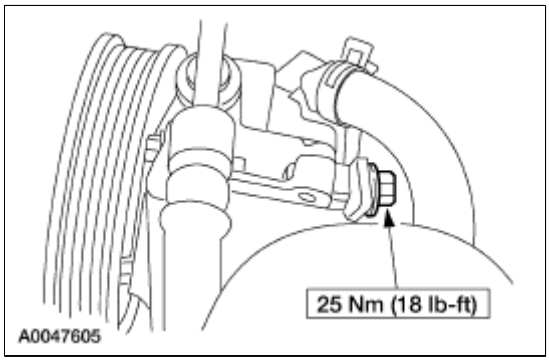
85. Install A/C manifold assembly to the A/C compressor.



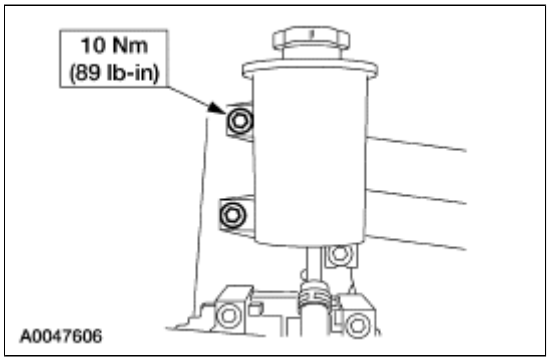
86. Position the power steering pump and install the bolts.



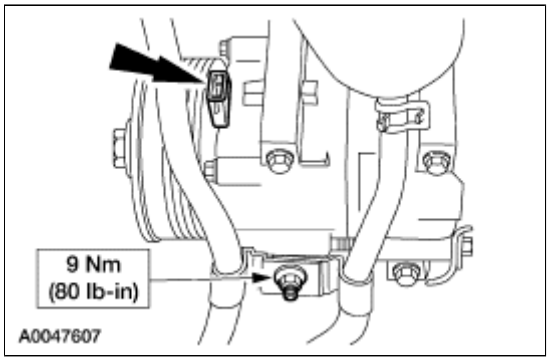
87. Install the rear power steering pump bolt.



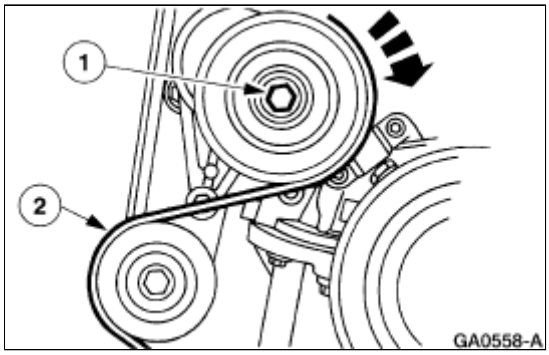
88. Install the power steering reservoir and the bolts.



89. Install the power steering tube clamp and connect the A/C compressor electrical connector.

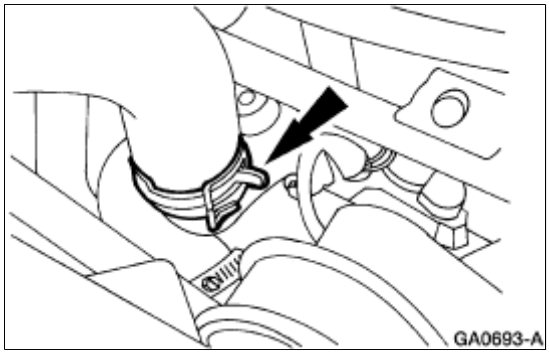


90. Install the drive belt.
    1. Rotate the drive belt tensioner clockwise.
    2. Install the drive belt.



91. Install the fan shroud. For additional information, refer to Section 303-03 .

92. Connect the upper radiator hose.



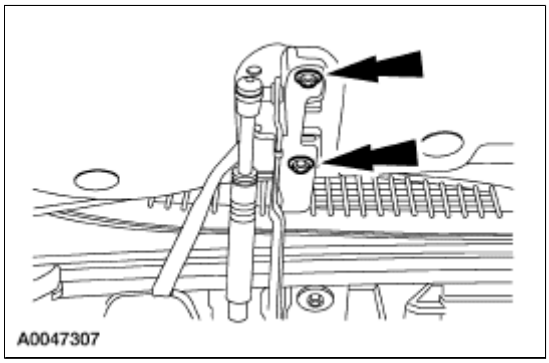
93. Install the battery. For additional information, refer to Section 414-01 .

94. Fill the engine with clean engine oil.

95. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

96. Recharge the A/C system. For additional information, refer to Section 412-00 .

97. Install the hood.



General Specifications

Item	Specification
Cooling System Capacity	
4.0L OHV	11.4 liters (12.0 quarts)
4.0L SOHC	13.2 liters (14.0 quarts)
5.0L	14.9 liters (15.7 quarts)
Pressure Test	
Cooling system	138 kPa (20 psi)
Cap	89-124 kPa (13-18 psi)
Thermostat Opening Temperature	
Starts to open	90°C (194°F)
Fully open	99°C (210°F)
Lubricants/Adhesives/Cleaners	
Premium Engine Coolant E2FZ-19549-AA (in Canada, Motorcraft CXC-8-B, in Oregon, F5FZ-19549-CC)	ESE-M97B44-A
Premium Cooling System Flush F1AZ-19A503-A	ESR-M14P7-A
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Gasket and Trim Adhesive F3AZ-19B508-AA	ESR-M18P7-A
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Dow Corning Silastic 734-R7V	Equivalent Commercial Product
Dow Corning Primer 1200	Equivalent Commercial Product
Premium Long-Life Grease XG-1-C	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
5.0L			
Block heater screw	1.6-1.8	—	14-16
Engine compartment light switch assembly bolt	—	—	—
Engine coolant temperature sensor	13-20	10-15	—

Fan clutch bolts	19-26	14-19	—
Fan clutch to water pump pulley nut	46-63	34-46	—
Fan shroud bolts	6-8	—	53-71
Radiator coolant recovery reservoir bolts	6-8	—	53-71
Radiator to radiator support bolts	6-8	—	53-71
Speed control servo bolt	8.9-12.1	—	79-107
Thermostat housing bolts	16-24	12-18	—
Transmission cooling line fitting to radiator	20-30	17-22	—
Transmission cooling line to cooler fitting nut	20-30	17-22	—
Fan blade to fan clutch bolts	6-8	—	53-71
Hose clamps	11-15	8-11	—
Water pump bolts	20-28	15-21	—
Water pump pulley bolts	16-25	12-18	—
Water temperature indicator sender unit	11-24	8-18	—
4.0L			
Battery ground cable	7-10	—	62-89
Belt idler pulley bolts	45	33	—
Block heater screw	1.6-1.8	—	14-16
Engine block coolant drain plug	16-24	12-18	—
Engine coolant temperature sensor	13-20	10-15	—
Fan blade to fan clutch bolts	19-26	14-19	—
Fan clutch to water pump pulley nut	43-63	34-46	—
Fan shroud bolts	6-8	—	53-71
Radiator coolant recovery reservoir bolts	6-8	—	53-71
Radiator draincock	2.0-2.7	—	18-25
Radiator to radiator support bolts	6-8	—	53-71
Speed control servo bolt	8.9-12.1	—	79-107
Thermostat housing bolts (4.0L push rod)	16-24	12-18	—
Thermostat housing bolts (4.0L SOHC)	8-11	—	71-97
Transmission cooling line fitting to radiator	30	22	—
Water pump bolts	8.5-12	6-9	—
Water pump pulley bolts	22-28	17-20	—
Water pump stud bolts	8.5-12	6-9	—
Water temperature indicator sender unit	11-24	8-18	—

Engine Cooling

The engine cooling system consists of the:

- block heater (6A051)
- engine coolant temperature (ECT) sensor (12A648)
- fan blade (8600)
- fan clutch (8A616)
- fan shroud (8146)
- radiator (8005)
- radiator cap (8100)
- radiator coolant recovery reservoir (8A080)
- water thermostat (8575)
- water pump (8501)
- ECT sender unit (10884)

- radiator draincock (8115)
- oil filter adapter (6881)

The radiator allows excess engine heat to be transferred to the air.

Radiator tanks cannot be repaired, install as an assembly.

For the 2.3L engine, the thermostat and housing must be serviced as an assembly.

Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Engine Coolant VC-4-A (CXC-10 in Canada, VC-5 in Oregon) or equivalent meeting Ford specification ESE-M97B44-A.
- Do not add orange-colored extended life coolant VC-2 or equivalent, meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol or methanol or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A. Not all coolant recycling processes meet this Ford specification; use of such a coolant may harm the engine and cooling system components.

The water temperature indicator sender unit provides a signal to the temperature gauge.

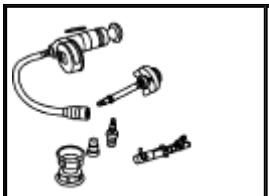
The optional block heater:

- electrical heating element is installed in the core plug opening.

    - uses a standard 110V electrical supply
- keeps the engine coolant warm during cold weather.

Engine Cooling

Special Tool(s)

 ST1474-A	Pressure Tester 014-R1072 or equivalent

Inspection and Verification

1. Verify the customer's concern by operating the engine to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
• Leaks • Damaged hoses • Loose/damaged hose clamps • Damaged water thermostat gasket • Damaged head gaskets • Damaged intake manifold gasket • Damaged water pump • Damaged radiator coolant recovery reservoir • Damaged heater core • Damaged fan/fan clutch	• Damaged engine coolant temperature sensor • Damaged wiring

3. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary.
4. If the concern remains after the inspection, determine the symptom(s) and go to the Symptom Chart.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Loss of coolant	• Radiator (8005). • Water pump seal. • Radiator hoses.	• GO to Pinpoint Test A .

	• Heater hoses. • Heater core. • Engine gaskets. • Radiator coolant recovery reservoir bottle.	
• The engine overheats	• Water thermostat (8575). • Water pump. • Internal engine coolant leak. • Radiator. • Heater core. • Inoperative cooling fan radiator cap.	• GO to Pinpoint Test B .
• The engine (6007) does not reach normal operating temperature	• Water thermostat.	• GO to Pinpoint Test C .
• The block heater (6A051) does not operate correctly	• Block heater power cable. • Block heater.	• GO to Pinpoint Test D .

Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the engine coolant level.	
1	2 Visually check the engine coolant level at the radiator coolant reservoir bottle. • **Is the engine coolant level within specification?** → **Yes** GO to A2 . → **No** REFILL the engine coolant as necessary. GO to A6 .
A2 CHECK THE PRESSURE RELIEF CAP	
	1 Carry out the radiator cap test; refer to the Component Tests in this section. • **Is radiator cap OK?**

	→ **Yes** GO to A3 . → **No** INSTALL a new radiator cap. TEST the system for normal operation.
A3 CHECK THE ENGINE COOLANT FOR INTERNAL LEAK	
1 	2 Inspect the engine coolant in radiator coolant recovery reservoir for signs of transmission fluid or engine oil. • **Is oil or transmission fluid evident in coolant?** → **Yes** If engine oil is evident, GO to Section 303-00 . If transmission fluid is evident, INSTALL a new radiator as necessary. → **No** GO to A4 .
A4 CHECK THE ENGINE AND THE TRANSMISSION FOR COOLANT	
	1 Remove the oil level dipsticks (6750) from the engine and the transmission. • **Is coolant evident in oil or transmission fluid?** → **Yes** If coolant is in engine, GO to Section 303-00 . If coolant is in transmission (7003), INSTALL a new radiator as necessary. GO to Section 307-01A or Section 307-01B to repair the automatic transmission. → **No** GO to A5 .
A5 PRESSURE TEST THE ENGINE COOLING SYSTEM	
	1 Pressure test the engine cooling system; refer to the Component Tests in this section. • **Does the engine cooling system leak?** → **Yes** REPAIR or INSTALL new components. TEST the system for normal operation. → **No** The cooling system is operational. RETURN to the Symptom Chart.
A6 CHECK THE COOLANT RECOVERY SYSTEM	
	1 **WARNING: Never remove the radiator cap under any conditions while**

	the engine is operating. Failure to follow these instructions could result in personal injury and/or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, press down on the radiator cap (with a cloth), turn and remove. Allow the engine to cool. 2 Remove the radiator cap. 3 Inspect the radiator cap for foreign material between the sealing gasket and the diaphragm. • **Is the radiator cap OK?** → **Yes** GO to A7 . → **No** CLEAN or INSTALL a new radiator cap. TEST the system for normal operation. GO to A1 .
A7 CHECK THE DEGAS BOTTLE	
	1 **NOTE:** The engine must be cool when coolant is added to the radiator coolant recovery reservoir. Add coolant to the radiator coolant recovery reservoir until fluid is between the coolant fill level marks. • **Check the radiator coolant recovery reservoir for leaks?** → **Yes** INSTALL a new radiator coolant recovery reservoir. TEST the system for normal operation. → **No** CARRY OUT the cooling system pressure test; REFER to Pressure Tests in this section. REPAIR as necessary. TEST the system for normal operation.

PINPOINT TEST B: THE ENGINE OVERHEATS

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE ENGINE COOLANT LEVEL	
NOTE: If the engine is hot, allow the engine to cool before proceeding.	
1	1 **WARNING: Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in personal injury and/or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use**

	extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, press down on the radiator cap (with a cloth), turn and remove. 2 Check the engine coolant level at the radiator coolant recovery reservoir. • **Is the engine coolant OK?** → **Yes** GO to B2 . → **No** REFILL the engine coolant at the radiator coolant recovery reservoir. GO to Pinpoint Test A .
B2 CHECK THE COOLANT CONDITION	
	1 Check the coolant for contaminants such as rust, corrosion, or discoloration. • **Is the coolant condition OK?** → **Yes** GO to B3 . → **No** FLUSH the engine cooling system; REFER to Flushing—Engine and Radiator in this section. TEST the system for normal operation.
B3 CHECK FOR AN AIRFLOW OBSTRUCTION	
	1 Inspect the A/C condenser core (19712) and radiator for obstructions such as leaves or dirt. • **Is there an obstruction?** → **Yes** REMOVE the obstruction. CLEAN the A/C condenser core and radiator. TEST the system for normal operation. → **No** GO to B4 .
B4 CHECK THE HEATER CORE OPERATION	
2	1 Install the radiator cap. 3 As the engine starts to heat up, feel the inlet and outlet heater water hoses (18472). They should feel approximately the same after three or four minutes.

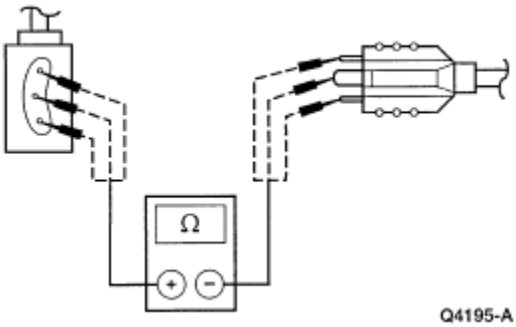
	• **Is the heater water hose approximately the same temperature as the inlet heater water hose?** → **Yes** GO to B5 . → **No** TURN the engine off. REPAIR or INSTALL a new heater core. REFER to Section 412-02 . TEST the system for normal operation.
B5 CHECK THE WATER THERMOSTAT OPERATION	
1 	1 Start the engine and allow the engine to run for 10 minutes. 2 Feel the inlet and outlet heater water hoses and the underside of the upper radiator hose (8260). • **Are the upper radiator hose and the heater water hoses cold?** → **Yes** INSTALL a new water thermostat. TEST the system for normal operation. → **No** GO to B6 .
B6 CHECK THE COOLING FAN OPERATION	
1 	1 Carry out the cooling fan component tests; refer to the Fan Clutch Test in this section. • **Is the cooling fan operation OK?** → **Yes** GO to Section 303-00 for diagnosis and testing of the engine. → **No** INSTALL a new fan component determined to be faulty; REFER to Fan Clutch Test in this section. TEST the system for normal operation.

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ENGINE TEMPERATURE	
1	1 Start the engine and allow the engine to idle for 10 minutes.

 2 	2 Feel the inlet and heater water hoses and the underside of the upper radiator hose. • **Are the upper radiator hose and the heater water hoses cold?** → **Yes** INSTALL a new water thermostat. TEST the system for normal operation. → **No** GO to Section 413-01 for diagnosis and testing of the engine coolant temperature gauge.

PINPOINT TEST D: THE BLOCK HEATER DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE POWER CABLE	
1 2 Block Heater 3  Q4195-A	3 Check resistance in circuits 1, 2, and 3 of the block heater. • **Is the resistance in circuits 1, 2, and 3 less than 5 ohms?** → **Yes**

	INSTALL a new block heater. → **No** INSTALL a new power cable. TEST the system for normal operation.

Component Tests

Pressure Test

WARNING: Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in personal injury and/or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, press down on the radiator cap (with a cloth), turn and remove.

1. Remove the radiator cap. Fill the radiator as needed. Fit the pressure tester to the radiator neck using an aftermarket adapter.

2. **CAUTION: Do not pressurize the cooling system beyond 102 kPa (14.9 psi).**

   Pump the cooling system to a maximum of 102 kPa (14.9 psi) and hold for two minutes. If the pressure drops within this time, inspect for leaks and repair as necessary.

Cap

1. Inspect the radiator cap and seals for damage or deterioration. Install a new radiator cap (8100) if necessary.

2. Fit the radiator cap to the Radiator/Heater Core Pressure Tester Kit using the aftermarket adapter.

3. **NOTE:** If the plunger of the pressure tester is depressed too fast, an incorrect pressure reading will result.

   Slowly pump the pressure tester until the pressure gauge stops increasing and note the highest pressure reading. Release the pressure and repeat the test. Install a new radiator cap if the pressure is not 99.3-121.4 kPa (14.4-17.6 psi).

Thermostat—Water

A new water thermostat should be installed only after the following electrical and mechanical tests have been carried out.

Thermostat—Electrical Test

CAUTION: Always vent the exhaust to the outside when carrying out this test.

NOTE: The electrical thermostat test is most accurate if carried out indoors at less than 37.8°C (100°F) ambient air. This test may be carried out with or without the hood open and with the engine warm or cold.

1. Check the engine coolant level. Fill as needed.

2. With the ignition OFF, remove the engine coolant temperature (ECT) sensor harness connector and attach ECT Sensor "T" Cable as a jumper between the powertrain control module (PCM) (12A650) and the ECT Sensor. Attach the 73 Digital Multimeter to the ECT Sensor "T" Cable. Voltage values (0-5 V) may now be monitored while the sensor retains its connection to the wiring harness.
   A scan tool may be used to monitor the ECT on vehicles equipped with data link connector (DLC). The SBDS sequence to use for the screen is: Toolbox-Electronic Engine Control and DCL-Item.

3. **NOTE:** Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause incorrect diagnosis.

   Place the transmission in PARK (P) or NEUTRAL (N).

4. Start the engine and allow the engine to idle throughout this test. Allow the engine to run for two minutes, then record the ECT voltage. Record the ECT voltage every 60 seconds. When the ECT voltage trend changes direction or only changes slightly (0.03 volt or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below.

Coolant Temperature °C (°F)	ECT (Volts)
22 (71)	3.00
43 (109)	2.01
71 (159)	1.01
82 (180)	0.75
91 (195)	0.059
97 (206)	0.050
105 (221)	0.040

5. If the thermostat opening voltage is greater than 0.58 volt and less than 90°C (194°F), install a new water thermostat.

6. If the thermostat opening voltage is less than 0.58 volt and less than 90°C (194°F), the water thermostat is good and a new thermostat should not be installed. Refer to the Symptom Chart for further instructions.

Thermostat—Mechanical Test

1. Remove the water thermostat.

2. Check the water thermostat for seating. Hold the water thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates that a new water thermostat should be installed. Some water thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.

3. Immerse the water thermostat in a boiling antifreeze and water mixture.

4. See the General Specifications chart for water thermostat opening temperatures.

Radiator Leak Test, Removed From Vehicle

CAUTION: Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.

NOTE: Always install plugs in the oil cooler fittings before leak testing or cleaning any radiator.

NOTE: Clean the radiator before leak testing to avoid contamination of tank.

1. Leak test the radiator in clean water with 138 kPa (20 psi) air pressure.

Fan Clutch Test

1. Spin the fan blade (8600) by hand. A light resistance should be felt. If there is no resistance or very high resistance, the minimum and maximum fan speeds must be checked as follows:

Fan Clutch Test—Minimum Speed Requirement

1. Use a suitable marker to mark the water pump pulley (8509), one of the fan blade retaining bolts and the crankshaft pulley (6312).
2. Connect a tachometer to the engine.
3. Install a throttle adjusting tool.
4. Connect a digital photoelectric tachometer.
5. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation.**

   Start the engine and run it at approximately 1,500 rpm until the normal operating temperature has been achieved.
6. Adjust the engine speed to 2,300 rpm.
7. Operate the digital photoelectric tachometer at 3,000 rpm and aim it at the water pump pulley. Adjust the engine speed until the light flash and the water pump pulley mark are synchronized.
8. Aim the digital photoelectric tachometer at the fan blade bolts. Adjust the strobe light until the light flash is synchronized with the marked fan blade bolt (the fan blade appears to stand still).
9. The fan blade speed must not be greater than 1,500 rpm at 3,000 water pump rpm.
10. Turn the engine off.

11. If the fan blade speed was greater than 1,500 rpm, install a new fan clutch (8A616).

Fan Clutch Test—Maximum Speed Requirement

1. Carry out Steps 1 through 5 of the Fan Clutch Test—Minimum Speed Requirement.

2. **NOTE:** The temperature should be above 96°C (205°F) for maximum fan speed.

   Block off areas on each side of the radiator in the engine compartment and the front of the radiator grille (8200). This will raise the temperature of the air striking the fan clutch and should cause the fan blade to operate at maximum speed.

3. Place the climate control function selector switch in the MAX A/C position and the blower motor switch in the HI position.

4. Adjust the strobe to 3,000 rpm.

5. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation.**

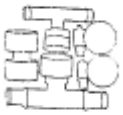
   Start the engine and adjust the engine speed until the digital photoelectric tachometer light and the water pump pulley mark are synchronized.

6. Aim the digital photoelectric tachometer light at the fan blade retaining bolts. Adjust the digital photoelectric tachometer light until the light flash is synchronized with the marked fan blade bolt (the fan blade appears to stand still).

7. If the fan blade speed is less than 2,300 rpm, install a new fan clutch.

Cooling System Inspection

Special Tool(s)

ST1720-A	Fluid Tester 014-R1060 or equivalent
 ST1168-A	Flush Kit 164-R3658 or equivalent

1. **WARNING: Never remove the radiator cap (8100) under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the radiator (8005), use extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When it is certain all the pressure has been released, press down on the cap (still with a cloth), turn and remove.**

   NOTE: Check the coolant in the radiator coolant recovery reservoir (8A080) and radiator, if vehicle has not been allowed to reach normal operating temperature. This will make sure sufficient coolant exchange has occurred.

   Allow the engine to cool and remove the radiator cap.

2. Inspect the coolant in both the radiator and the radiator coolant recovery reservoir for coolant color:
   - Clear light green or blue indicates higher water content than necessary.
   - Dark brown indicates possible use of unauthorized Stop Leak. Use Cooling System Stop Leak Powder E6AZ-19558-A or equivalent meeting Ford specification ESE-M99B170-A only.
   - A light or reddish brown color indicates rust in the cooling system. Flush the system and refill with the correct mixture of water and Premium Engine Coolant E2FZ-19549-AA (in Canada, Motorcraft CXC-8-B, in Oregon, F5FZ-19549-CC) or equivalent meeting Ford specification ESE-M97B44-A.
   - An iridescent sheen on top of the coolant indicates a trace of oil is entering the cooling system.
   - A milky brown color indicates that oil is entering the cooling system.
   - A reddish milky appearance indicates transmission fluid is entering the system.

3. **CAUTION: If there is coolant in the engine oil, the cause must be corrected and the oil changed or engine damage may occur.**

The causes of the leak might be:

- a blown head gasket (6051).
- a cracked or warped cylinder head (6049).
- a crack in the engine oil gallery and the cooling passageways.

4. The causes of other leaks might be:
   - a leaky radiator.
   - a leaky transmission fluid cooler.
     Drain the fluids and repair or install new fluids as necessary. Add the correct mixture of water and Premium Engine Coolant E2FZ-19549-AA (in Canada, Motorcraft CXC-8-B, in Oregon, F5FZ-19549-CC) or equivalent meeting Ford specification ESE-M97B44-AA.

5. If the coolant appearance is OK, test the coolant range with the Rotunda Battery and Antifreeze Tester:
   - Maximum range is 60/40.
   - Minimum range is 45/55.

6. Coolant system conditions:
   - If the cooling system is low, top off only with a premixed solution.
   - If the coolant mixture is weak, add straight coolant until the readings are within acceptable levels.
   - If the coolant mixture is strong, remove some coolant and add water until the readings are within acceptable levels.

Cooling System Hoses

7. **CAUTION: Cooling system hoses, which operate under a positive pressure of approximately 110 kPa (16 psi) and a temperature of over 95°C (200°F), are subject to considerable vibration. Any hoses with cuts or deterioration should be replaced, as they are likely to fail on the road with the attendant risk of engine damage.**

   CAUTION: Reasonably fresh replacement hoses should be used. Replacement hoses which have been in storage for several years should be checked for ozone-caused hardening. Hoses which have become hard will be difficult to seal and may break in service.

   Inspect the hoses for:
   - Visible signs of deterioration such as cracking or checking. Install a new hose if there is visible deterioration.
   - Swelling near the clamps and at the hose ends. Install a new hose if there is swelling.
   - Oil or oily dirt on the hoses from engine oil leaks or careless filling. Clean off the oil and oily dirt on the hoses. Oil will attack the rubber over time. If there is weakening or deterioration of a hose, install a new hose.
   - Cuts. If a hose is cut other than a very superficial cut, install a new hose.
   - A hose contacting metal parts, especially sharp edges. If a hose is contacting metal parts, loosen the clamps and relocate the hose. In some cases it may be necessary to put plastic shielding on the hose to protect it. If the hose has already been cut or worn, install a new hose.

8. Inspect the clamps for any damage.

Fan Blade

WARNING: Do not attempt to straighten or repair the fan blade. Install a new fan blade if it is damaged.

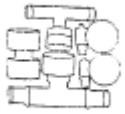
1. Inspect the fan for damage or cracking. Cracking is most likely to occur near the base of each individual blade. If the fan is damaged, install a new one. For additional information, refer to Fan—Blade in this section.

Transmission Fluid Cooler Connection Leaks

1. Check to see that the fitting nut is fully tightened. If the leak persists, apply a thin, even coat of Dow Corning 1200 Primer or equivalent using a brush. Allow to dry for 10 minutes at room temperature. Apply Dow Corning Silastic 734RTV or equivalent in undiluted form around the leaking connection and allow it to dry for one hour.

Cooling System Draining, Filling and Bleeding

Special Tool(s)

 ST1168-A	Flush Kit 164-R3658 or equivalent

Draining

WARNING: Do not open the cooling system while it is hot or engine is running.

CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly.

NOTE: About 80% of the coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

1. Release the pressure in the cooling system by slowly turning the radiator cap (8100) one half to one turn counterclockwise to the first stop on the filler neck. When the pressure has been released, remove the radiator cap.
2. Place a suitable container below the radiator draincock (8115). Drain the coolant.
3. Close the radiator draincock when finished.

Filling

1. Install the radiator and reconnect all radiator hoses and transmission oil cooler lines (if equipped).
2. Fill the radiator through the radiator cap opening. Close the cap when full.
3. Fill the radiator coolant recovery reservoir to the cold fill line.
4. Run the engine until it reaches operating temperature.
5. Turn off the engine and allow the cooling system to cool. Release the pressure in the cooling system by slowly turning the radiator cap (8100) one half to one turn counterclockwise to the first stop on the filler neck. When the pressure has been released, remove the radiator cap. Add more coolant mixture (with the correct 50/50 ethylene glycol and water mixture) to the radiator until full.
6. Add more coolant mixture to the radiator coolant recovery reservoir until the level reaches the cold fill line.

7. Repeat Steps 2 through 6 as necessary.

Bleeding

1. Bleed the cooling system as follows:
   - Select the maximum heater temperature and blower motor speed settings. Position the control to discharge air from the A/C vents to the instrument panel (04320).
   - **WARNING: Do not stand in line with or near the engine cooling fan blade when revving the engine.**

     Start the engine and allow it to idle. While the engine is idling, feel for hot air from the A/C vents.
   - **CAUTION: If the air discharge remains cool and the engine coolant temperature gauge does not move, the engine coolant level is low in the engine and must be filled. Stop the engine, allow it to cool and fill the cooling system; refer to Cooling System Draining, Filling and Bleeding in this section.**

     Start the engine and allow it to idle until the normal operating temperature is reached. Hot air should discharge from the A/C vents. The engine coolant temperature gauge should maintain a stabilized reading in the middle of the NORMAL range and the upper radiator hose (8260) should feel hot to the touch.
   - Shut the engine off and allow it to cool.
   - Check the engine for coolant leaks.
   - Check the engine coolant level in the radiator coolant recovery reservoir and fill it as necessary.

Cooling System, Cleaning

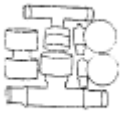
1. **CAUTION: Always remove the water thermostat (8575) prior to pressure flushing.**

   To remove the rust, sludge and other foreign material from the cooling system, use Premium Cooling System Flush F1AZ-19A503-A or equivalent meeting Ford specification ESR-M14P7-A that is safe for use with aluminum radiators.
   Cleaning restores cooling efficiency and helps prevent overheating. A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal coolant flow direction.
   In severe cases, cleaning solvents may not correctly clean the cooling system for efficient operation. It will be necessary to use the pressure flushing method, using Rotunda Flush Kit.

2. Dispose of old coolant and flushing water contaminated with antifreeze and cleaning chemicals in accordance with local, state and federal laws.

Flushing —Engine and Radiator

Special Tool(s)

 ST1168-A	Flush Kit 164-R3658 or equivalent
ST1167-A	Drain Kit 164-R3662 or equivalent

1. **WARNING: Do not open the cooling system while it is hot or while the engine is running.**

   Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the water thermostat.

3. Install the water thermostat housing (8A587) without the water thermostat.

4. **NOTE:** Refer to the cooling system Flush-All Operating Instructions for specific vehicle hook-up.

   Use cooling system Flush-All, Flush Kit Hardware Package and Drain Kit to flush the engine and radiator.
   Use Ford Premium Cooling System Flush F1AZ-19A503-A or equivalent meeting Ford specification ESR-M14P7A.

5. Install the water thermostat.

6. Backflush the heater core (18476) if necessary. For additional information, refer to Flushing—Heater Core in this section.

7. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Flushing —Heater Core

1. **WARNING: Do not open the cooling system while it is hot or while the engine is running.**

   Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. **NOTE:** Refer to the cooling system Flush-All Operating Instructions for particular vehicle hook-up.

   Use cooling system Flush-All, Flush Kit Hardware Package and Drain Kit to back flush the heater core. Use Premium Cooling System Flush F1AZ-19A503-A or equivalent meeting Ford specification ESR-M14P7A.

3. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

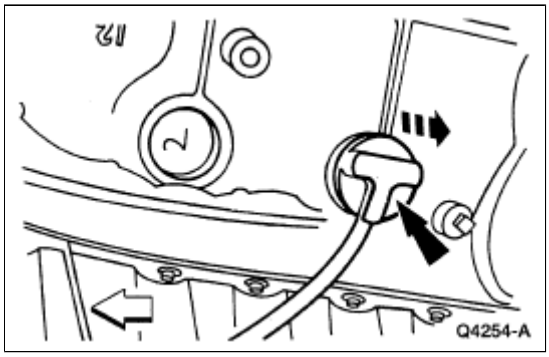
Block Heater

Removal

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

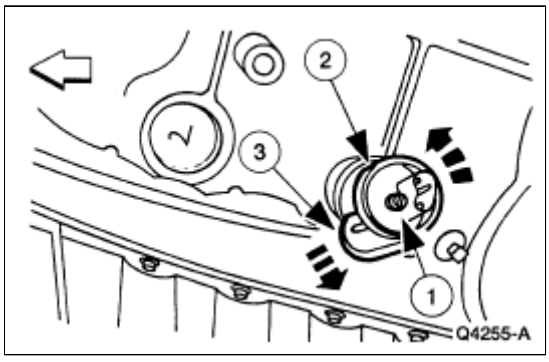
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Disconnect the connector.



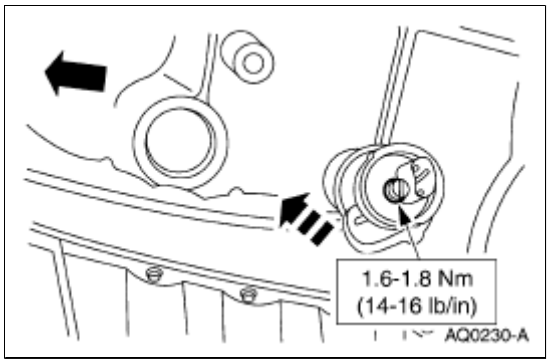
4. Remove the block heater (6A051).
    1. **NOTE:** Do not loosen the screw more than necessary for removal.

       Loosen the screw.
    2. Twist and slide the block heater to release the retainer clip and discard the retainer clip.
    3. Remove the block heater.



Installation

1. To install, reverse the removal procedure.

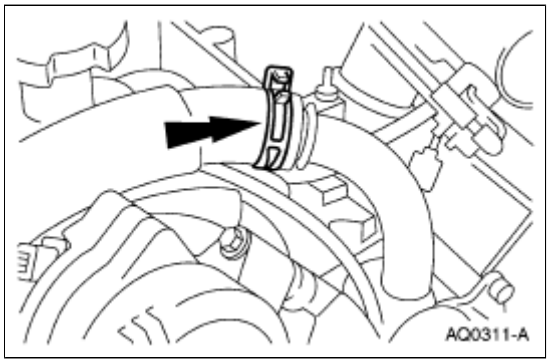

1.6-1.8 Nm
(14-16 lb/in)
AQ0230-A

Thermostat —4.0L (Push Rod)

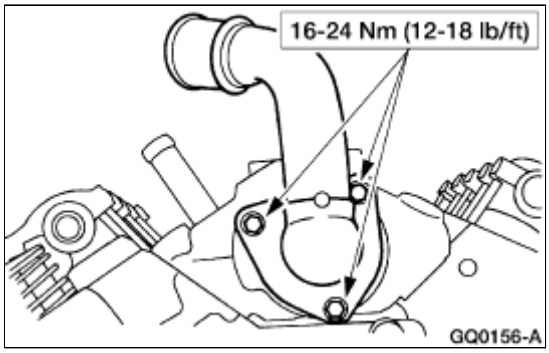
Removal and Installation

1. Drain the cooling system. For additional information, refer to the Cooling System Draining, Filling and Bleeding in this section.

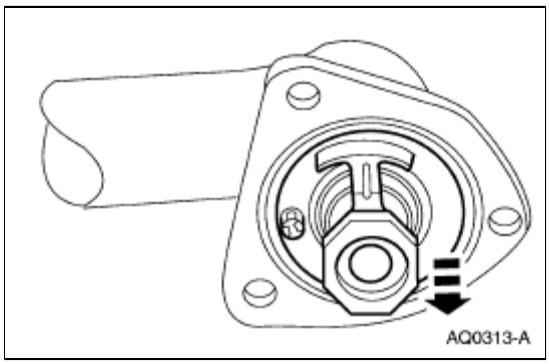
2. Disconnect the upper radiator hose.



3. Remove the thermostat housing.



4. Remove the thermostat and gasket assembly.
   - Clean and inspect the mating surfaces.



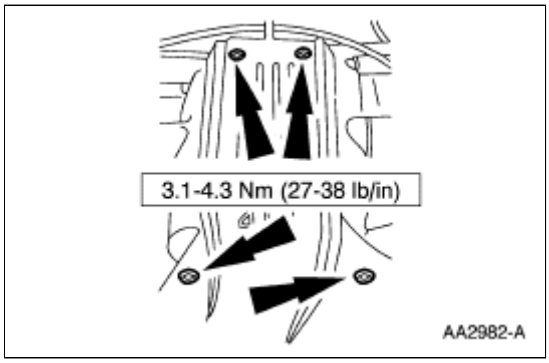
5. To install, reverse the removal procedure.

Thermostat —4.0L SOHC

Removal and Installation

1. Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

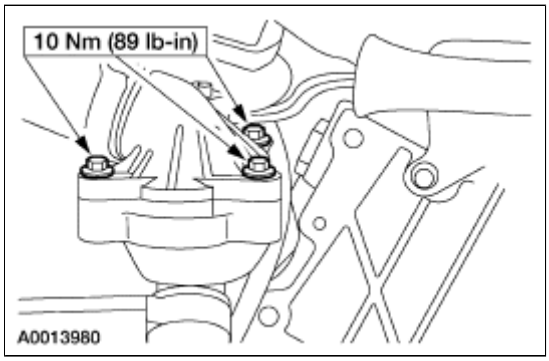
2. Remove the bolts and the accelerator control splash shield.



3. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

4. Remove the upper radiator hose.

5. Remove the bolts, water outlet adapter and thermostat.
   - Inspect the O-ring seal. Install a new O-ring seal if necessary.



6. To install, reverse the removal procedure.

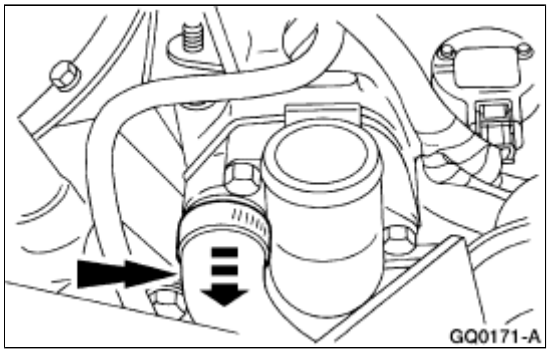
Thermostat —5.0L

Removal

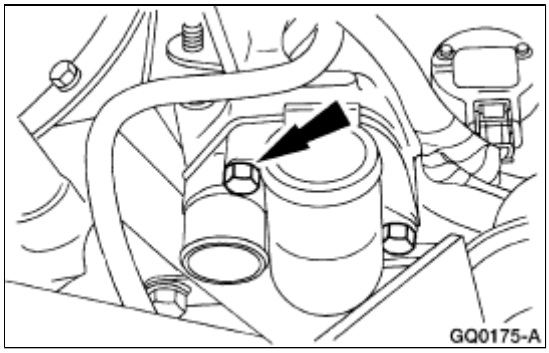
1. Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the upper radiator hose (8260).

3. Position the hose clamp back and remove the water bypass hose from the water hose connection.

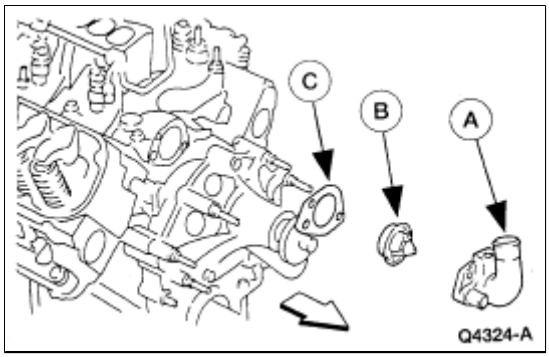


4. Remove the two bolts from the water hose connection (8592).



5. **CAUTION: Do not pry on the water hose connection to remove.**

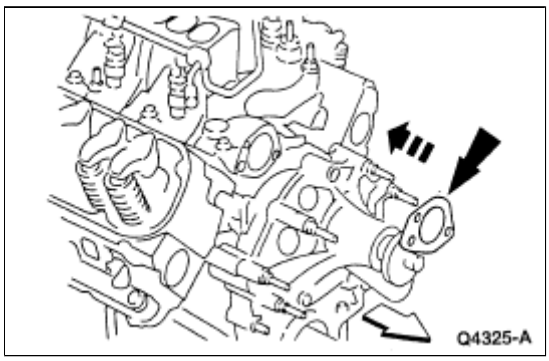
   Remove the (A) water hose connection, the (B) water thermostat (8575) and the (C) thermostat gasket.
   - Clean and inspect the mating surfaces.



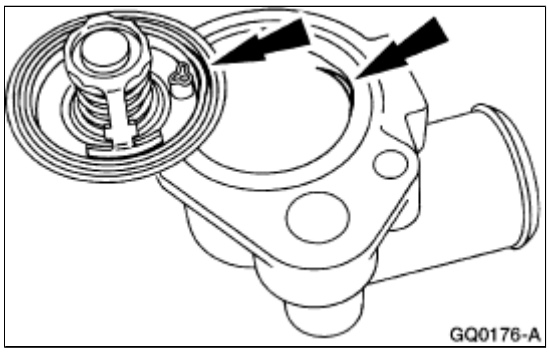
Installation

1. **NOTE:** Coat the new thermostat gasket with Gasket and Trim Adhesive F3AZ-19B508-AA or equivalent prior to installation.

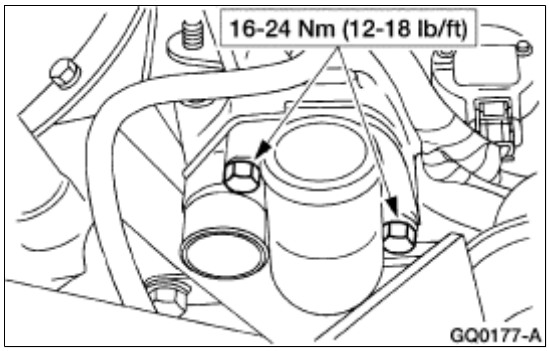
   Install the new thermostat gasket.



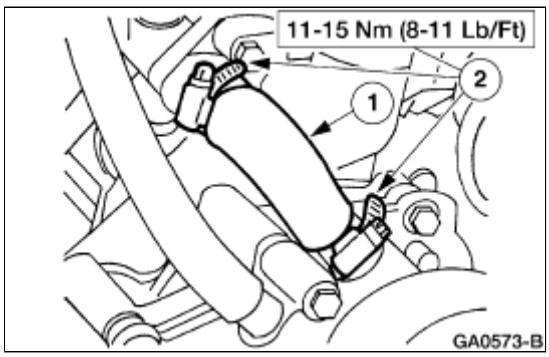
2. Install the water thermostat into the water hose connection.
   - Align the notch in the thermostat with the notch in the water hose connection.



3. Install the water hose connection.



4. Install the water bypass tube (8548).
    1. Position the water bypass tube and hose clamps.
    2. Tighten the hose clamps.



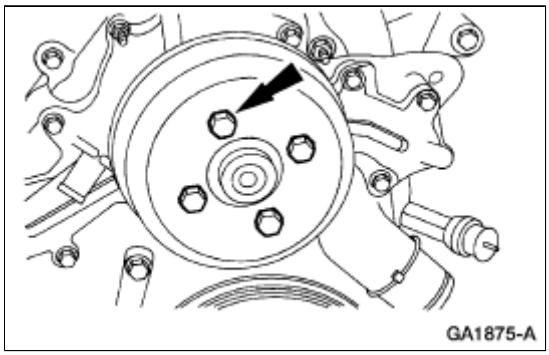
5. Install the upper radiator hose.

6. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

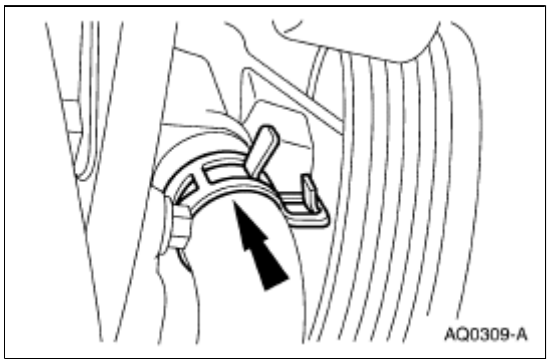
Water Pump —4.0L (Push Rod)

Removal

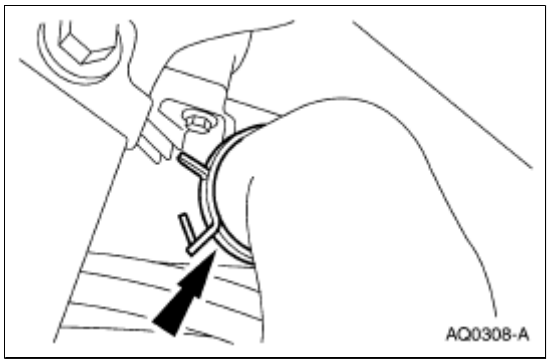
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Remove the fan shroud. For additional information, refer to Shroud—Fan in this section.
3. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
4. Remove the water pump pulley.



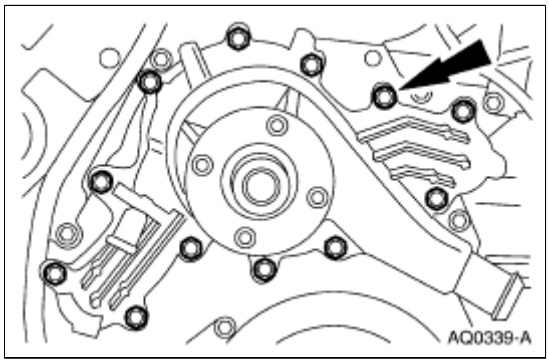
5. Disconnect the heater water hose (18472) at the water pump.



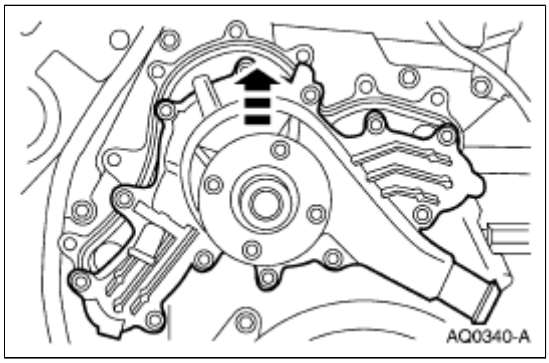
6. Disconnect the lower radiator hose (8286) at the water pump.



7. Remove the bolts.



8. Remove the water pump.

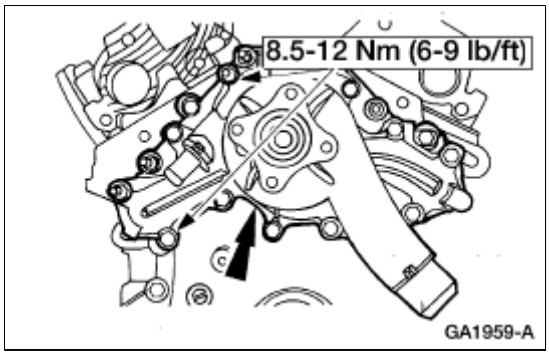


9. **CAUTION: Use care when scraping the water pump-to-engine block mating surfaces. Gouges in the aluminum could form leak paths.**

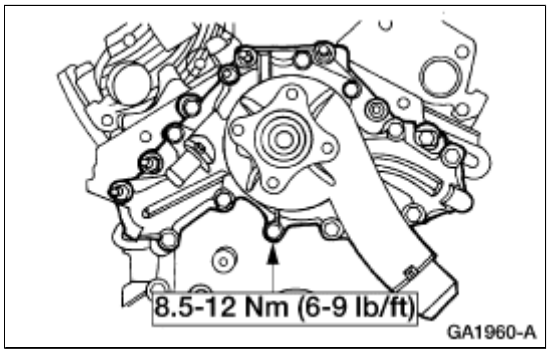
   Clean all the sealing surfaces.

Installation

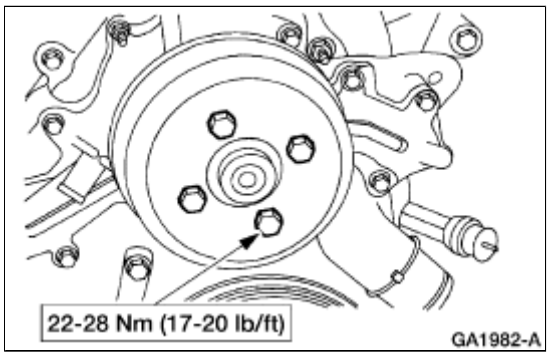
1. Position the water pump and install the two stud bolts.



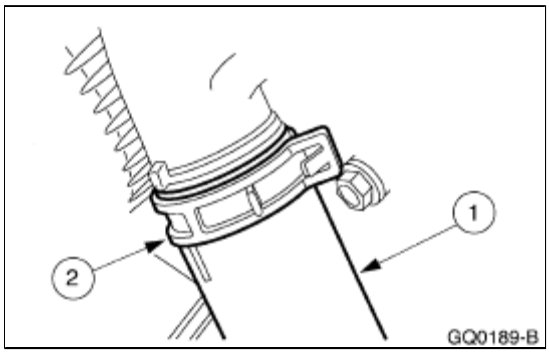
2. Install the water pump bolts.



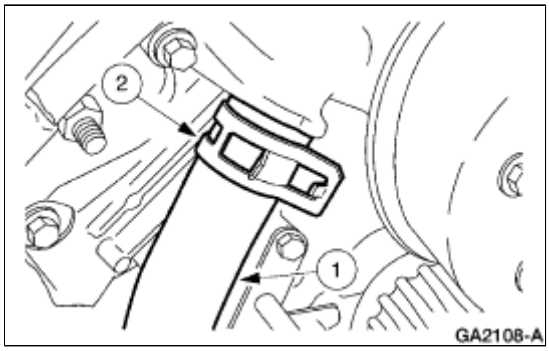
3. Install the water pump pulley.



4. Connect the lower radiator hose to the water pump.
    1. Position the hose.
    2. Install the clamp.



5. Connect the heater hose to the water pump.
    1. Position the hose.
    2. Install the clamp.



6. Install the accessory drive belt. For additional information, refer to Section 303-05 .

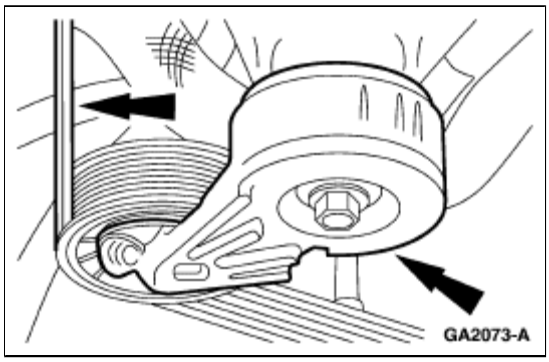
7. Install the fan shroud. For additional information, refer to Shroud—Fan in this section.

8. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

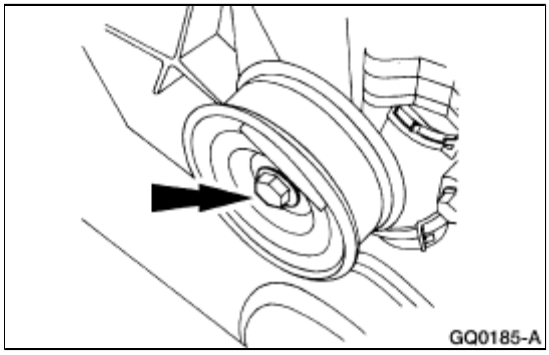
Water Pump —4.0L SOHC

Removal

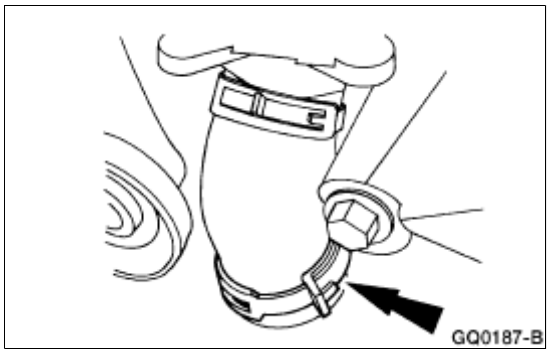
1. Remove the fan shroud. For additional information, refer to Shroud—Fan in this section.
2. Remove the fan and clutch assembly. For additional information, refer to Fan—Blade in this section.
3. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
4. Lift the accessory drive belt tensioner and remove the accessory drive belt.



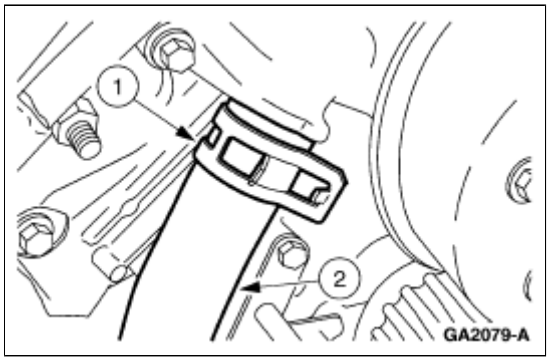
5. Remove the belt idler pulley.



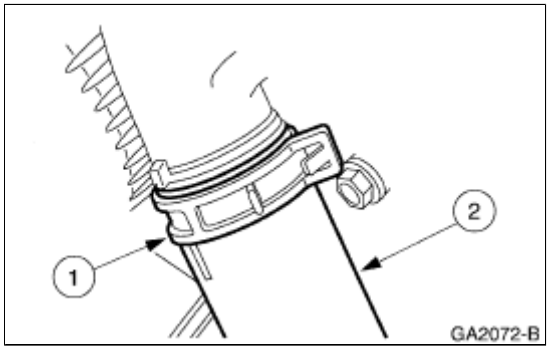
6. Slide the water bypass hose clamp back.



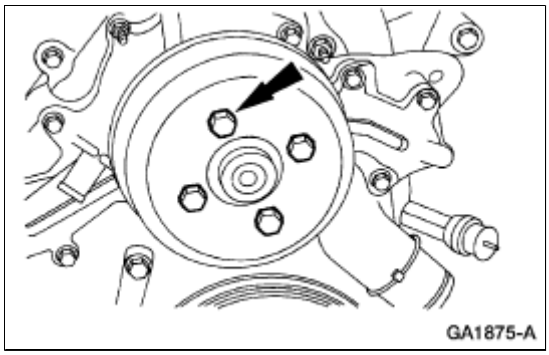
7. Disconnect the heater hose at the water pump.
    1. Release the clamp.
    2. Remove the hose.



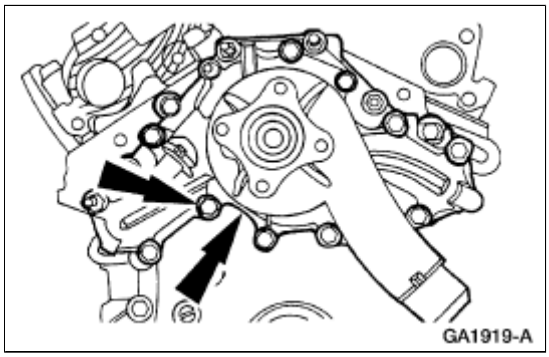
8. Disconnect the lower radiator hose at the water pump.
    1. Release the clamp.
    2. Remove the hose.



9. Remove the water pump pulley.



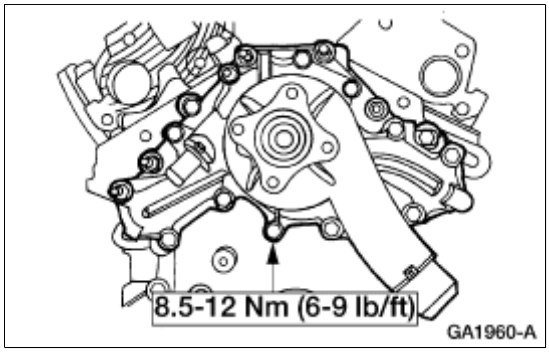
10. Remove the water pump.



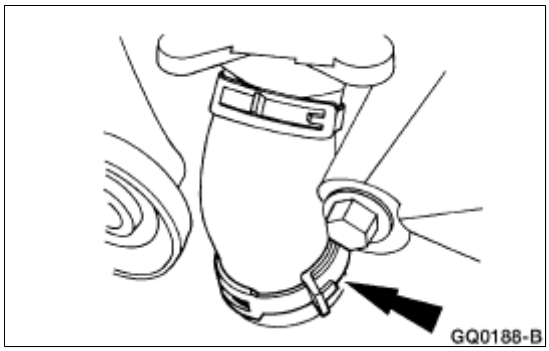
Installation

1. **NOTE:** Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A and a suitable plastic or wooden scraper to clean the sealing surfaces.

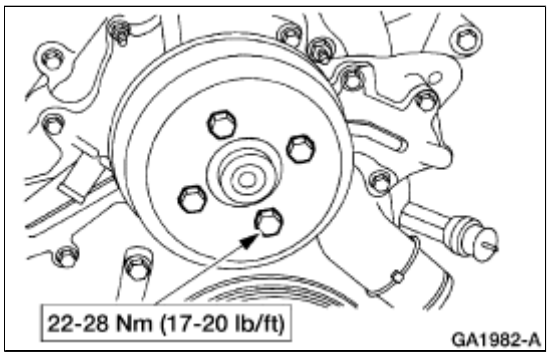
   Install the water pump.



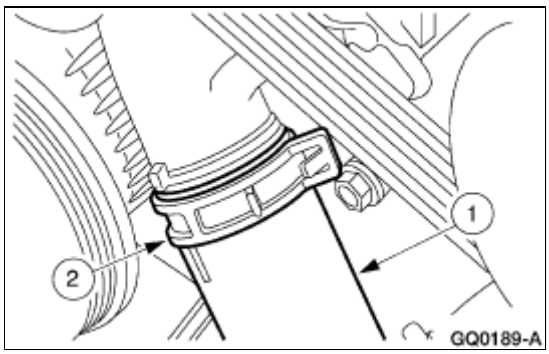
2. Connect the water bypass hose and position the clamp.



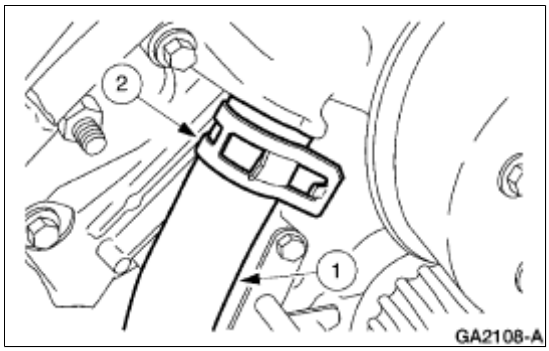
3. Install the water pump pulley.



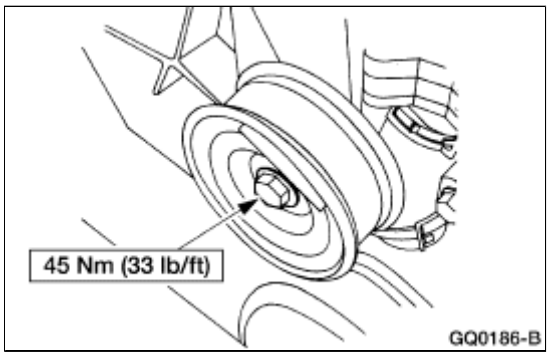
4. Connect the lower radiator hose to the water pump.
    1. Position the hose.
    2. Install the clamp.



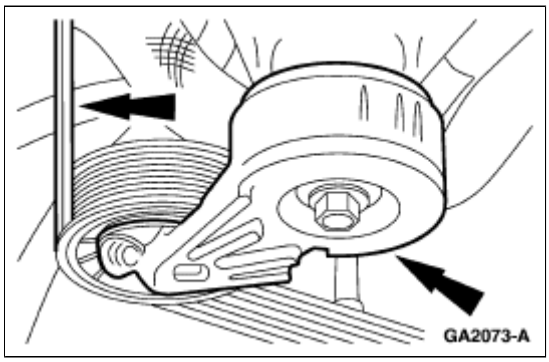
5. Connect the heater hose to the water pump.
    1. Position the hose.
    2. Install the clamp.



6. Install the belt idler pulley.



7. Lift the accessory drive belt tensioner and install the drive belt.



8. Install the fan and clutch assembly. For additional information, refer to Fan—Blade in this section.
9. Install the fan shroud. For additional information, refer to Shroud—Fan in this section.
10. Fill and bleed the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

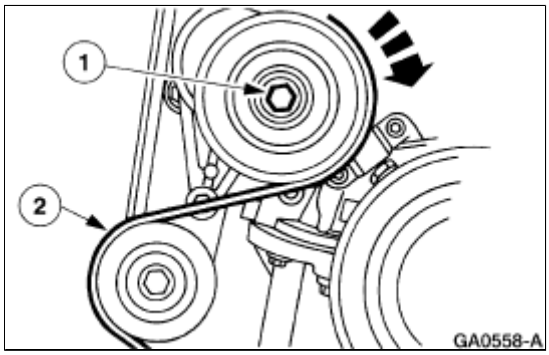
Water Pump —5.0L

Removal

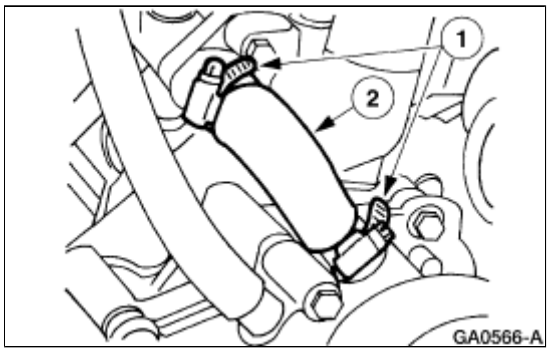
1. Remove the fan shroud. For additional information, refer to Shroud—Fan in this section.

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

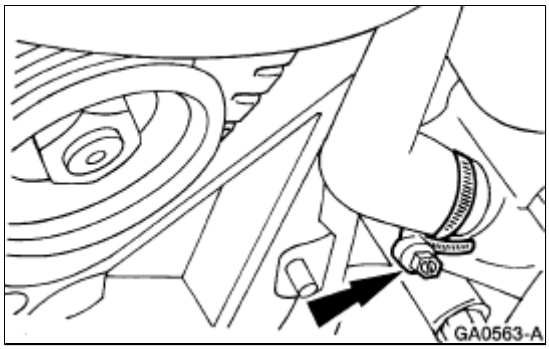
3. Remove the accessory drive belt.
    1. Turn the tensioner pulley clockwise.
    2. Remove the accessory drive belt.



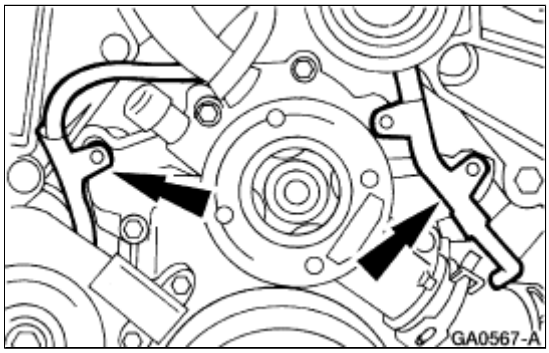
4. Remove the water bypass hose (8597).
    1. Loosen the water bypass hose clamps.
    2. Remove the water bypass tube (8548).



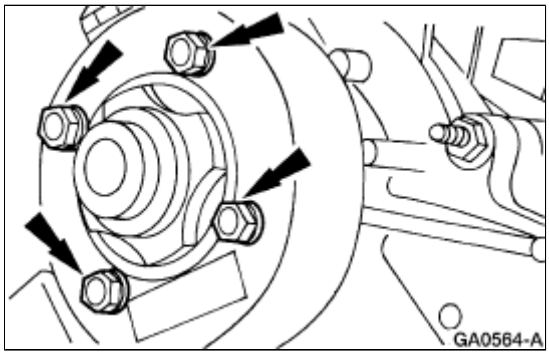
5. Loosen the water heater hose clamp and disconnect the water heater hose from the water pump (8501).



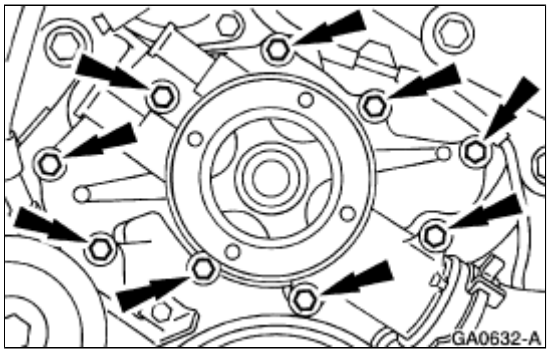
6. Position the engine control sensor wiring aside.



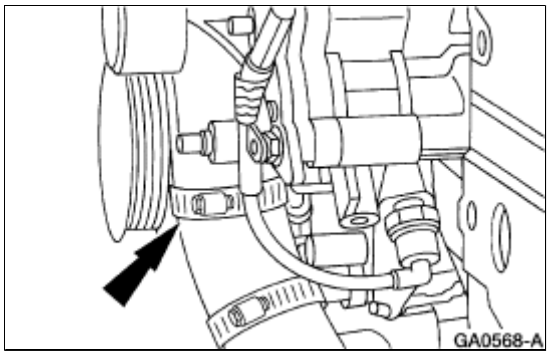
7. Remove the bolts and the water pump pulley.



8. Remove the bolts and remove the water pump from the engine front cover (6019).



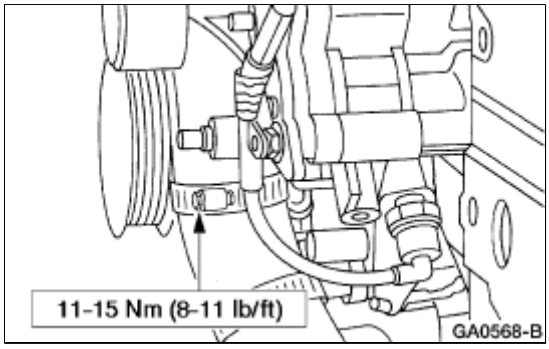
9. Loosen the water pump inlet hose clamp and remove the water pump.



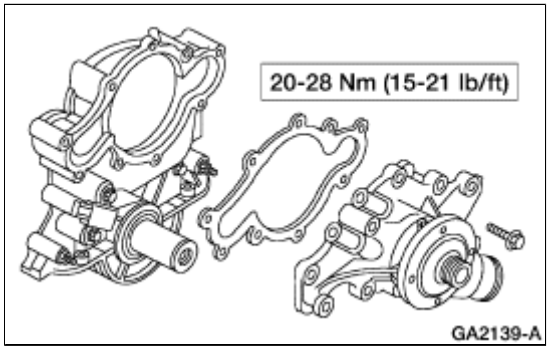
Installation

1. Use Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A and a suitable plastic or wooden scraper to clean the gasket surfaces of the engine front cover and water pump.

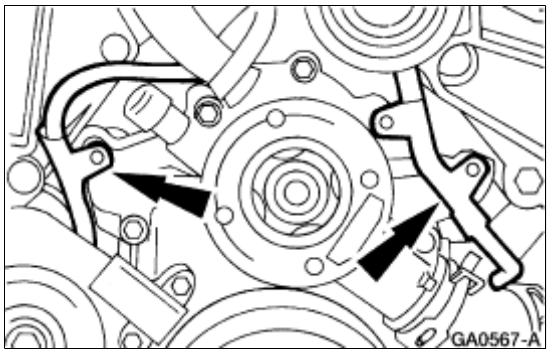
2. Install the water pump inlet hose on the water pump.



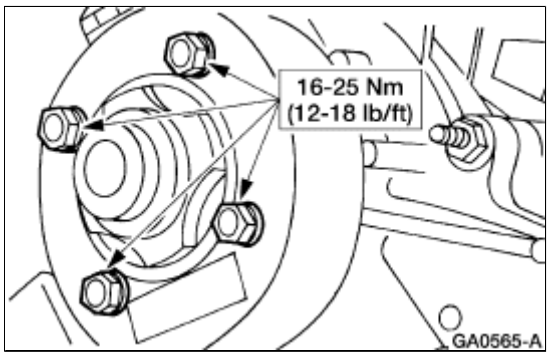
3. Position the water pump and install the bolts.



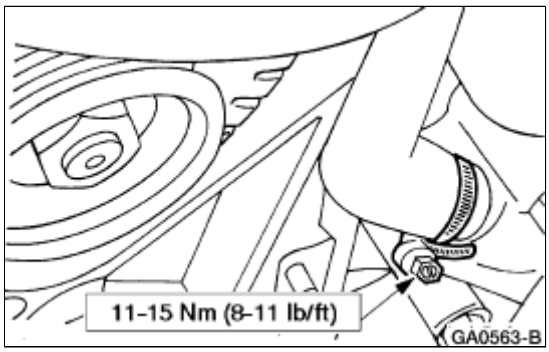
4. Position the engine control sensor wiring.



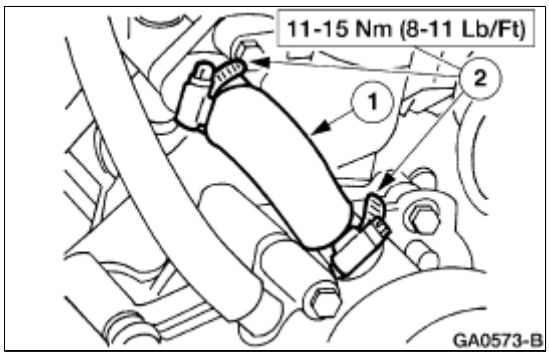
5. Install the water pump pulley.



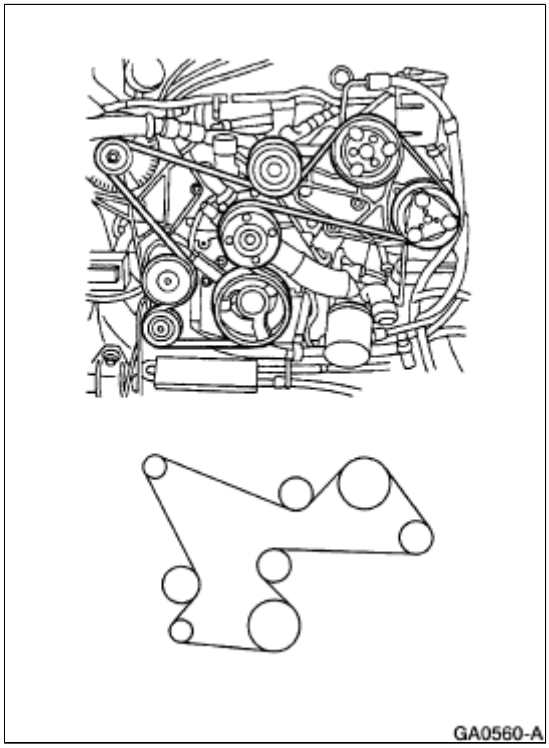
6. Install the water heater hose and clamp.



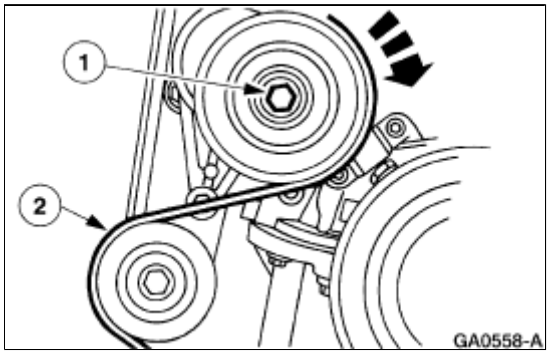
7. Install the water bypass tube.
    1. Position the water bypass tube.
    2. Install the two water bypass hose clamps.



8. Position the accessory drive belt.



9. Install the accessory drive belt.
    1. Turn the tensioner clockwise.
    2. Install the belt.



10. Install the fan shroud. For additional information, refer to Shroud—Fan in this section.

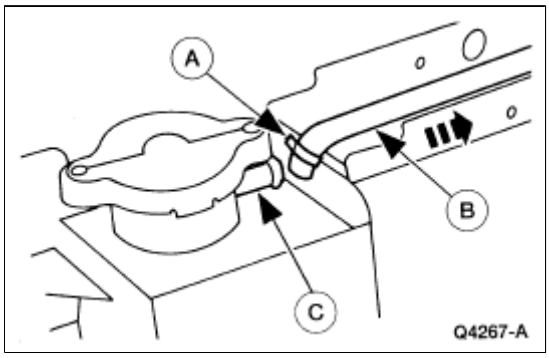
11. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

12. Start the engine and check for leaks.

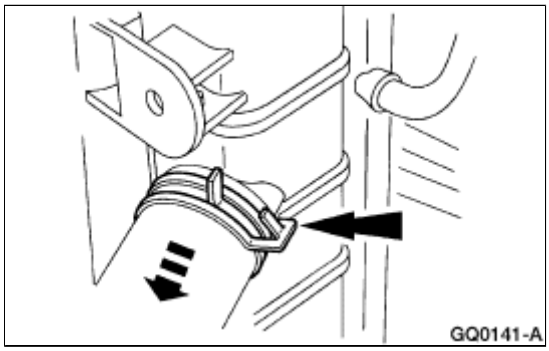
Radiator —4.0L

Removal

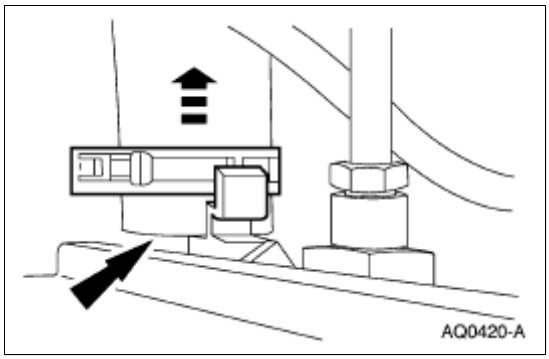
1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Remove the air cleaner outlet tube (9B659). For additional information, refer to Section 303-12 .
3. Position the (A) overflow tube clamp back and disconnect the (B) radiator overflow tube from the (C) radiator filler neck.



4. Remove the fan shroud. For additional information, refer to Shroud—Fan in this section.
5. Position the hose clamp back and disconnect the upper radiator hose from the radiator.

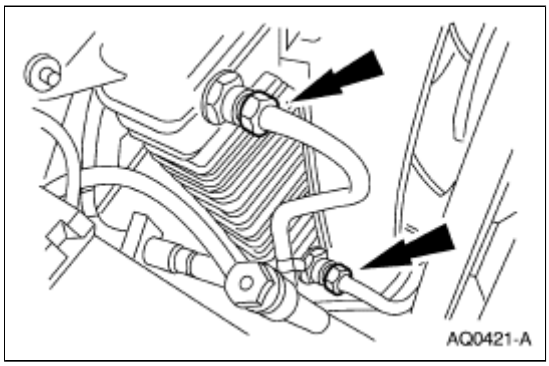


6. Position the hose clamp back and disconnect the lower radiator hose.

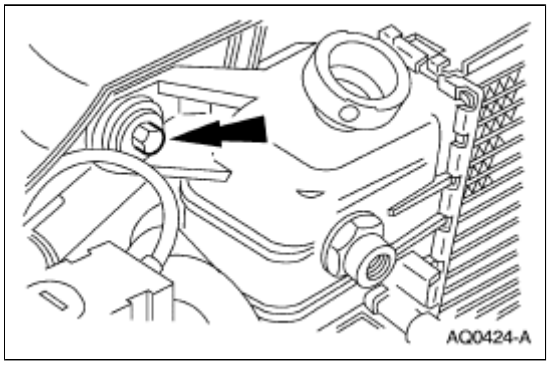


7. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

   Disconnect the two transmission cooling lines, if equipped.



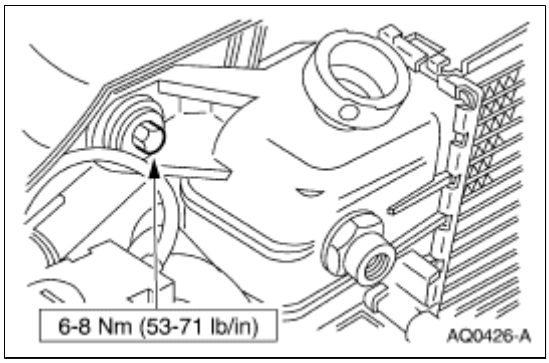
8. Remove the two bolts.



9. Lift the radiator up and remove from the vehicle.

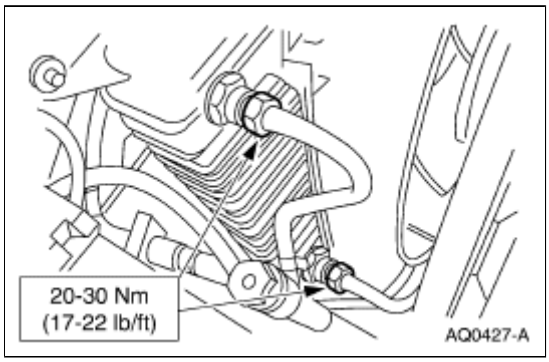
Installation

1. Position the radiator onto the lower radiator support rubber insulators and install the two bolts.

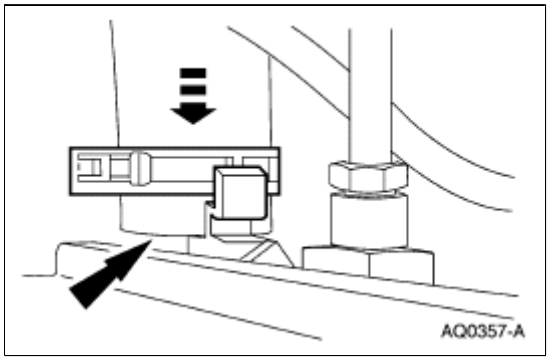


2. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

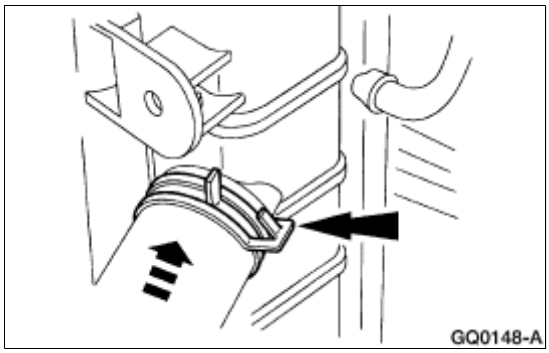
   Connect the transmission cooler lines, if equipped.
   - Make sure the transmission fluid is at the correct level.



3. Position the lower radiator hose and slide the clamp forward.

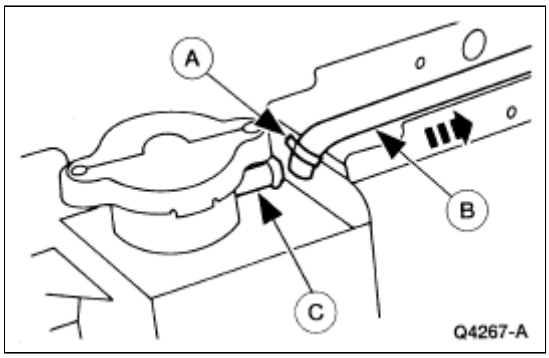


4. Position the upper radiator hose and slide the clamp forward.



5. Install the fan shroud. For additional information, refer to Shroud—Fan in this section.

6. Connect the (B) radiator overflow hose to the (C) radiator filler neck and position the (A) clamp.



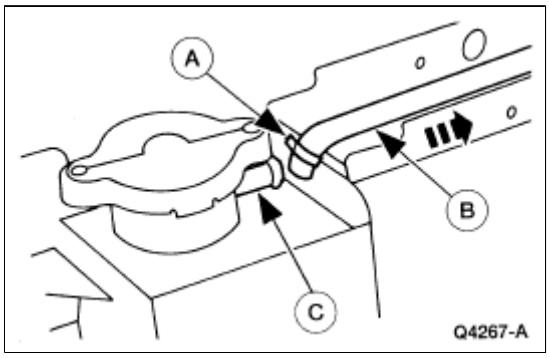
7. Install the engine air cleaner outlet tube. For additional information, refer to Section 303-12 .

8. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

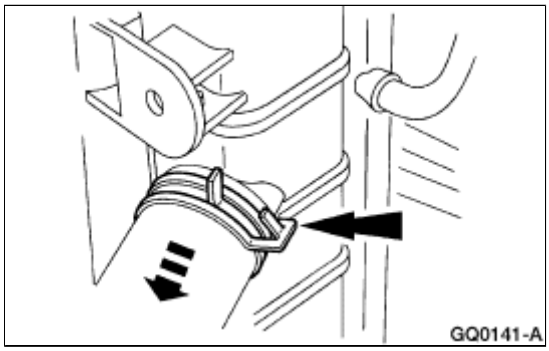
Radiator —5.0L

Removal

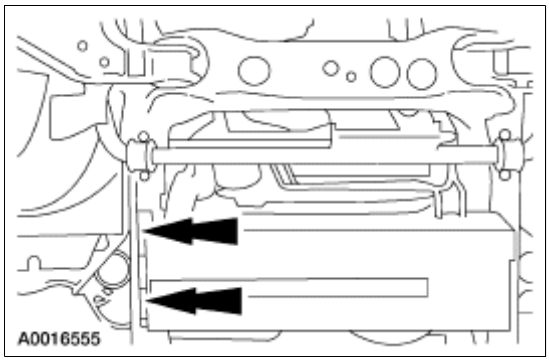
1. Remove the air cleaner outlet tube (9B659). For additional information, refer to Section 303-12 .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Position the (A) overflow tube clamp back and disconnect the (B) radiator overflow tube from the (C) radiator filler neck.



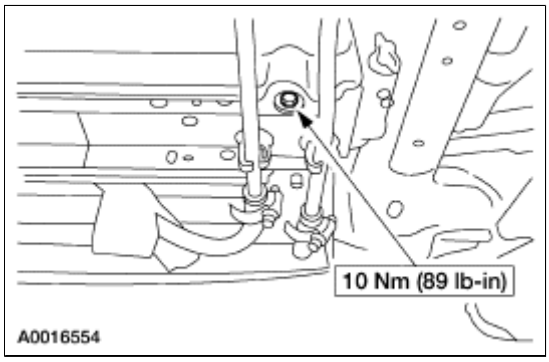
4. Remove the fan shroud. For additional information, refer to Shroud—Fan in this section.
5. Position the hose clamp back and disconnect the upper radiator hose from the radiator.



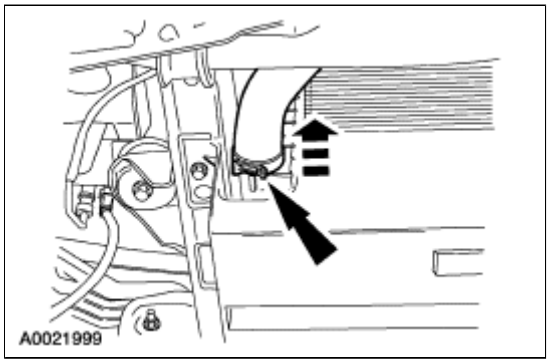
6. Raise and support the vehicle. For additional information, refer to Section 100-02 .
7. Remove the air deflector.



8. Remove the bolt.



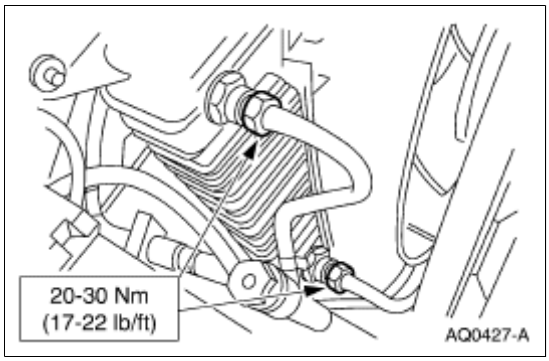
9. Position the hose clamp back and disconnect the lower radiator hose.



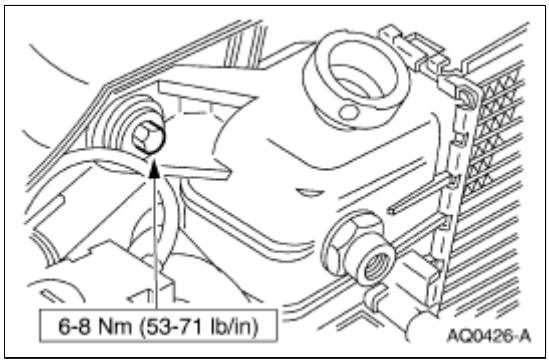
10. Lower the vehicle.

11. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

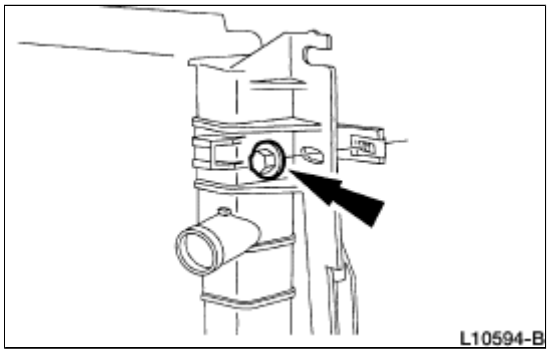
    Disconnect the two transmission cooling lines.



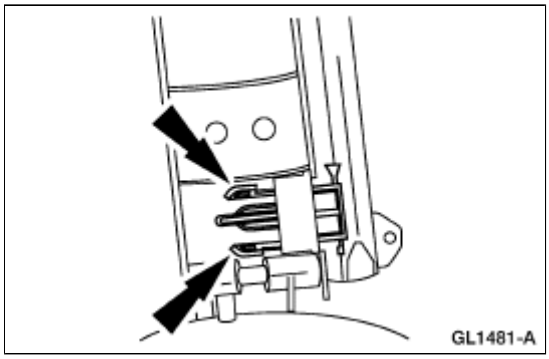
12. Remove the bolts.



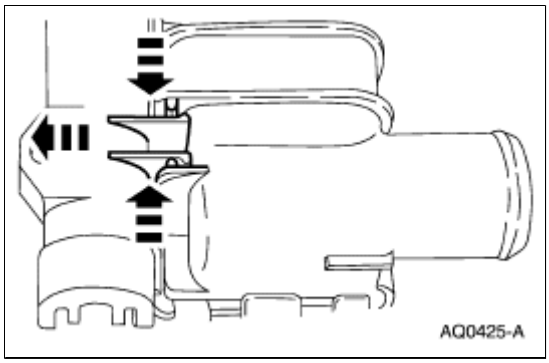
13. Remove the bolt.



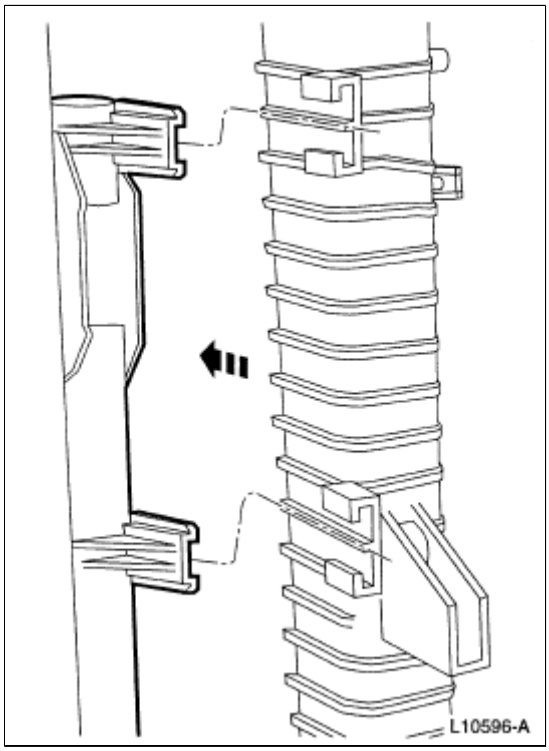
14. Squeeze to release the buckle.



15. Squeeze to release the anti rattle clip.



16. Slide the A/C condenser out of the locators.



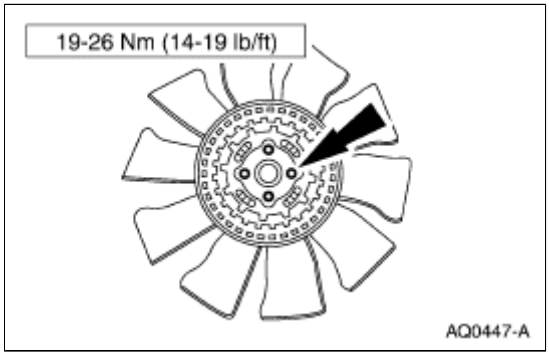
17. Lift the radiator up and remove from the vehicle.

18. To install, reverse the removal procedure.

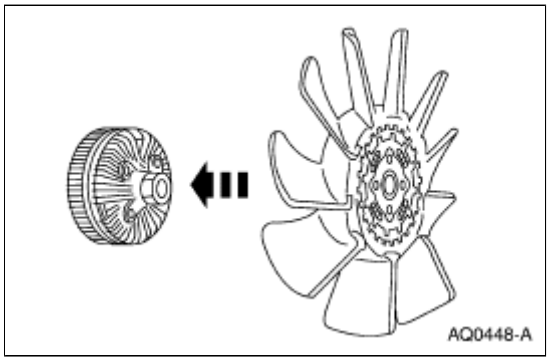
Fan —Blade

Removal and Installation

1. Remove fan shroud. For additional information, refer to Shroud—Fan in this section.
2. Remove the bolts.



3. Separate the fan blade from the fan clutch.



4. To install, reverse the removal procedure.

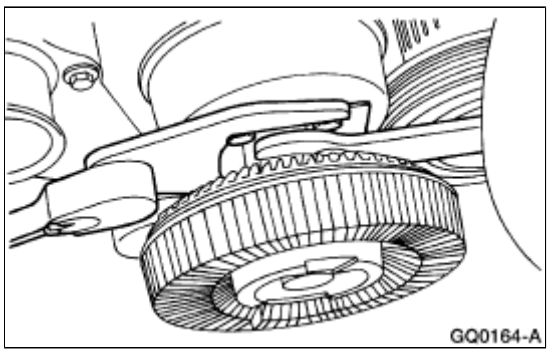
Shroud —Fan

Special Tool(s)

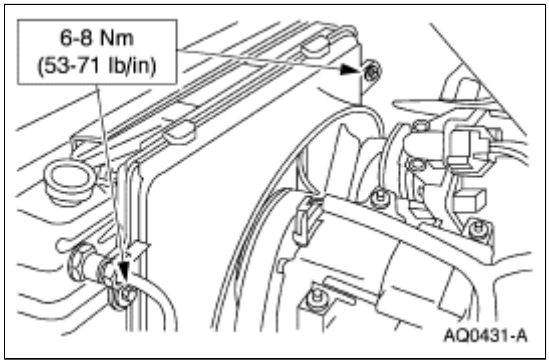
ST1828-A	Fan Pulley Holding Wrench (3.0L, 4.0L) 303-239 (T84T-6312-C)
	Fan Clutch Nut Wrench (3.0L, 4.0L) 303-240 (T84T-6312-D)
ST1128-A	Fan Clutch Wrench (5.0L) 303-558 (T96T-6312-A)
ST1129-A	Fan Hub Wrench (5.0L) 303-559 (T96T-6312-B)

Removal and Installation

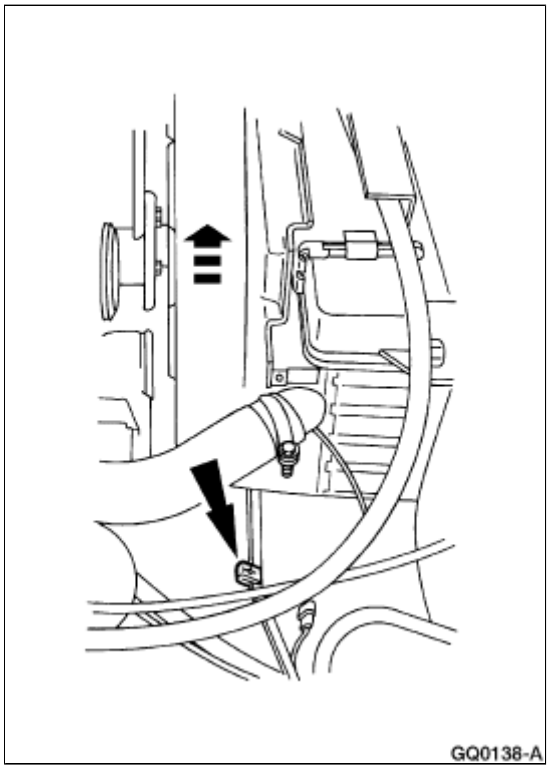
1. Remove the air cleaner outlet tube (9B659). For additional information, refer to Section 303-12 .
2. Use the Fan Clutch Wrench and the Fan Hub Wrench to loosen and remove the fan blade.


GQ0164-A

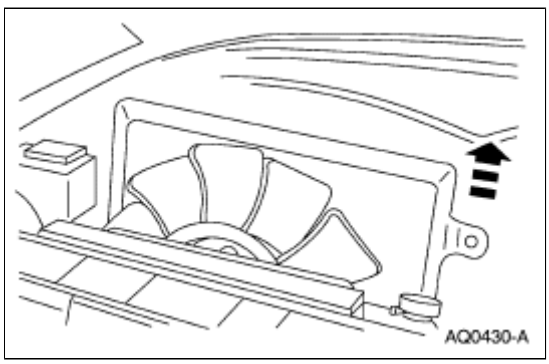
3. Remove the bolts.



4. Lift the fan shroud out of the lower retaining clips.



5. Lift the fan shroud and the fan blade and clutch assembly together and remove from the vehicle.



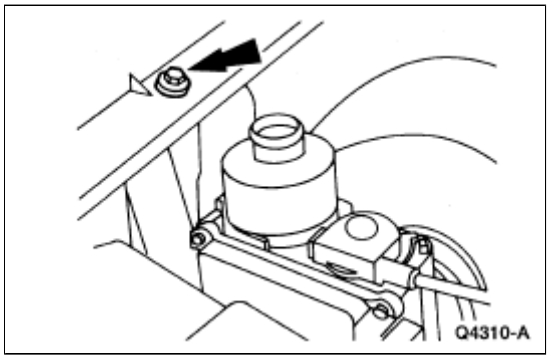
6. To install, reverse the removal procedure.

Coolant Recovery Reservoir

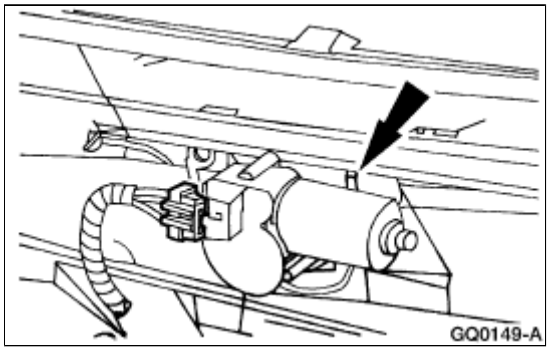
Removal

1. Remove the air cleaner outlet tube (9B659) and the engine air cleaner (ACL) (9600). For additional information, refer to Section 303-12 .

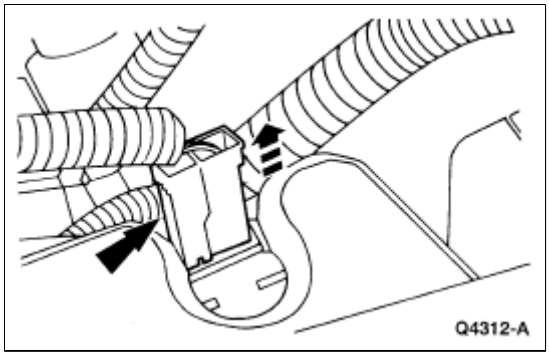
2. Remove the bolt and position the speed control servo aside.



3. Disconnect the windshield washer hose from under the dash panel and plug the end of the hose.

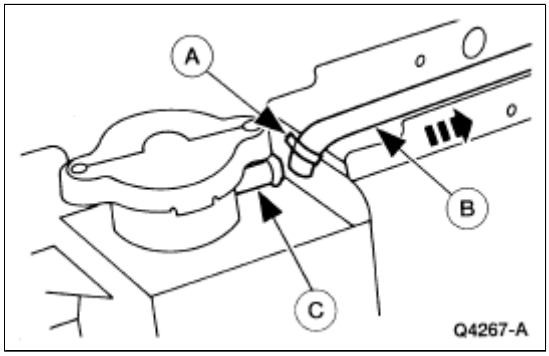


4. Disconnect the windshield washer pump electrical connector from the windshield washer reservoir (17618).

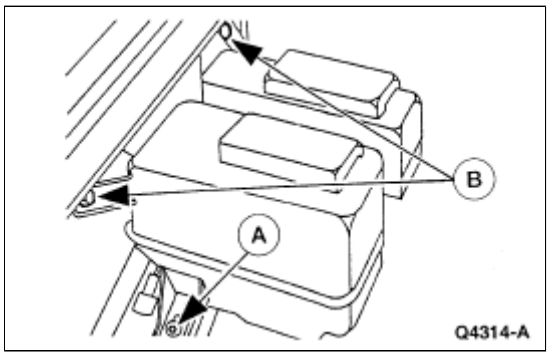


5. Position the (A) clamp back and disconnect the (B) radiator overflow hose (8075) from the (C)

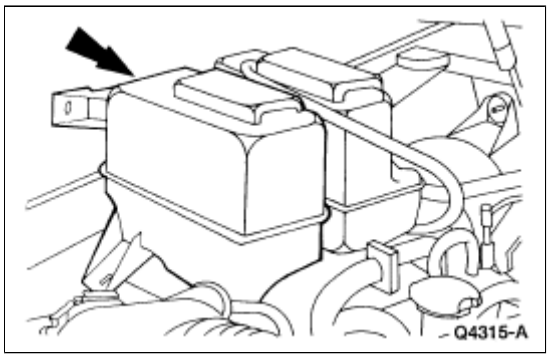
radiator filler neck and plug the hose.



6. Remove the (A) two nuts and the (B) bolts.

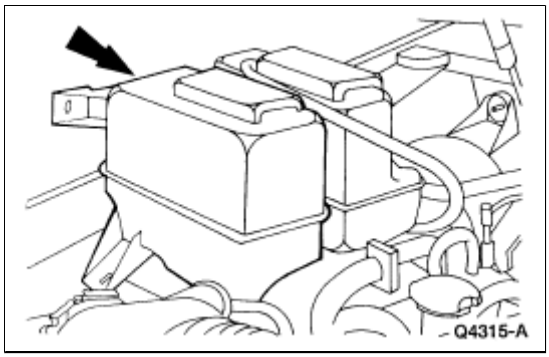


7. Remove the radiator coolant recovery reservoir (8A080) and the windshield washer reservoir.

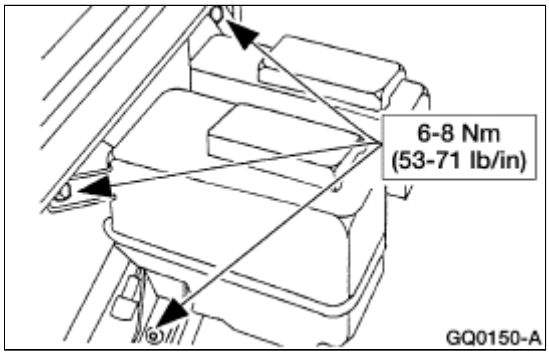


Installation

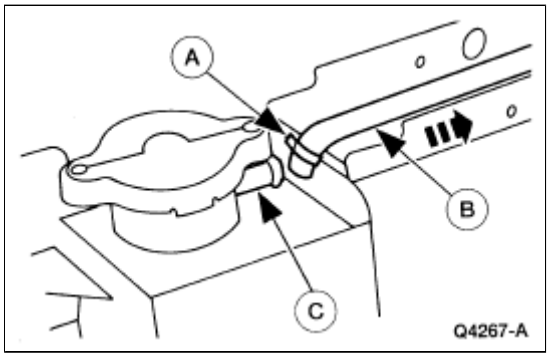
1. Install the radiator coolant recovery reservoir and the windshield washer reservoir.



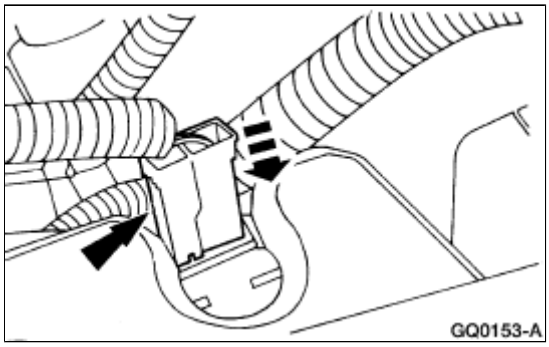
2. Install the bolts and the two nuts.



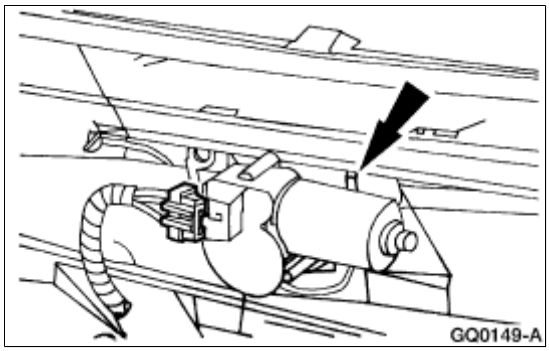
3. Connect the (B) radiator overflow hose to the (C) radiator filler neck and position the (A) clamp.



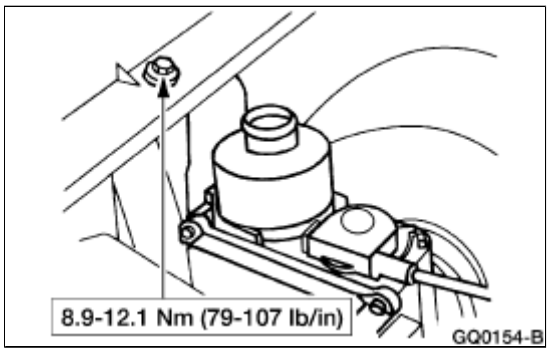
4. Connect the windshield washer pump electrical connector to the windshield washer reservoir.



5. Connect the windshield washer hose under the dash panel.



6. Position the speed control servo and bracket and install the bolt.



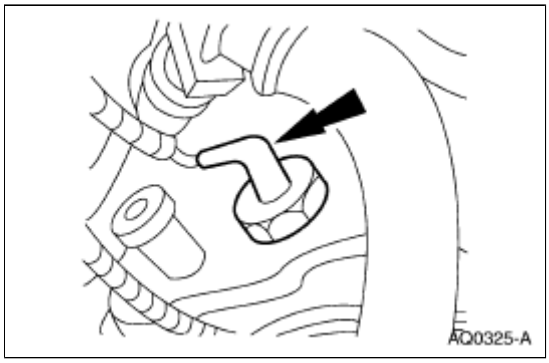
7. Install the engine air cleaner (ACL) and the air cleaner outlet tube. For additional information, refer to Section 303-12 .

8. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

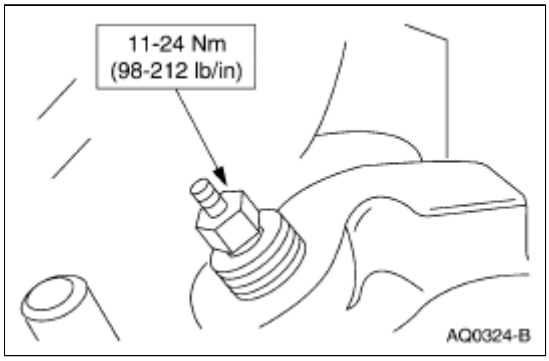
Sender Unit —Water Temperature Indicator, 4.0L (Push Rod), 5.0L

Removal and Installation

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Disconnect the water temperature sending wire.



4. Remove the water temperature indicator sender unit (10884).

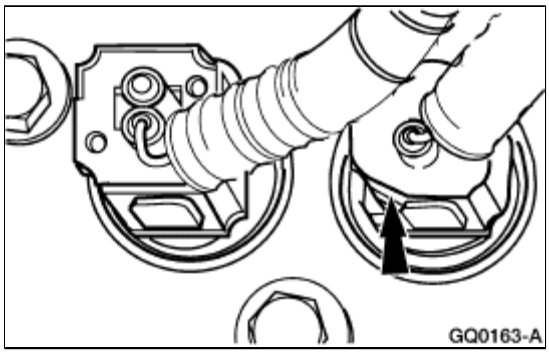


5. To install, reverse the removal procedure.

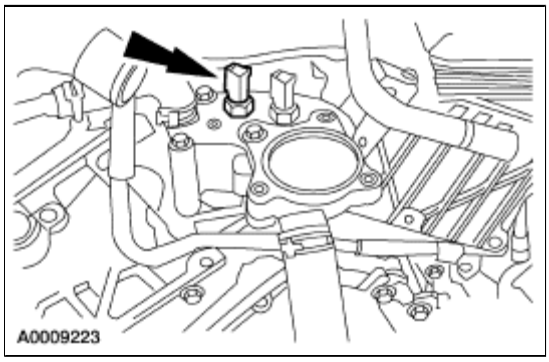
Sender Unit —Water Temperature Indicator, 4.0L SOHC

Removal and Installation

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Remove the upper intake manifold; refer to Section 303-01B .
4. Disconnect the electrical connector.



5. Remove the water temperature indicator sending unit.



6. To install, reverse the removal procedure.

General Specifications

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP	Ford specification WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel damper bolts	9	—	80
Fuel line to damper	20	15	—
Fuel supply manifold stud bolts	15	11	—
Throttle body bolts	10	—	89
Engine bulkhead connector bolt	6	—	53
PCM connector bolt	6	—	53

Fuel Charging and Controls

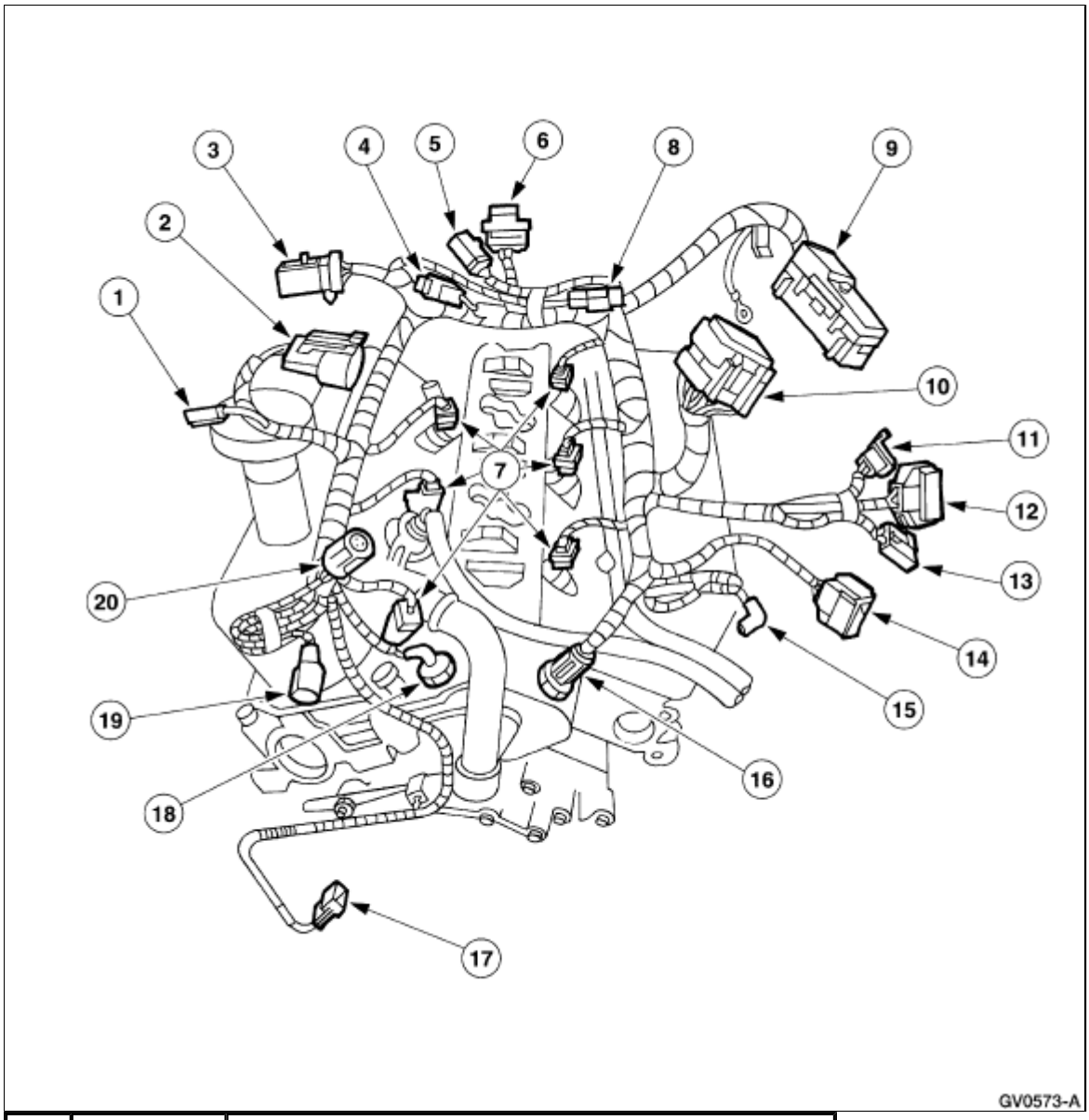
The fuel charging and controls system consists of the:

- throttle body.
- fuel injectors.
- fuel charging wiring.
- fuel injection supply manifold.
- fuel damper.
- fuel pressure relief valve.

The fuel charging and controls system is:

- a sequential, multiport fuel injection (SFI) system.
- pulse-width modulated.
- mass air flow controlled.

Fuel Charging Wiring Harness



Item	Part Number	Description
1	—	Radio ignition interference capacitor electrical connector
2	—	Ignition coil electrical connector
3	—	LH transmission harness electrical connector
4	—	RH heated oxygen (HO2S) sensor electrical connector
5	—	RH transmission harness electrical connector
6	—	Camshaft position (CMP) sensor electrical connector
7	—	Fuel injector electrical connectors.
8	—	LH HO2S electrical connector
9	—	Powertrain control module (PCM) electrical connector
10	—	Engine bulkhead electrical connector

11	—	Idle air control (IAC) solenoid electrical connector
12	—	EGR pressure transducer electrical connector
13	—	EGR vacuum regulator (EVR) electrical connector
14	—	Throttle position (TP) sensor electrical connector
15	—	Oil pressure sending unit electrical connector
16	—	Engine coolant temperature (ECT) sensor electrical connector
17	—	Crankshaft position (CKP) sensor electrical connector
18	—	Water temperature indicator sender electrical connector
19	—	Manifold absolute pressure (MAP) sensor electrical connector
20	—	Intake air temperature (IAT) sensor electrical connector

The fuel injection supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.

The throttle body:

- controls air supply to the upper intake manifold by positioning the throttle plate.
- connects the accelerator cable and, if equipped, the speed control actuator cable to the throttle lever.

The fuel injectors:

- are electrically operated by the powertrain control module (PCM).
- atomize the fuel as the fuel is delivered.
- are deposit-resistant.
- each have an internal solenoid which opens to inject fuel into the lower intake manifold .

The fuel pressure relief valve is used to inspect and relieve fuel pressure.

The fuel pulse damper:

- reduces fluctuation of fuel pressure during injector operation.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

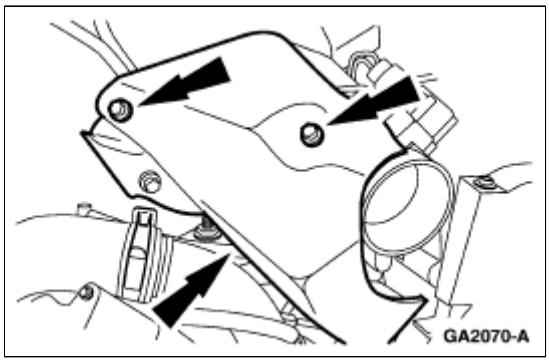
Throttle Body

Removal and Installation

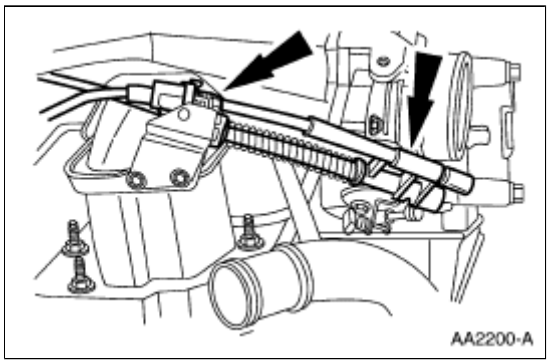
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

CAUTION: The throttle body bore and plate area have a special coating and cannot be cleaned.

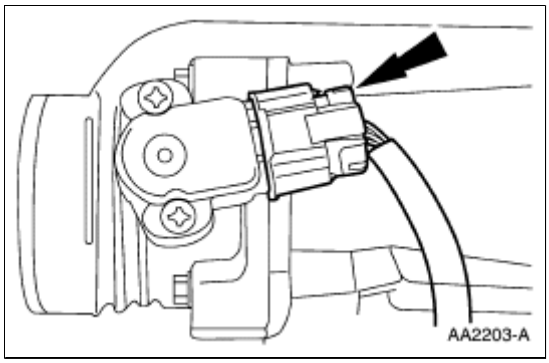
1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Remove the accelerator cable snow shield.



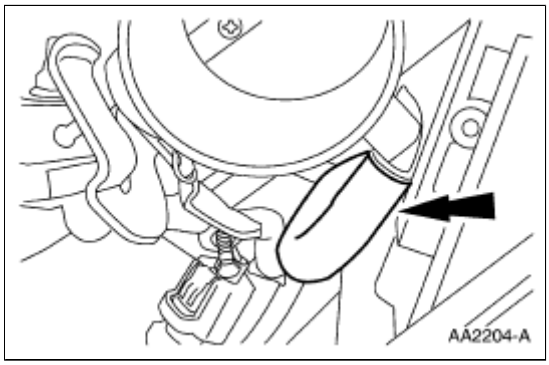
3. Disconnect the accelerator control actuator cable and the speed control actuator cables (if equipped).



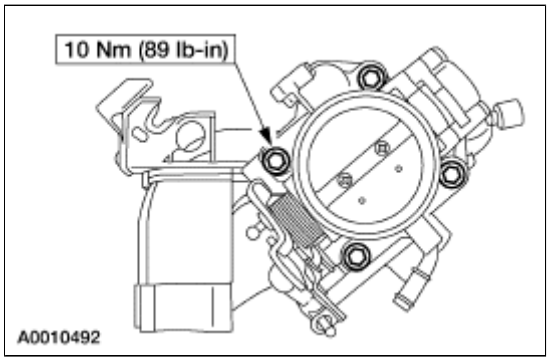
4. Disconnect the throttle position (TP) sensor electrical connector.



5. Disconnect the canister purge line.



6. Remove the throttle body.



7. Inspect and install a new throttle body gasket if necessary.

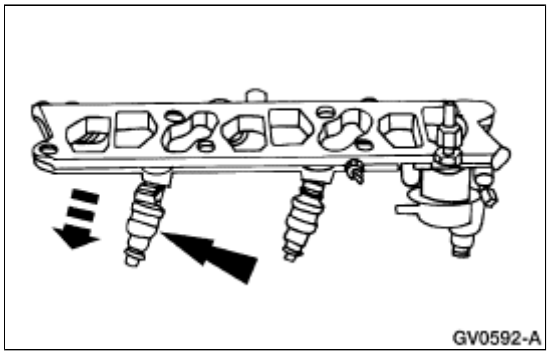
8. To install, reverse the removal procedure.

Fuel Injectors

Removal and Installation

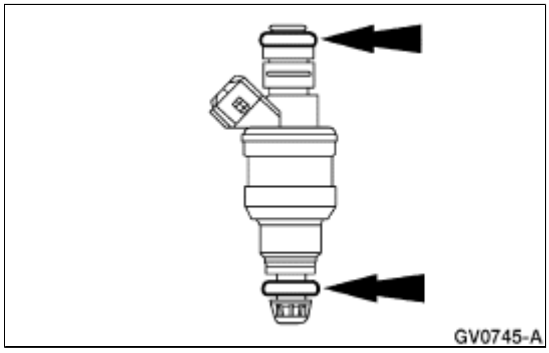
1. Remove the fuel injection supply manifold. For additional information, refer to Supply Manifold—Fuel Injection in this section.

2. Remove the six fuel injectors.



3. **NOTE:** Lubricate new O-ring seals with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G, to aid installation.

   Inspect and install new O-ring seals if necessary.



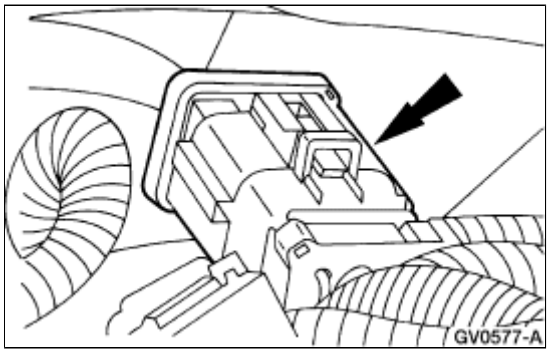
4. To install, reverse the removal procedure.

Wiring Harness

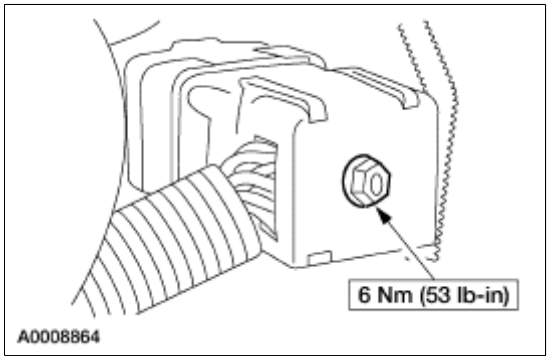
Removal and Installation

1. Remove the upper intake manifold. For additional information, refer to Section 303-01A .
2. **NOTE:** Automatic transmissons have two harness connections, manual transmissions have only one.

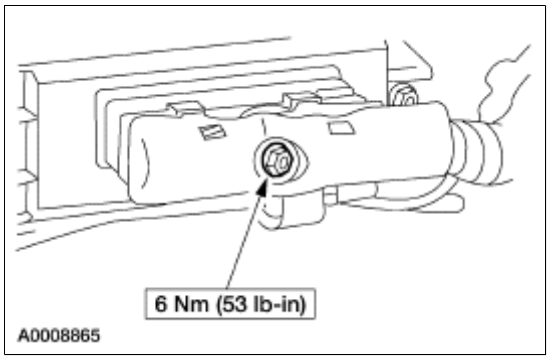
   Disconnect the two transmission harness electrical connectors.



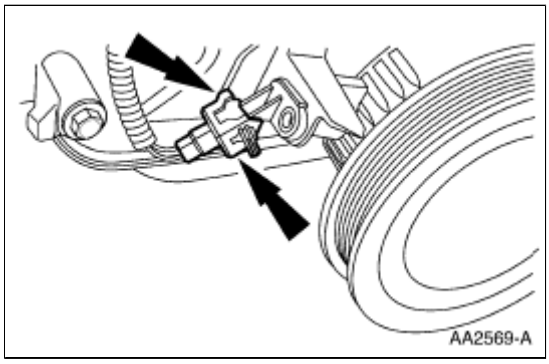
3. Disconnect the two heated oxygen (HO2S) sensor electrical connectors.
4. Disconnect the engine bulkhead connector.



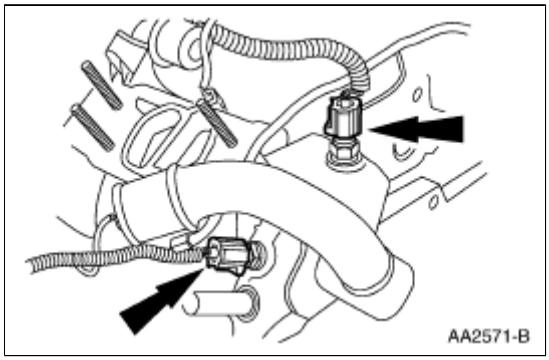
5. Disconnect the PCM electrical connector.



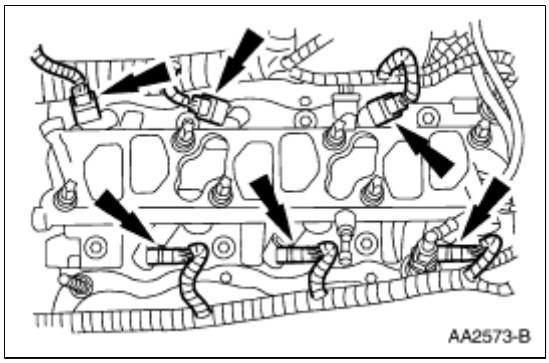
6. Disconnect the crankshaft position (CKP) sensor electrical connector.



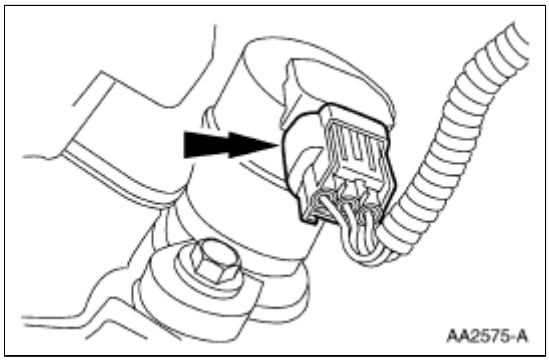
7. Disconnect the electrical connectors:
   - Engine coolant temperature (ECT) sensor
   - Water temperature indicator sender unit



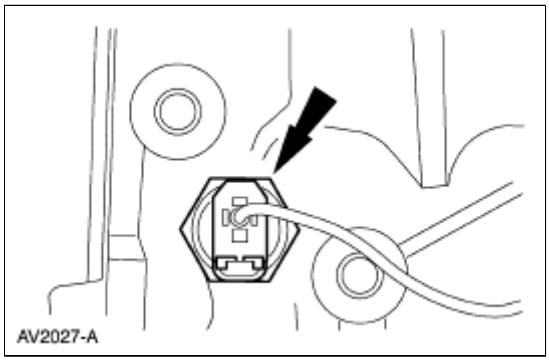
8. Disconnect the fuel injector electrical connectors.



9. Disconnect the camshaft position (CMP) sensor electrical connector.



10. Disconnect the engine oil pressure sensor electrical connector.



11. Remove the wiring harness.

12. To install, reverse the removal procedure.

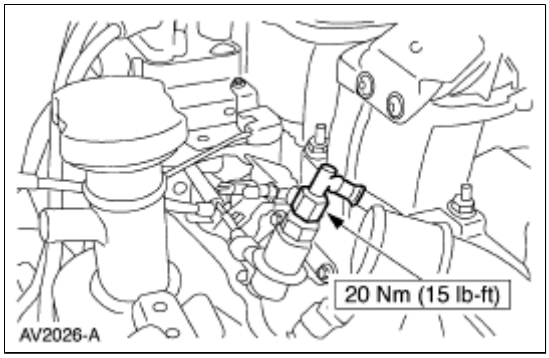
Fuel Pulse Damper

Removal and Installation

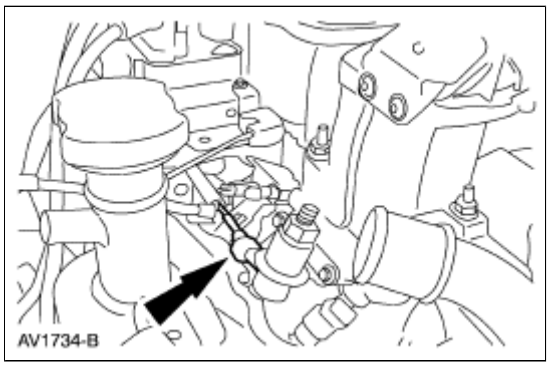
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

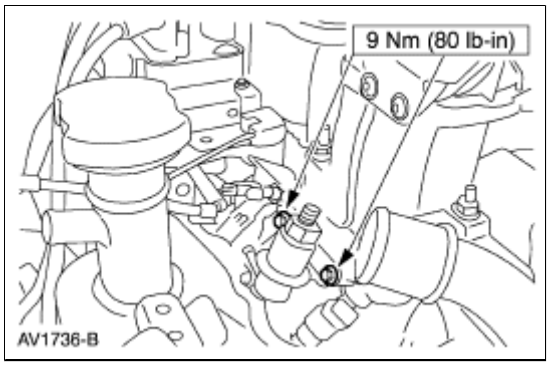
1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Disconnect the fuel supply line.



3. Disconnect the vacuum line.



4. Remove the fuel pulse damper and discard the O-ring seal.



5. **NOTE:** Lubricate the O-ring seal with Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

   To install, reverse the removal procedure.

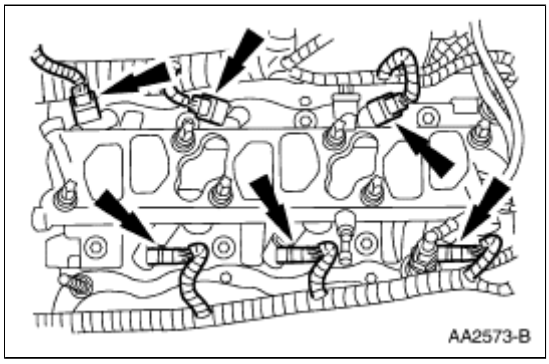
Supply Manifold —Fuel Injection

Removal and Installation

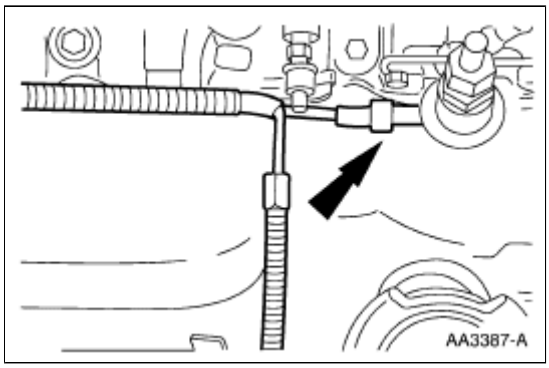
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the upper intake manifold. For additional information, refer to Section 303-01A .
3. Disconnect the fuel injector electrical connectors.

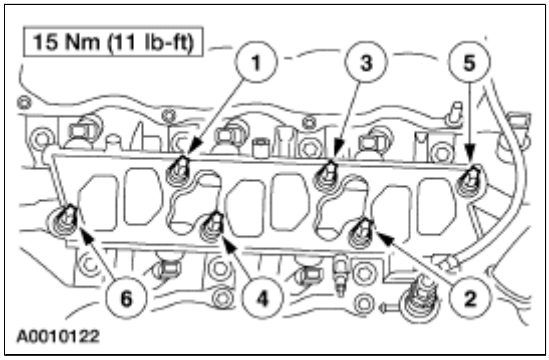


4. Disconnect the fuel damper vacuum line.



5. Disconnect the fuel line. For additional information, refer to Section 310-00 .

6. Remove the fuel injection supply manifold.



7. Remove and discard the fuel injection supply manifold gasket.

8. To install, reverse the removal procedure.

General Specifications

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel injection supply manifold bolts	25	18	—
Fuel pressure relief valve bolts	10	—	89
Throttle body bolts	7	—	62
Engine bulkhead connector	6	—	53
PCM connector	6	—	53
Fuel supply line support bracket bolt	10	—	89
Fuel pulse damper bolts	10	—	89

Fuel Charging And Controls

The fuel charging and control system consists of the:

- throttle body
- fuel injectors
- fuel charging wiring
- fuel injection supply manifold
- fuel pulse damper
- fuel pressure relief valve

The fuel charging and controls system is:

- a sequential, multiport fuel injection (SFI) system.
- pulse-width modulated.
- mass air flow controlled.

The fuel injection supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.

The throttle body:

- controls air supply to the upper intake manifold by positioning the throttle plate.
- connects the accelerator cable and, if equipped, the speed control actuator cable to the throttle plate.

The fuel injectors:

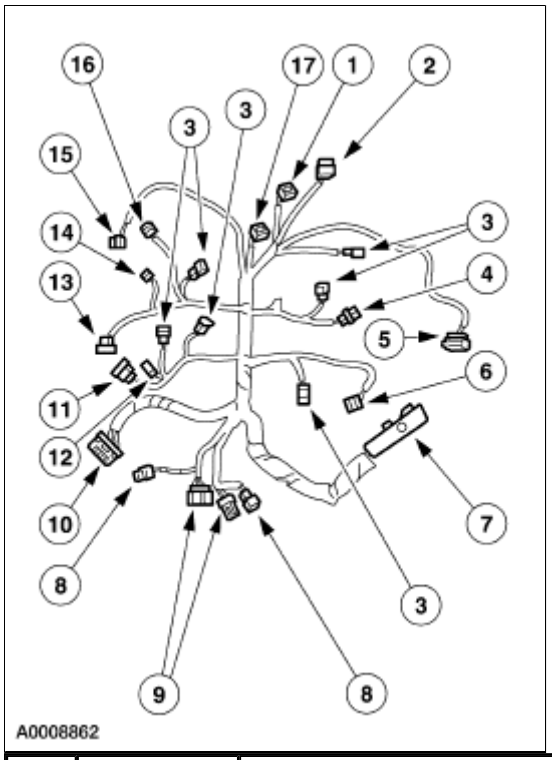
- are electrically operated by the powertrain control module (PCM).
- atomize the fuel as the fuel is delivered.
- are deposit-resistant and self-cleaning.
- each have an internal solenoid which opens a needle valve to inject fuel into the lower intake manifold.

The fuel pressure relief valve is used to monitor and relieve fuel pressure.

The fuel pulse damper:

- reduces fluctuation of the fuel pressure during injector operation.

Fuel Charging Wiring Harness



Item	Part Number	Description
1	—	Engine coolant temperature (ECT) sensor electrical connector
2	—	Throttle position (TP) sensor electrical connector
3	—	Fuel injector electrical connectors
4	—	Knock sensor (KS) electrical connector
5	—	Mass air flow (MAF) sensor electrical connector
6	—	EGR vacuum regulator (EVR) electrical connector
7	—	Powertrain control module (PCM) electrical connector
8	—	Heated oxygen sensor (HO2S) electrical connector
9	—	Transmission harness electrical connectors
10	—	Engine bulkhead electrical connector
11	—	Ignition coil electrical connector
12	—	Radio ignition interference capacitor electrical connector
13	—	Differential pressure feedback EGR transducer electrical connector
14	—	Camshaft position (CMP) sensor electrical connector
15	—	Crankshaft position (CKP) sensor electrical connector
16	—	Idle air control (IAC) electrical connector
17	—	Water temperature indicator sender unit electrical connector

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

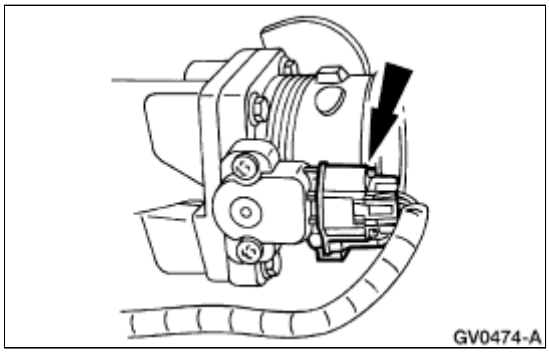
Throttle Body

Removal and Installation

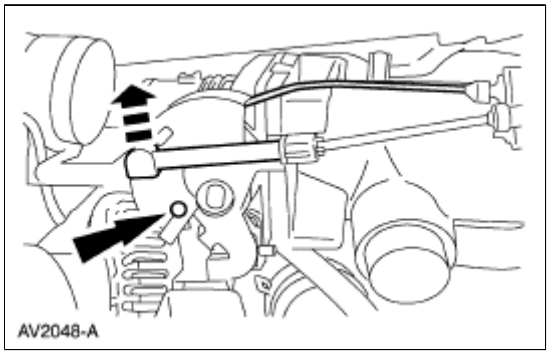
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

CAUTION: Throttle body bore and plate area have a special coating and cannot be cleaned, or possible damage to the throttle body may occur.

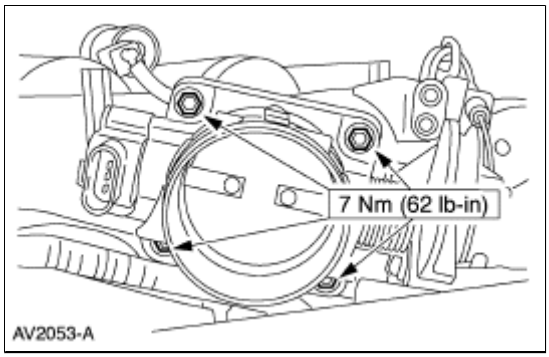
1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Disconnect the throttle position (TP) sensor electrical connector.



3. Disconnect the accelerator cable and the speed control cable (if equipped).



4. Remove the throttle body.
   - Discard the gasket.



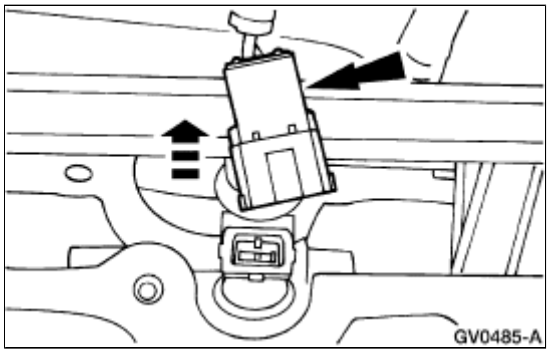
5. To install, reverse the removal procedure.

Wiring Harness

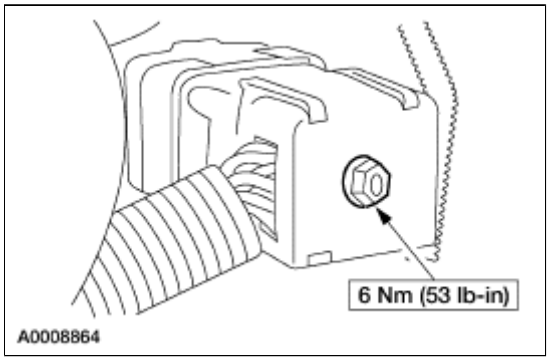
Removal and Installation

1. Remove the lower intake manifold. For additional information, refer to Section 303-01B .
2. **NOTE:** One connector is shown, the other five are similar.

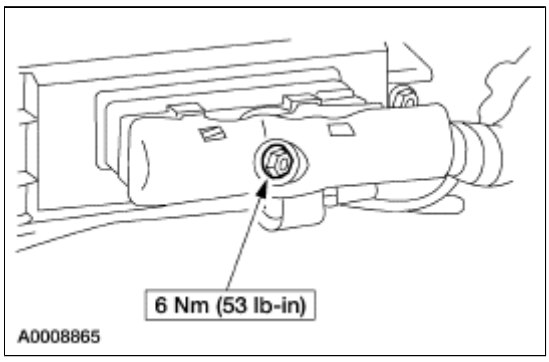
   Disconnect the six fuel injector electrical connectors.



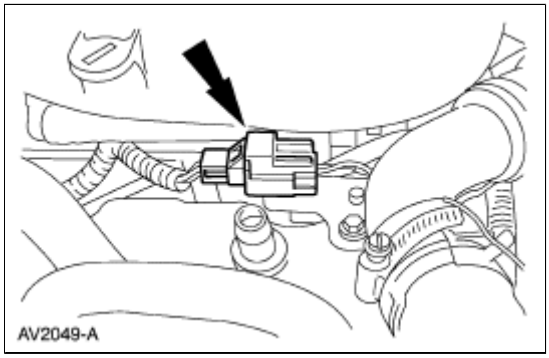
3. Disconnect the engine bulkhead electrical connector.



4. Disconnect the powertrain control module (PCM) electrical connector.

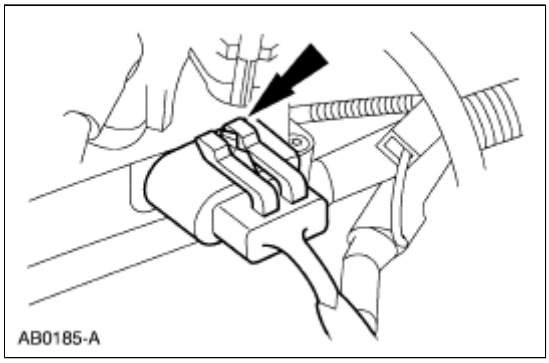


5. Disconnect the knock sensor (KS) electrical connector.

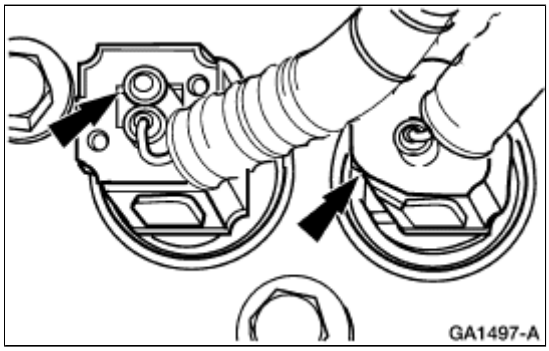


6. Disconnect the heated oxygen sensor (HO2S) connectors.

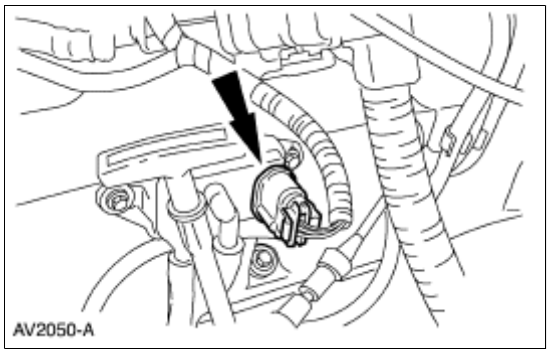
7. Disconnect the ignition coil electrical connector.



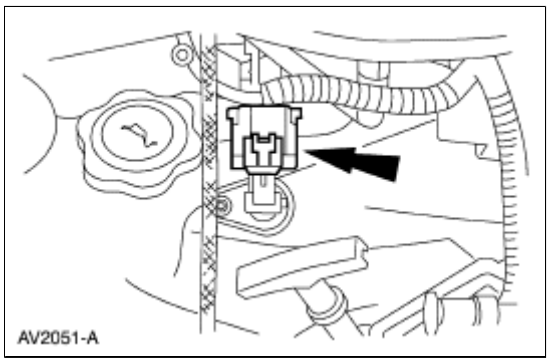
8. Disconnect the electrical connectors:
   - engine coolant temperature (ECT) sensor
   - water temperature indicator sender unit



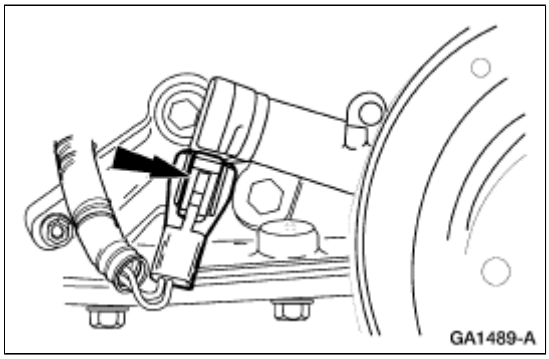
9. Disconnect the differential pressure feedback transducer electrical connector.



10. Disconnect the camshaft position (CMP) sensor electrical connector.



11. Disconnect the crankshaft position (CKP) sensor electrical connector.



12. Remove the wiring harness from the vehicle.

13. To install, reverse the removal procedure.

Fuel Injection Supply Manifold and Fuel Injector

Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

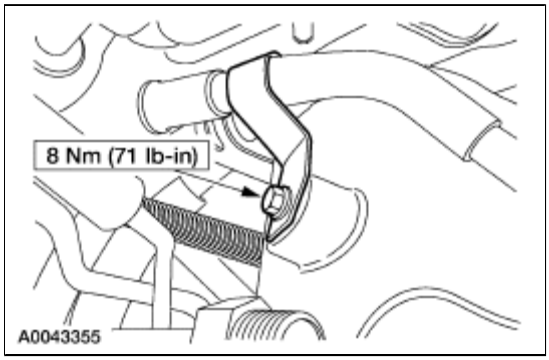
Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

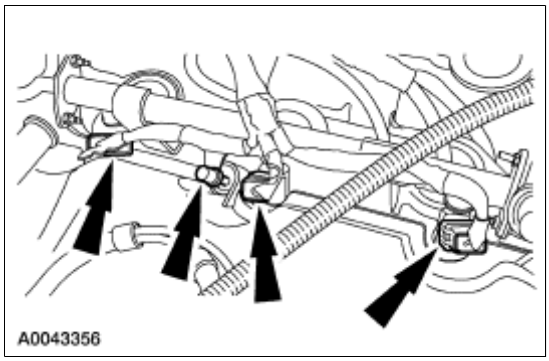
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

CAUTION: If the supply manifold is used as a leverage device, damage may occur to the supply manifold. Care must be taken when working around the supply manifold.

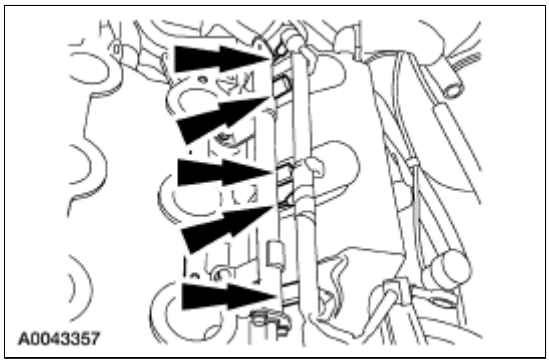
1. Remove the intake manifold. For additional information, refer to Section 303-01B .
2. Disconnect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .
3. Remove the bolt and the bracket.



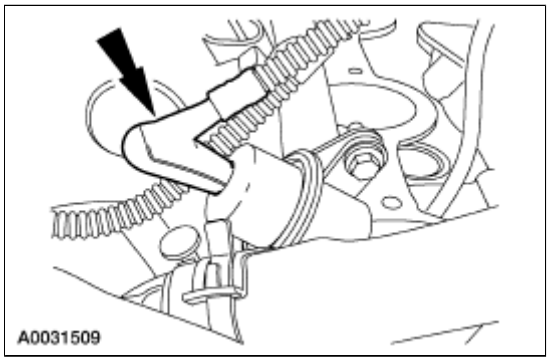
4. Disconnect the right side fuel injector electrical connectors and the two wiring harness retainers.



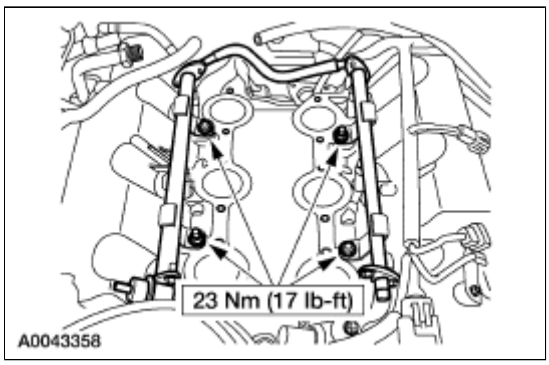
5. Disconnect the left side fuel injector electrical connectors and the wiring harness retainers.



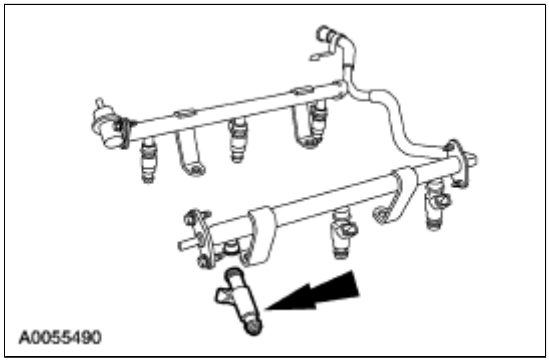
6. Disconnect the fuel pulse damper vacuum hose.



7. Remove the fuel injection supply manifold and the fuel injectors as an assembly.

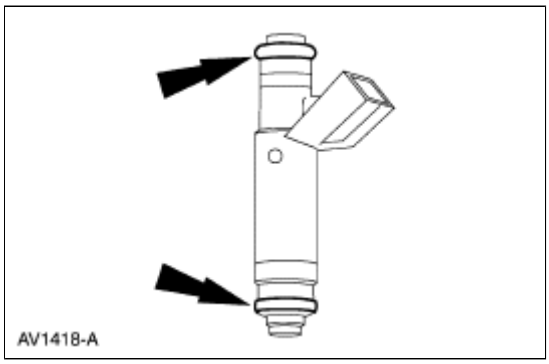


8. Remove the fuel injectors from the fuel injector supply manifold.

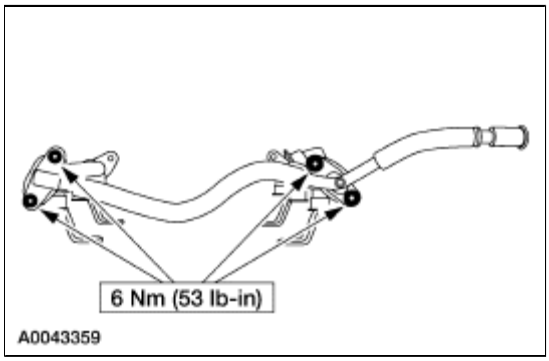


9. **NOTE:** Install new fuel injector O-rings whenever fuel injector removal is required.

   Remove and discard the O-ring seals from the fuel injectors.



10. If necessary, remove the bolts and the fuel supply tube.
    - Discard the O-rings.



11. **CAUTION: O-ring seals are made of special fuel resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

    To install, reverse the removal procedure.
    - Install new O-ring seals on the fuel injectors and, if necessary, on the fuel supply tube. Lubricate the O-ring seals with clean engine oil.

Fuel Pulse Damper

Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

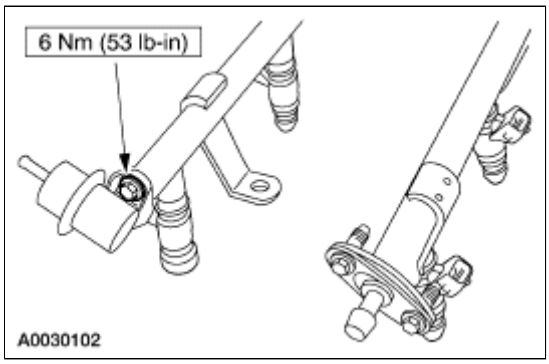
Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Remove the fuel injection supply manifold. For additional information, refer to Fuel Injection Supply Manifold and Fuel Injector in this section.

2. Remove the two bolts, the fuel pulse damper and the O-ring seals.



3. **CAUTION: Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse O-ring seals.**

   NOTE: Lubricate the new O-ring seals with clean engine oil to aid in installation.

   To install, reverse the removal procedure.

Fuel Pressure Relief Valve

Material

Item	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

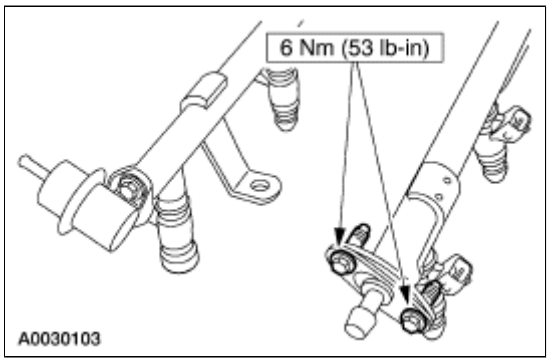
Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Remove the fuel injection supply manifold. For additional information, refer to Fuel Injection Supply Manifold and Fuel Injector in this section.

2. Remove the two bolts, the pressure relief valve and the O-ring seals.



3. **CAUTION: Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse O-ring seals.**

   NOTE: Lubricate the new O-ring seals with clean engine oil to aid installation.

   To install, reverse the removal procedure.

General Specifications

Item	Specification
Fluid/Lubricant Specification	
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Engine bulkhead connector bolt	6	—	53
Transmission harness connector bolt	6	—	53
Powertrain control module bolt	6	—	53
Fuel injection supply manifold bolts	8-12	—	71-106
Throttle body bolts	8-10	—	71-89

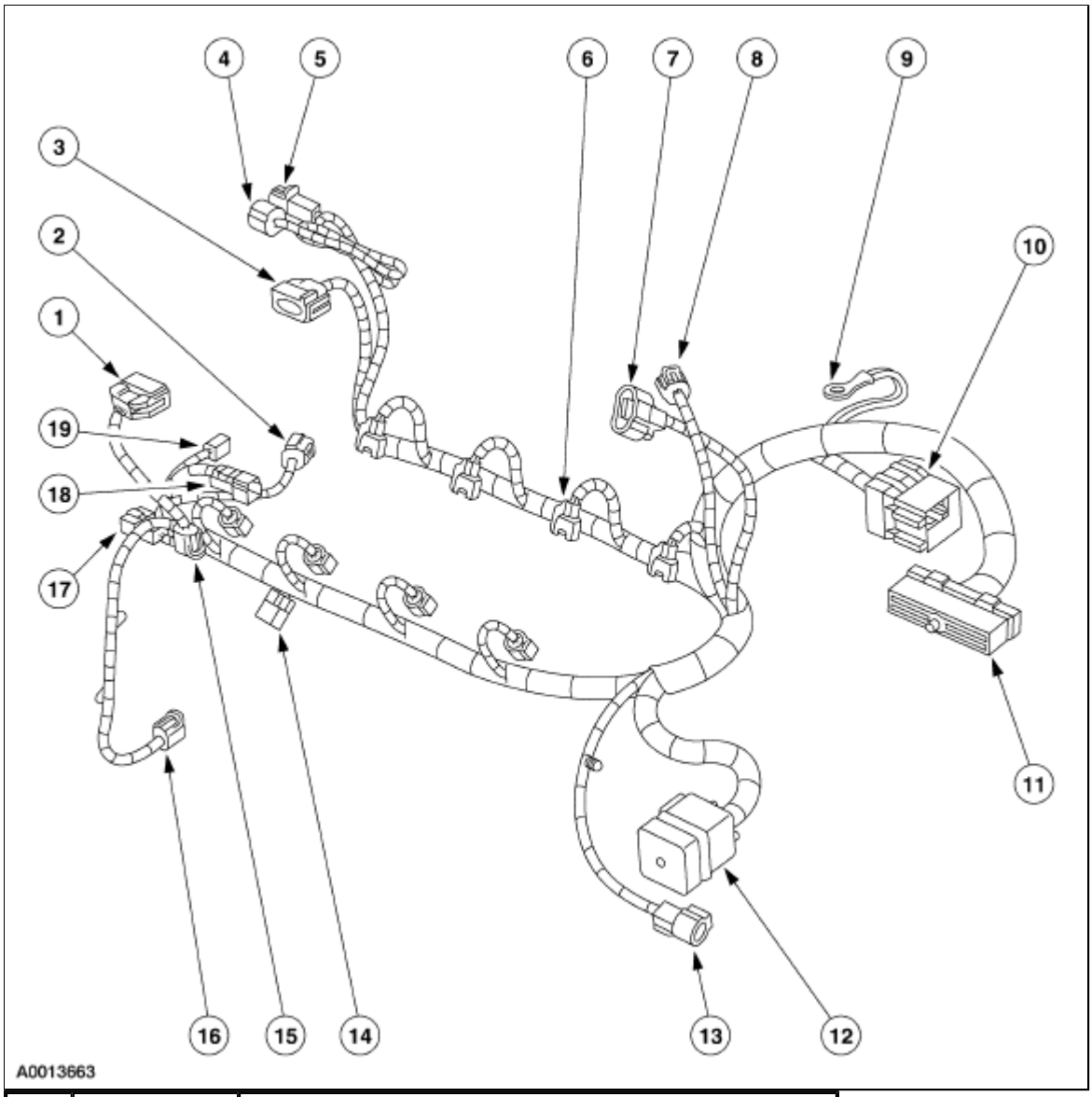
Fuel Charging And Controls

The fuel charging and controls system consists of the:

- throttle body.
- fuel injectors.
- fuel charging wiring.
- fuel injection supply manifold.
- fuel damper.
- fuel pressure relief valve.

The fuel charging and controls system is:

- a sequential, multiport fuel injection (SFI) system.
- pulse-width modulated.
- mass air flow controlled.



Item	Part Number	Description
1	—	Ignition coil connector LH
2	—	Engine coolant temperature (ECT) sensor connector
3	—	Ignition coil connector RH
4	—	Intake air temperature (IAT) sensor connector
5	—	Mass air flow (MAF) sensor connector
6	—	Fuel injector connector (8) places
7	—	Throttle position (TP) sensor connector
8	—	EGR vacuum regulator (EVR) connector
9	—	Ground connector
10	—	Engine bulkhead connector
11	—	Electronic engine control (EEC) electrical connector
12	—	Transmission harness connector

13	—	Heated oxygen sensor (HO2S) connector
14	—	Crankshaft position (CKP) sensor connector
15	—	Water temperature indicator sender connector
16	—	Engine oil pressure sending unit connector
17	—	Octane adjust sensor
18	—	CID connector
19	—	Radio capacitor connector

The fuel injection supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.

The throttle body:

- controls air supply to the upper intake manifold by positioning the throttle plate.
- connects the accelerator cable and, if equipped, the speed control actuator cable to the throttle lever.

The fuel injectors:

- are electrically operated by the powertrain control module (PCM).
- atomize the fuel as the fuel is delivered.
- are deposit-resistant.
- each have an internal solenoid which opens to inject fuel into the lower intake manifold.

The fuel pressure relief valve is used to inspect and relieve fuel pressure.

The fuel pulse damper:

- reduces fluctuation of fuel pressure during injector operation.

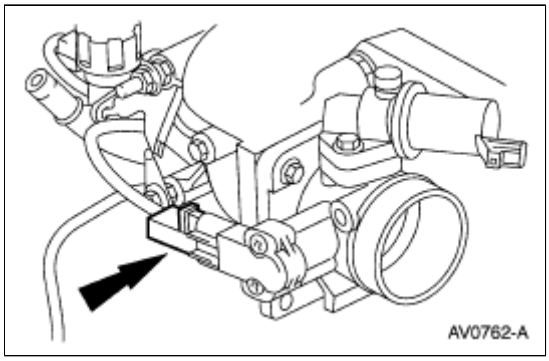
Throttle Body

Removal and Installation

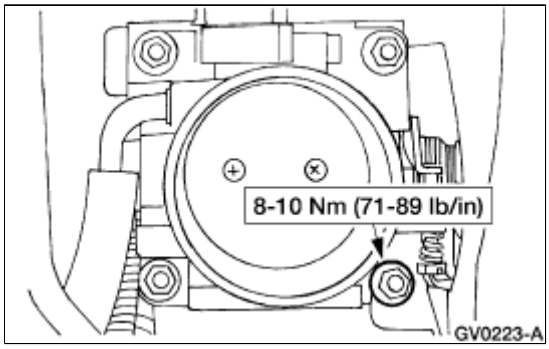
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

CAUTION: Throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Disconnect the accelerator cable and bracket. For additional information, refer to Section 310-02 .
3. Disconnect the throttle position (TP) sensor electrical connector.



4. Remove the throttle body.



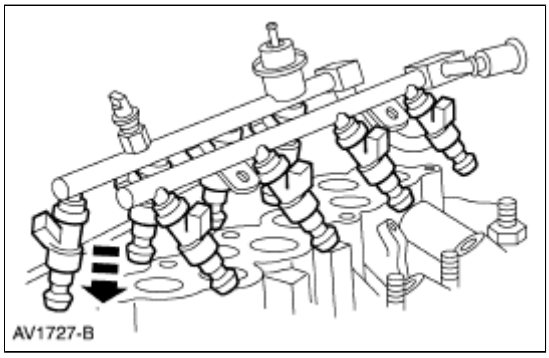
5. To install, reverse the removal procedure.

Fuel Injectors

Removal and Installation

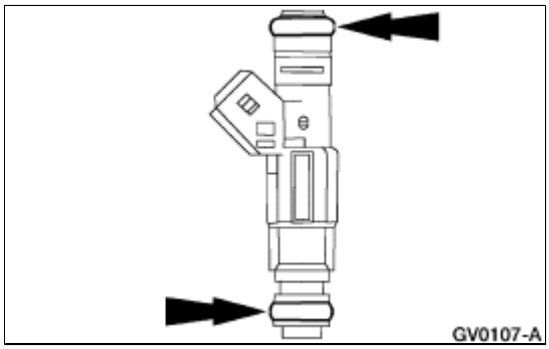
1. Remove the fuel injection supply manifold. For additional information, refer to Supply Manifold—Fuel Injection in this section.

2. Remove the eight fuel injectors.



3. **NOTE:** Lubricate new O-ring seals with Super Premium SAE 5W-30 Motor Oil, XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G, to aid installation.

   Inspect and install new O-ring seals if necessary.

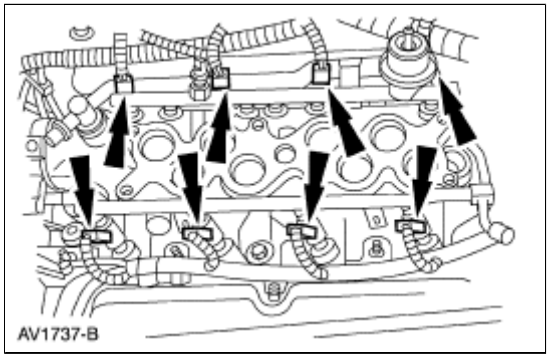


4. To install, reverse the removal procedure.

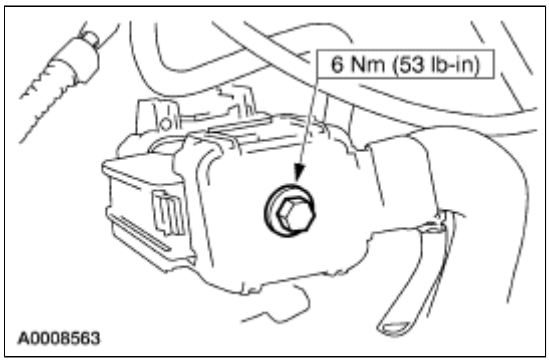
Wiring Harness

Removal and Installation

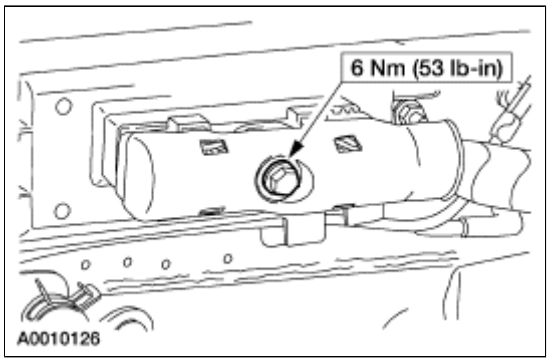
1. Remove the upper intake manifold. For additional information, refer to Section 303-01C .
2. Disconnect the fuel injector electrical connectors.



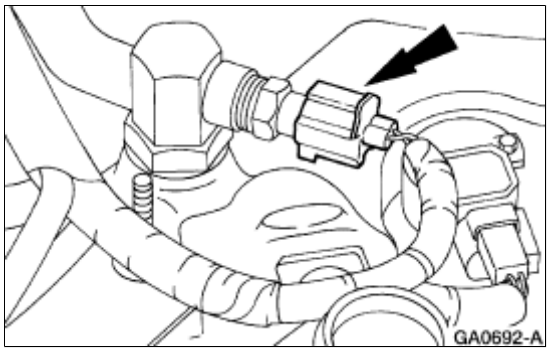
3. Disconnect the engine bulkhead connector.



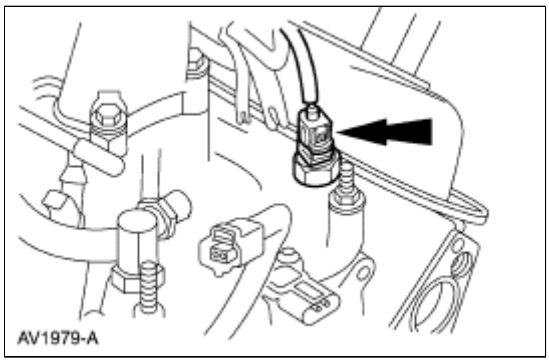
4. Disconnect the powertrain control module (PCM) connector.



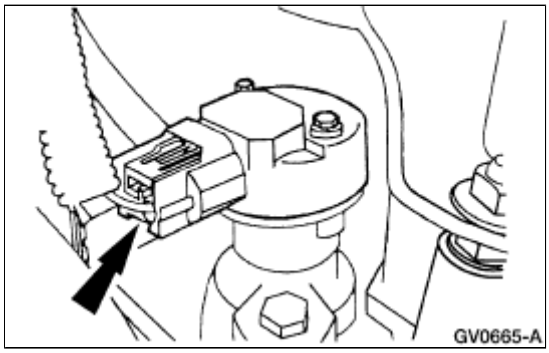
5. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



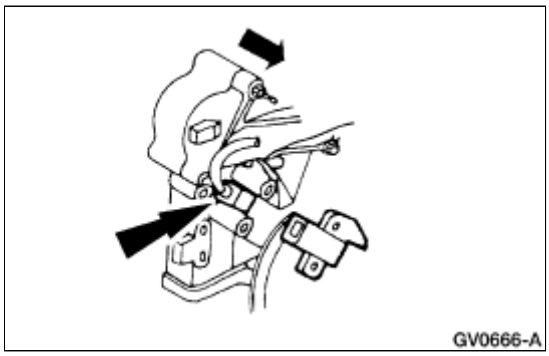
6. Disconnect the water temperature indicator electrical connector.



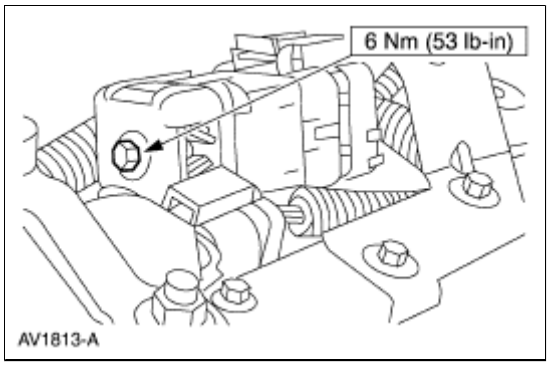
7. Disconnect the camshaft position (CMP) sensor electrical connector.



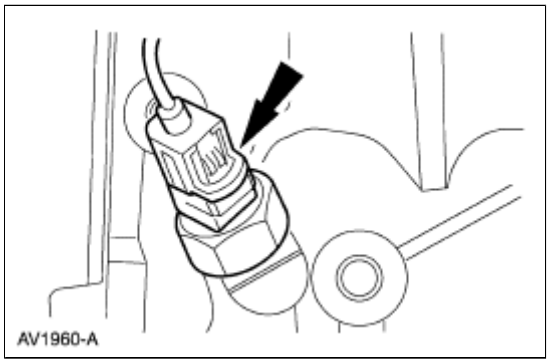
8. Disconnect the crankshaft position (CKP) sensor electrical connector.



9. Disconnect the transmission harness electrical connector.

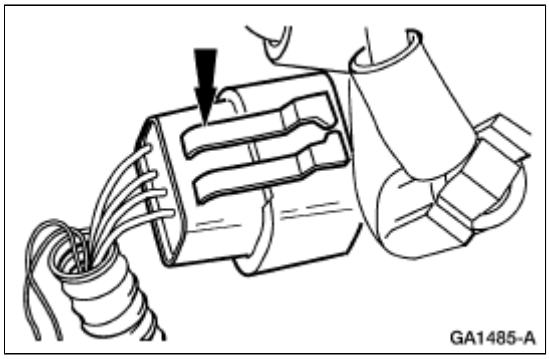


10. Disconnect the engine oil pressure sending unit electrical connector.

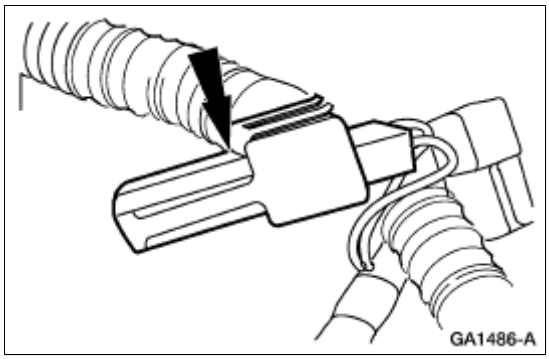


11. Disconnect the two heated oxygen sensor (HO2S) electrical connectors.

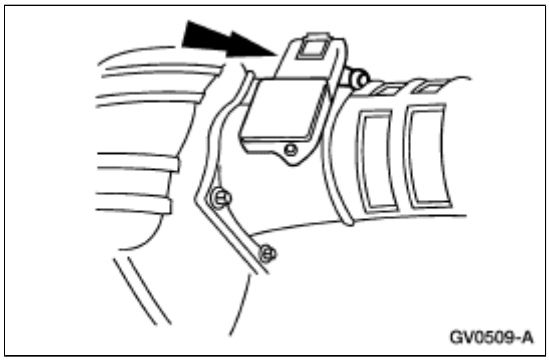
12. Disconnect the ignition coil electrical connectors.



13. Disconnect the radio ignition interference capacitor electrical connector.



14. Disconnect the mass air flow (MAF) sensor electrical connector.



15. Remove the wiring harness from the vehicle.

16. To install, reverse the removal procedure.

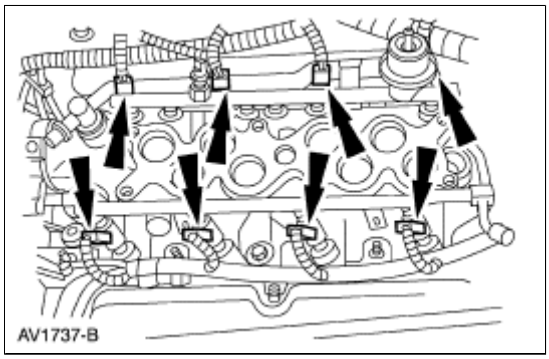
Supply Manifold —Fuel Injection

Removal and Installation

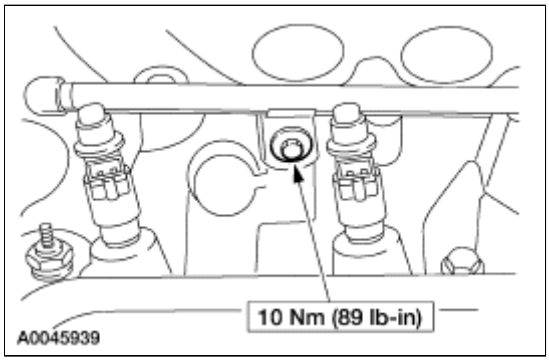
WARNING: Do not smoke, carry lighted tobacco or open flame of any type when working on or near any fuel- related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

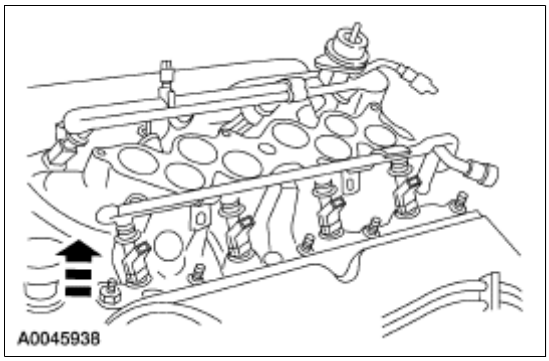
1. Remove the upper intake manifold. For additional information, refer to Section 303-01C .
2. Disconnect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .
3. Disconnect the eight fuel injector electrical connectors.



4. Remove the four bolts from the fuel injection supply manifold.



5. Remove the fuel injection supply manifold from the lower intake manifold.



6. To install, reverse the removal procedure.

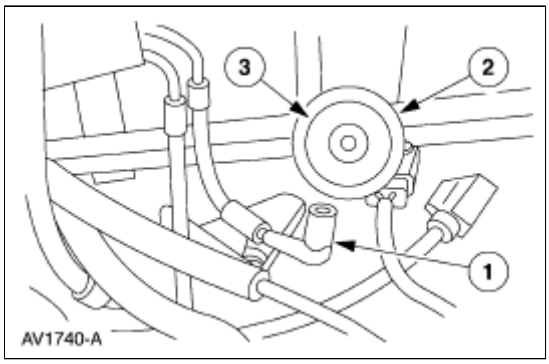
Fuel Pulse Damper

Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Relieve fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the fuel pulse damper.
    1. Disconnect the vacuum hose.
    2. Remove the snap ring.
    3. Remove the fuel pulse damper and O-ring seals.



3. **CAUTION: Use O-ring seals that are made of special fuel resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse O-ring seals.**

   NOTE: Lubricate the new O-ring seals with clean engine oil, XO-10W30-DSP or equivalent meeting Ford specification WSS-M2C153-G, to aid installation.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft
4.0L (Push Rod) Engine		
Drive belt tensioner bolt	40-55	30-40
Belt idler pulley bolt	40-55	30-40
4.0L SOHC Engine		
Drive belt tensioner bolt	40-55	30-40
Belt idler pulley bolt	40-55	30-40
5.0L Engine		
Belt idler pulley bolt (upper)	47	35
Belt idler pulley bolt (lower)	21-29	16-21
Drive belt tensioner bolts	25	18

Accessory Drive

4.0L (Push Rod)

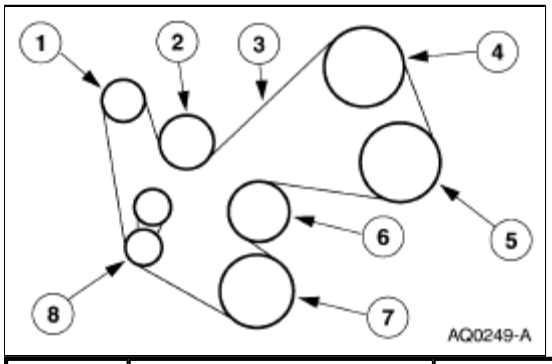
The accessory drive system consists of the following:

- drive belt
- generator
- power steering pump
- A/C compressor
- water pump pulley
- drive belt tensioner
- belt idler pulley
- crankshaft pulley

The accessory drive:

- has a single serpentine drive belt (six ribs).
- has an automatic tensioner.
- is not adjustable.

Component Locations



Item	Part Number	Description
1	10300	Generator
2	8678	Belt idler pulley
3	8620	Drive belt
4	19703	A/C compressor
5	3A674	Power steering pump
6	8509	Water pump pulley
7	6312	Crankshaft pulley
8	6B209	Drive belt tensioner

4.0L SOHC

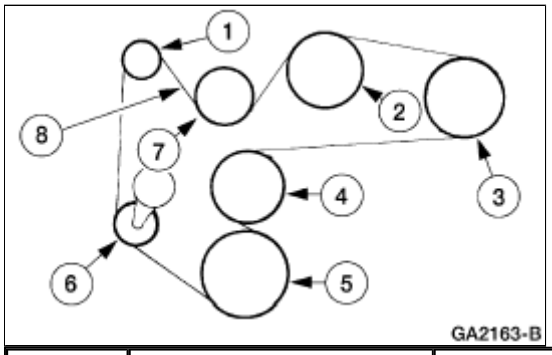
The accessory drive system consists of the following:

- drive belt
- generator
- power steering pump
- A/C compressor
- water pump pulley
- drive belt tensioner
- belt idler pulley
- crankshaft pulley

The accessory drive:

- has a single serpentine drive belt (six ribs).
- has an automatic tensioner.
- is not adjustable.

Component Locations



Item	Part Number	Description
1	10300	Generator
2	3A674	Power steering pump
3	19703	A/C compressor
4	8509	Water pump pulley
5	6312	Crankshaft pulley
6	6B209	Drive belt tensioner
7	8678	Belt idler pulley
8	8620	Drive belt

5.0L

The accessory drive system consists of the following:

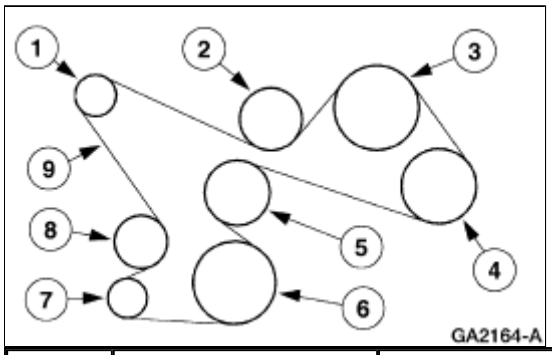
- drive belt
- generator
- power steering pump
- A/C compressor
- crankshaft pulley

- water pump pulley
- drive belt tensioner
- belt idler pulley

The accessory drive:

- has a single serpentine drive belt (six ribs).
- has an automatic tensioner.
- is not adjustable.

Component Locations



Item	Part Number	Description
1	10300	Generator
2	8678	Belt idler pulley
3	3A733	Power steering pump pulley
4	19703	A/C compressor
5	8509	Water pump pulley
6	6312	Crankshaft pulley
7	8678	Belt idler pulley
8	6B209	Drive belt tensioner
9	8620	Drive belt

Accessory Drive

Inspection and Verification

1. Verify the customer's concern by operating the engine to duplicate the condition.
2. Inspect to determine if any of the following mechanical concerns apply:

Visual Inspection Chart

Mechanical
• Drive belt cracking/chunking/wear. • Drive belt noise or squeal. • Pulley misalignment or excessive pulley runout.

3. Inspect for drive belt cracking/chunking/wear.
4. If the concerns remain after inspection, determine the symptoms and go to the symptom chart.

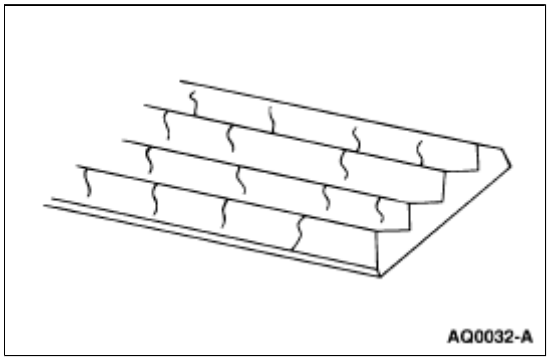
Under severe operating conditions (high temperature, low humidity), drive belt rib cracking can occur at less than 96,000 km (60,000 miles). Drive belt rib cracking (cracks across grooves):

- is not a reason for concern.
- has no detrimental effect on drive belt performance.

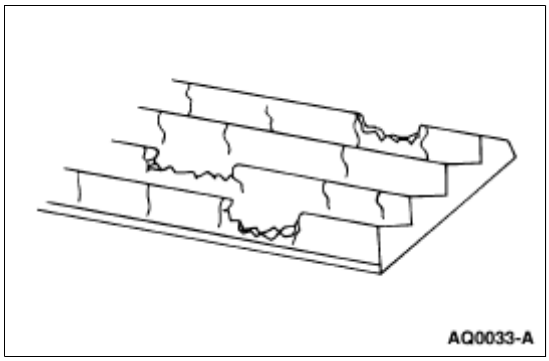
Cracks parallel to grooves are acceptable.

The drive belt is still perfectly functional until rib chunking occurs. Drive belt chunking is where the rubber material actually chunks out between the cracks. The drive belt should be replaced if chunking occurs.

Vee-Ribbed Serpentine Drive Belt With Cracks Across Backing



Vee-Ribbed Serpentine Drive Belt With Chunks of Rib Missing



5. If the concern(s) remains after inspection, determine the symptoms and go to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Drive belt cracking	• Drive belt.	• System OK.
• Drive belt chunking	• Drive belt.	• INSTALL a new drive belt. For additional information, REFER to Belt—Drive in this section.
• Drive belt noise or squeal	• Drive belt. • Pulley(s).	• DETERMINE what area of the pulley(s) the noise is coming from, then check that area with a straightedge and look for the accessory pulley(s) to be out of position in the fore or aft direction, or at an angle to the straightedge.
• Drive belt does not hold tension	• Drive belt cracking or damaged.	• INSPECT the drive belt for cracking parallel with and through to the backing. INSTALL a new drive belt if necessary.
	• Drive belt tensioners worn or damaged.	• CHECK the drive belt tensioner for damage and correct operation. REFER to the Component Test in this section. INSTALL a new drive belt tensioner if necessary.
• Drive belt squeal or chirp	• Incorrect drive belt installed.	• CHECK the drive belt for correct part application.
	• Lubricant or other contamination on the drive belt.	• CHECK the drive belt for oil, coolant, power steering fluid, brake fluid or other contamination. REMOVE the drive belt and wash with detergent and water. If the drive belt cannot be cleaned or is damaged (softened) by contamination, INSTALL a new drive belt.
	• Drive belt pulleys not aligned	• CHECK the pulleys for proper alignment, devices and pulleys for proper freedom

	properly, damaged or not rotating freely.	of rotation and damage. REPAIR the pulleys and devices as required.

Component Test

Drive Belt—Misalignment

CAUTION: Incorrect drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the drive pulleys.

NOTE: Original equipment drive belts are made of a special cord construction and are subjected to special testing before they are approved for use.

Non-standard new drive belts may track differently or incorrectly. If a new drive belt tracks incorrectly, install a new original equipment drive belt to avoid performance failure or loss of drive belt.

With the engine running, check drive belt tracking (the position of the drive belt on one of the grooveless pulleys, idlers or drive belt tensioner. If the edge of the drive belt rides beyond the edge of the pulley, noise and premature wear may result). If a drive belt tracking condition exists, visually check the drive belt tensioner for damage, especially the mounting pad surface. If the drive belt tensioner is not installed correctly with the locating pins in the locating holes, the mounting surface pad will be out of position. This will result in abnormal drive belt tension and chirp and squeal noises.

If the above procedures do not correct the drive belt noise, install a new drive belt. However, the drive belt noise may return (with mileage) if one of the above conditions still exists uncorrected.

- With engine running, visually observe the grooves in the pulleys (not the pulley flanges) for excessive wobble. Install new components as required.
- Check all accessories, mounting brackets and drive belt tensioner, for any interference that would prevent the component from mounting properly. Correct any interference condition and recheck belt tracking.
- Tighten all accessories, mounting brackets and drive belt tensioner retaining hardware to specification. Recheck drive belt tracking.

Belt Tensioner

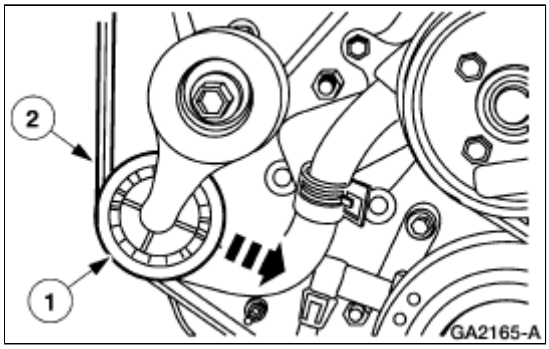
The automatic drive belt tensioner can be checked as follows:

1. With the engine running, observe the drive belt tensioner movement. The drive belt tensioner should move (respond) when the A/C clutch cycles or when the engine is accelerated rapidly. If the drive belt tensioner movement is constant without A/C clutch cycling or acceleration, a pulley or shaft is probably bent or a pulley is out of round. In rare cases, excessive drive belt rideout (uneven depth of grooves in drive belt) can cause excessive drive belt tensioner movement. This condition can be checked by installing the suspect drive belt with a known good original equipment drive belt and repeating the observation.

Belt — 4.0L (Push Rod)

Removal and Installation

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Remove the drive belt.
    1. Rotate the drive belt tensioner counterclockwise.
    2. Remove the drive belt.



3. **NOTE:** Refer to Component Locations in this section for correct drive belt routing.

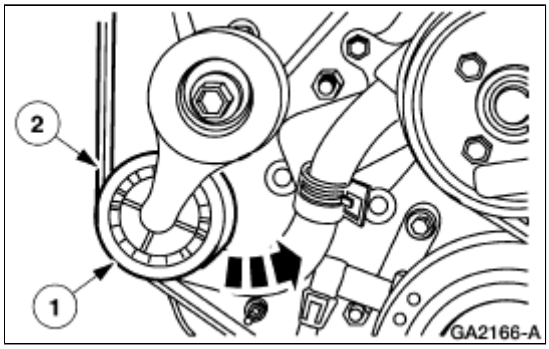
    To install, reverse the removal procedure.

Belt — 4.0L SOHC

Removal and Installation

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

2. Remove the drive belt.
    1. Rotate the drive belt tensioner counterclockwise.
    2. Remove the drive belt.



3. **NOTE:** Refer to Component Locations in this section for proper drive belt routing.

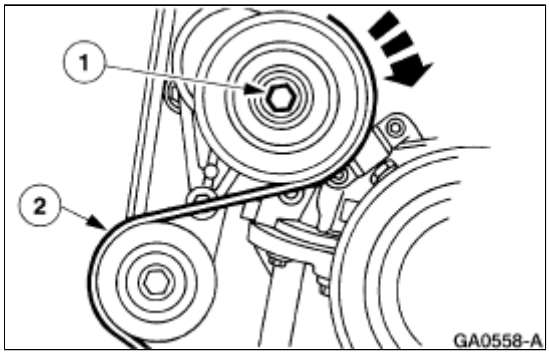
    To install, reverse the removal procedure.

Belt — 5.0L

Removal and Installation

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

2. Remove the drive belt.
    1. Rotate the drive belt tensioner clockwise.
    2. Remove the drive belt.



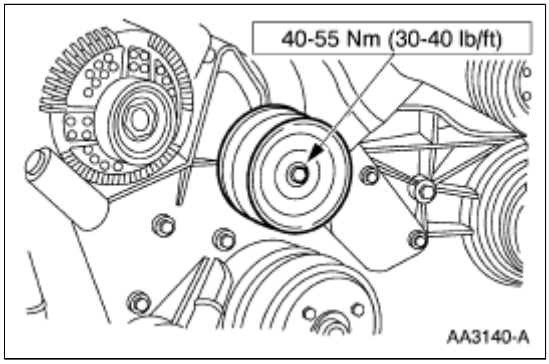
3. **NOTE:** Refer to Component Locations in this section for proper drive belt routing.

    To install, reverse the removal procedure.

Belt Idler Pulley — 4.0L (Push Rod)

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 4.0L (Push Rod) in this section.
2. Remove the belt idler pulley.

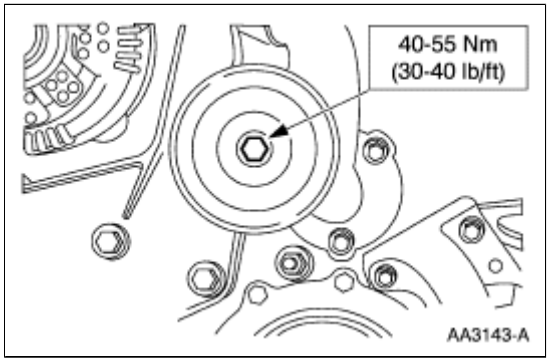


3. To install, reverse the removal procedure.

Belt Idler Pulley — 4.0L SOHC

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 4.0L SOHC in this section.
2. Remove the belt idler pulley.

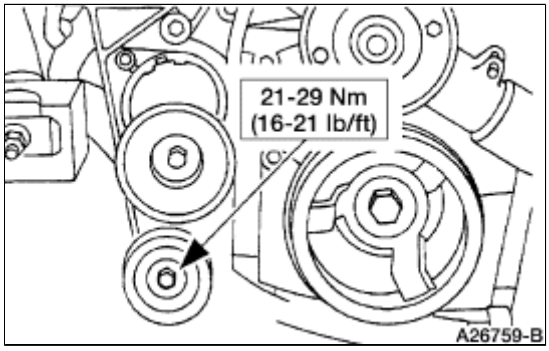


3. To install, reverse the removal procedure.

Belt Idler Pulley — 5.0L, Lower

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 5.0L in this section.
2. Remove the belt idler pulley.

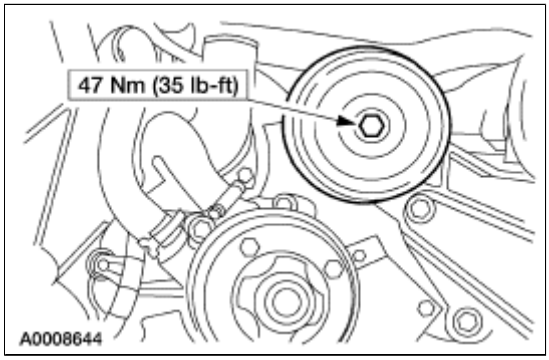


3. To install, reverse the removal procedure.

Belt Idler Pulley — 5.0L, Upper

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 5.0L in this section.
2. Remove the belt idler pulley.

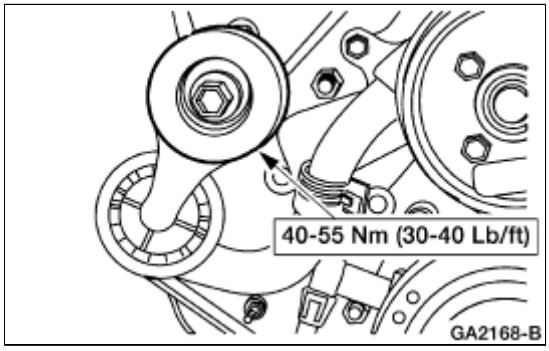


3. To install, reverse the removal procedure.

Belt Tensioner — 4.0L (Push Rod)

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 4.0L (Push Rod) in this section.
2. Remove the drive belt tensioner.

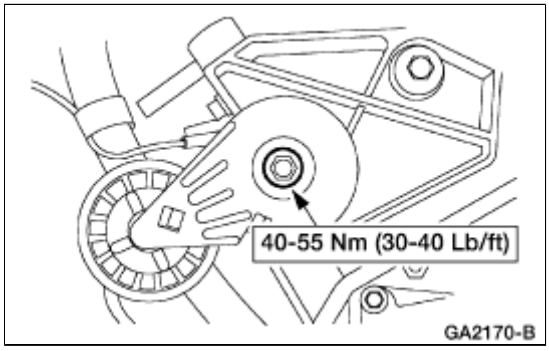


3. To install, reverse the removal procedure.

Belt Tensioner — 4.0L SOHC

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 4.0L SOHC in this section.
2. Remove the drive belt tensioner.

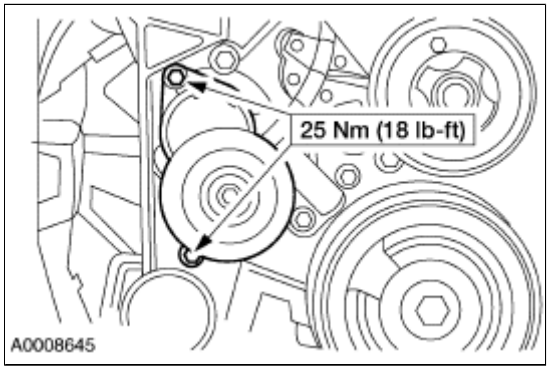


3. To install, reverse the removal procedure.

Belt Tensioner — 5.0L

Removal and Installation

1. Remove the drive belt. For additional information, refer to Belt— 5.0L in this section.
2. Remove the drive belt tensioner.



3. To install, reverse the removal procedure.

General Specifications

Item	Specification
Normal Engine Cranking Speed rpm	140-220
Starter Motor Armature Shaft Maximum Runout mm (in)	0.11 (0.005)
Starter Motor Brush Manufactured Length mm (in)	16.8 (0.66)
Starter Motor Brush Spring Tension N (oz)	18 (64)
Starter Motor Commutator Maximum Runout mm (in)	0.12 (0.005)
Starter Motor Diameter mm (in)	101.6 (4)
Starter Motor Maximum Load Amperes	800
Starter Motor Minimum Stall Torque (at 5 Volts) Nm	14.7
Starter Motor No Load Current Draw Amperes	60-80
Starter Motor Normal Load Current Draw Amperes	130-220
Starting Circuit Maximum Voltage Drop (Engine Temperature Normal) Volts	0.5

Torque Specifications

Description	Nm	lb-ft	lb-in
Brush Plate Bolts	2-3	—	17-26
Solenoid Bolts	5-10	—	44-88
Starter Motor Bolt	22-28	16-20	—
Starter Motor Stud Bolt	22-28	16-20	—
Starter Motor Ground Cable Nut	20-25	—	14-19
Starter Motor Solenoid Relay Switch Terminal Nuts	5-11	—	44-97
Starter Solenoid B-Terminal Nut	10-15	—	88-133
Starter Solenoid S-Terminal Nut	5-7	—	44-62
Battery Cable Clamp Bolts	7-10	—	62-89

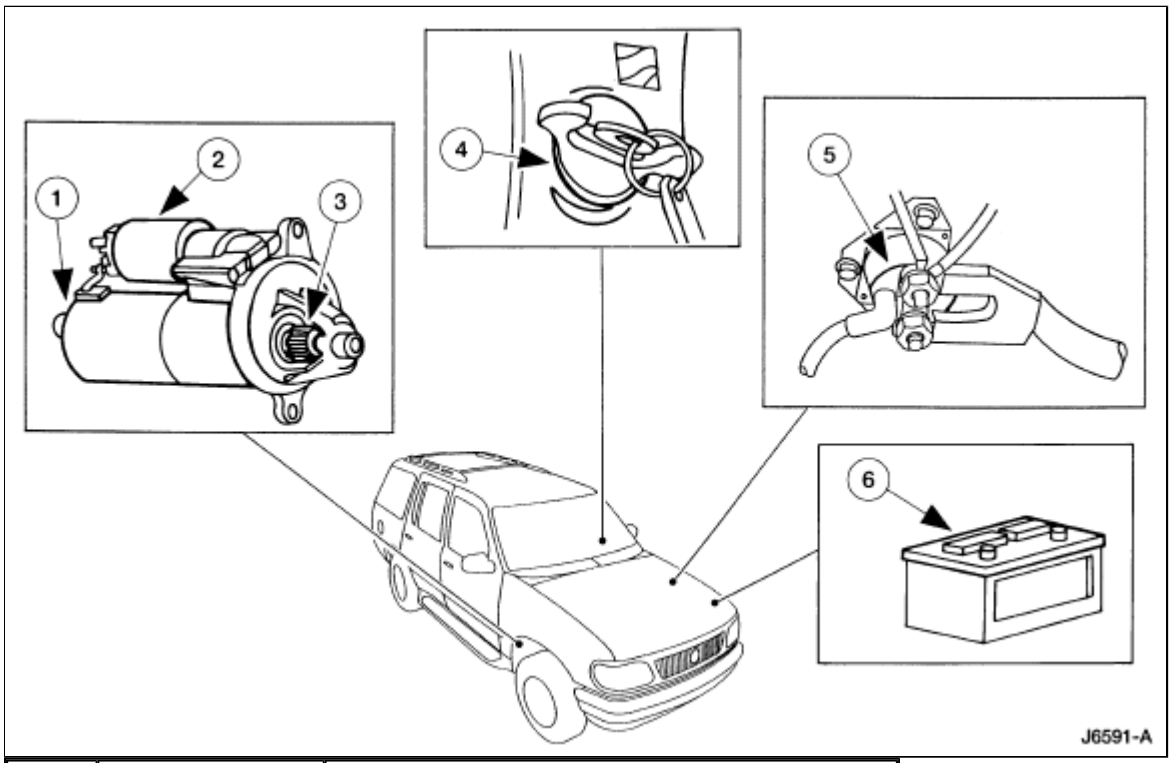
Starting System

The starting system consists of the:

- starter motor (11002).
- starter solenoid (11390).
- starter drive (11350).
- starter motor solenoid relay switch (11450).
- ignition switch (11572).
- digital transmission range (TR) sensor.
- transmission range (TR) sensor.
- battery (10653).

The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start.

Component Locations — 5.0L Shown, 4.0L (Push Rod) and 4.0L (SOHC) Similar



Item	Part Number	Description
1	11002	Starter Motor
2	11390	Starter Solenoid
3	11350	Starter Drive
4	11572	Ignition Switch

5	11450	Starter Motor Solenoid Relay Switch
6	10653	Battery

Starting System

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
ST1179-A	Alternator, Regulator, Battery and Starter Tester (ARBST) 010-00725 or equivalent

Inspection and Verification

WARNING: When servicing starter motor or performing other underhood work in the vicinity of the starter motor (11002), be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over the terminal of this lead and must be replaced after servicing.

WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components.

NOTE: When working on the starter system, make sure the anti-theft system is deactivated, if equipped.

1. Verify the customer concern by operating the starting system.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Starter motor • Starter motor relay switch • Brackets • Anti-theft relay	• Battery • Failed fuse 24 (10A) • Damaged wiring harness • Loose or corroded connections

3. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

SYMPTOM CHART

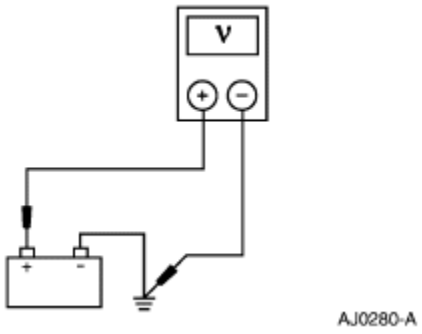
Condition	Possible Sources	Action
• The Engine Does Not Crank	• Battery (10653). • Starter motor • Starter motor relay. • Ignition switch. • Damaged fuse. • Anti-theft system. • Circuitry.	• GO to Pinpoint Test A .
• The Engine Cranks Slowly	• Battery. • Starter motor. • Circuitry.	• PERFORM the Starter Motor—Voltage Drop Test Component Test.
• Unusual Starter Noise	• Starter mounting. • Flywheel/ring gear. • Starter motor.	• GO to Pinpoint Test B .
• The Starter Spins But the Engine Does Not Crank	• Starter motor. • Damaged flywheel/ring gear teeth.	• INSPECT the starter motor mounting and engagement. REPLACE the starter motor. • INSPECT the flywheel/ring gear for damaged, missing or worn teeth. REPAIR as required.

Pinpoint Tests

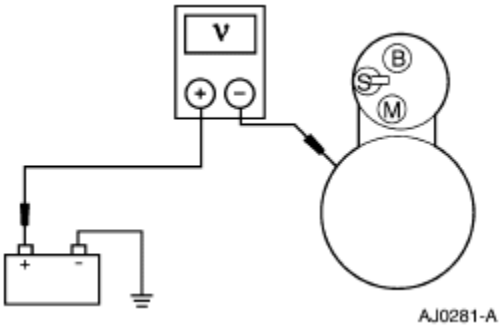
PINPOINT TEST A: THE ENGINE DOES NOT CRANK OR RELAY CLICKS

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE BATTERY	
	1 Check the battery condition and charge; refer to Section 414-00 . • **Is the battery OK?** → **Yes** GO to A2 . → **No** CHARGE or REPLACE the battery as required. TEST the system for normal operation.

A2 CHECK THE BATTERY GROUND CABLE

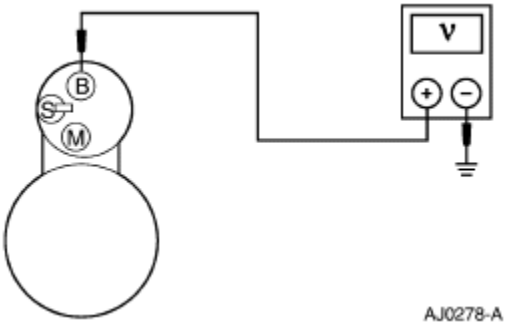
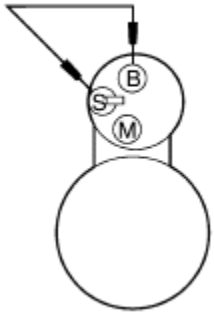
1  	1 Measure the voltage between the positive battery post and the battery ground cable connection at the cylinder block (6010). • **Is the voltage reading greater than 10 volts?** → **Yes** GO to A3 . → **No** REPLACE the battery ground cable. TEST the system for normal operation.

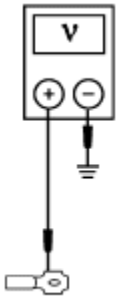
A3 CHECK THE STARTER MOTOR GROUND

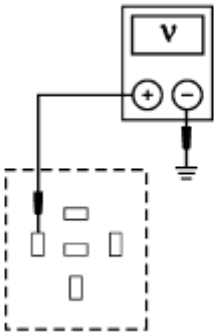
1  	1 Measure the voltage between the positive battery post and the starter motor case. • **Is the voltage reading greater than 10 volts?** → **Yes** GO to A4 . → **No** CLEAN the starter motor mounting flange and make sure the starter motor is properly mounted. TEST the system for normal operation.

A4 CHECK THE POWER SUPPLY TO THE STARTER MOTOR

1	

 2  AJ0278-A	2 Measure the voltage at the starter motor B terminal. • **Is the voltage reading greater than 10 volts?** → **Yes** GO to A5 . → **No** REPLACE the positive battery cable. TEST the system for normal operation.
A5 CHECK THE STARTER MOTOR	
1  AJ0279-A	1 Connect one end of a jumper wire to the B terminal of the starter motor and momentarily connect the other end to the starter solenoid S-terminal. • **Does the starter motor engage and the engine crank?** → **Yes** GO to A6 . → **No** REPLACE the starter motor (11001). TEST the system for normal operation.
A6 CHECK START INPUT TO THE STARTER MOTOR	
1	

 Starter S Connector 3  AJ0285-A	2 Hold the ignition switch to the START position. 3 Measure the voltage at the starter motor solenoid S connector. • **Is the voltage reading greater than 10 volts?** → **Yes** CLEAN the starter solenoid S terminal and connector. CHECK the wiring and the starter motor for a loose or intermittent connection. TEST the system for normal operation. → **No** GO to A7 .
A7 CHECK THE START INPUT TO THE STARTER RELAY	
1 2 Starter Relay 4	3 Hold the ignition switch in the START position. 4 On vehicles equipped with a manual transmission, push in clutch pedal and hold.



5 Measure the voltage at the starter relay connector Pin 86, Circuit 1093 (T/R).

- **Is the voltage reading greater than 10 volts?**

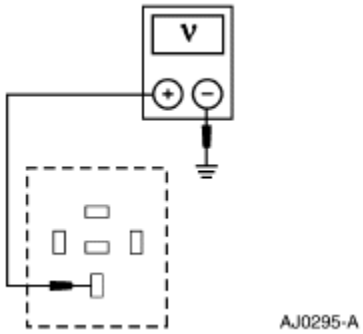
→ **Yes**
GO to A8.

→ **No**
GO to A13.

A8 CHECK THE BATTERY SUPPLY TO THE STARTER RELAY

1

2



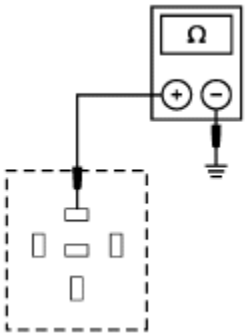
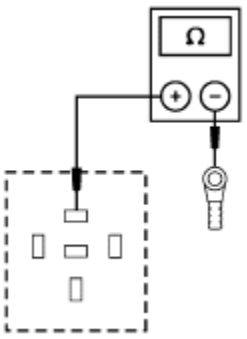
2 Measure the voltage at the starter relay connector Pin 30, Circuit 37 (Y).

- **Is the voltage reading greater than 10 volts?**

→ **Yes**
GO to A9.

→ **No**
REPAIR the open in Circuit 37 (Y). TEST the system for normal operation.

A9 CHECK CIRCUIT 113 (Y/LB) FOR A SHORT TO GROUND

1 Starter S Connector 2  	2 Measure the resistance between the starter relay connector Pin 87, Circuit 113 (Y/LB) and ground. • **Is the resistance reading less than 10,000 ohms?** → **Yes** REPAIR Circuit 113 (Y/LB) for a short to ground. TEST the system for normal operation. → **No** GO to A10 .
A10 CHECK CIRCUIT 113 (Y/LB) FOR AN OPEN	
1  	1 Measure the resistance of Circuit 113 (Y/LB) between the starter relay connector Pin 87 and the starter S connector. • **Is the resistance reading less than 5 ohms?** → **Yes** GO to A11 . → **No** REPAIR Circuit 113 (Y/LB) for an open. TEST the system for normal operation.
A11 CHECK THE PASSIVE ANTI-THEFT SYSTEM (PATS)	

1

Starter Relay

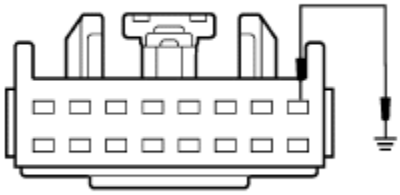
2

Starter S Terminal

3

PATS C222

4



AJ0338-B

5

4 Connect a jumper wire between the PATS module connector Pin C222-1, Circuit 325 (DB/O) and ground.

- **Did the engine crank?**

→ **Yes**
REFER to Section 419-01 to diagnose passive anti-theft system concern.

→ **No**
GO to A12 .

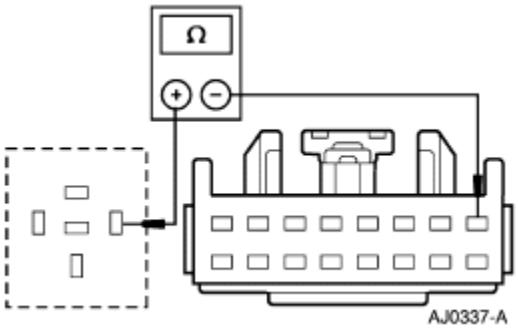
A12 CHECK CIRCUIT 325 (DB/O) FOR AN OPEN

1

2

Starter Relay

3



3 Measure the resistance of Circuit 325 (DB/O) between the starter relay connector Pin 85 and the PATS module connector Pin C222-1.

- **Is the resistance reading less than 5 ohms?**

→ **Yes**
REPLACE the starter relay. TEST the system for normal operation.

→ **No**
REPAIR Circuit 325 (DB/O) for an open. TEST the system for normal operation.

A13 CHECK FUSE 24 (7.5A)

1

2

Fuse 24 (7.5A)

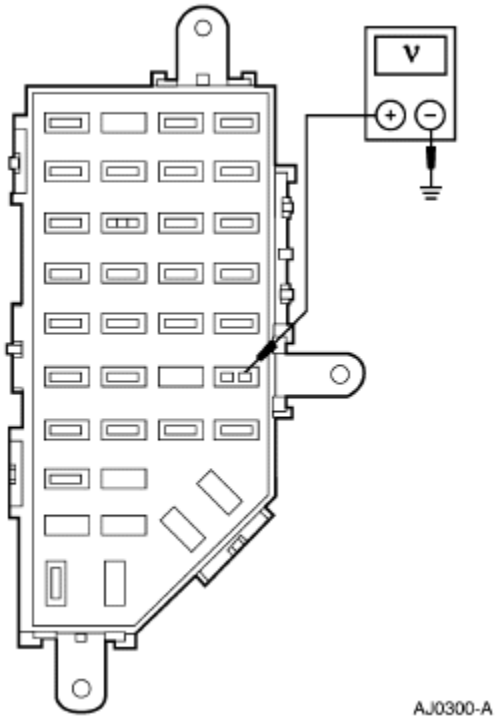
3

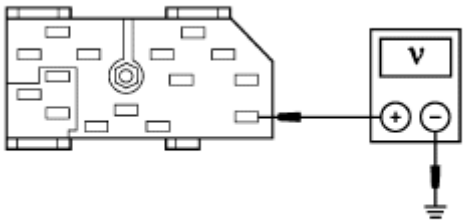
Fuse 24 (7.5A)

- **Is Fuse 24 (7.5A) OK?**

→ **Yes**
GO to A14 .

→ **No**

	GO to A23.
A14 CHECK THE INPUT TO FUSE 24 (7.5A)	
2  	1 Hold the ignition switch to the START position. 2 Measure the voltage at the input cavity of Fuse 24 (7.5A). • **Is the voltage reading greater than 10 volts?** → **Yes** If not equipped with a center console, GO to A18. If equipped with a center console, GO to A22. → **No** GO to A15.
A15 CHECK THE SUPPLY TO THE IGNITION SWITCH	
1 Ignition Switch C233 2	2 Measure the voltage at the ignition switch connector Pin C233-B4, Circuit 37 (Y).



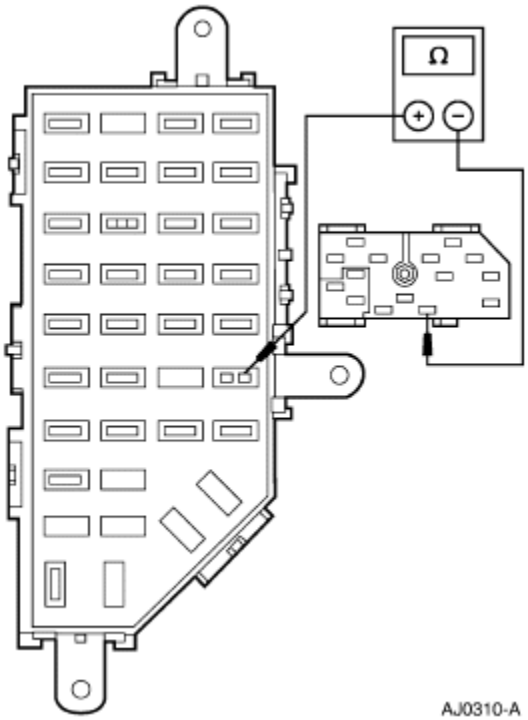
- **Is the voltage reading greater than 10 volts?**

→ **Yes**
GO to A16 .

→ **No**
REPAIR Circuit 37 (Y) for an open. TEST the system for normal operation.

A16 CHECK CIRCUIT 32 (R/LB) FOR AN OPEN

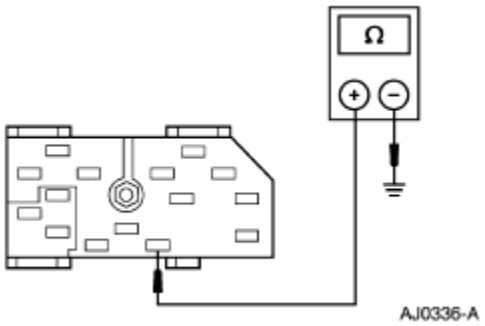
1

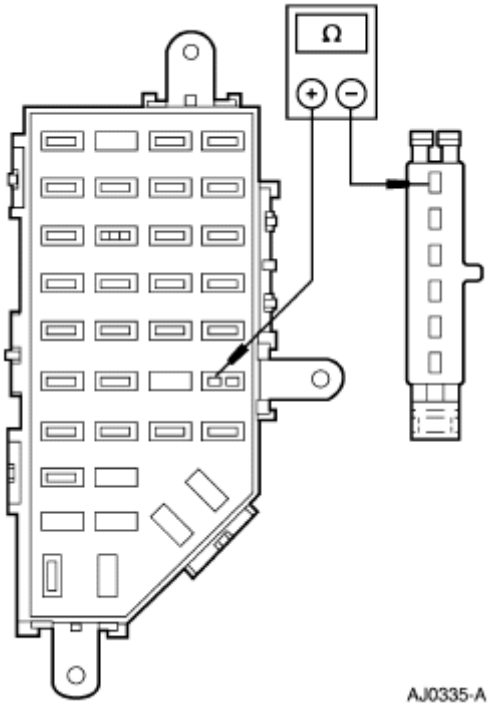


1 Measure the resistance of Circuit 32 (R/LB) between the ignition switch connector Pin C233-STA and the input cavity of Fuse 24 (7.5A).

- **Is the resistance reading less than 5 ohms?**

→ **Yes**
GO to A17 .

	→ **No** REPAIR Circuit 32 (R/LB) for an open. TEST the system for normal operation.
A17 CHECK CIRCUIT 32 (R/LB) FOR A SHORT TO GROUND	
1  	1 Measure the resistance between the ignition switch connector Pin C233-STA, Circuit 32 (R/LB) and ground. • **Is the resistance reading less than 10,000 ohms?** → **Yes** REPAIR Circuit 32 (R/LB) for a short to ground. TEST the system for normal operation. → **No** REPLACE the ignition switch; refer to Section 211-05 . TEST the system for normal operation.
A18 CHECK CIRCUIT 33 (W/PK) FOR AN OPEN	
1 2	1 Disconnect the clutch pedal position (CPP) switch or jumper Connector C209. 2 Measure the resistance of Circuit 33 (W/PK) between the CPP switch or jumper connector Pin C209-6 and the fuse junction panel fuse 24 output cavity.



- **Is the resistance reading less than 5 ohms?**

→ **Yes**
GO to A19 .

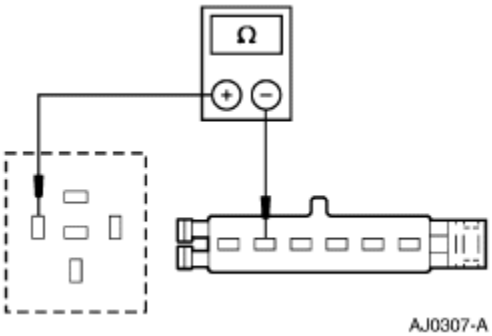
→ **No**
REPAIR Circuit 33 (W/PK) for an open. TEST the system for normal operation.

A19 CHECK CPP OUTPUT FOR AN OPEN

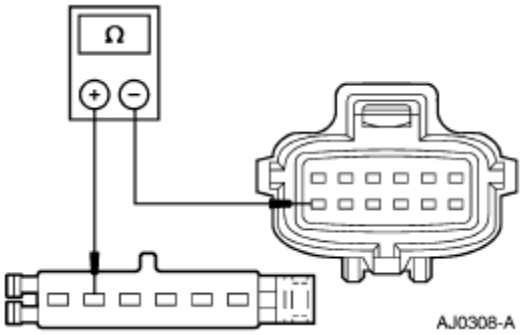
1

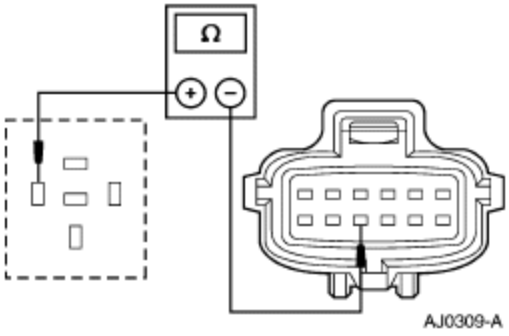
Starter Relay

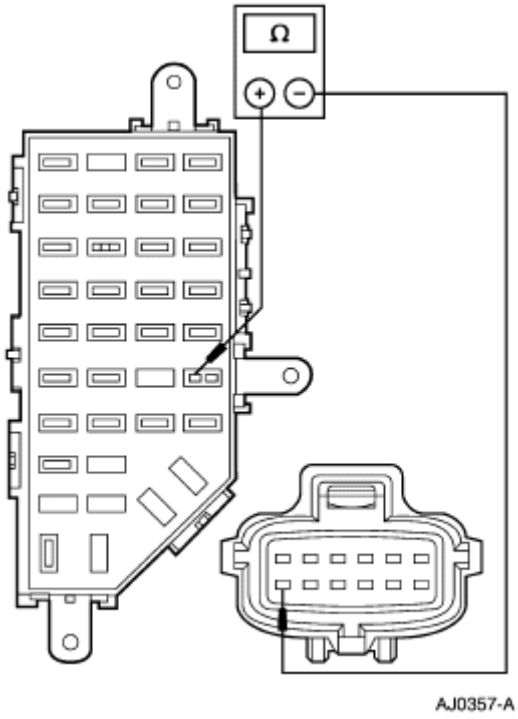
2



2 Measure the resistance between the CPP connector Pin C209-5, Circuit 329 (PK) and the starter relay connector Pin 86, Circuit 1093 (T/R).

	• **Is the resistance reading less than 5 ohms?** → **Yes** If equipped with a manual transmission, REPLACE the clutch pedal position switch or jumper. TEST the system for normal operation. If equipped with an automatic transmission, CHECK the digital TR sensor adjustment; refer to Section 307-01A (5R55E) or Section 307-01B (4R70W). If the digital TR sensor is adjusted properly, REPLACE the digital TR sensor. TEST the system for normal operation. → **No** If equipped with a manual transmission, REPAIR Circuit 329 (PK) or Circuit 1093 (T/R) for an open. TEST the system for normal operation. If equipped with an automatic transmission, GO to A20.
A20 CHECK CIRCUIT 329 (PK) FOR OPEN	
1 Digital TR C112 2 	2 Measure the resistance of Circuit 329 (PK) between the CPP connector Pin C209-5 and the digital TR sensor connector Pin C112-12. • **Is the resistance reading less than 5 ohms?** → **Yes** GO to A21. → **No** REPAIR Circuit 329 (PK) for an open. TEST the system for normal operation.
A21 CHECK CIRCUIT 1093 (T/R) FOR AN OPEN	

1  	1 Measure the resistance of Circuit 1093 (T/R) between the starter relay connector Pin C86 and the digital TR sensor connector Pin C112-10. • **Is the resistance reading less than 5 ohms?** → **Yes** CHECK the digital TR sensor adjustment; refer to Section 307-01A (5R55E) or Section 307-01B (4R70W). If the digital TR sensor is adjusted properly, REPLACE the digital TR sensor. TEST the system for normal operation. → **No** REPAIR Circuit 1093 (T/R) for an open. TEST the system for normal operation.
A22 CHECK CIRCUIT 33 (W/PK) OR CIRCUIT 329 (PK) FOR AN OPEN	
1 Digital TR C112	
2	2 Measure the resistance between the digital TR sensor connector Pin C112-12, Circuit 329 (PK) and the fuse junction panel Fuse 24 output cavity, Circuit 33 (W/PK).



- **Is the resistance reading less than 5 ohms?**

→ **Yes**
GO to A21 .

→ **No**
REPAIR Circuit 33 (W/PK) or Circuit 329 (PK) for an open. TEST the system for normal operation.

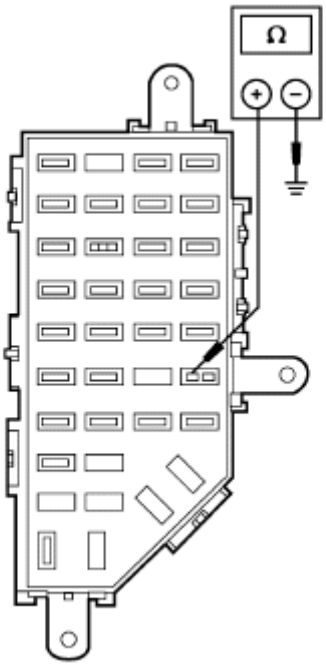
A23 CHECK FOR A SHORTED SYSTEM

1

Starter Relay

2

2 Measure the resistance between the fuse junction panel Fuse 24 output cavity, Circuit 33 (W/PK) and ground.



AJ0333-A

3 If equipped with a manual transmission, press and hold the clutch pedal.

- **Is the resistance reading greater than 10,000 ohms?**

→ **Yes**
INSPECT all circuits and connections. CHECK for chafed wires or an intermittent connection to ground. REPLACE Fuse 24 (7.5A). TEST the system for normal operation.

→ **No**
If equipped with a center console, GO to A27 .

If not equipped with a center console, GO to A24 .

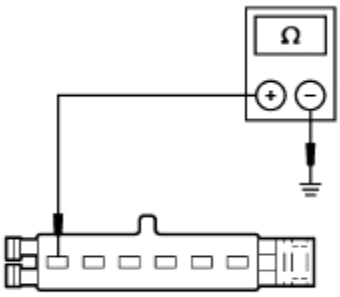
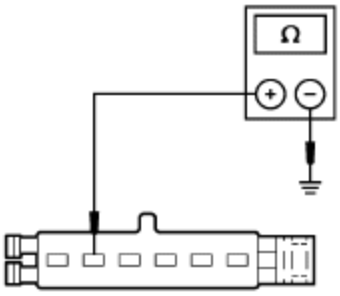
A24 CHECK THE CPP INPUT FOR A SHORT TO GROUND

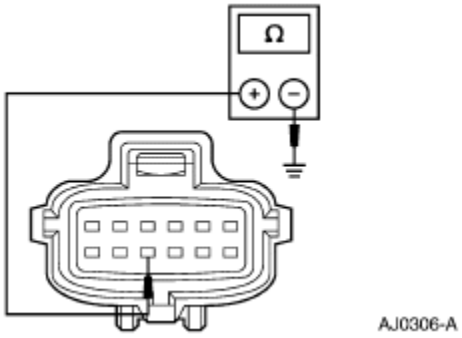
1

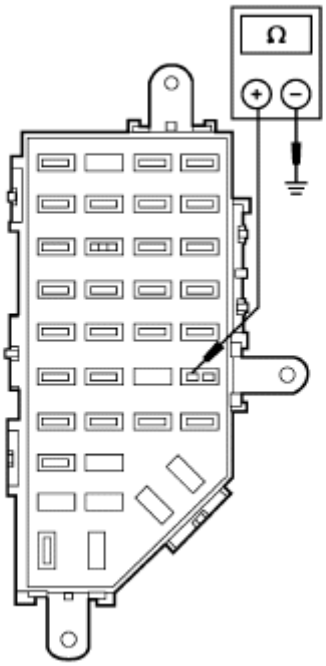
Starter Relay

2

CPP C209

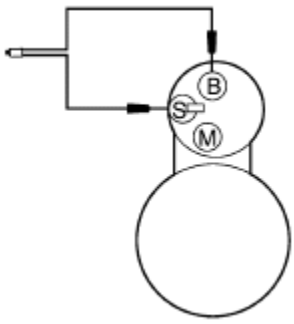
3  AJ0304-A	3 Measure the resistance between the CPP switch or jumper connector Pin C209-6, Circuit 33 (W/PK) and ground. • **Is the resistance reading greater than 10,000 ohms?** → **Yes** If equipped with a manual transmission, REPAIR Circuit 329 (PK) or Circuit 1093 (T/R) for a short to ground. TEST the system for normal operation. If equipped with an automatic transmission, GO to A25 . → **No** REPAIR Circuit 33 (W/PK) for a short to ground. TEST the system for normal operation.
A25 CHECK FOR A SHORTED DIGITAL TRANSMISSION RANGE (TR) SENSOR	
1 Digital TR C1005 2  AJ0305-A	2 Measure the resistance between the CPP switch or jumper connector Pin C209-5, Circuit 329 (PK) and ground. • **Is the resistance reading greater than 10,000 ohms?** → **Yes** GO to A26 .

	→ **No** REPAIR Circuit 329 (PK) for a short to ground. TEST the system for normal operation.
A26 CHECK CIRCUIT 1093 (T/R) FOR A SHORT TO GROUND	
1  	1 Measure the resistance between the digital TR sensor connector Pin C112-10, Circuit 1093 (T/R) and ground. • **Is the resistance reading greater than 10,000 ohms?** → **Yes** CHECK the digital TR sensor adjustment; refer to Section 307-01A (5R55E) or Section 307-01B (4R70W). If the digital TR sensor is adjusted properly, REPLACE the digital TR sensor. TEST the system for normal operation. → **No** REPAIR Circuit 1093 (T/R) for a short to ground. TEST the system for normal operation.
A27 CHECK CIRCUIT 33 (W/PK) OR CIRCUIT 329 (PK) FOR A SHORT TO GROUND	
1 Digital TR C209 2 Starter Relay 3	3 Measure the resistance between the fuse junction panel Fuse 24 output cavity, Circuit 33 (W/PK) and ground.

	• **Is the resistance reading greater than 10,000 ohms?** → **Yes** GO to A26 . → **No** REPAIR circuit 329 (PK) for short to ground. TEST the system for normal operation.

PINPOINT TEST B: UNUSUAL STARTER NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK STARTER MOUNTING	
	1 Inspect the starter mounting bolts and brackets for looseness. • **Is the starter motor mounted properly?** → **Yes** GO to B2 . → **No** INSTALL the starter motor properly; refer to Starter Motor—4.0L or Starter Motor—5.0L in this section. TEST the system for normal operation.

B2 CHECK FOR ENGINE NOISE	
1 2  AJ0286-A	2 Connect a remote starter switch between the starter solenoid B and S terminals. 3 Engage the starter motor and verify the noise is due to the starter operation. • **Is the noise due to the starter motor engagement?** → **Yes** GO to B3 . → **No** REFER to Section 303-00 to continue the diagnosis.
B3 CHECK FOR UNUSUAL WEAR	
	1 Remove the starter motor; refer to Starter Motor—4.0L or Starter Motor—5.0L in this section. 2 Inspect the ring gear for damaged or worn teeth. • **Is the noise due to ring gear tooth damage?** → **Yes** REPLACE the ring gear. EXAMINE the starter pinion teeth. If damaged, REPLACE the starter motor. TEST the system for normal operation. → **No** REPLACE the starter motor. TEST the system for normal operation.

Component Tests

Starter Motor—Voltage Drop Test

WARNING: When servicing the starter motor or performing other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times.

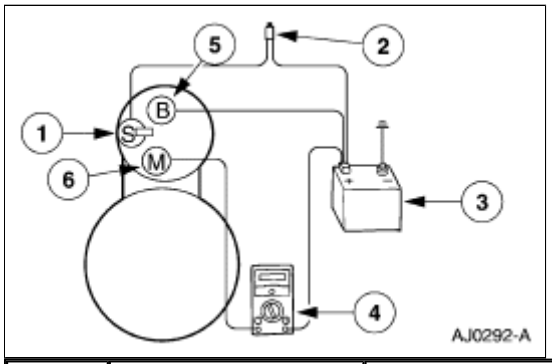
CAUTION: A protective cap or boot is provided over the battery input terminal on all vehicle lines and must be replaced after servicing. Be sure to disconnect the battery ground cable before servicing the starter motor.

Always make the Rotunda 73 Digital Multimeter connections at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

Starter Motor—Motor Feed Circuit

1. Make sure the battery is fully charged; refer to Section 414-00 .
2. Disconnect the inertia fuel shutoff switch (IFS switch) (9341)
3. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.
4. Connect the Rotunda 73 Digital Multimeter positive lead to the battery positive (+) post. Connect negative lead to the starter solenoid M-terminal.

Motor Feed Circuit



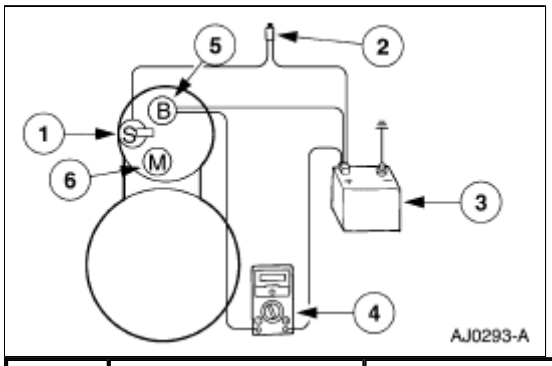
Item	Part Number	Description
1	—	S-Terminal (Part of 11002)
2	—	Remote Starter Switch
3	10653	Battery
4	—	Rotunda 73 Digital Multimeter
5	—	B-Terminal (Part of 11002)
6	—	M-Terminal (Part of 11002)

5. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volts or less.

6. If the voltage reading is 0.5 volts or less, go to the Starter Motor—Motor Ground Circuit Component Test.

7. If the voltage reading is greater than 0.5 volts, indicating excessive resistance, move the Rotunda 73 Digital Multimeter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is lower than 0.5 volts, the concern is either in the connections at the starter solenoid or in the solenoid contacts.

Motor Feed Circuit



Item	Part Number	Description
1	—	S-Terminal (Part of 11002)
2	—	Remote Starter Switch
3	10653	Battery
4	—	Rotunda 73 Digital Multimeter
5	—	B-Terminal (Part of 11002)
6	—	M-Terminal (Part of 11002)

8. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the proper terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.5 volts when checked at the M-terminal or less than 0.5 volts when checked at the B-terminal, the concern is in the solenoid contacts. Replace the starter motor.

9. If the voltage reading taken at the solenoid B-terminal is still greater than 0.5 volts after cleaning the cables and connections at the solenoid, the concern is either in the positive (+) battery cable connection or in the positive battery cable itself.

10. By moving the Rotunda 73 Digital Multimeter negative lead toward the battery and checking each mechanical connection point, the excessive voltage drop can be located. When the high reading disappears, the last mechanical point that was checked is the concern. Repair or replace this connection as required.

Starter Motor—Motor Ground Circuit

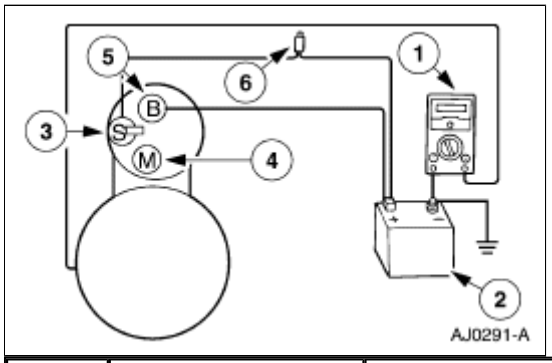
A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Disconnect the inertia fuel shutoff switch.

2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.

3. Connect the Rotunda 73 Digital Multimeter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.

Motor Ground Circuit



Item	Part Number	Description
1	—	Rotunda 73 Digital Multimeter
2	10653	Battery
3	—	S-Terminal (Part of 11002)
4	—	M-Terminal (Part of 11002)
5	—	B-Terminal (Part of 11002)
6	—	Remote Starter Switch

4. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.2 volts or less.

5. If the voltage drop is more than 0.2 volts, clean the negative cable connections at the battery and body connections, and retest.

6. If the voltage drop is greater than 0.2 volts, determine which way the current is flowing in the cable. Connect the Rotunda 73 Digital Multimeter positive lead to the end of the cable nearest battery positive.

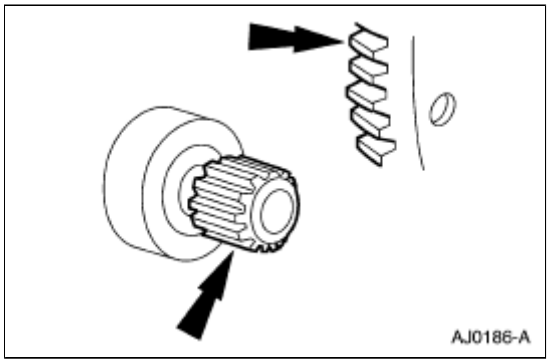
7. Connect the multimeter negative lead to the terminal at the other end of the cable.

8. Crank the engine and observe the voltage reading. The voltage reading should be 0.2 volts or lower. If the voltage drop is too high, clean the terminal ends. Retest, and if still high, replace the cable. If the voltage reading is less than 0.2 volts and the engine still cranks slowly, replace the starter motor.

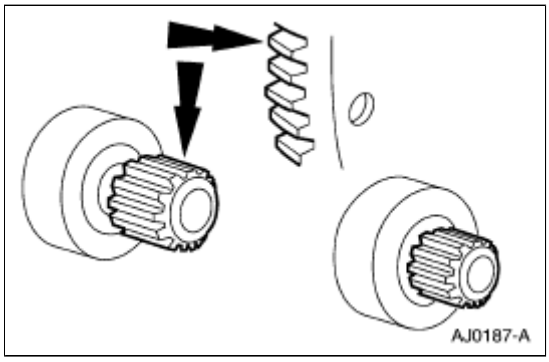
Starter Drive and Flywheel Ring Gear Inspection

1. Remove the starter motor; refer to Starter Motor—4.0L or Starter Motor—5.0L in this section.

2. Check the wear patterns on the starter drive gear and the flywheel ring gear (6384). If the wear pattern is normal, install the starter motor; refer to Starter Motor—4.0L or Starter Motor—5.0L in this section.



3. If the starter drive gear and the flywheel ring gear are not fully meshing and both of the gears are scored or damaged, replace the starter motor; refer to Starter Motor—4.0L or Starter Motor—5.0L in this section. If necessary, replace the flywheel; refer to Section 303-01A (4.0L Push Rod), Section 303-01B (4.0L SOHC) or Section 303-01C (5.0L).



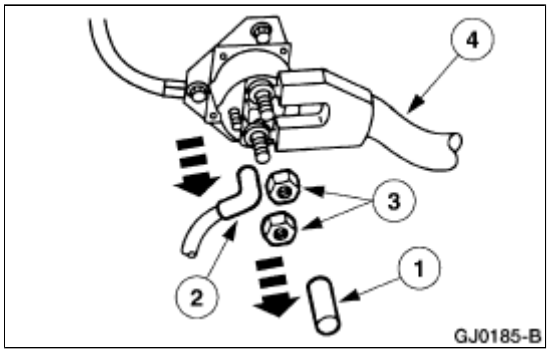
Relay Switch —4.0L

Removal

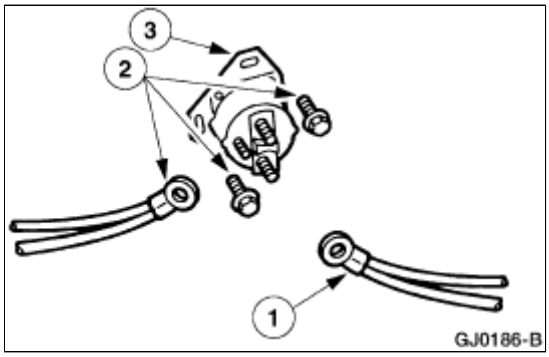
WARNING: When performing maintenance on the starting system be aware that heavy gauge leads are connected directly to the battery (10653). Make sure protective caps are in place.

1. Disconnect the battery ground cable (14301).

2. Disconnect the starter motor solenoid relay switch wiring.
    1. Remove the protective cover.
    2. Disconnect the push-on electrical connector.
    3. Remove the nuts.
    4. Remove the cable.

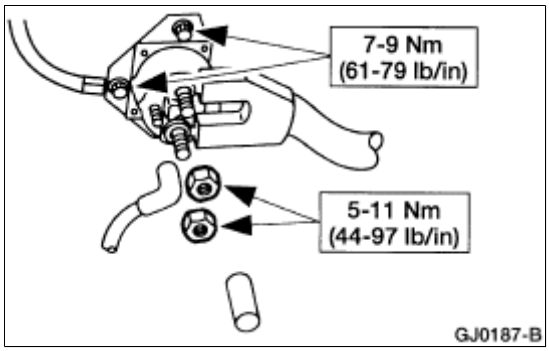


3. Remove the starter motor solenoid relay switch (11450).
    1. Remove the engine sensor/generator wires.
    2. Remove the bolts and ground wire.
    3. Remove the starter motor solenoid relay switch.



Installation

1. Follow the removal procedure in reverse order.

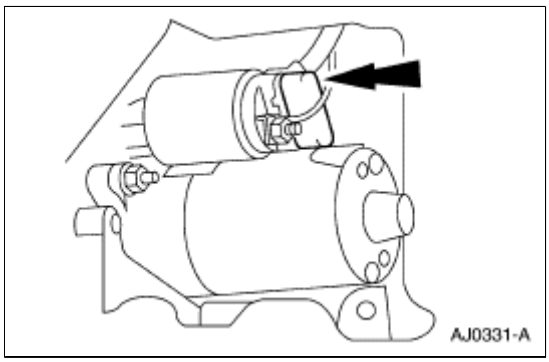

7-9 Nm
(61-79 lb/in)
5-11 Nm
(44-97 lb/in)
GJ0187-B

Starter Motor —4.0L

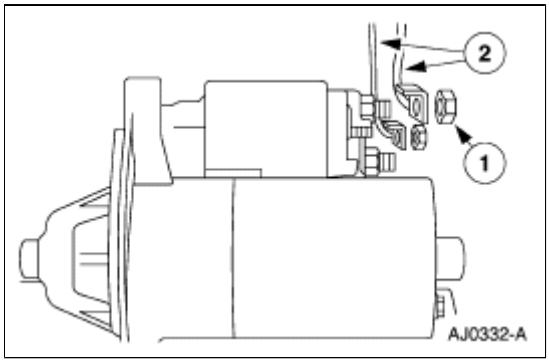
Removal

WARNING: When performing maintenance on the starting system be aware that heavy gauge leads are connected directly to the battery. Make sure protective caps are in place when maintenance is completed.

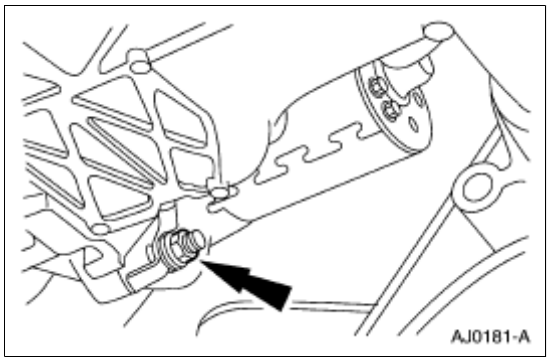
1. Disconnect the battery ground cable (14301).
2. Raise and support the vehicle; refer to Section 100-02 .
3. Remove the starter motor solenoid terminal cover.



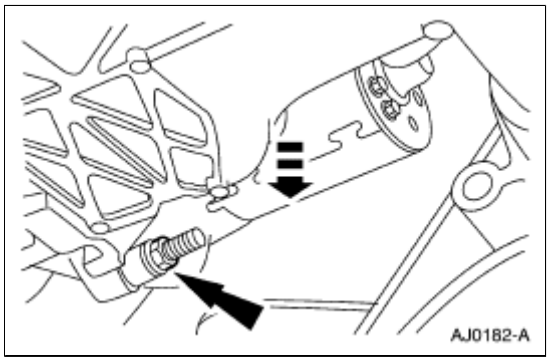
4. Disconnect the starter wires.
    1. Remove the nuts.
    2. Disconnect the wires.



5. Remove the nut and the starter ground cable.

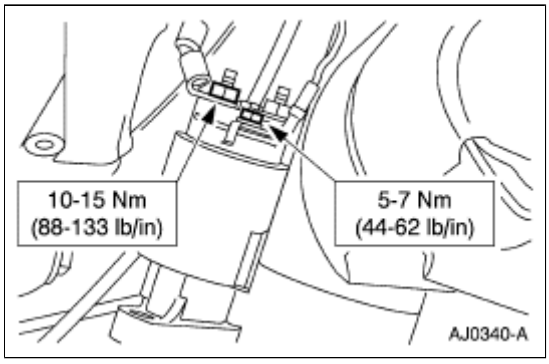


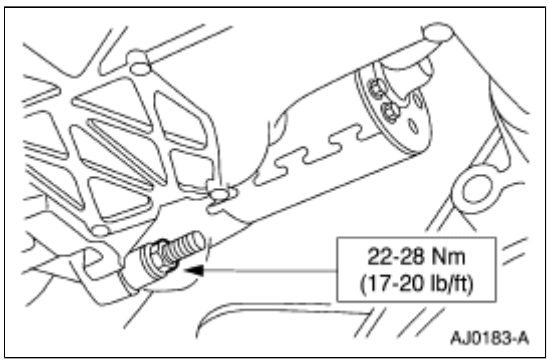
6. Remove the bolt and the starter motor (11002).

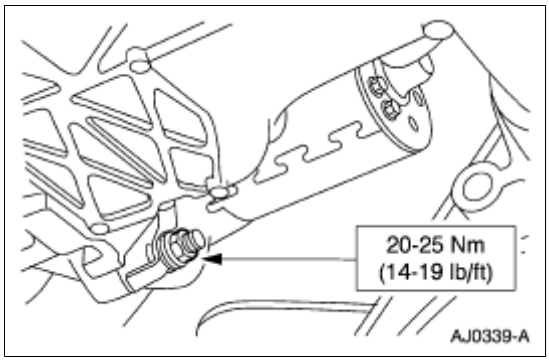


Installation

1. Follow the removal procedure in reverse order.





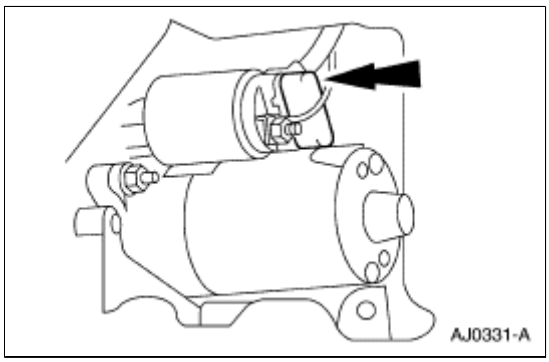

20-25 Nm
(14-19 lb/ft)
AJ0339-A

Starter Motor —5.0L

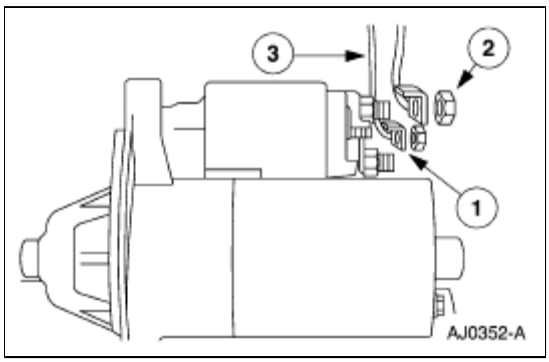
Removal

WARNING: When performing maintenance on the starting system be aware that the heavy gauge leads are connected directly to the battery. Make sure the protective caps are in place when maintenance is completed.

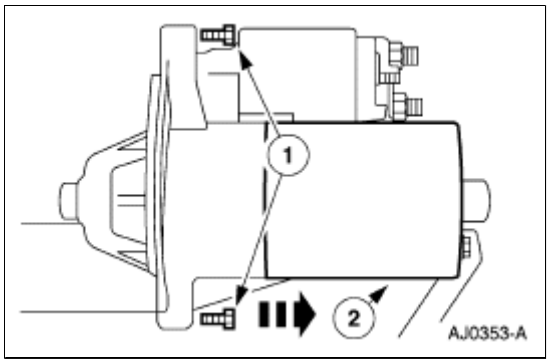
1. Disconnect the battery ground cable (14301).
2. Raise and support the vehicle; refer to Section 100-02 .
3. Remove the starter motor solenoid terminal cover.



4. Disconnect the starter wires.
    1. Disconnect the starter solenoid wire.
    2. Remove the nuts.
    3. Remove the battery cable.

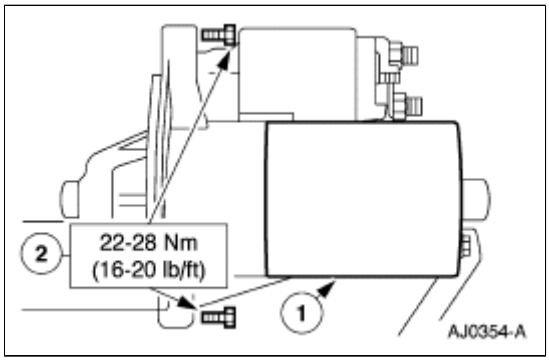


5. Remove the starter motor (11002).
    1. Remove the bolts.
    2. Remove the starter motor.

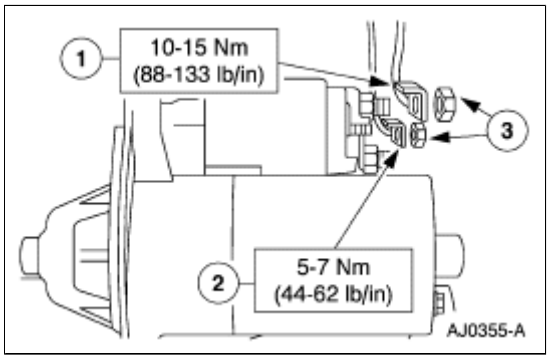


Installation

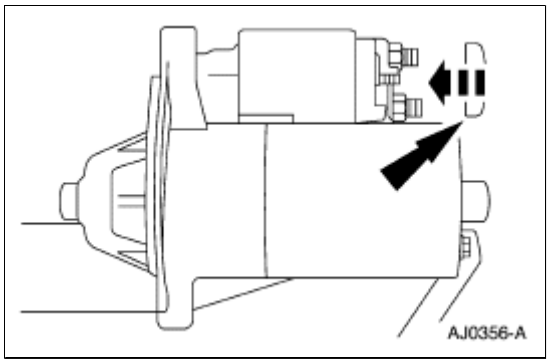
1. Position the starter motor and install the bolts.



2. Connect the starter wiring.
    1. Position the battery cable.
    2. Position the starter solenoid wire.
    3. Install the nuts.



3. Install the starter motor solenoid terminal cover.


AJ0356-A

General Specifications

Item	Specification
Base timing	10 degrees; BTDC Non-adjustable
Firing order	1-4-2-5-3-6
Spark plug gap	1.3-1.4 mm (.052-.056 in)
RH original spark plug	AGRF22PG
LH original spark plug	AGRF22P
New spark plug (either side)	AGSF22PP
Lubrication	
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil bolts	6	—	53
Spark plugs	20	15	—

Engine Ignition

The 4.0L (push rod) engine ignition system consists of the:

- crankshaft position (CKP) sensor
- ignition coil
- spark plug wire
- spark plugs

The ignition system:

- is an electronic ignition system controlled by an electronic engine control integrated into the powertrain control module (PCM).
- base timing is set at 10 degrees before top dead center (BTDC) and is not adjustable.

The crankshaft position (CKP) sensor :

- is a variable reluctance sensor.
- senses a missing tooth on the crankshaft damper pulse ring.
- generates a crankshaft position signal which is sent to the PCM. The PCM counts this signal for engine rpm.

For additional information on the CKP sensor, Refer to Section 303-14 .

The ignition coil :

- changes low voltage pulses from the PCM to high voltage pulses.
- has three transformers.

The spark plug wires carry high voltage pulses from the ignition coil to the spark plugs.

The spark plugs :

- change high voltage pulses into spark at the gap, which ignites the fuel and air mixture.
- have a platinum-enhanced active electrode for long life. The active electrode is different for LH and RH sides.
- have replacements (with both electrodes platinum-enhanced) so they can be used on either side.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Ignition Coil

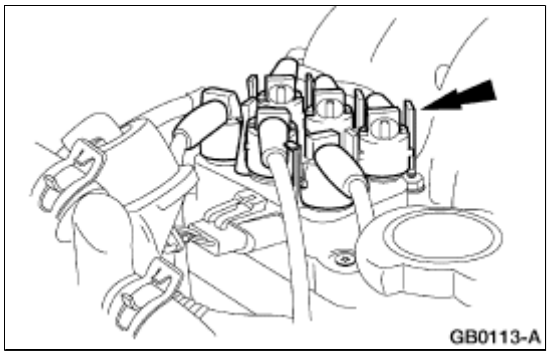
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

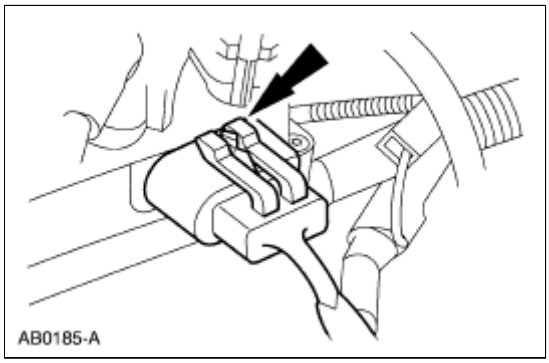
2. **NOTE:** Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire locations before removing them.

   NOTE: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

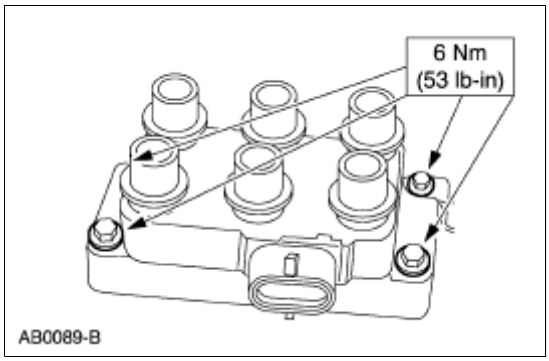
   Squeeze the locking tabs and twist while pulling upward to disconnect the six spark plug wires.



3. Disconnect the ignition coil electrical connector.



4. Remove the ignition coil.



5. **NOTE:** Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A to the inside of the spark plug wire coil boot.

   NOTE: Be sure to reinstall the radio ignition interference capacitor under the correct mounting bolt.

   To install, reverse the removal procedure.

Spark Plug Wire

Special Tool(s)

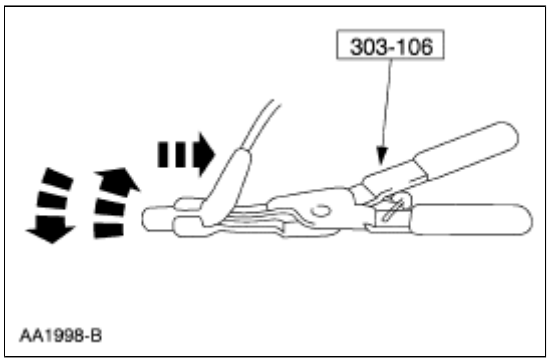
ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666A)

Removal and Installation

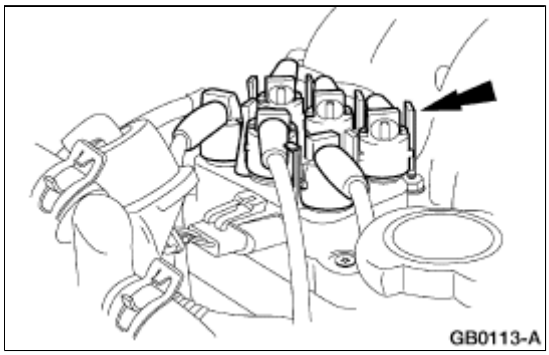
CAUTION: Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire locations before removing them.

NOTE: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

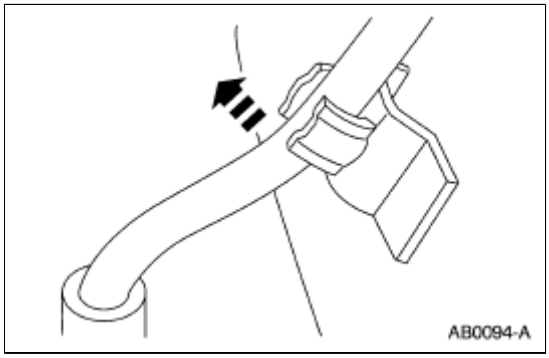
1. Use the special tool with a twisting motion to pull the spark plug wire off the spark plug.



2. Squeeze the locking tabs and twist while pulling upward to disconnect the spark plug wires from the ignition coil.



3. Remove the spark plug wires from the retaining brackets and remove the spark plug wires.



4. **NOTE:** Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.

   NOTE: Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171A to the inside of spark plug and ignition coil boots of the spark plug wire.

   To install, reverse the removal procedure.

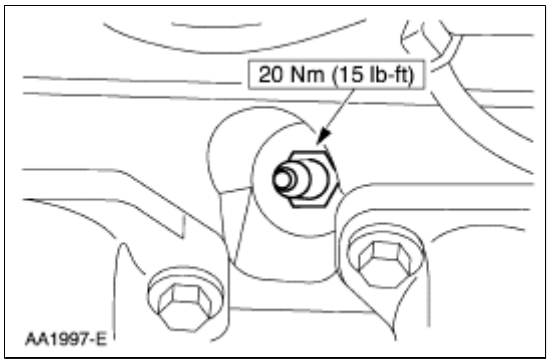
Spark Plug

Removal and Installation

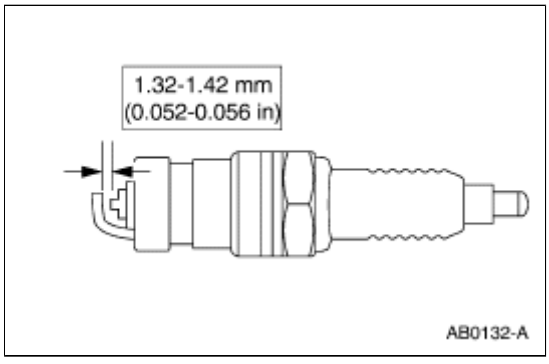
1. Remove the spark plug wires. For additional information, refer to Spark Plug Wire in this section.
2. **NOTE:** Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

   NOTE: If an original spark plug is reused, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

   Remove the spark plugs.



3. Inspect the spark plugs. For additional information, refer to Section 303-00 .
4. Use a suitable spark plug gap tool to check and adjust the spark plug gap.



5. To install, reverse the removal procedure.

General Specifications

Item	Specification
Base timing	10° BTDC Non-adjustable
Firing order	1-4-2-5-3-6
Spark plug gap	1.3-1.4 mm (.052-.056 in)
RH original spark plug	AGRF22PG
LH original spark plug	AGRF22P
New spark plug (either side)	AGSF22PP
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil bolts	6	—	53
Spark plugs	20	15	—

Engine Ignition

The ignition system consists of the following:

- crankshaft position (CKP) sensor
- ignition coil
- spark plug wire
- spark plug

The ignition system is:

- an electronic distributorless ignition system (EDIS) is controlled by an electronic engine control integrated into the powertrain control module (PCM).
- set at 10 degrees before top dead center (BTDC) for base timing, and is not adjustable.

The crankshaft position (CKP) sensor:

- is a variable reluctance sensor.
- senses a missing tooth on the crankshaft damper pulse ring.
- generates a crankshaft position signal which is sent to the PCM. The PCM counts this signal for engine rpm.

For additional information on the CKP sensor, refer to Section 303-14 .

The ignition coil:

- changes low voltage pulses from the PCM to high voltage pulses.
- has three transformers.
- fires two spark plugs simultaneously.

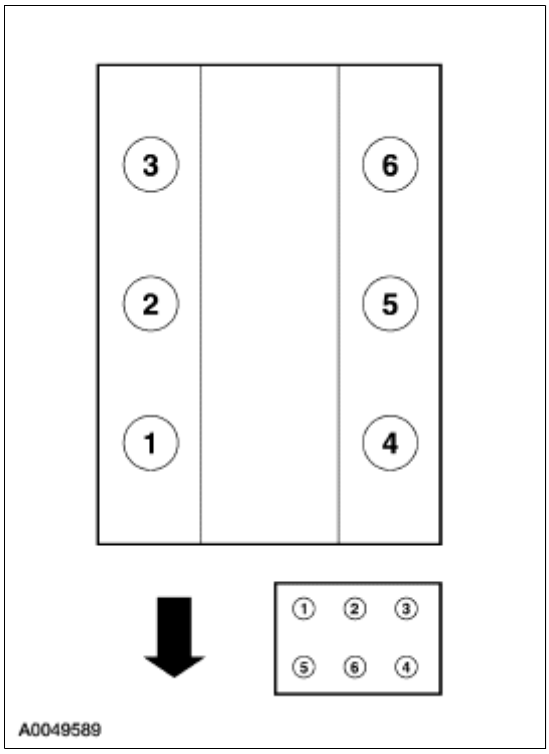
Spark plug wires carry high voltage pulses from the ignition coil to the spark plugs.

The spark plugs:

- change high voltage pulses to spark at the gap, which ignites the fuel and air mixture.

The firing order is: 1-4-2-5-3-6.

Coil Terminal-To-Cylinder Relationship


3
6
2
5
1
4
1 2 3
5 6 4
A0049589

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Ignition Coil

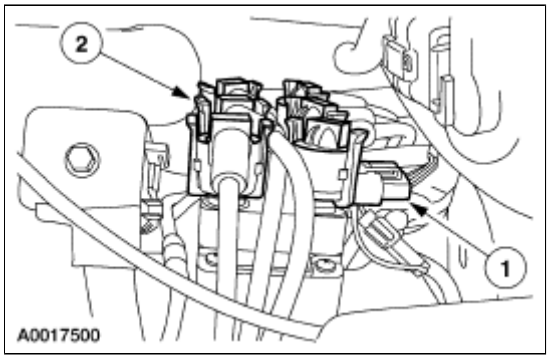
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

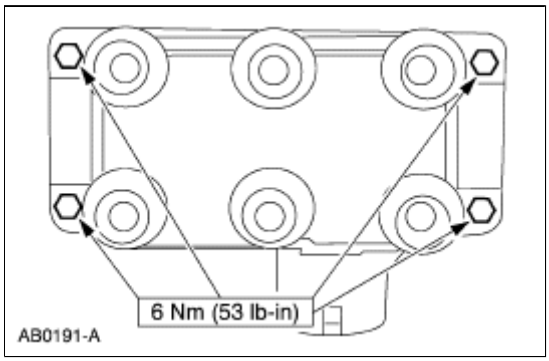
2. Disconnect the ignition coil electrical connections.
   1. Disconnect the ignition coil electrical connector.
   2. **CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.**

      NOTE: Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire locations before removing them.

      Squeeze the locking tabs and twist while pulling upward to disconnect the six spark plug wires.



3. Remove the bolts and the ignition coil.



4. **NOTE:** Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A to the inside of the spark plug wire coil boots.

   NOTE: Be sure to reinstall the radio ignition interference capacitor under the correct ignition coil mounting bolt.

   To install, reverse the removal procedure.

Spark Plug Wire

Special Tool(s)

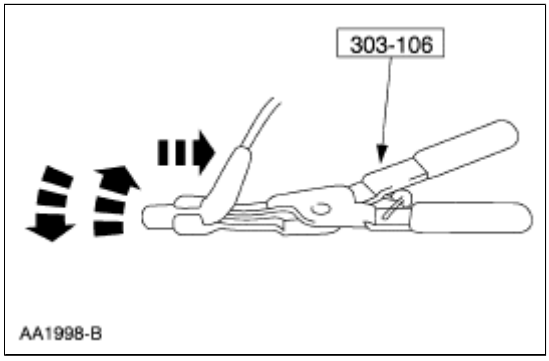
ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666-A)

Removal and Installation

1. Remove the right front tire. For additional information, refer to Section 204-04 .
2. Remove the right front fenderwell splash shield.
3. **CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

   CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

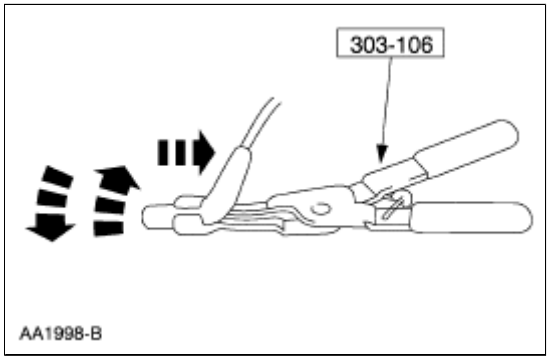
   With a twisting motion, use the special tool to pull the spark plug wires from the right side of the engine.

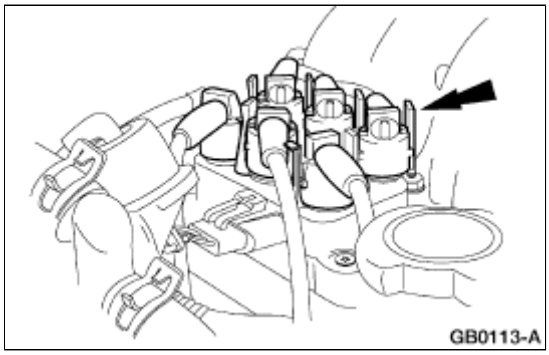
4. Lower the vehicle.
5. **CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

   CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

With a twisting motion, use the special tool to pull the spark plug wires from the left side of the engine.



6. Squeeze the locking tabs and twist while pulling upward to remove the spark plug wires from the ignition coil.



7. Disconnect the spark plug wires from the separators and remove the spark plug wires.

8. **CAUTION: Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.**

NOTE: Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A to the inside of the spark plug and ignition coil boots of the spark plug wire.

To install, reverse the removal procedure.

Spark Plug

Special Tool(s)

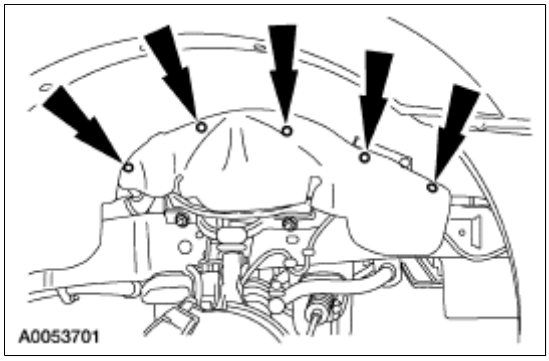
ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666-A)

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation

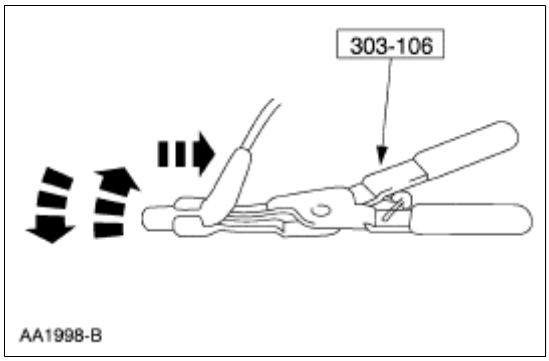
1. Remove the right front tire and wheel. For additional information, refer to Section 204-04 .
2. Remove the right front fenderwell splash shield.



3. **CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

   CAUTION: It is important to twist the spark plug wire boots while pulling upwards, to avoid possible damage to the spark plug wires.

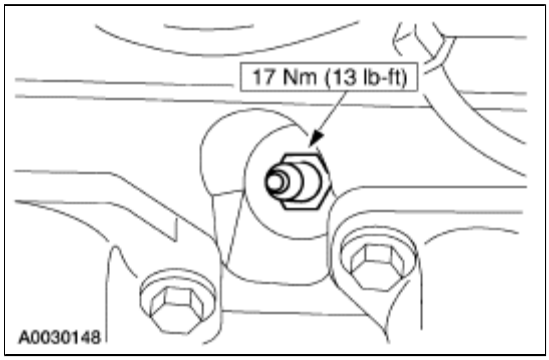
   With a twisting motion, use the special tool to pull the spark plug wires from the right side of the engine.



4. **NOTE:** Use compressed air to remove any foreign material in the spark plug wells before removing the spark plugs.

   NOTE: If an original spark plug is reused, make sure it is installed in the same cylinder it was taken from. New spark plugs can be used in any cylinder.

   Remove the RH spark plugs.

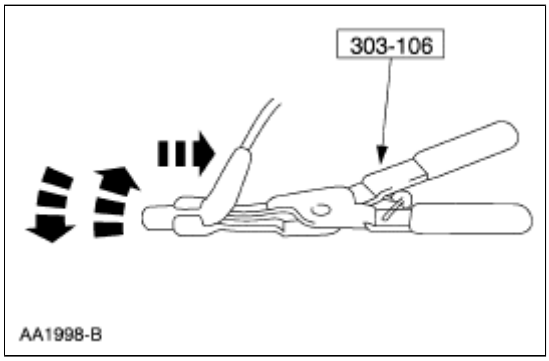


5. Lower the vehicle.

6. **CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

   CAUTION: It is important to twist the spark plug wire boots while pulling upwards, to avoid possible damage to the spark plug wires.

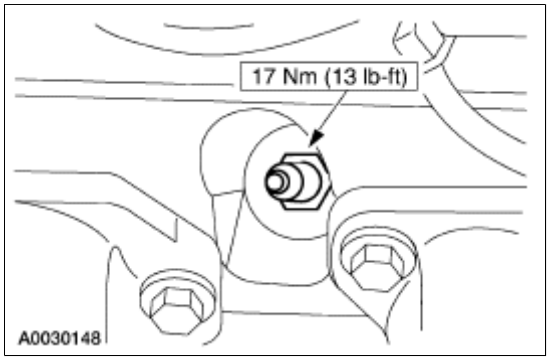
   With a twisting motion, use the special tool to pull the spark plug wires from the left side of the engine.



7. **NOTE:** Use compressed air to remove any foreign material in the spark plug wells before removing the spark plugs.

   NOTE: If an original spark plug is reused, make sure it is installed in the same cylinder it was taken from. New spark plugs can be used in any cylinder.

   Remove the LH spark plugs.



8. Inspect the spark plugs. For additional information, refer to Section 303-00 .

9. Use a suitable spark plug gap tool to check and adjust the spark plug gap.

10. To install, reverse the removal procedure.
    - Apply silicone dielectric compound to the inside of the spark plug wire boots.

General Specifications

Item	Specification
Base timing	10° BTDC Non-adjustable
Firing order	1-3-7-2-6-5-4-8
Spark plug gap	1.3-1.4 mm (.052-.056 in)
RH original spark plug	AWSF32EG
LH original spark plug	AWSF32E
New spark plug (either side)	AWSF32EE
Lubricant	
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil bolts	6	—	53
Spark plugs	20	15	—

Engine Ignition

The 5.0L ignition system consists of the:

- crankshaft position (CKP) sensor
- ignition coil
- spark plug wire
- spark plugs

The ignition system is:

- an electronic distributorless ignition system (EDIS) controlled by an electronic engine control integrated into the powertrain control module (PCM).
- set at 10 degrees before top dead center (BTDC) for base timing and it is not adjustable.

The crankshaft position sensor:

- is a variable-reluctance sensor.
- senses a missing tooth on crankshaft damper pulse ring.
- generates a crankshaft position signal which is sent to the powertrain control module. The powertrain control module counts this signal for engine rpm and spark advance.

For additional information on the CKP sensor, refer to Section 303-14 .

The ignition coil:

- changes low voltage pulses from the powertrain control module to high voltage pulses.
- has two transformers.

Spark plug wires:

- carry high voltage pulses from the ignition coil to the spark plugs.

The spark plugs:

- change high voltage pulses to spark at gap which ignites fuel and air mixture.
- have a platinum-enhanced active electrode for long life. The active electrode is different for LH and RH sides.
- have replacements with both electrodes platinum-enhanced so they can be used on either side.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Ignition Coil

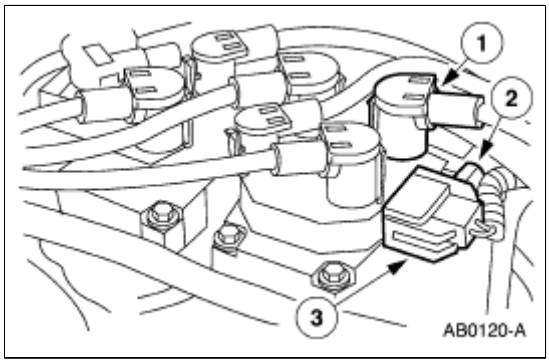
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

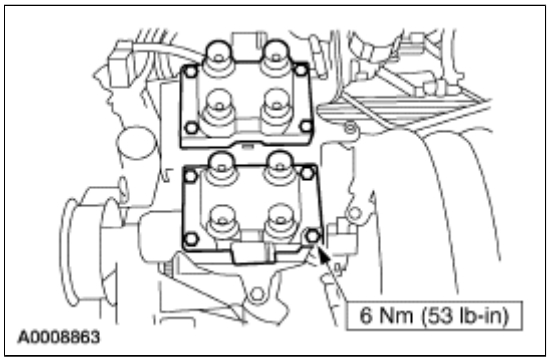
2. **CAUTION: The spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire locations before removing them.**

   CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

   Disconnect the ignition coil electrical connections.
   1. Squeeze the locking tab and twist while pulling upward to disconnect the eight spark plug wires.
   2. Disconnect the radio ignition interference capacitor electrical connector.
   3. Disconnect the two ignition coil electrical connectors.



3. Remove the ignition coils.



4. **NOTE:** Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A to the inside of the spark plug wire ignition coil boots.

   To install, reverse the removal procedure.

Spark Plug Wire

Special Tool(s)

ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666-A)

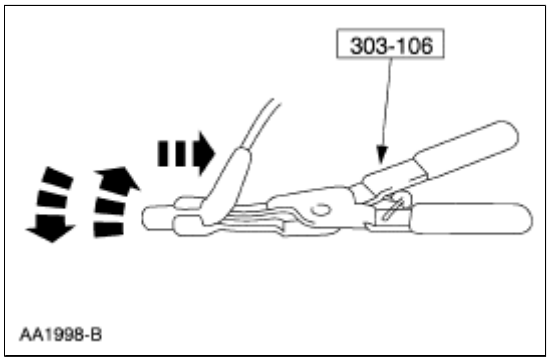
Removal

CAUTION: The spark plug wires must be connected correctly. Mark the spark plug wires before removing them from the spark plugs.

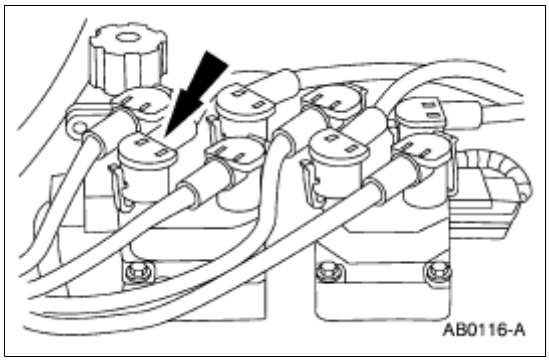
CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

CAUTION: Do not use special tool on spark plug wire boots with metal heat shields. Damage to the spark plug wire boots may occur.

1. Use the special tool to pull the spark plug wire off the spark plug with a twisting motion.



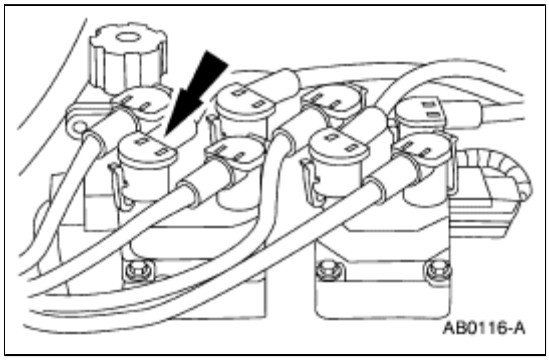
2. Squeeze the locking tab and twist while pulling upward to remove the spark plug wires from the ignition coils.



Installation

1. **NOTE:** Apply Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A to the inside of spark plug and ignition coil boots of the spark plug wire.

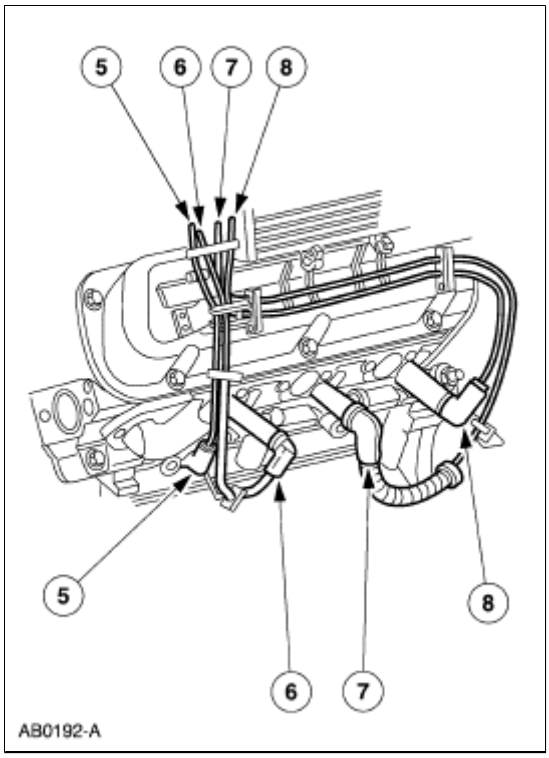
   Connect the spark plug wires to the ignition coils.



2. **CAUTION: Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.**

   Install the LH spark plug wire.

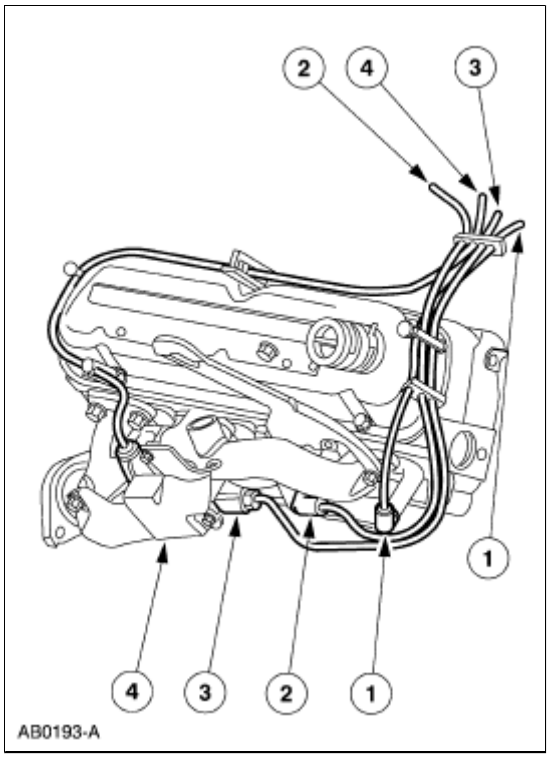
Item	Orientation
5	12 o'clock
6	8 o'clock
7	4 o'clock
8	1 o'clock



3. **CAUTION: Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.**

   Install the RH spark plug wire.

Item	Orientation
1	1 o'clock
2	3 o'clock
3	3 o'clock
4	12 o'clock


2
4
3
1
4
3
2
1
AB0193-A

Spark Plug

Special Tool(s)

ST1394-A	Spark Plug Wire Remover 303-106 (T74P-6666-A)

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

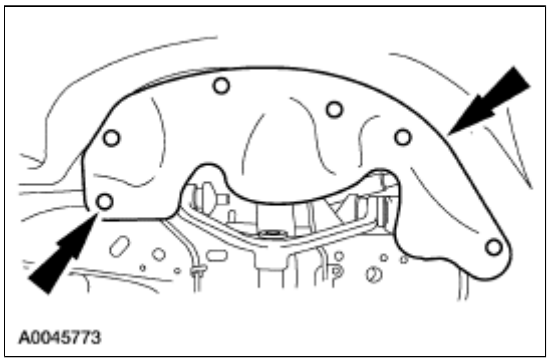
Removal and Installation

CAUTION: The spark plug wires must be connected correctly. Mark the spark plug wires before removing them from the spark plugs.

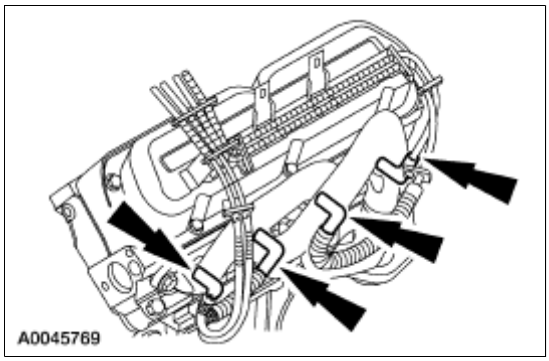
CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wires.

CAUTION: Do not use a special tool on spark plug wire boots with metal heat shields. Damage to the spark plug wire boots can occur.

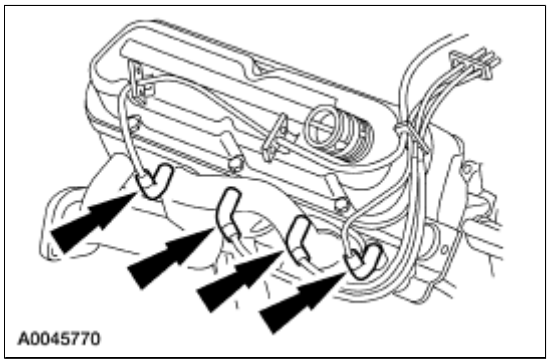
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the pushpins and the LH and RH front wheel well splash shields.



3. Disconnect the left side spark plug wires.



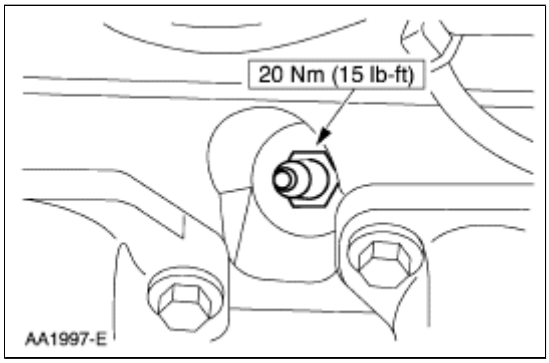
4. Disconnect the right side spark plug wires.



5. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

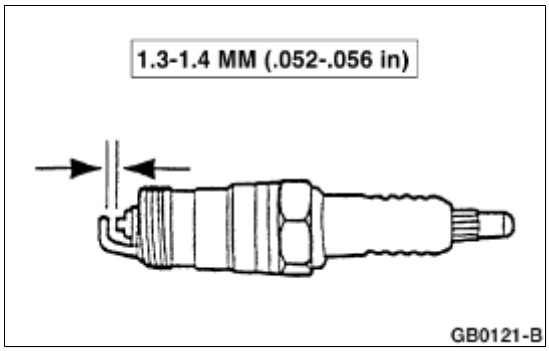
   NOTE: If an original spark plug is reused, make sure it is installed in the same cylinder it was taken from. New spark plugs can be used in any cylinder.

   Remove the spark plugs.



6. Inspect the spark plugs. For additional information, refer to Section 303-00 .

7. Use a suitable spark plug gap tool to check and adjust the spark plug gap.



8. To install, reverse the removal procedure.
    - Lightly coat the inside of the spark plug boots with brake caliper grease.

Torque Specifications

Description	Nm	lb-ft	lb-in
5.0L			
Differential pressure feedback EGR nuts	4.5-7	—	41-62
EGR tube fittings	34-48	26-35	—
EGR valve bolts	20	15	—
EGR vacuum regulator solenoid nuts	8-12	—	71-106
4.0L (Push Rod)			
Differential pressure feedback EGR screws	8-10	—	72-89
EGR tube bracket (upper) stud	40	30-40	—
EGR tube fittings (lower)	34-46	25-33	—
EGR valve bolts	20	15	—
EGR vacuum regulator solenoid nuts	8-12	—	71-106
Oil level indicator tube nut	20-30	15-22	—
Upper EGR tube retaining stud bolt	40-55	30-40	—
4.0L SOHC			
Differential pressure feedback EGR bolts	8-10	—	72-89
EGR tube bracket (upper) bolt	7.6-10.4	—	68-92
EGR tube fittings (lower)	34-46	25-33	—
EGR tube fittings (upper)	34-46	25-33	—
EGR valve bolts	20	15	—
EGR vacuum regulator solenoid nuts	8-12	—	71-106
Power steering bracket bolts	7.6-10.4	—	68-92
Engine accessory bracket bolts	40.3-54.7	30-40	—

Engine Emission Control

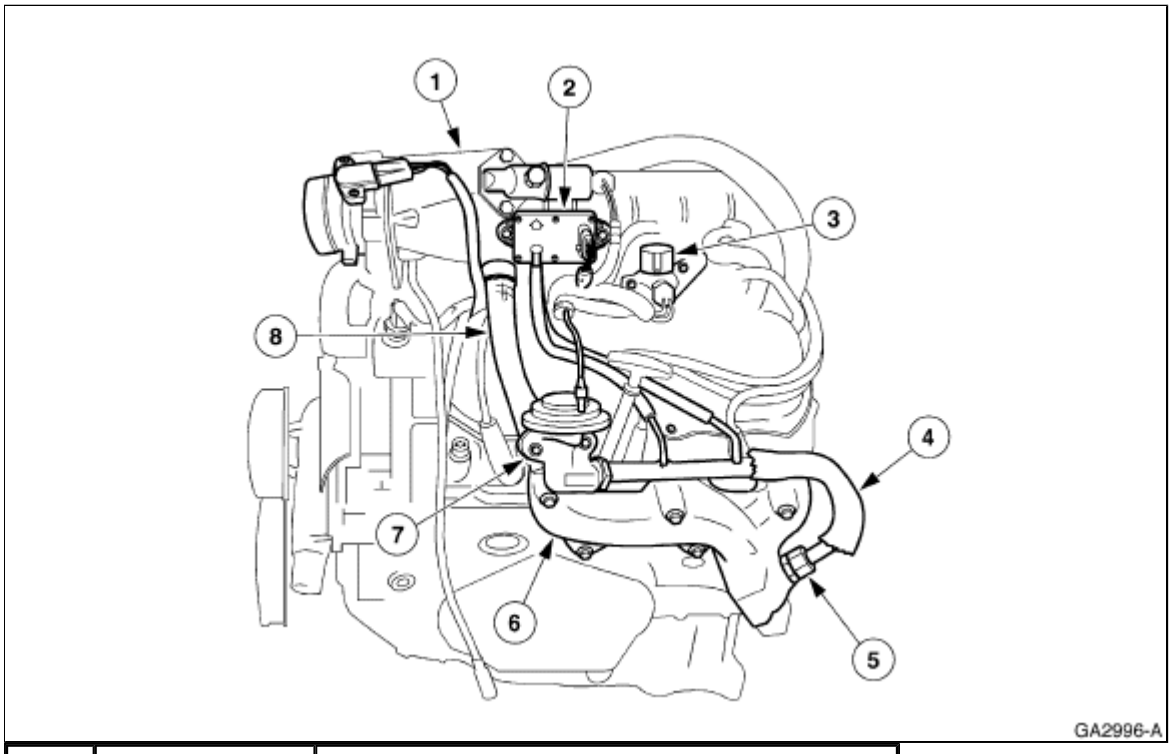
The engine emission control system consists of the:

- EGR valve (EGR valve) (9D475)
- differential pressure feedback EGR
- EGR vacuum regulator solenoid (9J459)
- EGR tube

The engine emissions control system:

- cycles crankcase gases back through the engine intake system.
- regulates ventilating air and blow-by fuel vapors.
- reintroduces exhaust gases into the combustion cycle.
- assists in the reduction of nitrogen oxides.

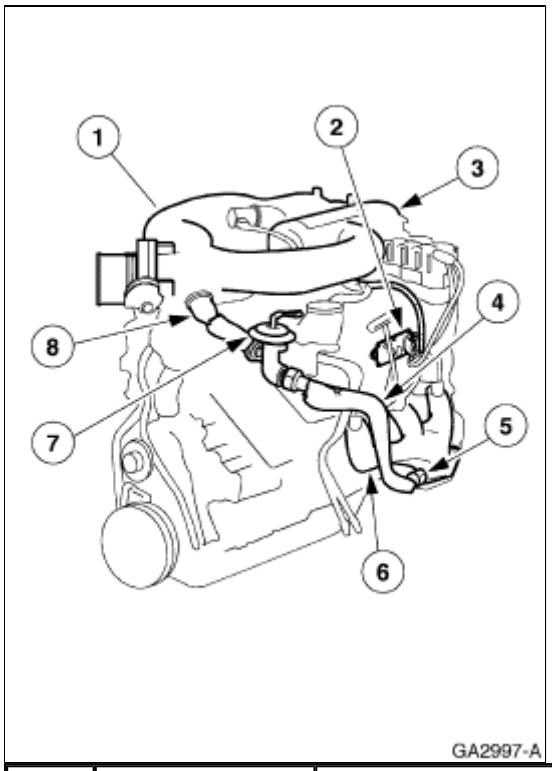
4.0L (Push Rod)



Item	Part Number	Description
1	9424	Intake manifold
2	9J433	Differential pressure feedback EGR
3	9J459	EGR vacuum regulator solenoid
4	9E469	EGR tube, lower
5	9F485	EGR valve tube to manifold connector

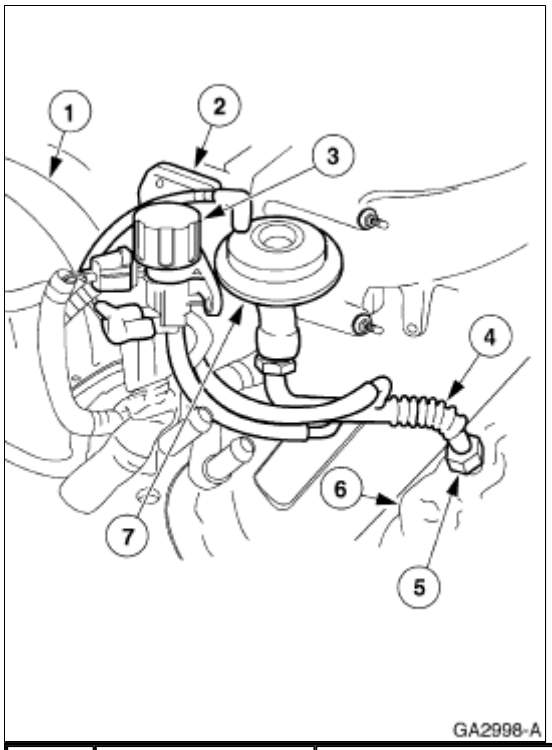
6	9430	Exhaust manifold
7	9D475	EGR valve
8	9E469	EGR tube, upper

4.0L SOHC



Item	Part Number	Description
1	9424	Intake manifold
2	9J433	Differential pressure feedback EGR
3	9J459	EGR vacuum regulator solenoid
4	9E469	EGR tube, lower
5	9F485	EGR valve tube to manifold connector
6	9430	Exhaust manifold
7	9D475	EGR valve
8	9E469	EGR tube, upper

5.0L



Item	Part Number	Description
1	9424	Intake manifold
2	9J433	Differential pressure feedback EGR
3	9J459	EGR vacuum regulator solenoid
4	9D477	EGR tube
5	9F485	EGR valve tube to manifold connector
6	9430	Exhaust manifold
7	9D475	EGR valve

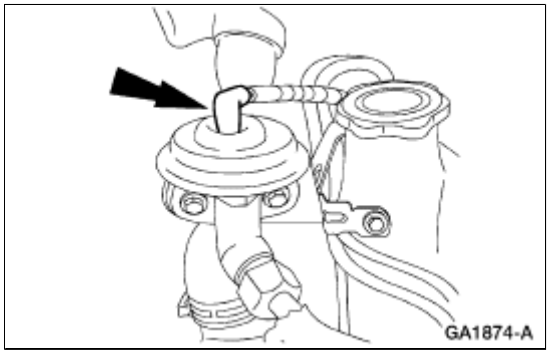
Engine Emission Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

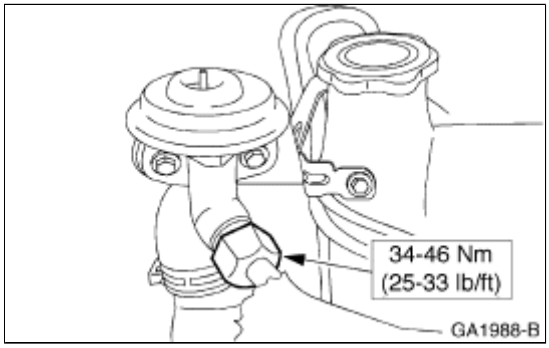
EGR Valve —4.0L SOHC

Removal and Installation

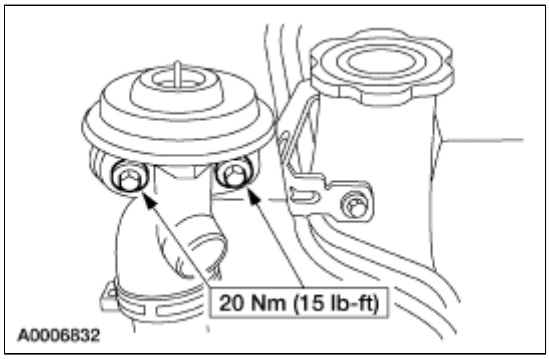
1. Disconnect the EGR valve vacuum connection.



2. Disconnect the EGR tube upper fitting.



3. Remove the EGR valve bolts and the EGR valve.



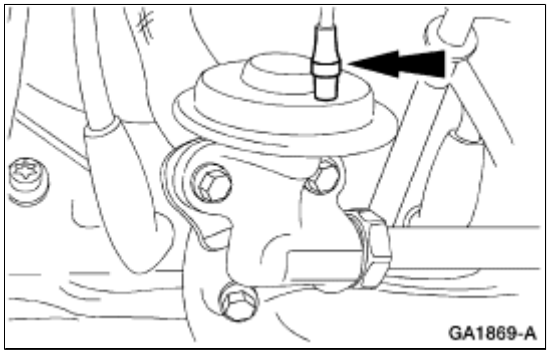
4. **NOTE:** The EGR valve sealing surfaces are soft metals.

   To install, reverse the removal procedure.
   - Carefully clean all sealing surfaces and install a new EGR valve gasket.

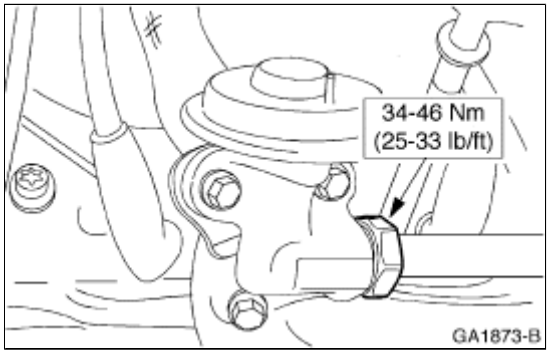
EGR Valve —4.0L (Push Rod)

Removal and Installation

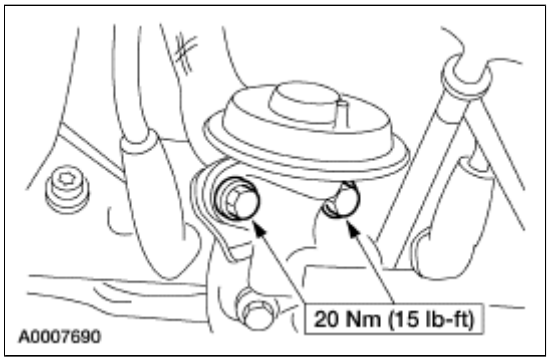
1. Disconnect the EGR valve vacuum connection.



2. Disconnect the lower EGR tube upper fitting.



3. Remove the EGR valve bolts and the EGR valve.



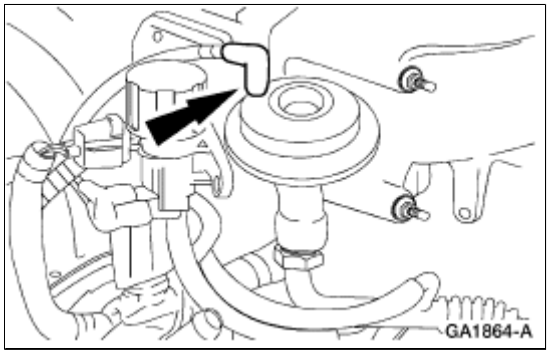
4. **NOTE:** The EGR valve sealing surfaces are soft metals.

   To install, reverse the removal procedure.
   - Carefully clean all sealing surfaces and install a new EGR valve gasket.

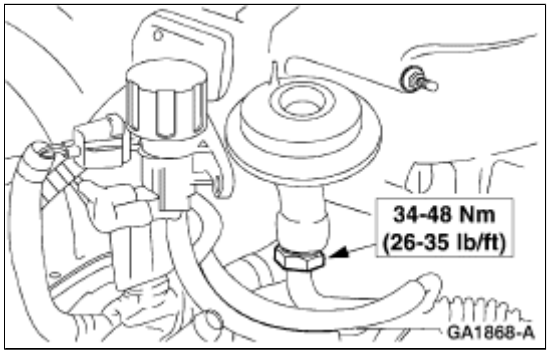
EGR Valve —5.0L

Removal and Installation

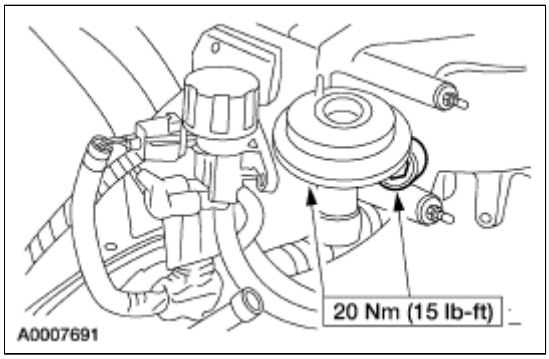
1. Disconnect the EGR valve vacuum connection.



2. Disconnect the EGR tube upper fitting.



3. Remove the two bolts and the EGR valve.



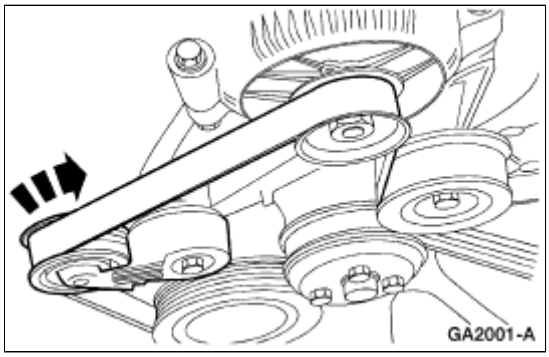
4. **NOTE:** The EGR valve sealing surfaces are soft metals.

   To install, reverse the removal procedure.
   - Carefully clean all sealing surfaces and install a new EGR valve gasket.

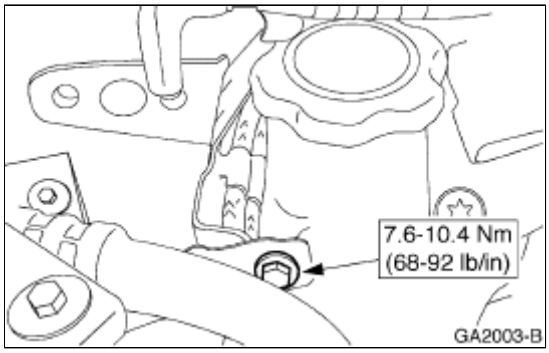
EGR Valve Tube —Upper, 4.0L SOHC

Removal and Installation

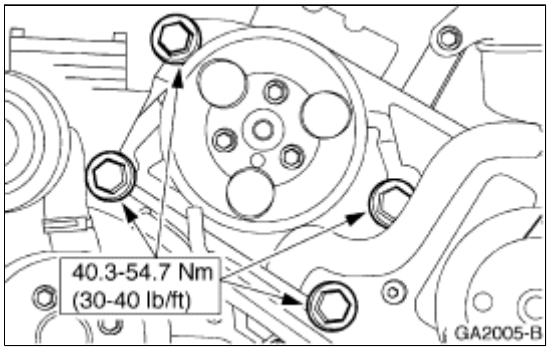
1. Remove the EGR valve. For additional information, refer to EGR Valve—4.0L SOHC in this section.
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Release the tension on the accessory drive belt and position the belt aside.



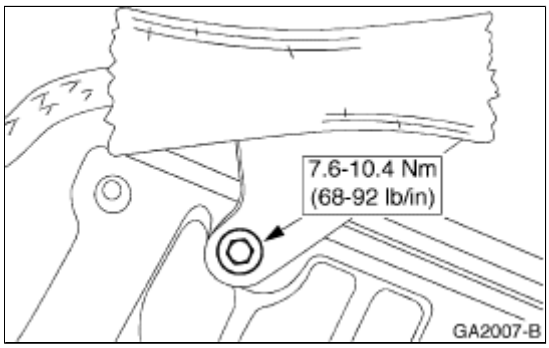
4. Remove the bolt.



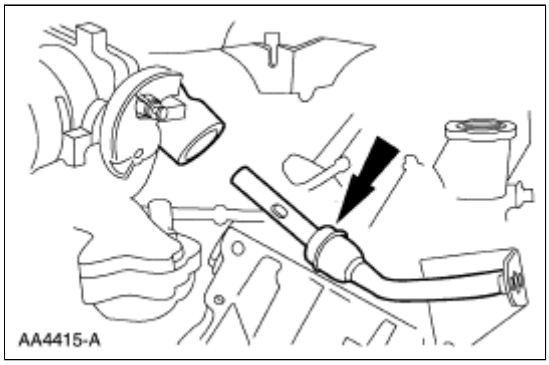
5. Remove the bolts and positon the engine accessory bracket forward.



6. Remove the bolt.



7. Remove the upper EGR tube.
    1. Inspect the O-ring seal and install a new O-ring seal if necessary.



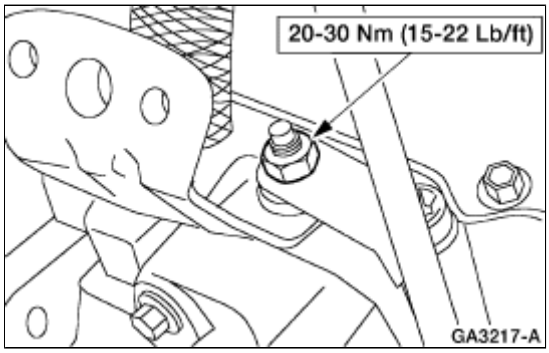
8. To install, reverse the removal procedure.

EGR Valve Tube —Upper, 4.0L (Push Rod)

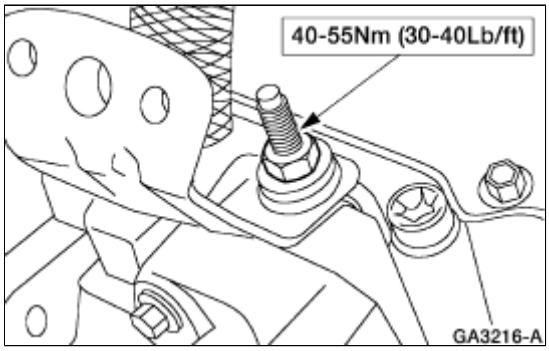
Removal and Installation

1. Remove the EGR valve. For additional information, refer to EGR Valve—4.0L (Push Rod) in this section.

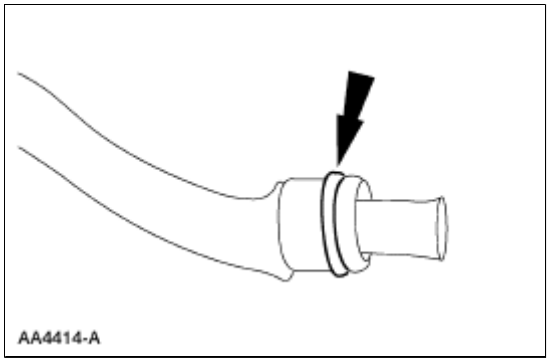
2. Remove the nut and position the oil level indicator tube aside.



3. Remove the upper EGR tube retaining stud bolt.



4. Remove the upper EGR tube.
   - Inspect the O-ring seal and install a new O-ring seal if necessary.

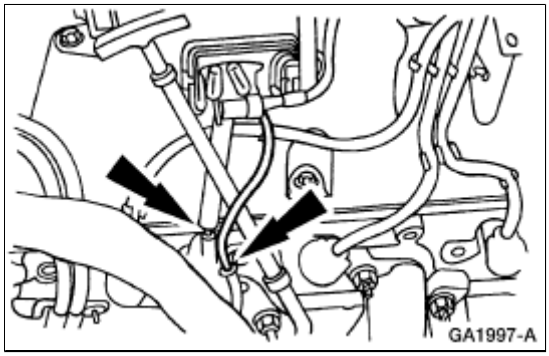


5. To install, reverse the removal procedure.

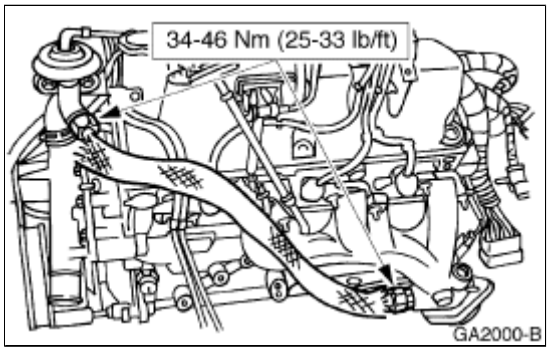
EGR Valve Tube —Lower, 4.0L SOHC

Removal and Installation

1. Disconnect the EGR pressure transducer hoses.



2. Disconnect the lower EGR tube fittings.

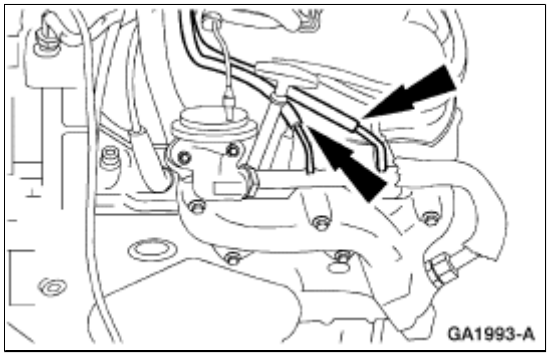


3. To install, reverse the removal procedure.

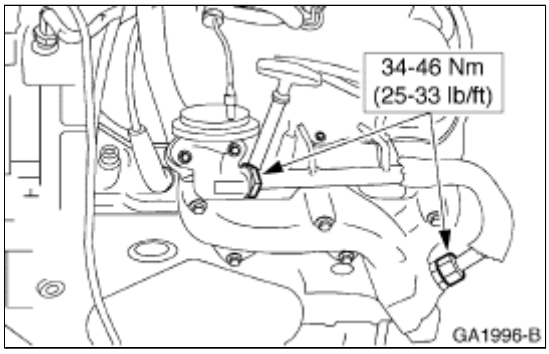
EGR Valve Tube —Lower, 4.0L (Push Rod)

Removal and Installation

1. Disconnect the EGR pressure transducer hoses.



2. Disconnect the lower EGR tube fittings.

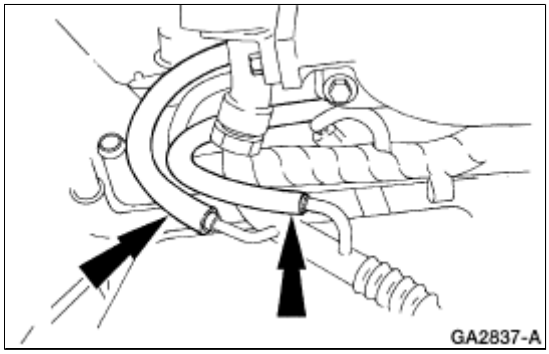


3. To install, reverse the removal procedure.

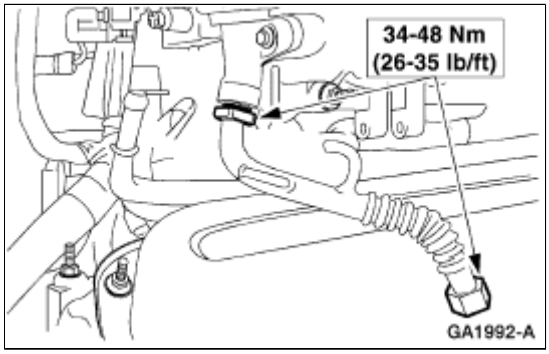
EGR Valve Tube —5.0L

Removal and Installation

1. Disconnect the EGR pressure transducer hoses.



2. Disconnect the EGR tube fittings.

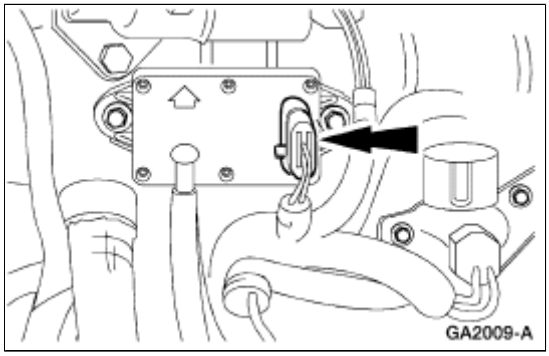


3. To install, reverse the removal procedure.

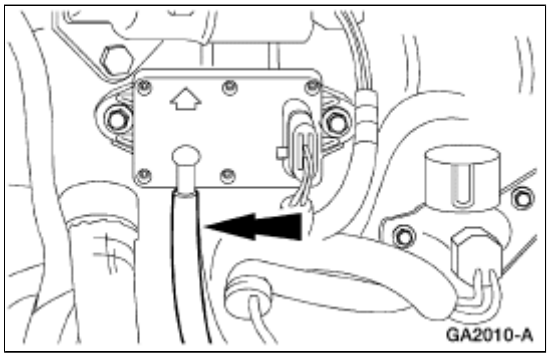
Differential Pressure Feedback EGR

Removal

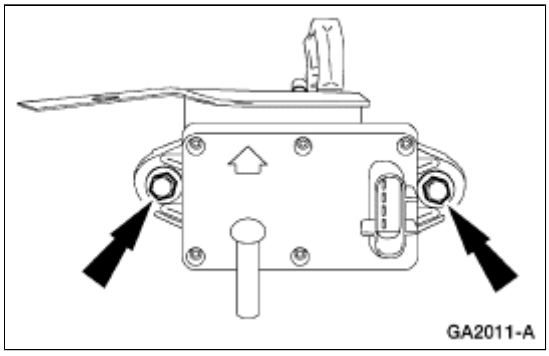
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the differential pressure feedback EGR electrical connector.



3. Disconnect the differential pressure feedback EGR hoses.

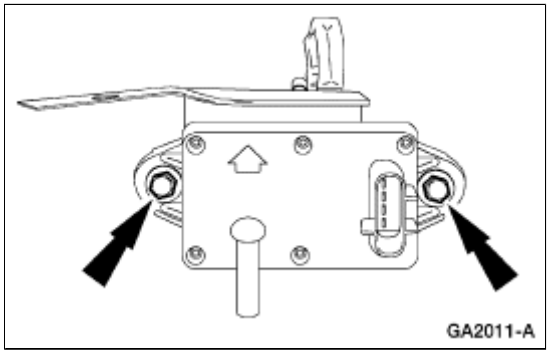


4. Remove the bolts and the differential pressure feedback EGR.

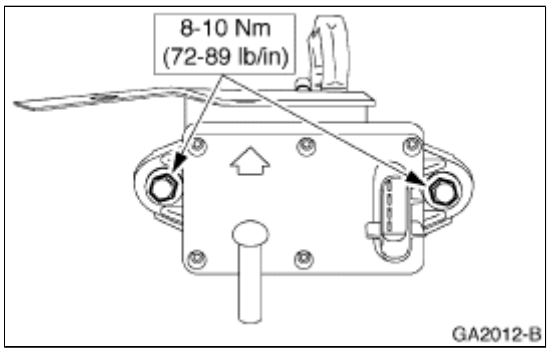


Installation

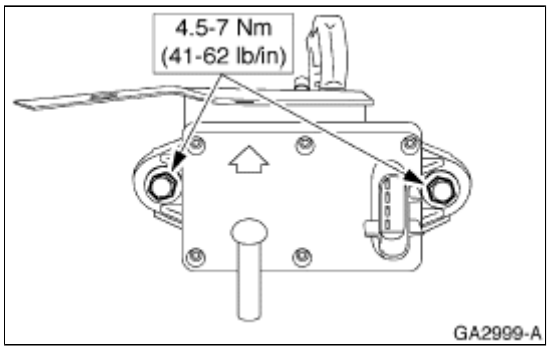
1. Fit the differential pressure feedback EGR and loosely install the bolts.



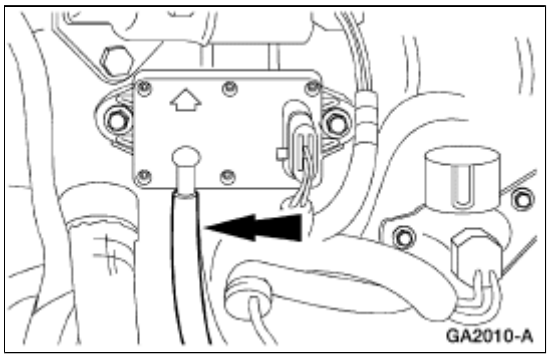
2. If the vehicle is equipped with the 4.0L engine, tighten the bolts.



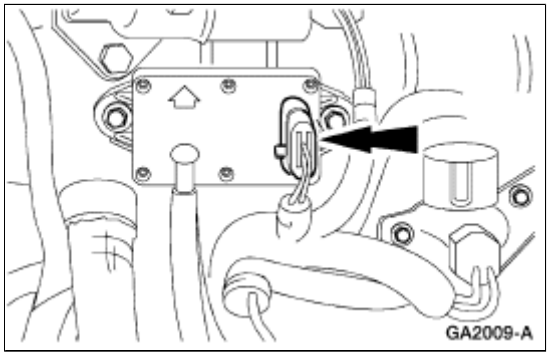
3. If the vehicle is equipped with the 5.0L engine, tighten the bolts.



4. Connect the differential pressure feedback EGR hoses.



5. Connect the differential pressure feedback EGR electrical connector.

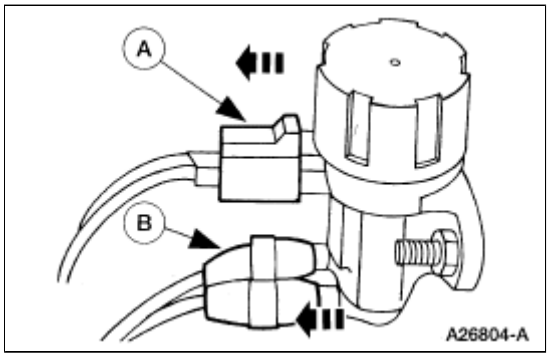


6. Connect the battery ground cable.

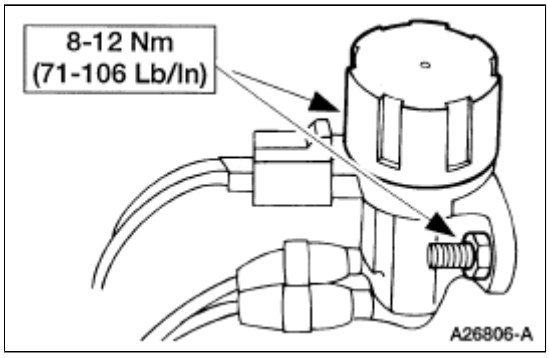
Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the (A) electrical connector and the (B) vacuum hoses from the exhaust gas recirculation (EGR) vacuum regulator solenoid.



3. Remove the nuts and the EGR vacuum regulator solenoid.



4. To install, reverse the removal procedure.

Intake Air Distribution and Filtering

The intake air system consists of the:

- engine air cleaner (ACL) (9600)
- air cleaner outlet tube (9B659)
- mass air flow (MAF) sensor (12B579)
- air cleaner (ACL) element (9601)
- engine air cleaner support insulator (9P686)
- air cleaner clamp
- mass air flow sensor plate

The intake air system:

- filters intake air with a replaceable, dry-type air cleaner element.
- measures air flow and air temperature with a mass air flow sensor.

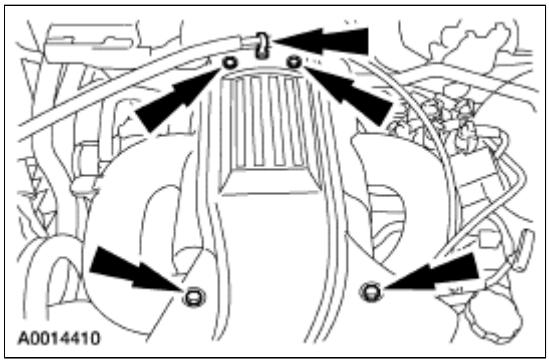
Intake Air Distribution and Filtering

Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

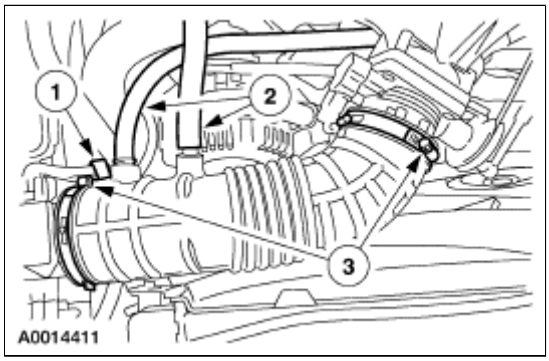
Air Cleaner Outlet Pipe — 4.0L SOHC

Removal and Installation

1. Remove the engine appearance cover.
   - Disconnect the speed control cable (if equipped).
   - Remove the bolts.



2. Remove the air cleaner outlet tube.
   1. Unclip the wire harness
   2. Disconnect the crankcase ventilation tubes.
   3. Loosen the air cleaner outlet tube clamps and remove the air cleaner outlet tube.



3. **NOTE:** Make sure the screw clamps do not interfere with the throttle body cam.

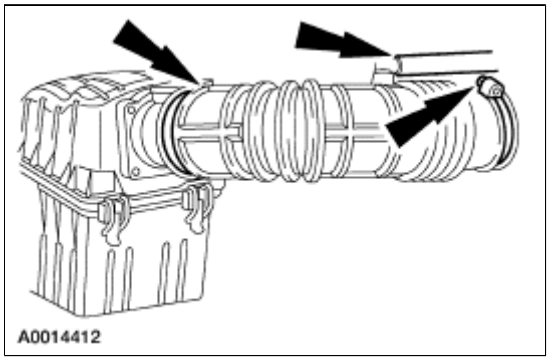
   To install, reverse the removal procedure.

Air Cleaner Outlet Pipe — 5.0L and 4.0L (Push Rod)

Removal and Installation

NOTE: The 5.0L engine is shown, the 4.0L (push rod) engine is similar.

1. Remove the air cleaner outlet tube.
   - Loosen the clamps.
   - Disconnect the vent hose.



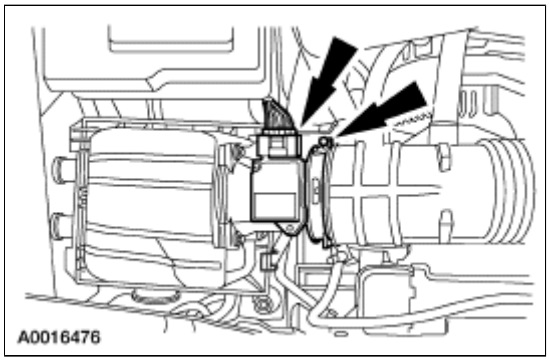
2. **NOTE:** Make sure the screw clamps do not interfere with the throttle body cam.

   To install, reverse the removal procedure.

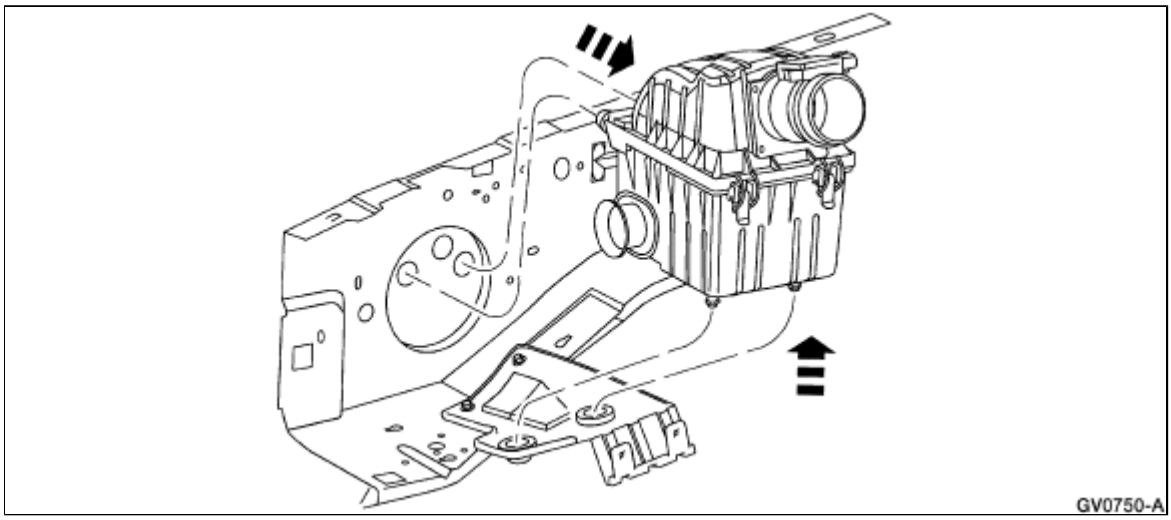
Air Cleaner

Removal and Installation

1. Disconnect the air cleaner assembly.
   - Loosen the clamp and disconnect the outlet tube.
   - Disconnect the mass air flow (MAF) sensor electrical connector.



2. Remove the air cleaner assembly.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft
Canister purge valve bracket retaining bolt	25	18
Evaporative emissions canister bolts	25	18

General Specifications

Item	Specification
MERPOL® O-Ring Seal Lubricant	ESE-M99B144-B

Evaporative Emissions

The evaporative emission (EVAP) system:

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the EVAP canister that are generated during vehicle operation or hot soak, until they can be consumed by the engine during normal engine operation.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the powertrain control module (PCM) which, using various sensor inputs, calculates the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.
- has an EVAP test port for test purposes.

The fuel vapors are routed:

- from the fuel tank (9002) through the fill limit valve and fuel vapor vent valve.
- to the EVAP canister(s) (9D653) through a vapor line.
- to the engine when the EVAP canister purge valve (9C915) is opened by the PCM (12A650).

The fuel tank pressure (FTP) sensor (9C052):

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBD II leak test.

The evaporative emissions (EVAP) canister (9E857):

- is located under the rear of the vehicle.
- contains activated carbon.
- stores fuel vapors.

The fuel tank filler cap (9030):

- relieves system pressure above 14 kPa (56.21 inches H_2O).
- relieves system vacuum below 3.8 kPa (15.26 inches H_2O).

The canister vent solenoid (9F945):

- is normally open.
- seals the evaporative emissions system for the inspection and maintenance (I/M 240) test and OBD II leak and pressure tests.
- is mounted to the evaporative emissions canister bracket.

The evaporative emission (EVAP) canister purge valve (9C915):

- is normally closed.
- regulates the purging of the EVAP canister.
- is controlled by the PCM.

The evaporative emission (EVAP) system test port:

- is located on the EVAP canister purge outlet tube near the EVAP canister purge valve.
- is used to connect the Evaporative Emissions System Leak Tester to the EVAP system.

The evaporative emission dust separator (9B328):

- is located on the EVAP canister bracket assembly.
- prevents suspended dust and dirt particles from entering the evaporative emission system.
- is serviced as a separate item.

The evaporative emission system monitor:

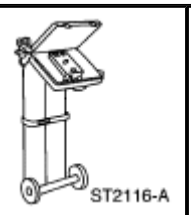
- is a self-test strategy within the PCM which tests the integrity of the EVAP system.
- monitors the EVAP system for leaks.
- monitors electronic EVAP components for irrationally high or low voltages.
- monitors for correct EVAP system operation.
- uses negative and positive leak test methods to test and activate the EVAP system.

The EVAP Running Loss System leak test:

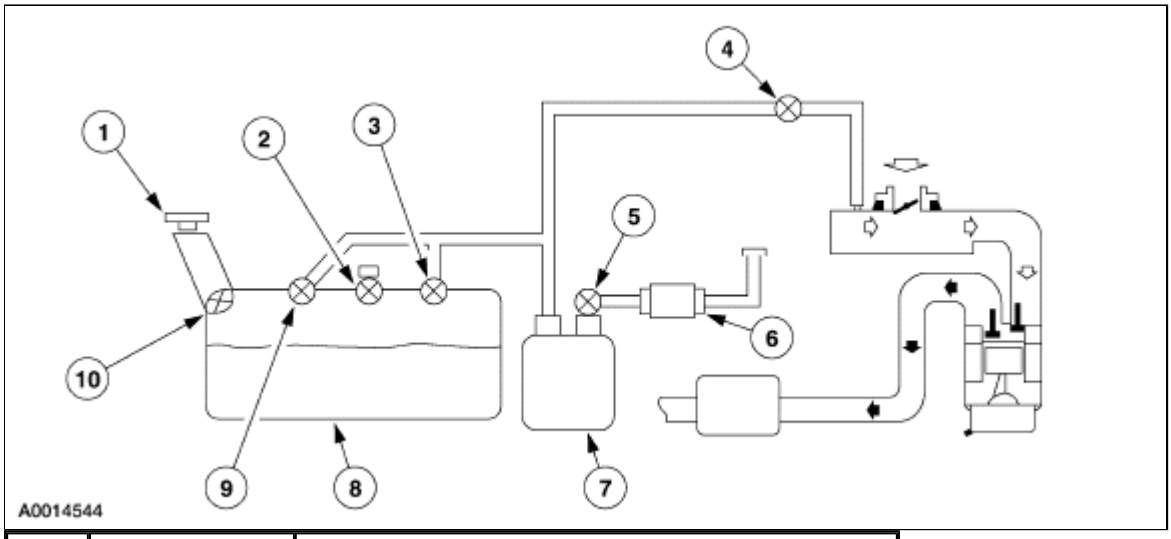
- utilizes intake manifold vacuum to test the system and involves several stages.

Evaporative Emissions

Special Tool(s)

 ST2116-A	Evaporative Emission System Leak Tester 310-F007 (134-00056) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418–F052, or equivalent scan tool

Evaporative Emission System



Item	Part Number	Description
1	9030	Fuel filler cap
2	9C052	Fuel tank pressure sensor
3	9B593	Fuel vapor vent valve
4	9C915	Evaporative emission canister purge valve
5	9F945	Canister vent solenoid
6	9B328	Evaporative emission dust separator
7	9D653	Evaporative emission canister
8	9002	Fuel tank

9	9B593	Fuel vapor vent valve
10	9189	Fuel filler pipe check valve

Principles of Operation

Evaporative Emission (EVAP) Canister Purge Valve

The EVAP canister purge valve is controlled by the powertrain control module (PCM). The EVAP canister purge valve controls the flow of fuel vapors from the EVAP canister to the engine intake manifold during various engine operating modes. The EVAP canister purge valve is normally closed.

Evaporative Emission (EVAP) Canister

Fuel vapors from the fuel tank are stored in the EVAP canister. When the engine is running, the vapors are purged from the EVAP canister for combustion. OBD II vehicles sometimes use multiple canisters, which is dependent upon the size and number of the fuel tanks used on a specific vehicle.

Canister Vent Solenoid

During the Evaporative Emission Running Loss System Monitor Test, Evaporative Emissions Repair Verification Drive Cycle, and the Evaporative Emission System Leak Test, the canister vent solenoid is closed to allow either a vacuum to be drawn on the fuel tank or to hold a specified pressure in the system. The canister vent solenoid is normally open.

Fuel Tank Pressure (FTP) Sensor

The fuel tank pressure sensor is used to measure the fuel tank pressure during the Evaporative Emissions monitor test. It is also used to control excessive fuel tank pressures by forcing the EVAP system to purge. The fuel tank pressure sensor is tank mounted.

Fuel Vapor Vent Valve (FVV) Assembly

The fuel vapor vent valve (FVV) assembly is mounted on the top of the fuel tank. It is used to control the flow of fuel vapors entering the EVAP system. The head portion of the assembly prevents the fuel tank from overfilling during refueling. The assembly also has a spring float, which prevents liquid fuel from entering the vapor delivery system under severe handling or vehicle rollover conditions. In the upright position, the open bottom of the float will lift and shut off the orifice. Under severe handling conditions, the spring will push the float closed when angles allow liquid fuel to reach the orifice. In a rollover condition, the weight of the open bottom float and spring pressure will close the orifice.

Fuel Filler Pipe Check Valve

The fuel filler pipe check valve is an integral part of the fuel tank or the fuel filler pipe. It is intended to prevent liquid fuel from re-entering the fuel filler pipe from the fuel tank on refueling or rollover conditions.

Fuel Filler Cap

The fuel filler cap is used to prevent fuel spill and to close the EVAP system to the atmosphere.

Evaporative Emission System Monitor

When a fault occurs, the EVAP system monitor is reset to NO and a diagnostic trouble code (DTC) is set in the PCM memory. After the DTC is repaired, the vehicle drive cycle must be completed to reset the monitor

in preparation for inspection and maintenance testing.

EVAP Running Loss System Leak Test

To start the testing, conditions of stable purging and vehicle speed must be satisfied. During the first stage, the EVAP canister vent solenoid is closed, while the EVAP canister purge valve remains open, applying and building vacuum in the system as indicated by the FTP sensor. This phase checks for major leaks in the EVAP system.

In the second stage, the EVAP canister purge valve closes and the system looks for minimal decay rate in the EVAP vacuum, indicating the absence of any small EVAP system leaks.

The last stage is entered only if the second stage of the leak test has failed. The last stage checks whether the failed test was due to excess vapor generation. It monitors fuel vapor generation rate. Initially, the canister vent solenoid is opened to equalize EVAP system pressure to atmosphere. Then the canister vent solenoid is closed, allowing pressure to build if vapor generation is present in sufficient quantity. If the rate of generation is found to be too high, the EVAP running loss system leak test is aborted. If not, then a small leak is diagnosed.

Inspection and Verification

1. Verify the customer concern is with the evaporative emission (EVAP) system.

2. Visually inspect for the following obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Fuel filler cap • EVAP test port • EVAP canister or vent solenoid • EVAP lines and hoses • Vacuum lines or hoses

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for PCM, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the

continuous DTCs and carry out the PCM KOEO self-test.

6. If the DTCs retrieved are related to the concern, go to the PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If the concern remains after the inspection, determine the symptom and proceed to the Symptom Chart.

PCM Diagnostics Trouble Code (DTC) Index

DTC	Description	Source	Action
P0442	Small Leak Detected in EVAP System (as small as 1.02 mm [0.040 inch])	PCM	GO to Pinpoint Test A .
P0455	Major Leak or No Flow Detected	PCM	GO to Pinpoint Test B .
P1443	Very Small or No Purge Flow Detected	PCM	GO to Pinpoint Test B .
P1450	Excessive Vacuum Detected in the Fuel Tank	PCM	GO to Pinpoint Test C .
—	Any Other PCM DTC	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Hissing sound when removing fuel cap	• Canister vent solenoid. • Evaporative emissions canister. • EVAP canister tube. • EVAP canister purge outlet tube.	• GO to Pinpoint Test D .
• Excessive fuel odor	• Canister vent solenoid. • Evaporative emissions canister. • Evaporative emissions test port. • EVAP canister purge outlet tube.	• GO to Pinpoint Test E .

Pinpoint Tests

NOTE: Reinstall or install new evaporative emission hose clamps removed or damaged during testing procedures.

PINPOINT TEST A: DTC P0442 SMALL LEAK IN EVAP SYSTEM

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Condition P0442 DTC set: less than 0.625 kPa (2.5 inches H_2O) bleed-up over 15 seconds at 75% fuel fill. Vapor generation limit: more than 0.625 kPa (2.5 inches H_2O) over 120 seconds.	
A1 VISUALLY INSPECT THE COMPONENTS FOR SMALL LEAKS	
	1 Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. 2 Verify the canister vent solenoid is correctly seated on the EVAP canister. 3 Check for cut or loose connections to fuel vapor hoses, tubes and connections in the following locations: • EVAP canister to EVAP canister purge valve • EVAP canister to fuel vapor vent valve assembly 4 Check the fuel filler pipe for damage. • **Is a concern with a hose, tube, connection or valve visually evident?** → **Yes** REPAIR or INSTALL new components as necessary. GO to A2. → **No** GO to A2.
A2 CHECK AT THE EVAP TEST PORT FOR SMALL SYSTEM LEAKS	
	1 Disconnect and plug the evaporative emission return tube at the intake manifold. 2 Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. • **Does the system pass the leak test?** → **Yes** GO to A3. → **No** GO to A4.
A3 VISUALLY INSPECT THE FUEL FILLER CAP	
	1 Visually inspect the fuel filler cap for damage. • **Is the fuel filler cap damaged?** → **Yes** INSTALL a new fuel filler cap. GO to A4. → **No** GO to A4.
A4 CHECK FOR SMALL LEAKS AT THE FUEL FILLER CAP AND EVAP TEST PORT	
	1 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe.

2	3 Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. 4 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). 5 Using the ultrasonic leak detector, check the fuel filler cap and EVAP test port for leaks. • **Is a leak detected?** → **Yes** REPAIR or INSTALL new components as necessary. GO to A5. → **No** INSTALL the fuel filler cap. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
A5 CHECK FOR CONCERN OTHER THAN THE FUEL FILLER CAP	
	1 Refer to previous test results. • **Did the system pass the evaporative emission system leak test carried out in Step A2?** → **Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** INSTALL the fuel filler cap. GO to A6.
A6 CHECK FOR SMALL LEAK WITH TESTER SET AT FILL POSITION	
2	1 Connect the Evaporative Emission System Leak Tester to the EVAP test port. 3 Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. 4 Turn the selector on the Evaporative Emission System Leak Tester to the FILL position. 5 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O).

	• **Does the pressure on the EVAP system hold between 3.43 kPa and 3.53 kPa (13.80 inches and 14.20 inches H_2O)?** → **Yes** GO to A7 . → **No** DISCONTINUE pressurizing the system. GO to A8 .
A7 CHECK FOR LEAKS IN THE COMPLETE EVAP SYSTEM	
2 	1 Connect the Evaporative Emission System Leak Tester to the EVAP test port. 3 Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. 4 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). 5 Using the ultrasonic leak detector, check the following EVAP system locations: • EVAP return tube to EVAP canister purge valve • EVAP canister purge valve to EVAP canister— canister vent solenoid assembly • EVAP canister — canister vent solenoid assembly to fuel tank • fuel filler cap and fuel filler tube • **Is a leak detected at EVAP return tube, EVAP canister purge outlet tube or EVAP canister tube or associated hose?** → **Yes** REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** DISCONTINUE pressurizing the system. GO to A8 .
A8 CHECK FOR SMALL LEAK FROM THE EVAP RETURN TUBE TO THE EVAP CANISTER	
3 	1 Disconnect the fuel tank vapor tube (9C047) at the fuel vapor tee. Plug the opening in the tee. 2 Connect the Evaporative Emission System Leak Tester to the EVAP test port. 4 Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing

	Procedure in this section. 5 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). 6 Using the ultrasonic leak detector, check the EVAP system from the intake manifold to the EVAP canister vent solenoid. • **Is a leak detected?** → **Yes** REPAIR or INSTALL new components as necessary. REPEAT Step A6 to verify the repair. GO to A9 . → **No** OPEN the canister vent solenoid. GO to A9 .
A9 CHECK FOR SMALL LEAK BETWEEN FUEL TANK VAPOR TUBE (9C047) AND FUEL TANK FILLER PIPE	
	1 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 2 Transfer the plug from the fuel vapor tee to the fuel tank vapor tube (9C047). 3 Turn the Evaporative Emission System Leak Tester selector to the FILL position. 4 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). 5 Using the ultrasonic leak detector, check the fuel tank vapor tube to the fuel tank for leaks. Check the fuel tank pressure sensor, fuel tank vapor tube and the fuel filler pipe. • **Is a leak detected?** → **Yes** REPAIR or INSTALL new components as necessary. GO to A10 . → **No** GO to A10 .
A10 CHECK EVAP SYSTEM AT FUEL FILLER PIPE	
	1 Reconnect the fuel tank vapor tube (9C047) to the fuel vapor tee. 2 Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. • **Does the EVAP system pass the leak test?** → **Yes** RESTORE the system to normal operation. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

	→ **No** GO to A6 .

PINPOINT TEST B: DTC P0455 MAJOR LEAK OR NO FLOW DETECTED OR DTC P1443 VERY SMALL OR NO PURGE FLOW DETECTED IN SYSTEM

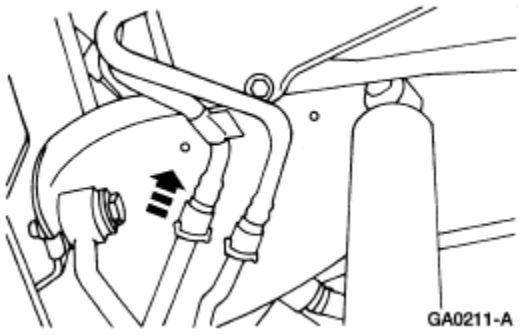
CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Condition DTC P0455 set: –1.74 kPa (-7.0 inches H_2O) over 30 seconds. **NOTE:** Condition DTC P1443 set: –1.74 kPa (-7.0 inches H_2O) over 30 seconds with more than 0.02 lb/min vapor flow.	
B1 CHECK FOR DIAGNOSTIC TROUBLE CODE P0455 OR P1443	
	1 Use the recorded results from the PCM DTCs. • **Is DTC P0455 present?** → **Yes** GO to B2 . → **No** GO to B3 .
B2 VISUALLY CHECK FOR GROSS EVAP SYSTEM LEAKS	
	1 Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. 2 Check that the input port vacuum and EVAP return tubes are connected to the EVAP canister purge valve. 3 Check that the canister vent solenoid is correctly attached to the EVAP canister. 4 Check for disconnected or cracked fuel vapor hoses or tubes between the intake manifold and following components: • EVAP canister purge valve • EVAP canister • fuel vapor vent valve assembly 5 Check for damaged fuel tank or fuel filler pipe. • **Is a concern with a hose, tube, connection or valve visually evident?** → **Yes** REPAIR or INSTALL new EVAP components as necessary. GO to B3 . → **No** GO to B3 .
B3 CHECK FOR EVAP SYSTEM LEAKS	
	1 Disconnect the EVAP return tube from the intake manifold and plug the EVAP return tube.

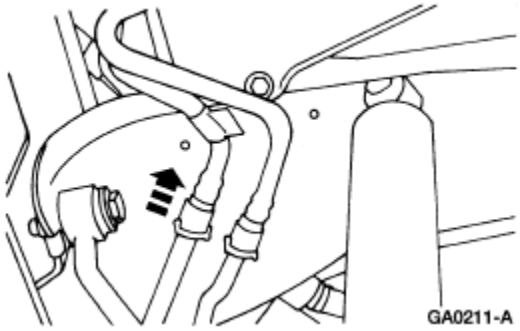
	2 Connect the Evaporative Emissions System Leak Tester to the EVAP test port. 3 Carry out the evaporative emissions system leak test. Refer to Evaporative Emission System Leak Test in this section. • **Does the system pressure stay above 1.99 kPa (8 inches H_2O)?** → **Yes** GO to B4 . → **No** VERIFY that the fuel filler cap is installed correctly. REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B4 CHECK FOR BLOCKAGE BETWEEN THE EVAP CANISTER PURGE VALVE AND FUEL VAPOR TEE	
1	2 Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). 4 Open the canister vent solenoid. • **Does the pressure drop immediately?** → **Yes** GO to B5 . → **No** INSTALL a new vapor line between the EVAP canister purge valve and the fuel vapor tee. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B5 CHECK FOR BLOCKAGE BETWEEN FUEL FILLER PIPE AND THE FUEL VAPOR TEE	
	1 Connect the Evaporative Emissions System Leak Tester to the fuel filler pipe. 2 Pressurize the EVAP system to 6.47 to 6.97 kPa (26 to 28 inches H_2O). • **Does the pressure drop immediately?** → **Yes** GO to B6 .

	→ **No** INSTALL new fuel tank vapor line(s). REPEAT Step B5 to verify the repair. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B6 CHECK FOR FAILED EVAP CANISTER PURGE VALVE OR FUEL TANK PRESSURE SENSOR	
	1 Use the recorded results from the PCM DTCs. • **Are DTC codes P0455 and P1443 present?** → **Yes** INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If no leak is detected, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** INSTALL a new fuel tank pressure sensor. REFER to Fuel Tank Pressure Sensor in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY out the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST C: DTC P1450 EXCESSIVE VACUUM DETECTED IN THE FUEL TANK

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Condition P1450 DTC set: More than -1.79 kPa (-7.2 inches H_2O) over 30 seconds.	
C1 CHECK FOR VISUAL CAUSES OF EXCESSIVE FUEL TANK VACUUM	
	1 Check for kinks or bends in the fuel vapor hoses and tubes. 2 Visually check the EVAP canister inlet port, canister vent solenoid filter or outlet hose for contamination or foreign material. 3 Check the canister vent solenoid for blockage or contamination. • **Is a concern with a hose, tube, connection or component visually evident?** → **Yes** REMOVE any contamination or foreign material around fuel vapor hoses and tubes. REPAIR the hoses, tubes or components as necessary. After all visual concerns are repaired, GO to C2.

	→ **No** GO to C2 .
C2 CHECK FOR BLOCKAGE BETWEEN EVAP TEST PORT AND CANISTER VENT SOLENOID	
	1 Disconnect and plug the EVAP return tube at the intake manifold. 2 Connect the Evaporative Emissions System Leak Tester to the EVAP test port. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** GO to C3 . → **No** GO to Pinpoint Test D .
C3 CHECK FOR BLOCKAGE BETWEEN THE FUEL FILLER PIPE AND THE FUEL VAPOR TEE	
	1 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 2 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** GO to C4 . → **No** GO to Pinpoint Test D .
C4 CHECK FOR FUEL TANK PRESSURE SENSOR PID WITHOUT PRESSURE APPLIED	
1  2	1 Disconnect the EVAP canister outlet tube at the EVAP canister.

	3 Access PCM PID FTP V. 4 Record the reading. • **Is PID FTP V reading between 2.40 and 2.80 volts?** → **Yes** GO to C5 . → **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis.
C5 CHECK FOR STUCK OPEN EVAP CANISTER PURGE VALVE CONDITION AT IDLE	
1  4 	1 Connect the EVAP canister outlet tube. 2 Remove the plug from the EVAP return tube and reconnect the tube to the intake manifold. 3 Verify that the fuel filler cap is correctly installed. 5 Access PCM PIDs FTP V and EVAPPDC. 6 Start the engine and allow to idle. 7 Monitor the FTP V and EVAPPDC PIDs. • **When PID EVAPPDC is zero, is PID FTP V reading below 2.40 volts?** → **Yes** INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister

	Purge Valve in this section. CARRY OUT an EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT an evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** CARRY OUT the EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST D: HISS WHEN OPENING FUEL CAP

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 TEST FOR EVAP CANISTER, CANISTER VENT SOLENOID AND CANISTER VENT HOSE ASSEMBLY BLOCKAGE	
	1 Connect the Evaporative Emission System Leak Tester to the fuel filler cap. 2 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** The EVAP system has passed the EVAP canister and bracket assembly blockage test. GO to D6. → **No** For vehicles equipped with a canister vent hose assembly, GO to D2. For vehicles equipped with a canister vent solenoid, GO to D3. For all others, GO to D4.
D2 TEST FOR CANISTER VENT HOSE ASSEMBLY BLOCKAGE	
	1 Disconnect the EVAP canister vent hose assembly from the EVAP canister. 2 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** INSTALL a new EVAP canister vent solenoid vent hose assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT

	the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** GO to D4.
D3 TEST FOR CANISTER VENT SOLENOID BLOCKAGE	
	1 Remove the canister vent solenoid from the EVAP canister. 2 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** INSTALL a new canister vent solenoid. REFER to Evaporative Emission Canister Vent Solenoid in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** GO to D4.
D4 TEST FOR EVAP CANISTER BLOCKAGE	
	1 Disconnect the EVAP canister tube (from the fuel tank) at the F-fitting from the EVAP canister. 2 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** INSTALL a new EVAP canister. REFER to Evaporative Emission Canister in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** GO to D5.
D5 TEST FOR EVAP CANISTER TUBE OR FUEL VAPOR VENT VALVE ASSEMBLY BLOCKAGE	
	1 Disconnect the fuel vapor vent valve assembly from the EVAP canister tube. 2 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**

	→ **Yes** INSTALL a new EVAP canister tube and/or fuel vapor tube(s) between the fuel tank and the EVAP canister and bracket assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** INSTALL a new fuel vapor vent valve(s) or assembly. REFER to Fuel Vapor Vent Valve in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
D6 TEST FOR BLOCKAGE BETWEEN THE EVAP CANISTER PURGE VALVE AND THE FUEL TANK	
3 	1 Remove the fuel vapor hose (from the fuel tank) at the EVAP canister purge valve. 2 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 4 For vehicles equipped with a canister vent solenoid, close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. 5 For vehicles without a canister vent solenoid, plug the canister vent hose assembly or plug the canister vent cap. 6 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** The EVAP system has passed all the blockage tests. RECONNECT all components. For vehicles equipped with a canister vent solenoid, CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. For vehicles equipped without a canister vent solenoid, PLUG the canister vent hose assembly or the canister vent cap. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** INSTALL a new fuel vapor hose. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the

	system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST E: EXCESSIVE FUEL ODOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 TEST THE EVAPORATIVE EMISSION (EVAP) RUNNING LOSS SYSTEM MONITOR	
	1 Complete the evaporative emission repair verification drive cycle. Refer to Evaporative Emission Repair Verification Drive Cycle in this section. • **Are PCM DTCs retrieved?** → **Yes** For DTC P0442, P0455, P1443 or P1450 REFER to the Diagnostic Trouble Code Index in this section. For all other DTCs REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of DTCs. → **No** GO to E2 .
E2 TEST FOR RESTRICTIONS IN THE EVAP SYSTEM FROM THE EVAPORATIVE EMISSION TEST PORT THROUGH THE CANISTER VENT SOLENOID	
	1 Connect the Evaporative Emission System Leak Tester to the evaporative emissions test port. 2 Attempt to pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.GO to E3 . → **No** GO to Pinpoint Test **D** .
E3 TEST FOR A RESTRICTED TUBE BETWEEN THE FUEL TANK AND THE EVAPORATIVE EMISSION CANISTER	
	1 Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. 2 Attempt to pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to

	Evaporative Emission Repair Verification Drive Cycle in this section. → **No** GO to E4 .
E4 TEST FOR EVAP CANISTER TUBE OR FUEL VAPOR VENT VALVE ASSEMBLY BLOCKAGE	
	1 Disconnect the fuel vapor vent valve assembly from the EVAP canister tube. 2 Connect the EVAP System Leak Tester to the fuel filler pipe. 3 Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?** → **Yes** INSTALL a new EVAP canister tube and/or fuel vapor tube(s) between the fuel tank and the EVAP canister and bracket assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. → **No** INSTALL a new fuel vapor vent valve(s) or assembly. REFER to Fuel Vapor Vent Valve in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

Canister Vent Solenoid Closing Procedure

Special Tool(s)

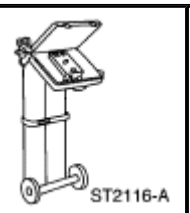
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

CAUTION: The canister vent solenoid must not be energized for more than nine minutes at one time. Once the canister vent solenoid is energized and de-energized, adequate time must be allowed for the component to cool adequately. Failure to allow the component to cool may create a false failure in the diagnostics, causing unnecessary repairs.

1. Connect the scan tool and select the output test mode.
2. If PID monitors are not active, select PIDs.
3. Select the fuel tank pressure (FTP) and the volts (V) parameter identification (PID) for monitoring.
4. Select the ALL OFF mode.
5. Close the canister vent solenoid by pushing the START button on the scan tool.

Evaporative Emission System Leak Test

Special Tool(s)

 ST2116-A	Evaporative Emission System Tester 310-F007 (134-00056) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

CAUTION: The evaporative emission system must not be pressurized to more than 3.48 kPa (14 inches H_2O) or damage to the evaporative emission system may occur.

1. Connect the Evaporative Emission System Leak Tester to the evaporative emission test port.
2. Close the canister vent solenoid. For additional information, refer to Canister Vent Solenoid Closing Procedure in this section.
3. Pressurize the evaporative emission system to 3.48 kPa (14 inches H_2O).
4. Monitor the system for two minutes. The system fails the leak test if the pressure falls below 2.0 kPa (8 inches H_2O).
5. Repair any leaks as necessary.
6. Repeat the leak test until the system remains above 2.0 kPa (8 inches H_2O) after the two-minute test period.

Evaporative Emission Repair Verification Drive Cycle

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Drive Cycle Recommendations

NOTE: The following procedure is designed to execute and complete the evaporative emission repair verification drive cycle and to clear the Ford P1000, inspection and maintenance (I/M) readiness code. When the ambient air temperature is below 4.4°C (40°F) or above 37.8°C (100°F), or the altitude is above 2,438 meters (8,000 feet), the EVAP monitor will not run. If the P1000 must be cleared in these conditions, the powertrain control module (PCM) must detect them once (twice on some applications) before the EVAP monitor can be bypassed and the P1000 cleared. The EVAP bypassing procedure is described in the following drive cycle.

1. Most OBD II monitors will complete more readily using a steady foot driving style during cruise or acceleration modes. Operating the throttle in a smooth fashion will minimize the time necessary for monitor completion.

2. Fuel tank level should be between one-half and three-quarters full with three-quarters full being the most desirable.

3. The evaporative monitor can only operate during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize fuel slosh.

Drive Cycle Preparation

NOTE: For best results, follow each of the following steps as accurately as possible.

4. **NOTE:** This step bypasses the engine soak timer and resets OBD II monitor status.

   Install the scan tool. Turn the key ON with the engine OFF. Cycle the key off, then on. Select the appropriate vehicle and engine qualifier. Clear all diagnostic trouble codes (DTCs) and carry out a PCM reset.

5. Begin to monitor the following PIDs: ECT, EVAPDC, FLI (if available) and TP MODE. Press Diagnostic Data Link, PCM, PID/Data monitor and record, press trigger to select each PID, then start.

6. Start the engine without returning the key to the OFF position.

Preparation for Monitor Entry

WARNING: Strict observance of posted speed limits and attention to driving conditions are mandatory when proceeding through the following drive cycle.

7. **NOTE:** This step allows engine warm-up and provides intake air temperature (IAT) input to the PCM.

   Idle the vehicle for 15 seconds. Drive at 64 km/h (40 mph) until the ECT is at least 76.7°C (170°F).

8. Is IAT above 4.4°C (40°F) and below 37.8°C (100°F)? If not, continue with the following steps but note that the EVAP Monitor Bypass portion of the drive cycle (Step 13) will be required to bypass the EVAP monitor and clear the P1000.

9. **NOTE:** This step executes the heated oxygen sensor (HO2S) monitor.

   Cruise at 64 km/h (40 mph) for 60 seconds.

10. **NOTE:** This executes the EVAP monitor if IAT is above 4.4°C (40°F) and below 37.8°C (100°F).

    NOTE: To initiate the monitor, TP MODE should equal PT, EVAPDC must be greater than 75%, and FLI must be between 15 and 85%.

    NOTE: Avoid sharp turns and hills.

    Cruise at 72 to 104 km/h (45 to 65 mph) for 10 minutes.

11. **NOTE:** This step executes the ISC portion of the Secondary Air/CCM.

    Bring the vehicle to a stop. Idle with the transmission in DRIVE (for automatic transmission) or NEUTRAL (for manual transmission) for two minutes.

Pending Code and EVAP Monitor Bypass Check

12. **NOTE:** This determines if a pending code is preventing the clearing of P1000.

    NOTE: If the EVAP monitor is not complete and IAT was below 4.4°C (40°F) or above 37.8°C (100°F) temperature range in Step 8, or the altitude is above 2,438 meters (8,000 feet), the EVAP Monitor Bypass (Step 13) must be carried out.

    Using the scan tool, check for pending codes. Conduct normal repair procedures for any pending code concerns. Rerun any incomplete monitor.

EVAP Monitor Bypass

13. **NOTE:** This allows the bypass counter to increment to two.

    NOTE: Do not repeat Step 4.

    Park the vehicle for a minimum of eight hours. Repeat Steps 5 through 12.

Evaporative Emission Canister

Removal and Installation

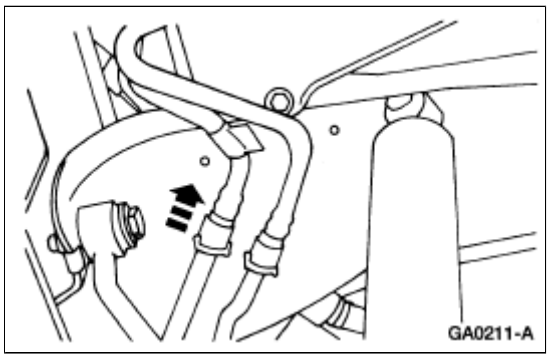
1. Open the liftgate, lower and remove the spare tire.

2. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.**

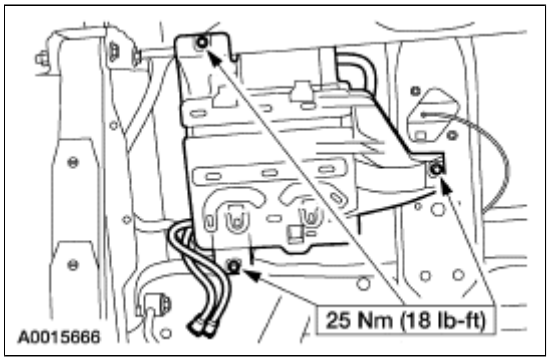
   Disconnect the battery ground cable. For additional information refer to Section 414-01 .

3. **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.**

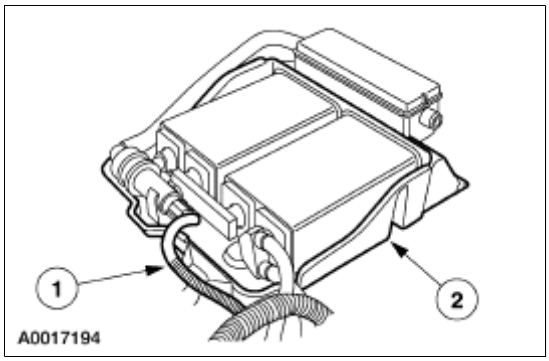
   Disconnect the two chassis emissions lines from the evaporative emission tube.



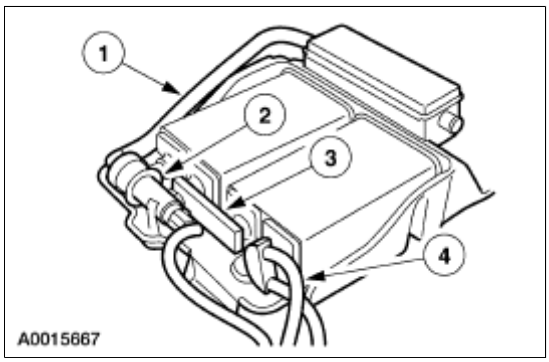
4. Remove the evaporative emissions canister bolts.



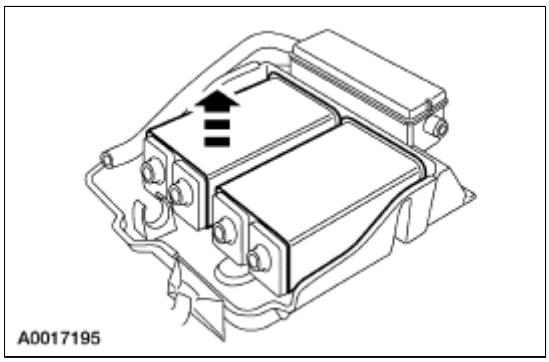
5. Remove the evaporative emission canister with bracket assembly (9E857).
   1. Disconnect the canister vent solenoid electrical connector.
   2. Remove the EVAP canister with bracket assembly.



6. Remove the canister vent solenoid and the evaporative emission tube.
    1. Disconnect the canister vent solenoid hose from the canister vent solenoid.
    2. Remove the canister vent solenoid.
    3. Remove the evaporative emission canister purge sleeve.
    4. Remove the evaporative emission tube.



7. Remove the evaporative emission canister from the evaporative emission canister bracket.



8. **NOTE:** Lubricate all O-ring seals with MERPOL® O-ring Seal Lubricant or equivalent meeting Ford specification ESE-M99B144-B.

To install, reverse removal procedure.

- Leak test the evaporative emissions system. For additional information, refer to Evaporative Emission System Leak Test in this section.
- Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Evaporative Emission Canister Purge Valve

Removal and Installation

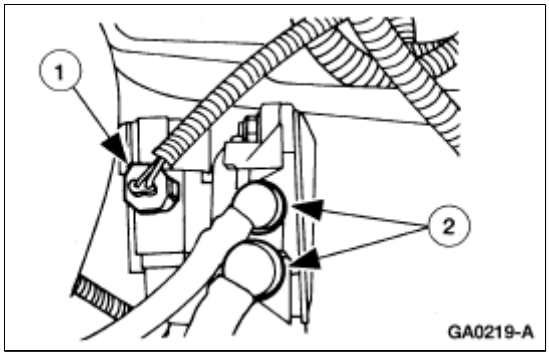
1. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

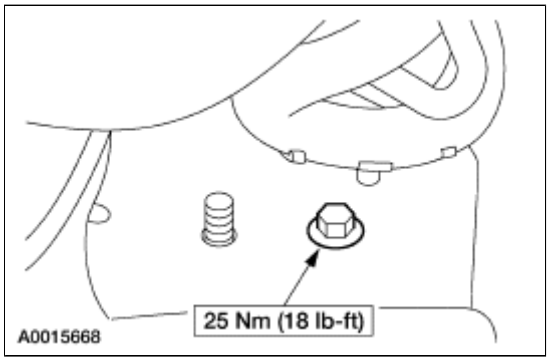
2. Remove the battery tray. For additional information, refer to Section 414-01 .

3. **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.**

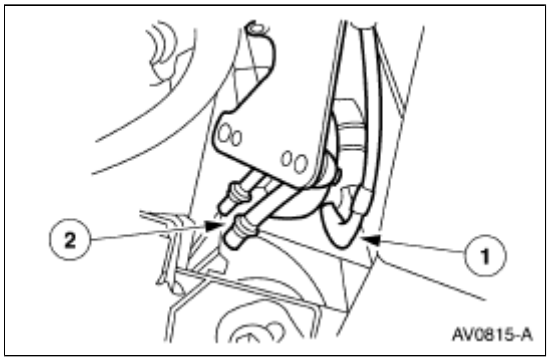
   Disconnect the tubes.
   1. Disconnect the electrical connector.
   2. Disconnect the tubes from the evaporative emission canister purge valve (EVAP canister purge valve).



4. Disconnect the evaporative emission canister purge valve and bracket.
   - Remove the bolt.



5. Remove the evaporative emission canister purge valve.
    1. Disconnect the vacuum line from the evaporative emission canister purge valve.
    2. Remove the evaporative emission canister purge valve.



6. To install, reverse the removal procedure.
    - Leak test the evaporative emissions system. For additional information, refer to Evaporative Emission System Leak Test in this section.
    - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Fuel Vapor Vent Valve

Removal and Installation

1. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

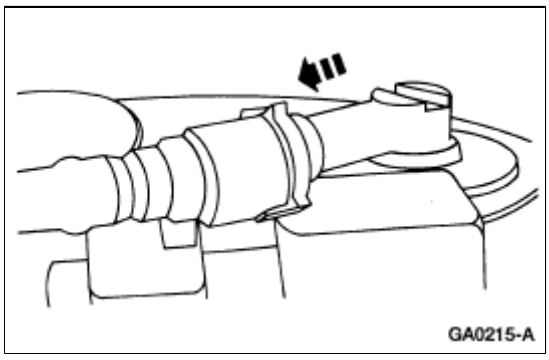
2. **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury. Failure to follow these instructions may result in personal injury.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

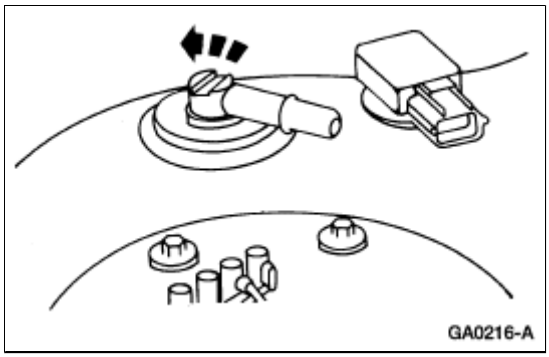
3. Drain the fuel tank. For additional information, refer to Section 310-00 .

4. Lower the fuel tank. For additional information, refer to Section 310-01 .

5. Remove the EVAP canister tube from the fuel vapor vent valve.



6. Remove the fuel vapor vent valve.
   - Press down and rotate the fuel vapor vent valve counterclockwise and remove it from the fuel tank.



7. To install, reverse the removal procedure.
    - Leak test the evaporative emissions system. For additional information, refer to Evaporative Emission System Leak Test in this section.
    - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

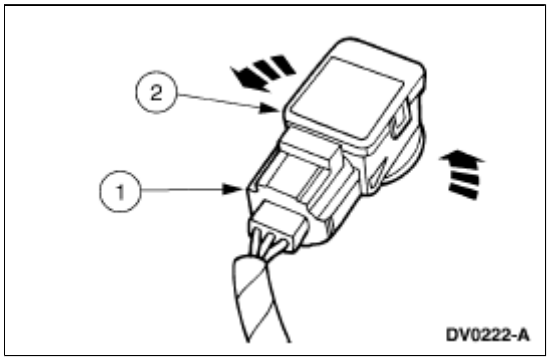
Fuel Tank Pressure Sensor

Removal and Installation

1. Remove the fuel tank. For additional information, refer to Section 310-01 .

2. **CAUTION: The fuel tank pressure sensor must be disengaged from the fuel tank before it can be removed. Push down and rotate the fuel tank pressure sensor counterclockwise to disengage it from the fuel tank. Failure to do so can cause damage to the fuel tank pressure sensor or the fuel tank.**

   Remove the fuel tank pressure sensor.
   1. Disconnect the electrical connector.
   2. Press down and rotate the fuel tank pressure sensor counterclockwise and remove it from the fuel tank.

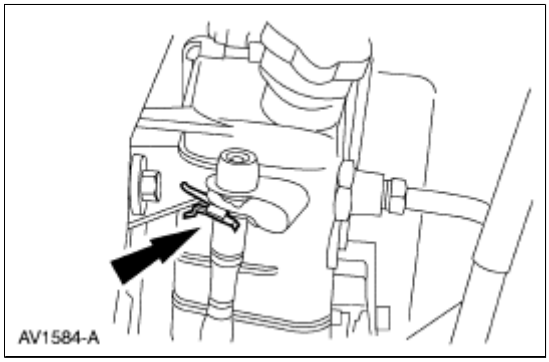


3. To install, reverse removal procedure.
   - Leak test the evaporative emission system. For additional information, refer to Evaporative Emission System Leak Test System in this section.
   - Carry out the evaporative emissions repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

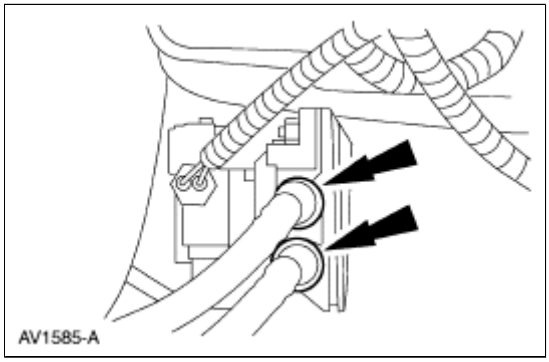
Evaporative Emission Test Port

Removal and Installation

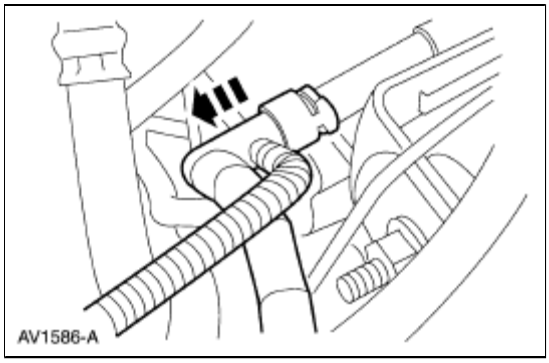
1. Remove the clip.



2. Disconnect the hoses.



3. Remove the test port assembly.
   - Disconnect the fitting.
   - Remove the test port assembly.



4. To install, reverse the removal procedure.

- Leak test the evaporative emissions system. For additional information, refer to Evaporative Emission System Leak Test in this section.
- Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Evaporative Emission Canister Vent Solenoid

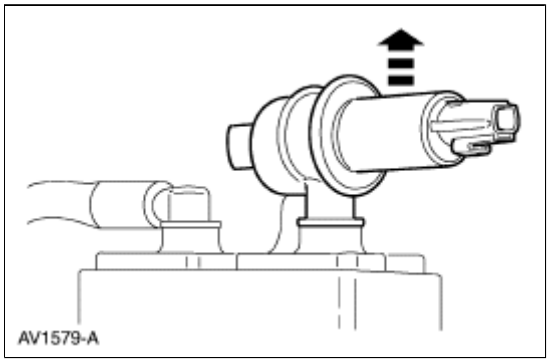
Removal and Installation

1. **WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring possibly causing a fire or explosion if fuel vapor or fuel liquid is present in the area. Failure to follow these instructions may result in personal injury.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the evaporative emissions (EVAP) canister. For additional information, refer to Evaporative Emission Canister in this section.

3. Remove the canister vent solenoid.



4. To install, reverse the removal procedure.
   - Leak test the evaporative emission canister and bracket assembly. For additional information, refer to Evaporative Emission System Leak Test in this section.
   - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Dust Separator

Removal and Installation

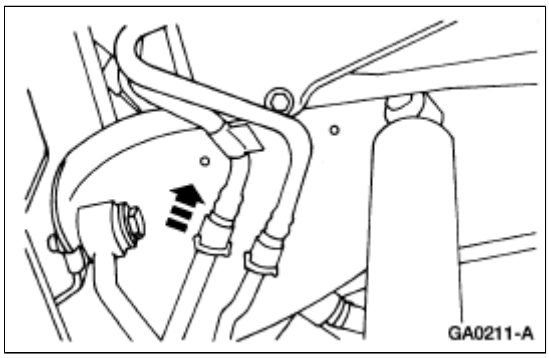
1. Open the liftgate, lower and remove the spare tire.

2. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.**

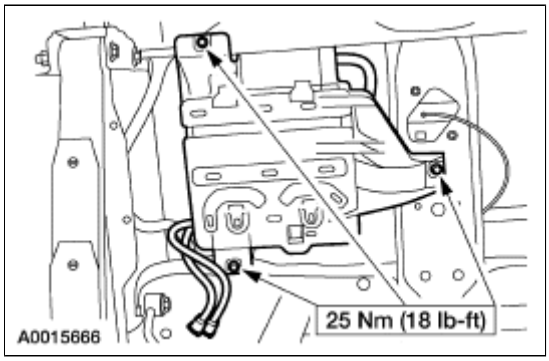
   Disconnect the battery ground cable. For additional information refer to Section 414-01 .

3. **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.**

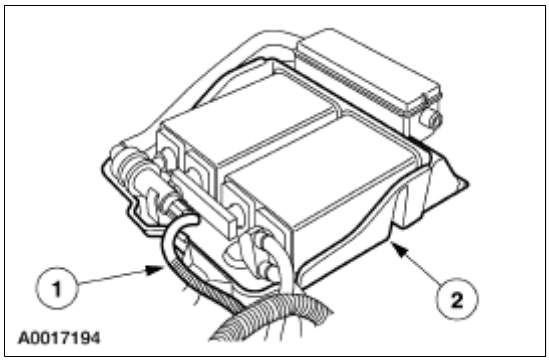
   Disconnect the two chassis emissions lines from the evaporative emission tube.



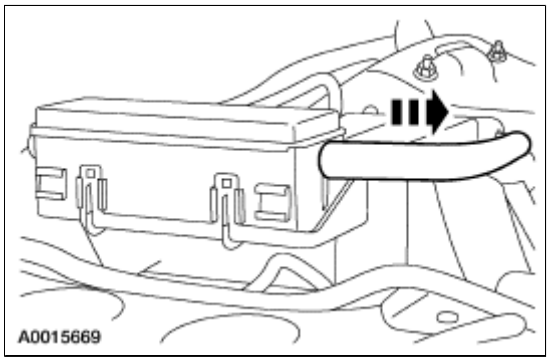
4. Remove the evaporative emissions canister bolts.



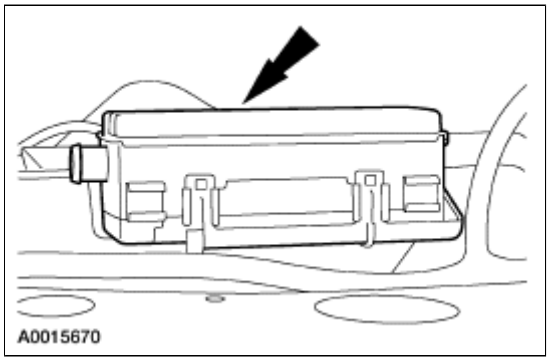
5. Remove the evaporative emission canister with bracket assembly (9E857).
   1. Disconnect the canister vent solenoid electrical connector.
   2. Remove the EVAP canister with bracket assembly.



6. Disconnect the canister vent hose.



7. Remove the evaporative emission dust separator.



8. To install, reverse the removal procedure.
   - Leak test the evaporative emission system. For additional information, refer to Evaporative Emission System Leak Test in this section.
   - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

General Specifications

Item	Specification
Penetrating and Lock Lubricant E8AZ-19A501-B	—
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft position synchronizer bolt, 4.0L (push rod) and 5.0L engines	19	14	—
Camshaft position sensor, stud bolt 4.0L SOHC	19	14	—
Crankshaft position sensor bolts	10	—	89
Engine coolant temperature sensor 4.0L	15	11	—
Engine coolant temperature sensor 5.0L	20	15	—
Heated oxygen sensor	41	30	—
Idle air control valve bolts	10	—	89
Knock sensor bolt	25	18	—
Mass air flow sensor nuts and bolts	10	—	89
Powertrain control module connector bolt	7	—	62
Skid plate bolts (4x4)	10	—	89

Electronic Engine Controls

The electronic engine controls consist of the following:

- powertrain control module (PCM)
- throttle position (TP) sensor
- idle air control (IAC) valve
- engine coolant temperature (ECT) sensor
- camshaft position (CMP) sensor
- camshaft synchronizer
- crankshaft position (CKP) sensor
- mass air flow (MAF) sensor
- intake air temperature (IAT) sensor
- heated oxygen sensor (HO2S)
- knock sensor (KS)

The PCM performs the following functions:

- accepts input from various engine sensors to compute the required fuel flow rate necessary to maintain a prescribed air/fuel ratio throughout the entire engine operational range.
- outputs a command to the fuel injectors to meter the appropriate quantity of fuel.
- determines and compensates for the age of the vehicle and its uniqueness, also automatically senses and compensates for changes in altitude.

The TP sensor:

- sends the PCM a signal indicating the throttle plate angle.
- is the main input to the PCM from the driver.

The IAC valve:

- controls bypass air around the throttle plate at low speeds.
- is controlled by the PCM.

The ECT sensor:

- sends the PCM a signal indicating engine temperature.
- resistance decreases as coolant temperature increases.

The CMP sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.

- is essential for calculating spark timing.

The MAF sensor:

- uses a hot wire sensing element to measure the amount of air entering the engine. Air passing over the hot wire causes it to cool.

The IAT sensor:

- sends the PCM a signal indicating the temperature of the air entering the engine.
- is repaired as an assembly with the MAF.

The front HO2S:

- creates a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The rear HO2S:

- monitors oxygen content after it flows through the catalytic converter.
- provides a voltage to the PCM used to calculate catalytic converter integrity.

The KS:

- is used to detect engine detonation.
- sends a voltage signal to the PCM.
- is able to provide a signal which retards the ignition timing, as necessary.

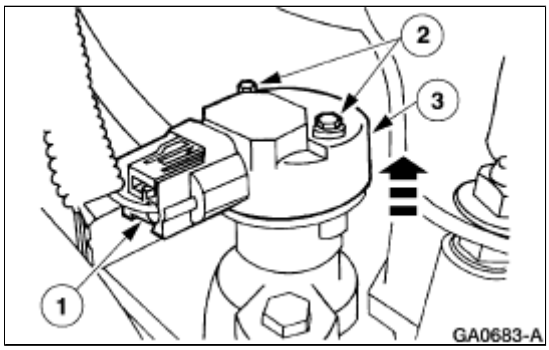
Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Camshaft Position (CMP) Sensor —5.0L, 4.0L (Push Rod)

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. For 4.0L (push rod) remove the upper intake manifold. For additional information, refer to Section 303-01A .
3. Remove the camshaft position (CMP) sensor.
    1. Disconnect the CMP electrical connector.
    2. Remove the screws.
    3. Remove the CMP sensor.



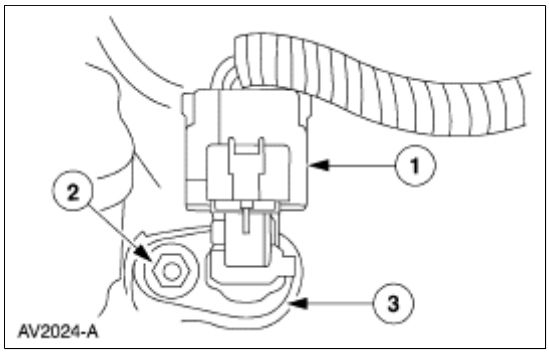
4. To install, reverse the removal procedure.

Camshaft Position (CMP) Sensor —4.0L SOHC

Removal

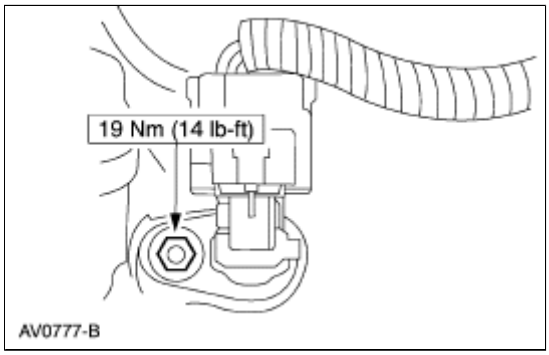
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

2. Remove the camshaft position (CMP) sensor.
    1. Disconnect the CMP sensor electrical connector.
    2. Remove the CMP sensor stud bolt.
    3. Remove the camshaft position sensor.



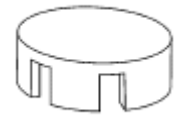
Installation

1. To install, reverse the removal procedure.



Synchronizer —4.0L (Push Rod)

Special Tool(s)

 ST2377-A	Syncro Positioning Tool 303-nt638

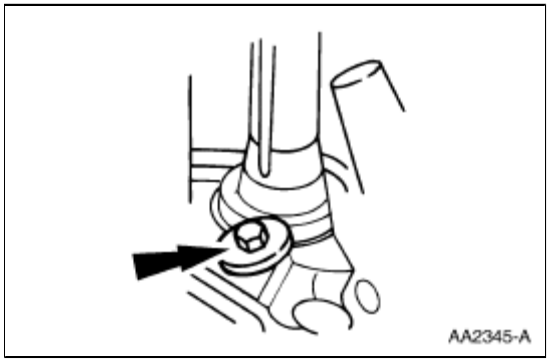
Removal

CAUTION: Do not turn the camshaft during the removal and installation procedure or the fuel system timing will be out of time with the engine and possibly cause engine damage.

NOTE: Prior to the removal of the camshaft position (CMP) sensor, set the No. 1 cylinder to top dead center (TDC) of the compression stroke. Then note the position of the CMP sensor electrical connector. Installation procedures require that the electrical connector be located in the same position.

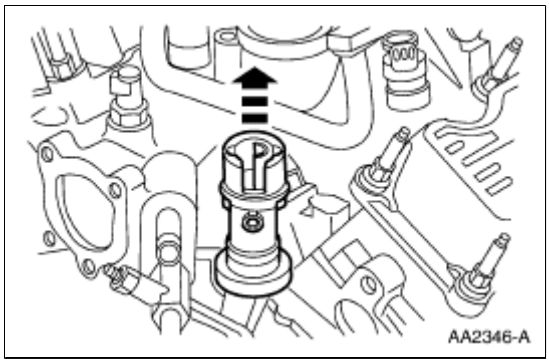
1. Remove the camshaft position (CMP) sensor. For additional information, refer to Camshaft Position (CMP) Sensor—5.0L, 4.0L (Push Rod) in this section.

2. Remove the camshaft synchronizer bolt.



3. **NOTE:** The oil pump driveshaft might come out with the camshaft synchronizer. If so, retrieve the oil pump driveshaft before proceeding.

   Remove the camshaft synchronizer.

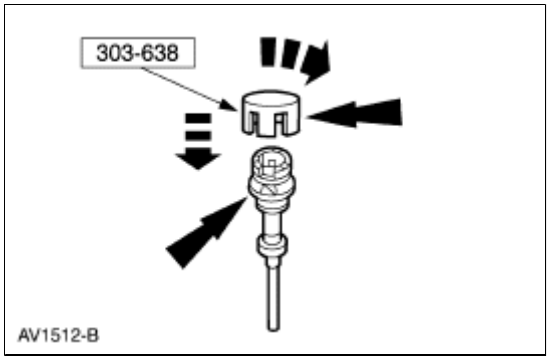


Installation

CAUTION: A special tool must be used during the installation of the replacement synchronizer assembly. Failure to follow this procedure will result in the fuel system being out of time with the engine, possibly causing engine damage.

CAUTION: It is very important to coat the gear on the camshaft synchronizer with Super Premium SAE-5W-30 Motor Oil XO-5W30-DSP or equivalent meeting Ford specification WSS-M2C153-G. Failure to do so could result in gear failure.

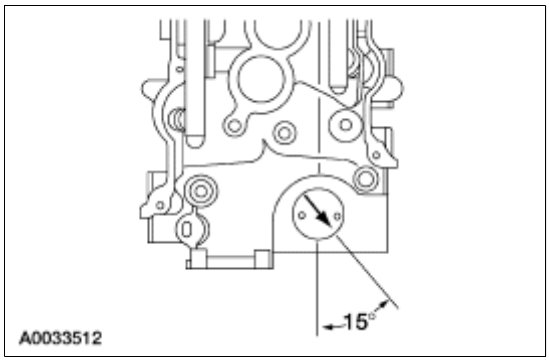
1. Install the special tool by rotating the tool until it engages the notch in the camshaft synchronizer housing and the armature.



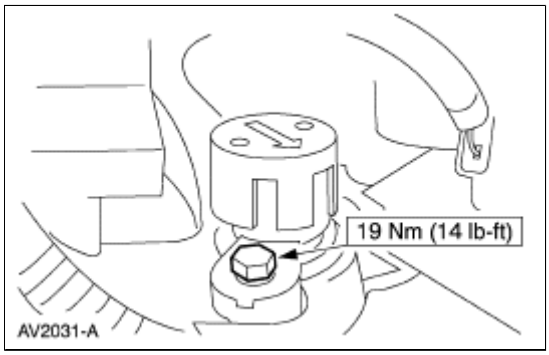
2. **NOTE:** When installing the camshaft synchronizer into the cylinder block, make sure that the arrow on the special tool is pointing to 60 degrees off the engine centerline to the right.

   NOTE: The synchronizer will rotate slightly as the synchronizer gear engages the camshaft gear. When the synchronizer is fully installed the arrow on the special tool should point to 15 degrees off the engine centerline to the right.

   Install the camshaft synchronizer.



3. Position the clamp and install the bolt.



4. Remove the special tool.

5. Install the camshaft position (CMP) sensor. For additional information, refer to Camshaft Position (CMP) Sensor—5.0L, 4.0L (Push Rod) in this section.

6. Install the upper intake manifold.

Synchronizer —5.0L

Special Tool(s)

ST2435-A	Syncro Positioning Tool 303-630

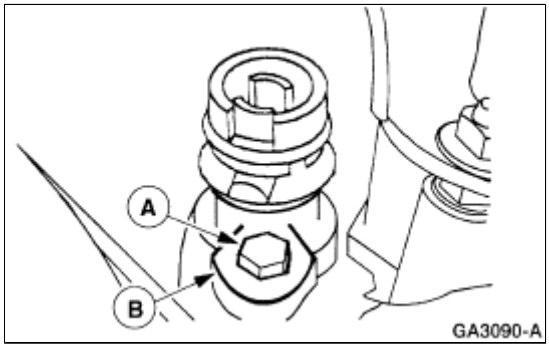
Removal

CAUTION: Once the engine is aligned at TDC, do not move the crankshaft until the entire procedure is complete. Doing so will result in the fuel system being out of time with the engine, causing a possible emissions fault.

NOTE: Prior to the removal of the camshaft position (CMP) sensor, set the No. 1 cylinder to top dead center (TDC) of the compression stroke. Then note the position of the CMP sensor electrical connector. Installation procedures require that the electrical connector be located in the same position.

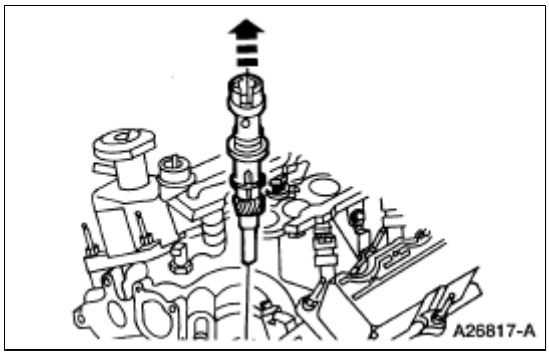
1. Remove the camshaft position (CMP) sensor. For additional information, refer to Camshaft Position (CMP) Sensor—5.0L, 4.0L (Push Rod) in this section.

2. Remove the (A) bolt and (B) clamp.



3. **NOTE:** The oil pump driveshaft might come out with the camshaft synchronizer. If so, retrieve the oil pump driveshaft before proceeding.

   Remove the camshaft synchronizer.

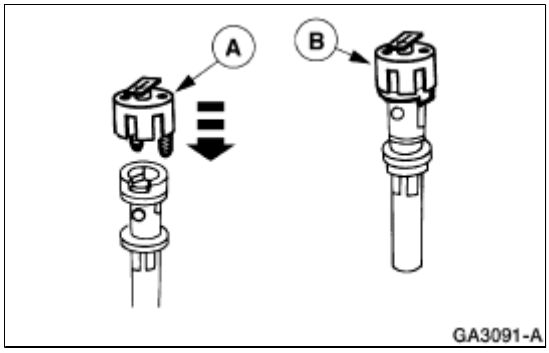


Installation

CAUTION: A special tool must be used during the installation of the replacement synchronizer assembly. Failure to follow this procedure will result in the fuel system being out of time with the engine, possibly causing engine damage.

CAUTION: It is very important to coat the gear on the camshaft synchronizer with Super Premium SAE-5W-30 Motor Oil XO-5W30-DSP or equivalent meeting Ford specification WSS-M2C153-G. Failure to do so could result in gear failure.

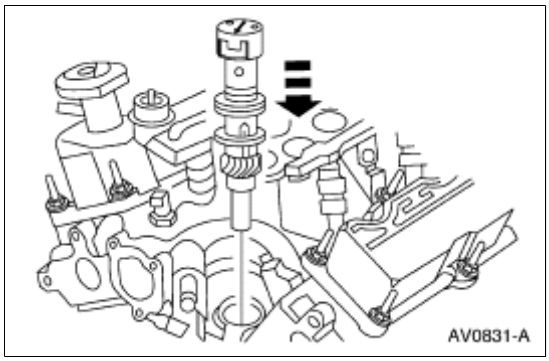
1. Install (A) Synchro Positioning Tool, aligning tabs and notches with those on the (B) camshaft synchronizer.



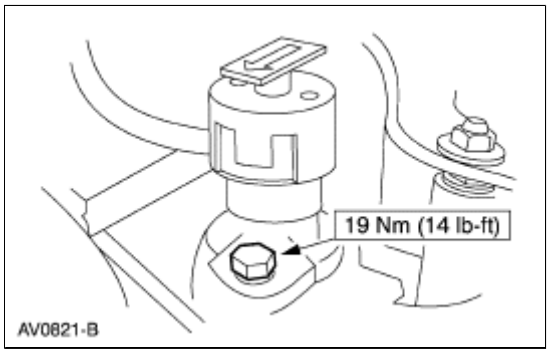
2. **NOTE:** When installing the camshaft synchronizer into the cylinder block, make sure that the arrow on special tool is pointing toward the front of the vehicle, on a line that is parallel to the center line of the crankshaft.

   NOTE: The synchronizer will rotate slightly as the synchronizer gear engages the camshaft gear. When the synchronizer is fully installed the arrow on the special tool should point to the position of the electrical connector.

   Install the camshaft synchronizer.



3. Position the clamp and install the bolt.



4. Remove the special tool.

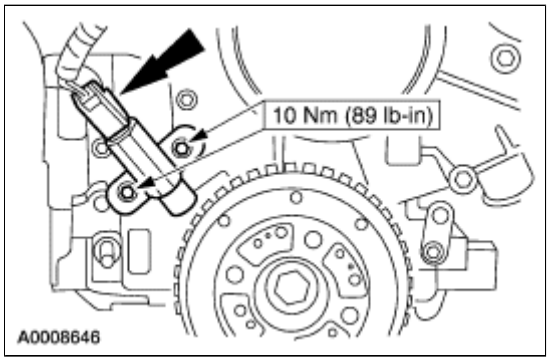
5. Install the CMP sensor. For additional information, refer to Camshaft Position (CMP) Sensor—5.0L, 4.0L (Push Rod) in this section.

Crankshaft Position (CKP) Sensor

Removal and Installation

NOTE: The 5.0L is shown, the 4.0L SOHC and the 4.0L (push rod) engines are similar.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the crankshaft position (CKP) sensor.



3. **NOTE:** 4.0L SOHC and 4.0L (push rod) CKP sensors need to be touching the damper. The CKP sensor has wear tabs that will wear off after several engine revolutions.

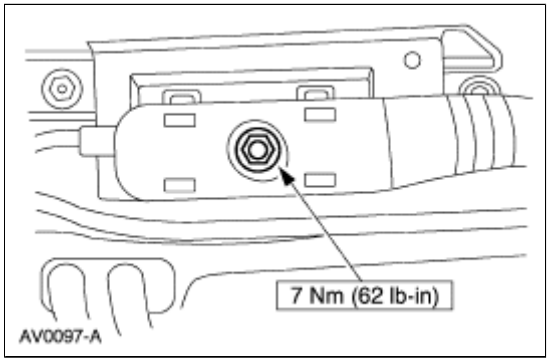
   NOTE: Be sure sensor wiring is routed away from the battery cable.

   To install, reverse the removal procedure.

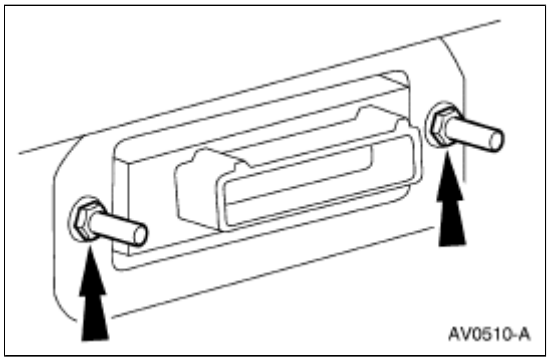
Powertrain Control Module (PCM)

Removal and Installation

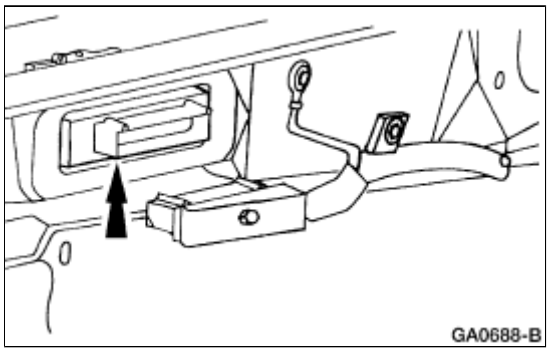
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the powertrain control module (PCM) electrical connector.



3. Remove the nuts and the PCM cover.



4. Remove the PCM.

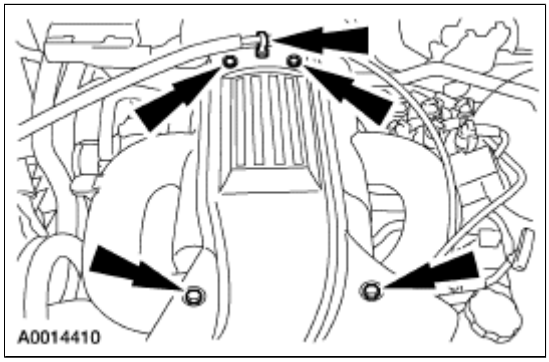


5. To install, reverse the removal procedure.

Throttle Position (TP) Sensor —4.0L (Push Rod), 4.0L SOHC

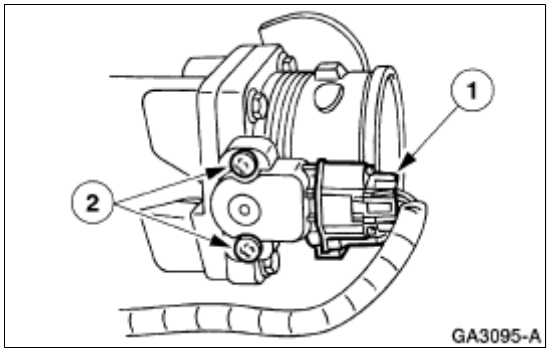
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the accelerator control snow shield.



3. **NOTE:** The 4.0L (SOHC) is shown, the 4.0L push rod is similar.

   Remove the throttle position (TP) sensor.
   1. Disconnect the TP sensor electrical connector.
   2. Remove the sensor.

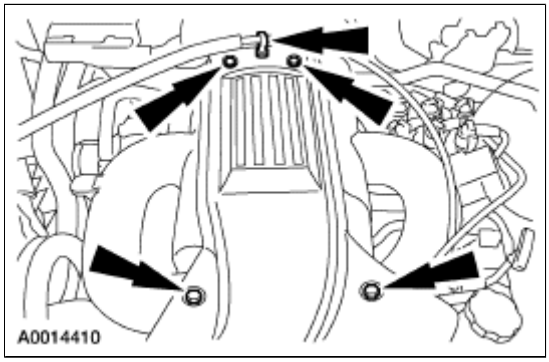


4. To install, reverse the removal procedure.

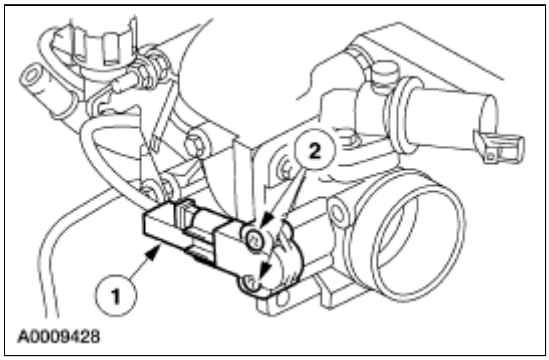
Throttle Position (TP) Sensor —5.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the accelerator control snow shield.



3. Remove the throttle position (TP) sensor.
    1. Disconnect the elctrical connector.
    2. Remove the sensor.



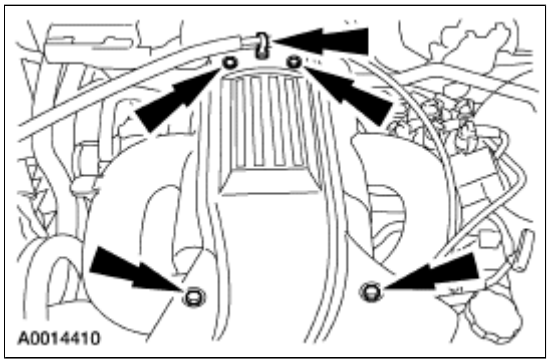
4. To install, reverse the removal procedure.

Idle Air Control (IAC) Valve

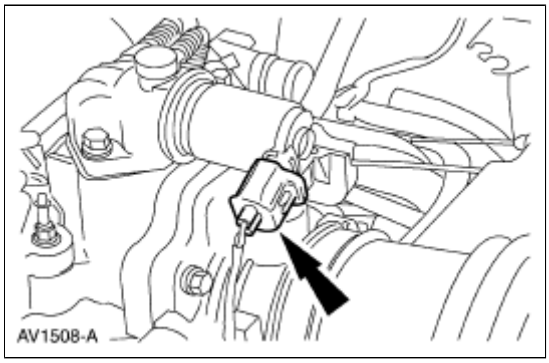
Removal and Installation

NOTE: The 5.0L is shown, the 4.0L SOHC and the 4.0L (push rod) engines are similar.

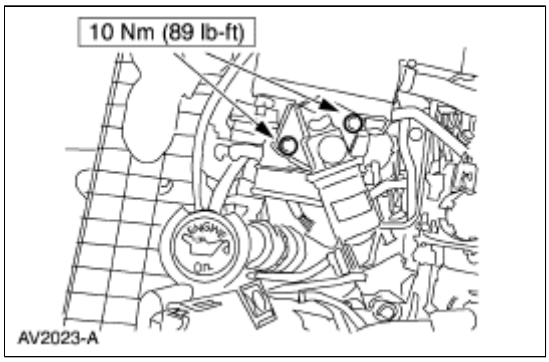
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the accelerator control snow shield.



3. Disconnect the idle air control (IAC) valve electrical connector.



4. Remove the IAC valve and discard the gasket.



5. **NOTE:** Install a new IAC valve gasket.

   To install, reverse the removal procedure.

Engine Coolant Temperature (ECT) Sensor —4.0L SOHC, 4.0L (Push Rod)

Removal and Installation

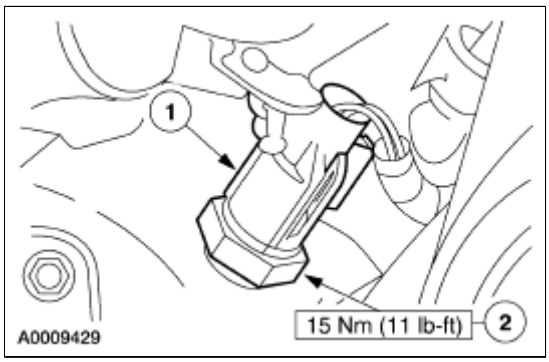
4.0L SOHC

1. Remove the thermostat and housing. For additional information, refer to Section 303-03 .

For All

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the engine coolant temperature (ECT) sensor.
    1. Disconnect the connector.
    2. Remove the sensor.

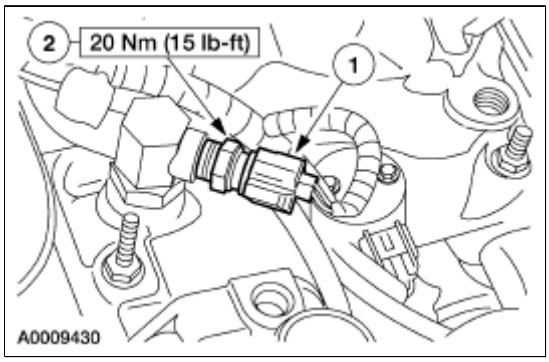


4. To install, reverse the removal procedure.

Engine Coolant Temperature (ECT) Sensor —5.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Partially drain the cooling system. For additional information, refer to Section 303-03 .
3. Remove the engine coolant temperature (ECT) sensor.
    1. Disconnect the electrical connector.
    2. Remove the sensor.

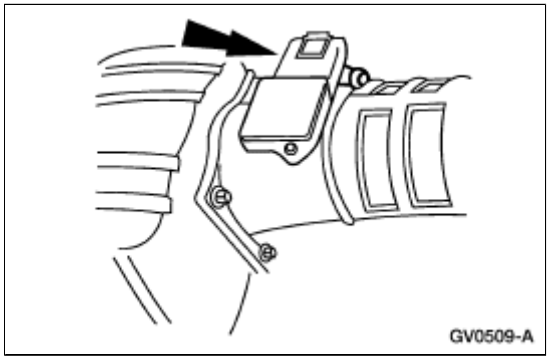


4. To install, reverse the removal procedure.

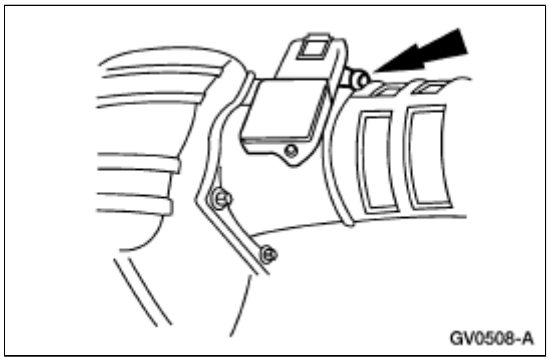
Mass Air Flow (MAF) Sensor —4.0L, 4.0L SOHC and 5.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the mass air flow (MAF) sensor electrical connector.

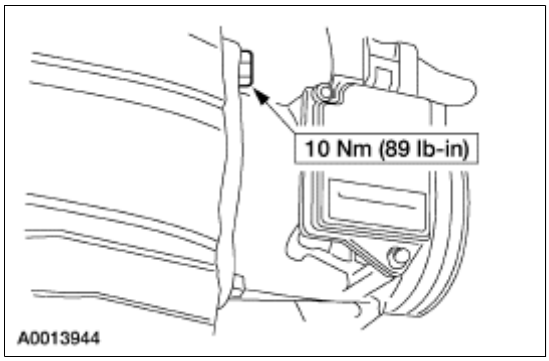


3. Loosen the air cleaner outlet tube clamp and position aside.



4. **CAUTION: The MAF sensor electronics module and body are calibrated as a unit and must be replaced as a unit. Do not tamper with the sensing elements located in the air flow bypass of the MAF body.**

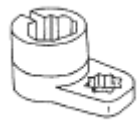
   Remove the four bolts and the MAF sensor.



5. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

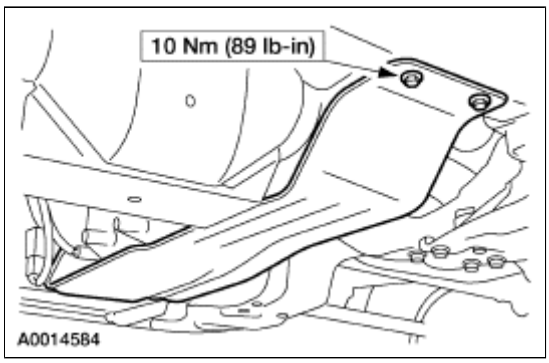
Material

Item	Specification
Penetrating and Lock Lubricant E8AZ-19A501-B or equivalent	N/A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A

Removal and Installation

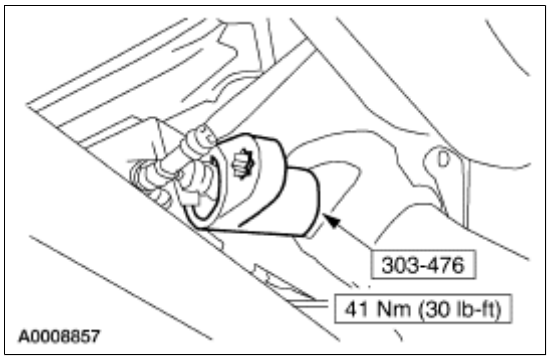
NOTE: The 5.0L RH is shown, the 4.0L SOHC and the 4.0L (push rod) engines are similar.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts and the skid plate.



3. **NOTE:** If necessary, lubricate the HO2S with lock lubricant to assist in removal.

   Using the special tool, remove the HO2S.



4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the HO2S.

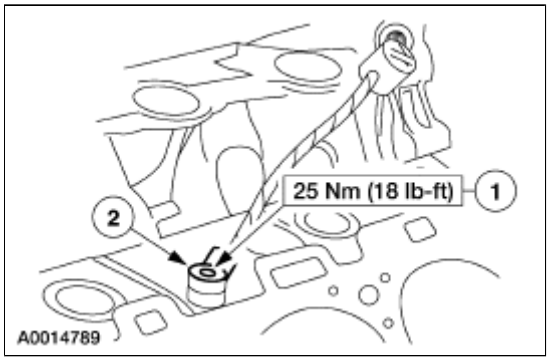
   To install, reverse the removal procedure.

Knock Sensor (KS) —4.0L SOHC

Removal and Installation

1. Remove the lower intake manifold. For additional information, refer to Section 303-01B .

2. Remove the knock sensor.
    1. Remove the bolt.
    2. Remove the knock sensor.



3. To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricant	
Ford Multi-Purpose Grease DOAZ-19584-AA	ESB-M1C93-B

General Specifications

Item	Specification			
Automatic Transmission				
Refill Capacity Liters (Quarts)	13.1 (13.9) Motorcraft MERCON® V (ATF) Transmission Fluid XT-5-QM meeting MERCON® V specification. MERCON V® is not interchangeable at this time with the current MERCON® service fluids. Check the transmission dipstick to determine the correct fluid and refer to the Workshop Information/Owner publication to determine the correct service interval for the specific vehicle.			
Torque Converter				
Stall Speed				
	Engine		Min	Max
	5.0L		2481	2904
End Play				
New or Rebuilt mm (inch)	0.355-1.04 (0.014-0.041)			
Used mm (inch)	0.355-1.87 (0.014-0.074)			
Forward Clutch Pack				
Clearance mm (inch)	1.17-1.63 (0.046-0.068)			
Snap Ring Thickness mm (inch)	1.524-1.625 (0.060-0.064) 1.880-1.981 (0.074-0.078) 2.235-2.337 (0.088-0.092) 2.591-2.692 (0.102-0.106)			
Reverse Clutch Pack				
Clearance mm (inch)	1.27-1.94 (0.050-0.076)			
Snap Ring Thickness mm (inch)	1.524-1.625 (0.060-0.064) 1.880-1.981 (0.074-0.078) 2.235-2.337 (0.088-0.092) 2.591-2.692 (0.102-0.106)			

Direct Clutch Pack	
Clearance mm (inch)	1.5748-2.159 (0.062-0.085)
Snap Ring Thickness mm (inch)	1.270-1.372 (0.050-0.054) 1.625-1.727 (0.064-0.068) 1.981-2.083 (0.078-0.082) 2.337-2.438 (0.092-0.096)
Intermediate Clutch Pack	
Clearance mm (inch)	41.7322-42.5958 (1.643-1.677)
Selective Steel Plate mm (inch)	1.702-1.803 (0.067-0.071) 1.956-2.057 (0.077-0.081) 2.210-2.311 (0.087-0.091) 2.464-2.565 (0.097-0.101)
Selective Thrust Washer - No. 1	
Green Thickness mm (inch)	1.217-1.371 (0.050-0.054)
Yellow Thickness mm (inch)	1.727-1.828 (0.068-0.072)
Natural Thickness mm (inch)	2.159-2.260 (0.085-0.089)
Red Thickness mm (inch)	2.590-2.692 (0.102-0.106)
Blue Thickness mm (inch)	3.022-3.124 (0.119-0.123)

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear Transmission Support Crossmember Bolts	47-63	35-46	—
Transmission Mount Nuts	34-46	25-34	—
Transmission Mount Bolts	68-92	50-68	—
Rear Insulator Bolts	79	58	—
Extension Housing Bolts	25-30	19-22	—
Transmission Fluid Pan Bolts	12-15	9-11	—
Front Pump Bolts	20-26	15-19	—
Front Pump Support Bolts	20-26	15-19	—
Harness Electrical Connector Bolt	4.0-5.6	—	36-49
Inspection Cover Bolts	11	8	—
Main Control Valve Body Bolts	9-11	—	80-97
Main Control Valve Body Cover Plate Bolts	9-11	—	80-97
Main Control Valve Body Separator Plate Bolts	9-11	—	80-97
Manual Lever Shaft Nut	26-37	20-27	—

Manual Lever Shaft Outer Nut	30-35	23-25	—
Fluid Cooler Line Case Fittings	20-26	15-19	—
Pressure Tap Plugs	8-16	—	71-141
Rear Driveshaft Bolts	88-119	65-87	—
Starter Bolts	22-28	17-20	—
TCC Solenoid Bolt	9-11	—	80-97
Torque Converter Drain Plug	28-30	21-22	—
Torque Converter Nuts	27-46	20-33	—
Digital Transmission Range (TR) Sensor Bolts	7-10	—	62-88
Transmission Bolts	40-55	30-40	—
Vehicle Speed Sensor (VSS) Plug Bolt	7-10	—	62-88
Output Shaft Speed (OSS) Sensor Bolt	12	9	—
Starter B+ Cable	9-14	—	80-123
Exhaust Manifold Bolts	34-46	25-33	—
Exhaust Pipe Bolts	34-46	25-33	—
Transmission Vent Tube	8-16	—	71-141
Manual Control Valve Detent Lever Spring Bolt	9-11	—	62-97
Cooler Tube Nut to Case Fitting	18	13	—
Rear Differential Retaining Nuts (Front)	77-103	57-75	—
Rear Differential Retaining Bolts and Nuts (Rear)	60-80	45-59	—
Transmission Linkage	19-26	14-19	—
Shift Cable Bracket	14	10	—

Band and Clutch Application Chart

Gear	Overdrive Band	Intermediate Clutch	Low/ Reverse Band	Reverse Clutch	Forward Clutch	Direct Clutch
PARK						
REVERSE			A [a]	A [a]		
NEUTRAL						
1st GEAR MANUAL LOW			A [a]		A [a]	
2nd GEAR MANUAL LOW	A [a]	A [a]			A [a]	
1st GEAR (D) (Overdrive)					A [a]	
2nd GEAR (D) (Overdrive)		A [a]			A [a]	
3rd GEAR (D) (Overdrive)		A [a]			A [a]	A [a]

4th GEAR (D) (Overdrive)	A [a]	A [a]				A [a]

[a] A = Applied

Band and Clutch Application Chart

Gear	Intermediate One-Way Clutch		Planetary One-Way Clutch		Solenoid States		
	Drive	Coast	Drive	Coast	SSA	SSB	TCC
PARK					ON	OFF	HD [a]
REVERSE			NE [b]		ON	OFF	HD [a]
NEUTRAL					ON	OFF	HD [a]
1st GEAR MANUAL LOW			H [c]		ON	OFF	HD [a]
2nd GEAR MANUAL LOW	H [c]				OFF	OFF	EC [d]
1st GEAR (D) (Overdrive)			H [c]	OR [e]	ON	OFF	HD [a]
2nd GEAR (D) (Overdrive)	H [c]	OR [e]	OR [e]		OFF	OFF	EC [d]
3rd GEAR (D) (Overdrive)	OR [e]	OR [e]			OFF	ON	EC [d]
4th GEAR (D) (Overdrive)	OR [e]	OR [e]	OR [e]		ON	ON	EC [d]

[a] HD = Hydraulically Disabled
[b] NE = No Effect
[c] H = Hold
[d] EC = Electronically Controlled
[e] OR = Overrunning

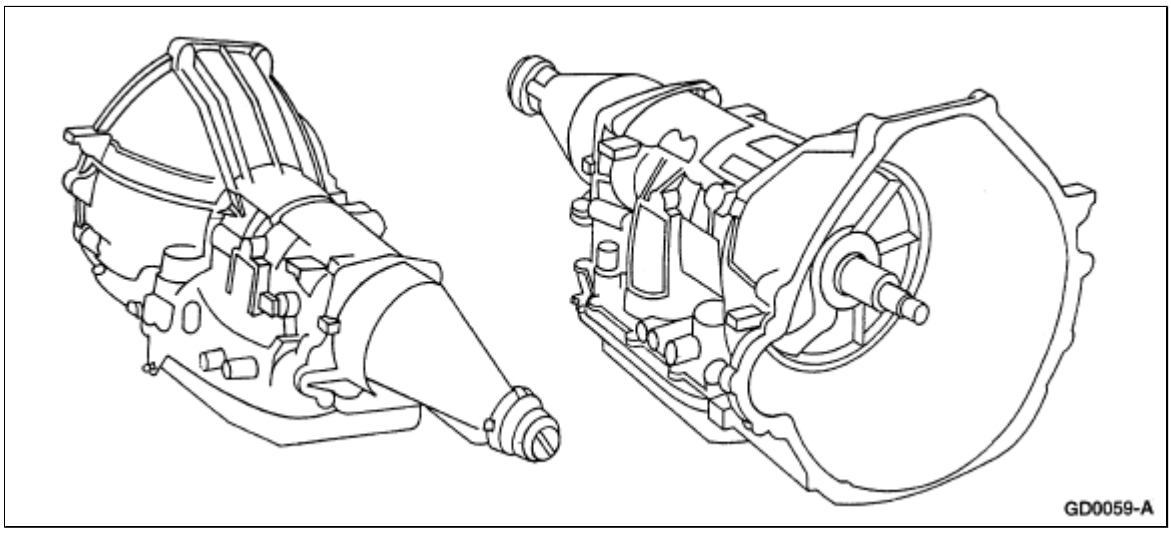
Automatic Transmission

The 4R70W has the following features:

- Wide ratio gears
- Four speeds
- Rear wheel drive
- Automatic
- Electronic shift
- Torque converter clutch control
- Line pressure controls

The transmission uses Ravigneaux-style double-pinion gearset with two bands, one one-way roller clutch, one mechanical diode and four friction clutches to produce four forward gears and Reverse.

4R70W Automatic Transmission

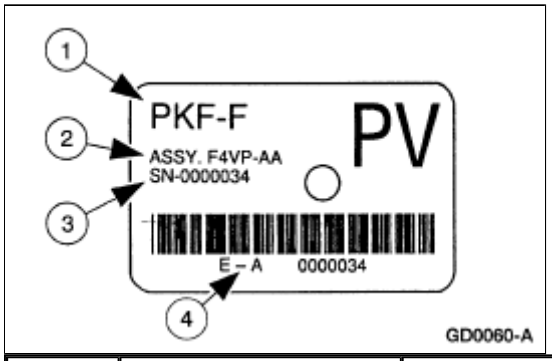


Identification Tags

All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. For correct transmission identification, refer to the code in the space marked TR.

For model, service ID level or build date information, refer to the transmission service ID tag located on the transmission case.

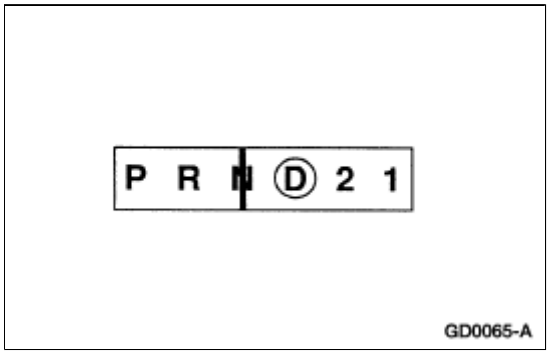
Identification Tag



Item	Part Number	Description
1	—	Model number
2	—	Assembly number
3	—	Serial number
4	—	Model and serial number

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- there is no powerflow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine can be started.
- the ignition key can be removed.

Reverse

In the REVERSE position:

- the vehicle can be operated in a rearward direction, at a reduced gear ratio.
- engine braking will occur.

Neutral

In the NEUTRAL position:

- there is no powerflow through the transmission.
- the output shaft is not held and is free to turn.
- the engine can be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- Automatic shifts.
- Apply and release of the torque converter clutch.

- Maximum fuel economy during normal operation.

Second Position

This position provides:

- Second gear start and hold.
- The torque converter clutch can apply and release.
- Improved traction and engine braking on slippery roads.
- Engine braking for descending steep grades.

First Position

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed below approximately 45 km/h (28 mph).

This position provides:

- First gear operation only.
- Engine braking for descending steep grades.

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

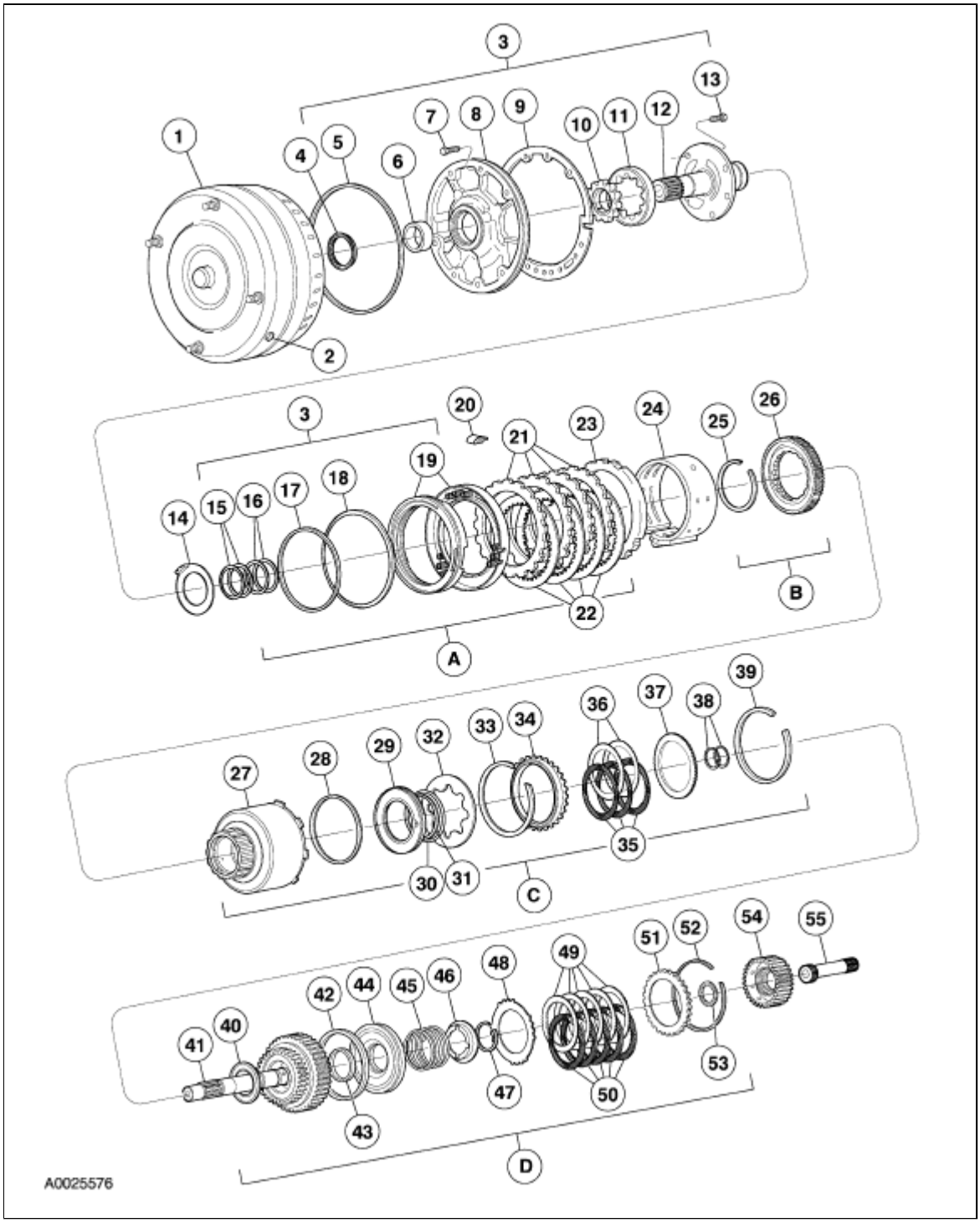
The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

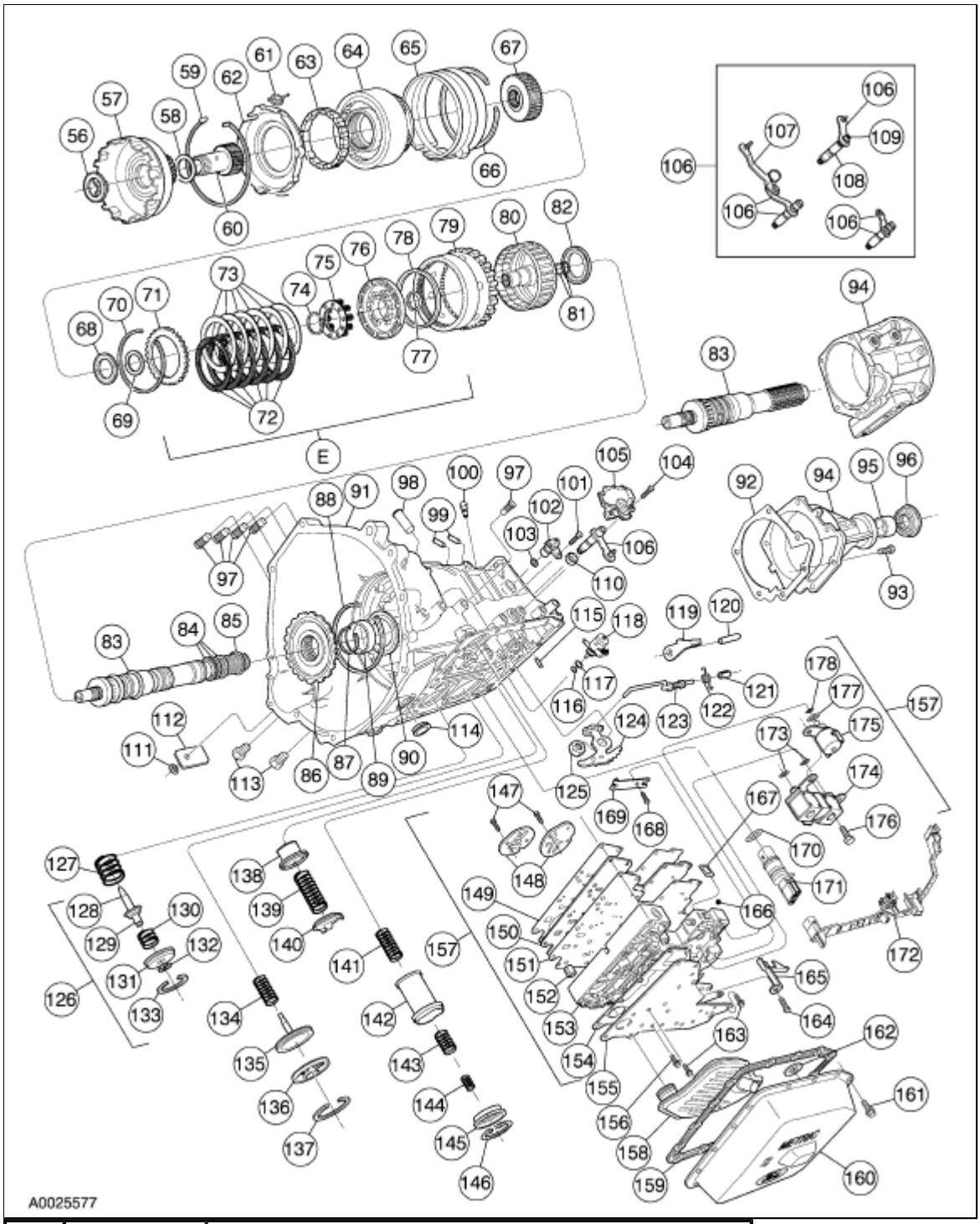
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Disassembled Views

4R70W Automatic Transmission — Disassembled View





Item	Part Number	Description
1	7902	Converter assembly (model dependent)
2	391855-S100	Plug — converter drain — 1/8-27 Dryseal (model dependent)
3	7A103	Pump assembly — front
4	7A248	Seal assembly — front pump
5	7A248	Seal — front pump

6	7B258	Bushing — front pump
7	N605789-S100	Bolt — M8-1.25 x 35 hex head (7-attaches 7A103 to 7005)
8	7A106	Body assembly — front pump (part of 7A103)
9	7A136	Gasket — front pump
10	7H169	Gear — pump inner gerotor (part of 7A103)
11	7H169	Gear — pump outer gerotor (part of 7A103)
12	7A108	Support assembly — front pump
13	N605787-S	Bolt — M8-1.25 x 25 hex flange head (5-attaches 7A108 to 7A103)
14	7D014	Washer — front pump support thrust — select fit No. 1
15	7D020	Seals — reverse clutch cylinder (2 req'd)
16	7D019	Seals — forward clutch cylinder (2 req'd)
17	7F225	Seal — intermediate clutch piston inner
18	7F224	Seal — intermediate clutch piston outer
19	7E005	Piston kit — intermediate clutch
20	7A609	Intermediate clutch anti-rattle clip (model dependent)
21	7B442	Plate — intermediate clutch external spline (select fit) (steel)
22	7B164	Plate assembly — intermediate clutch internal spline (friction)
23	7B066	Plate — intermediate clutch pressure
24	7F196	Band assembly — overdrive
25	391267-S	Ring —3-21/64 retains type SU external (retains 7F262 to 7F215)
26	7F271	Clutch assembly —intermediate one-way clutch
27	7D044	Drum assembly — reverse clutch
28	7D403	Seal — reverse clutch piston outer
29	7D402	Piston assembly — reverse clutch
30	7D404	Seal reverse clutch piston inner
31	7D256	Ring — reverse clutch piston pressure
32	7B070	Spring — reverse clutch piston return
33	7A577	Spring — reverse clutch piston spring
34	7B066	Plate — reverse clutch front pressure
35	7B164	Plate — reverse clutch internal spline (friction)
36	7B442	Plate — reverse clutch external spline (steel)
37	7B066	Plate — reverse clutch rear pressure
38	7B497	Seals — input shaft (2 req'd)
39	7D483	Retainer — reverse clutch pressure plate — (select fit)

40	7A166	Bearing and race assembly — forward clutch No. 2
41	7F207	Cylinder and input shaft assembly — forward clutch
42	7A548	Seal — forward clutch piston outer
43	7C099	Seal — forward clutch piston inner
44	7A262	Piston — forward clutch
45	7A480	Spring — forward clutch piston return
46	7A527	Retainer return spring — forward clutch
47	388099-S	Snap ring — retaining — 1-59/64 (retains 7A529 in 7F207)
48	7E085	Spring — rear clutch pressure plate (model dependent)
49	7B442	Plate — forward clutch external spline (steel)
50	7B164	Plate — forward clutch internal spline (friction)
51	7B066	Plate — forward clutch pressure
52	7D483	Snap ring — retaining (select fit)
53	7F231	Bearing and race assembly — forward clutch front No. 3
54	7B067	Hub — forward clutch
55	7F351	Shaft — intermediate stub
56	7C096	Bearing and race assembly — forward clutch hub No. 4
57	7A019	Gear assembly — reverse sun
58	7F244	Bearing and race assembly — forward clutch sun gear No. 5
59	388501-S	Retaining ring — center support — 7-7/92
60	7A399	Gear assembly — forward clutch sun
61	7F277	Spring — case to planet support
62	7A130	Support assembly — planetary gear
63	7A089	OWC cage spring and roller assembly — planetary
64	7A398	Planetary assembly (model dependent)
65	7D095	Band assembly — reverse
66	377437-S	Retaining ring — 0.58 thick (locates reverse band during assembly)
67	7F236	Hub — direct clutch
68	7F243	Bearing and race assembly — direct clutch inner No. 7
69	7F237	Support — direct clutch inner bearing
70	7D483	Retaining ring — direct clutch pressure plate (select fit)
71	7B066	Plate — direct clutch pressure
72	7B164	Plate — direct clutch internal spline (friction)

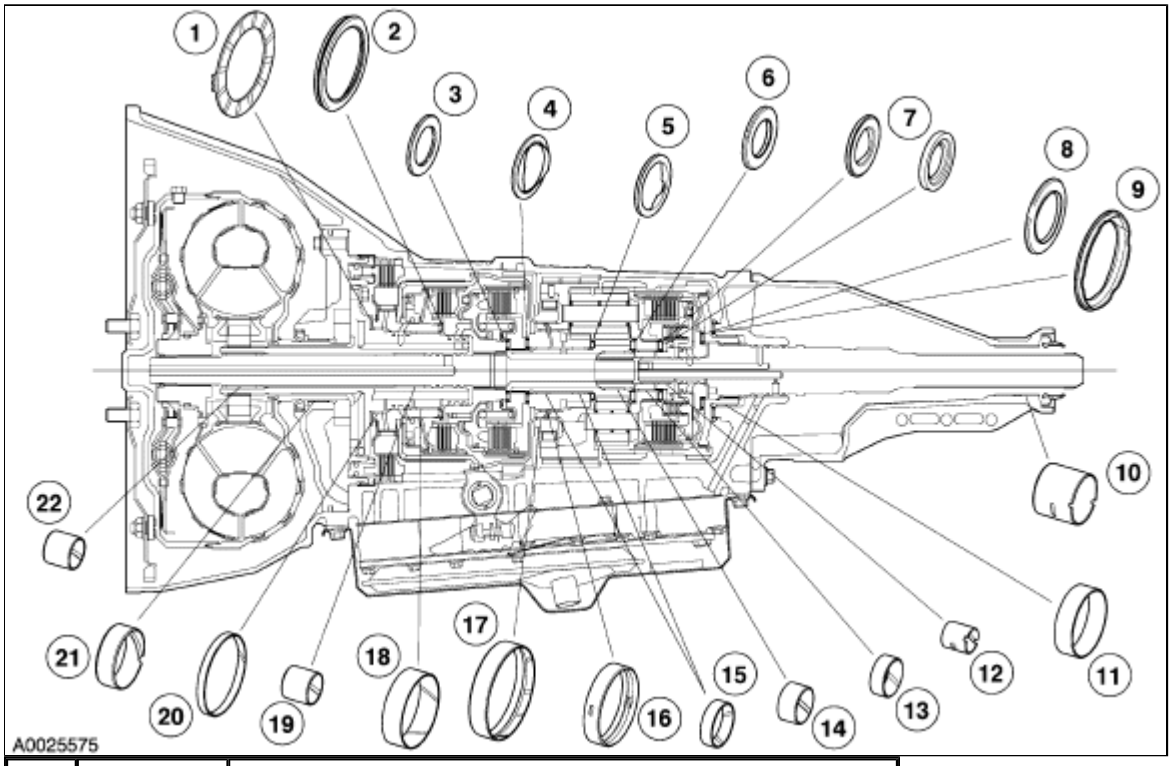
73	7B442	Plate — direct clutch external spline (steel)
74	388104-S	Retainer ring — 1-19/32 (retains 7F235 to 7F283)
75	7F235	Retainer and spring assembly — direct clutch
76	7A262	Piston assembly — direct clutch
77	7C099	Seal — direct clutch piston inner
78	7A233	Seal — direct clutch piston outer
79	7A153	Gear — output shaft ring
80	7F283	Cylinder assembly — direct clutch
81	7F274	Seals — output shaft small — direct clutch (2 req'd)
82	7F240	Bearing and race assembly — direct clutch outer No. 8
83	7060	Shaft assembly — output (model dependent)
84	7F273	Seal — output to case shaft large (3 req'd)
85	87054-S94	Seal — O-ring (piloted output shaft only) (model dependent)
86	7D164	Hub — output shaft
87	97713-S	Snap ring — 1-13/16 retaining (retains 7D164 to 7060)
88	7C122	Snap ring — retaining (retains 7D164 to 7A153)
89	7025	Bushing — rear case
90	7F242	Bearing and race assembly — case rear No. 9
91	7005	Case assembly
92	7086	Gasket — extension (model dependent)
93	N803747-S1101	Bolt — M8-1.25 x 30 (6-attaches 7A039 to 7005) (model dependent)
94	7A039	Extension housing assembly (model dependent)
95	—	Bushing — extension housing (part of 7A039)
96	7052	Seal assembly — extension housing (model dependent)
97	390318-S100	Pipe plug — 1/8-27 Dryseal tapered (5 req'd)
98	7F295	Pin — overdrive band anchor
99	388142-S	Pin — reverse band anchor (part of 7005)
100	7034	Vent assembly — case
101	N605771-S427	Bolt — M6-1.0 x 14 hex head (attaches output shaft speed sensor to case)
102	7H103	Sensor assembly — transmission output shaft speed
103	N811757-S100	Seal — 14.0 x 1.78 O-ring (2 req'd)
104	N806933-S102	Bolt and washer assembly — M6-1.0 x 25 mm (1 in) (2-attaches 7F293 to 7005) (model dependent)
105	7F293	Sensor — transmission range

106	7A256	Lever assembly — manual control (model dependent)
107	7H296	Link assembly — manual control (model dependent)
108	7C493	Shaft — transmission manual control lever (model dependent)
109	N808737-S427	Nut — M10-1.5 (attaches 7A256 to 7C493)
110	7B498	Seal assembly — manual control lever
111	373907-S2	Nut — 1/4 spring (retains identification tag to 7000)
112	7B148	Tag — identification (part of 7005)
113	7D273	Connector assembly — fluid tube (2 req'd)
114	7N171	Plug — converter housing access
115	7B210	Pin — manual lever shaft retainer
116	391131	Seal — 0.426 x 0.070 O-ring
117	N805862-S	Seal — 14.0 x 1.78 O-ring
118	7G383	Solenoid valve — transmission pressure control
119	7A441	Pawl — parking pawl
120	7D071	Shaft — parking pawl
121	7D419	Cup — park rod guide (part of 7A039)
122	7D070	Spring — parking pawl return
123	7A232	Rod assembly — park pawl actuating
124	7A115	Lever assembly — manual valve detent lever
125	N800287-S536	Nut — M14 x 1.5 hex intermediate detent lever (attaches 7A115 to 7A256)
126	7H188	Piston assembly — overdrive servo
127	7F201	Spring — overdrive servo piston
128	7F203	Rod — overdrive servo actuating (part of 7H188)
129	7H179	Washer — backup overdrive servo (part of 7H188)
130	7G277	Spring — overdrive cushion spring (part of 7H188)
131	7F200	Piston assembly — overdrive servo (part of 7H188)
132	97411-S	Ring — retaining (part of 7H188)
133	7384	Ring — 2.85 retaining type TVP "H" internal (retains 7H188 to 7005)
134	7D031	Spring — reverse band servo piston
135	7D189	Piston assembly — reverse band servo
136	7D036	Cover assembly — reverse band servo piston
137	388215-S100	Retaining ring internal — 3-13/16
138	7H292	Piston — 2-3 accumulator (bonded seals)
139	7F285	Spring — 2-3 shift accumulator piston (model dependent)
140	7B264	Retainer — 2-3 shift accumulator spring

141	7F284	Spring — 1-2 shift accumulator (model dependent)
142	7F251	Piston — 1-2 shift accumulator (bonded seals)
143	7F284	Spring — 1-2 shift accumulator
144	7G326	Nested spring — 1-2 (inner spring) (vehicle dependent)
145	7F247	Cover and seal assembly — 1-2 accumulator
146	7384	Ring — 2-1/16 retaining type HU internal (retains 7H300 to 7005)
147	N807178-S1000	Bolt — M6-1.0 x 18 hex head (12-attaches reinforcing plate to valve body)
148	7F282	Plate — valve body reinforcing (part of 7A100)
149	7C155	Gasket — valve body separator upper
150	7A008	Plate — control valve body separator (part of 7A100)
151	7D100	Gasket — valve body separator lower
152	7D174	Valve — converter drainback
153	7A091	Body assembly — main control
154	7H173	Gasket — valve body cover plate
155	7C034	Plate — valve body cover (part of 7A100)
156	N807178-S1000	Bolt — M6-1.0 x 18 hex head (11-attaches 7C034 to 7A100 (part of 7A100)
157	7A100	Control assembly — main (model dependent)
158	7A098	Filter and seal assembly — fluid
159	7A191	Gasket — transmission pan
160	7A194	Pan — transmission
161	N605785-S1036	Bolt — M8-1.25 x 18 hex flange head (14-attaches 7A194 to 7005)
162	7L027	Magnet — ceramic case (part of 7A194)
163	N808947-S1300	Bolt — M8-1.25 x 46 hex shoulder pilot (2-attaches 7C034 to 7A100)
164	N807179-S1000	Bolt — M6-1.0 x 52 hex flange head (12-attaches 7A100 to 7005)
165	7H111	Retainer — solenoid
166	7E195	Ball — 1/4 diameter coast booster valve shuttle (8 req'd)
167	7H187	Screen — solenoid pressure supply
168	N800670-S1000	Bolt — M6-1.0 x 40 hex flange head (13-attaches 7A100 to 7005)
169	7E332	Spring assembly — manual valve detent
170	7Z276	Seal — 0.864 x 0.070 O-ring (2 req'd)
171	7G276	Bulkhead assembly — wiring connector
172	7G276	Bulkhead assembly — connector (molded lead frame)

173	7Z484	Seal — 6.07 x 1.70 O-ring (2 req'd)
174	7G484	Solenoid valve — transmission shift
175	7G136	Solenoid valve — transmission torque converter clutch
176	N807178-S1000	Bolt — M6-1.0 x 16 hex head (retains 7D136 and 7G484 to 7A100)
177	7Z136	Seal — 0.489 x 0.070 O-ring
178	7Z484	Seal — 0.176 x 0.070 O-ring
A	—	Intermediate clutch assembly
B	—	Intermediate one-way clutch
C	—	Reverse clutch assembly
D	—	Forward clutch assembly
E	—	Direct clutch assembly

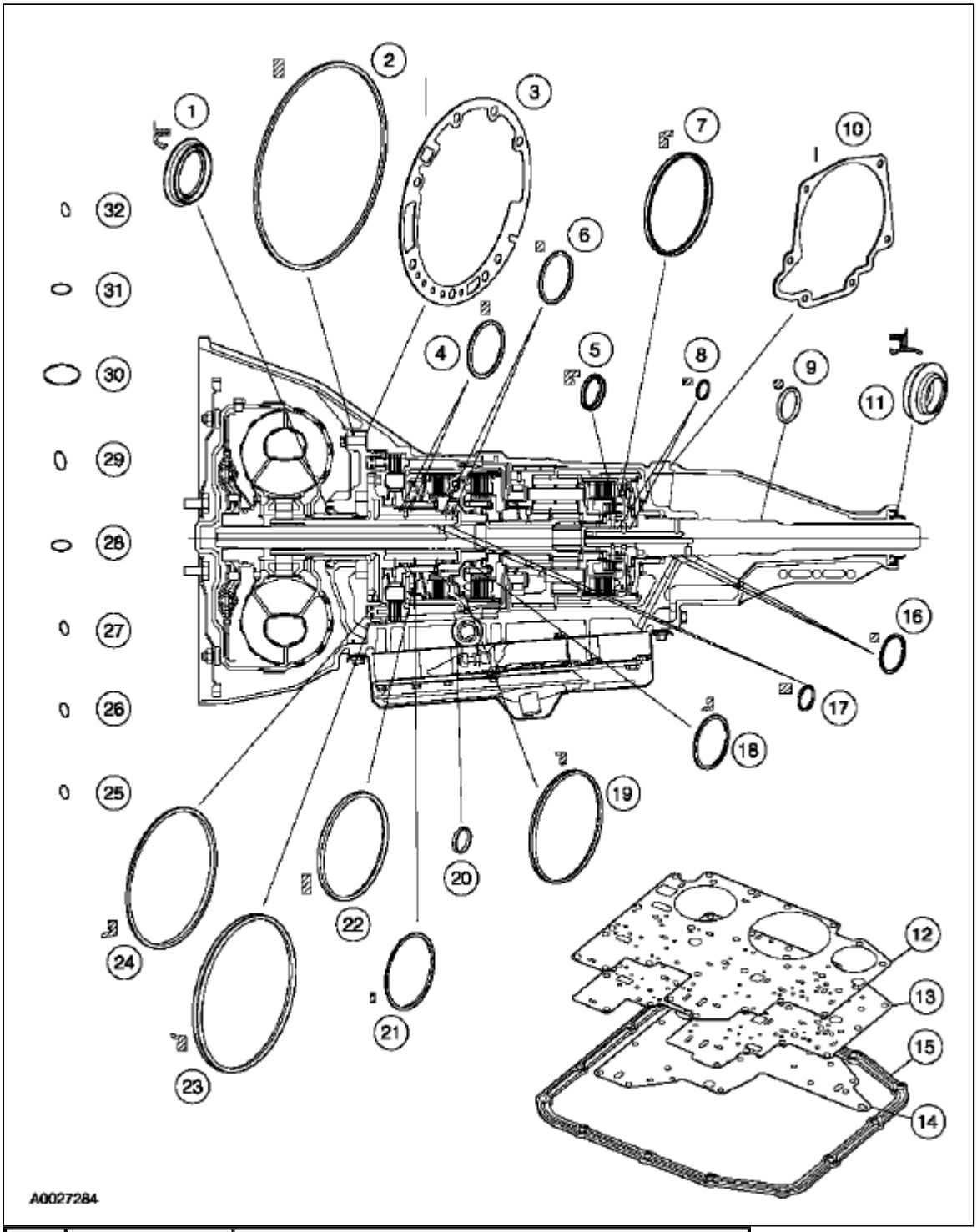
Bushings, Bearing and Thrust Washer Locator



Item	Part Number	Description
1	7D014	Pump No.1 thrust washer (select fit)
2	7A166	Forward clutch No. 2 bearing and race assembly
3	7F231	Forward clutch bearing and race assembly — front No. 3
4	7F244	Forward clutch hub bearing and race assembly No. 4
5	7F244	Forward clutch sun gear bearing and race assembly No. 5
6	7F241	Planet assembly bearing and race No. 6
7	7F243, 7F237	Direct clutch inner bearing, race assembly No. 7 and direct clutch inner bearing support No. 7
8	7F240	Direct clutch outer bearing and race assembly No. 8
9	7F242	Outer bearing and race assembly — rear No. 9
10	—	Extension bushing (part of 7A039)
11	7025	Case bushing
12	7B233	Output shaft bushing
13	7B375	Planet carrier bushing — rear
14	7F209	Forward clutch sun gear bushing

15	7N193	Reverse clutch sun gear bushing
16	7B374	Carrier bushing — front
17	7A132	Planetary support bushing
18	7F218	Reverse clutch drum bushing — rear
19	7B261	Front pump support bushing
20	7F217	Reverse clutch drum bushing — front
21	7B258	Front pump bushing
22	7B261	Front pump support bushing

Seals, Rings and Gasket Locator

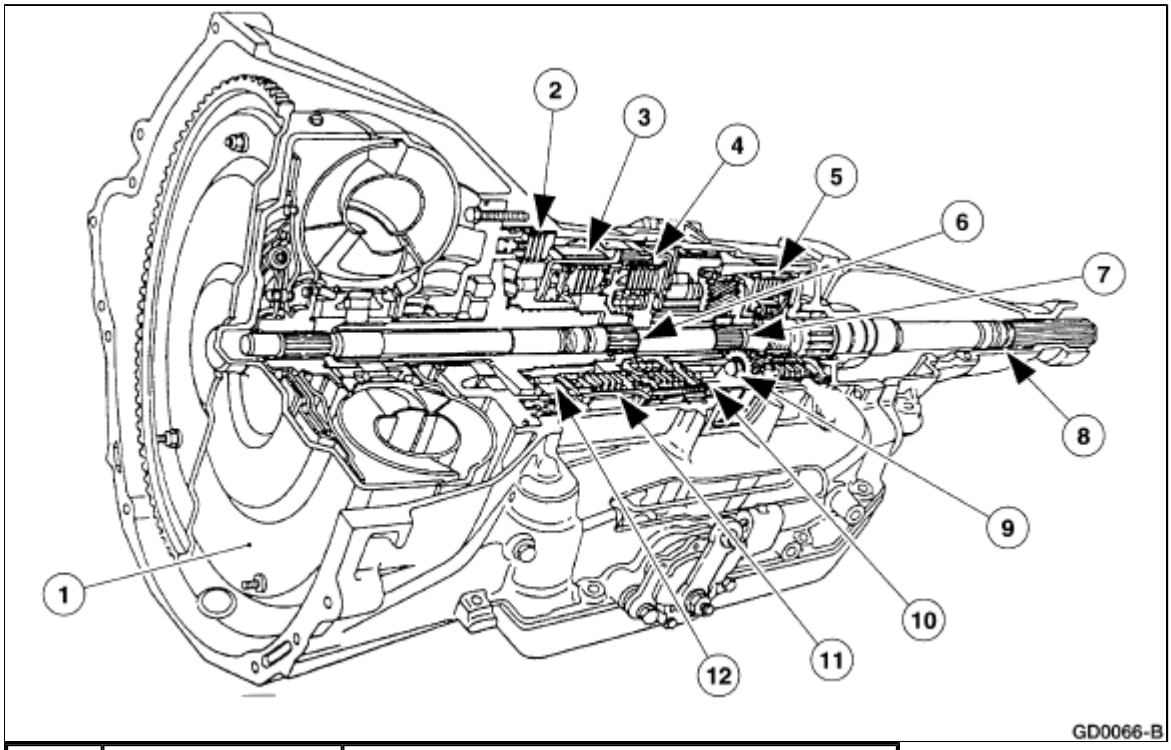


Item	Part Number	Description
1	7A248	Front pump seal assembly

2	7A248	Front pump seal
3	7A136	Front pump gasket
4	7D020	Reverse clutch cylinder seal (2 req'd)
5	7C099	Direct clutch piston inner seal
6	7D019	Forward clutch cylinder
7	7A548	Direct clutch piston outer seal
8	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
9	87054-S94	O-ring seal (piloted) (model dependent)
10	7086	Extension gasket
11	7052	Extension housing seal assembly
12	7C155	Control valve body upper gasket
13	7D100	Valve body separator plate lower gasket
14	7H173	Valve body cover plate gasket
15	7A191	Transmission pan to case gasket
16	7F273	Output shaft to case seal (3 req'd)
17	7B497	Input shaft seal (2 req'd)
18	7C099	Forward clutch piston inner seal
19	7A548	Forward clutch piston outer seal
20	7B498	Manual control lever seal assembly
21	7D403	Reverse clutch piston outer seal
22	7D404	Reverse clutch piston inner seal
23	7F224	Intermediate clutch piston outer seal
24	7F225	Intermediate clutch piston inner seal
25	391308-S	Fill tube level indicator seal
26	7Z484	TCC solenoid seal (large)
27	7Z136	TCC solenoid seal (small)
28	7Z484	Shift solenoid seal (2 req'd)
29	N811757-S100	Output shaft speed sensor seal
30	7Z276	Bulkhead seal (1 req'd)
31	N805862-S	Pressure control solenoid seal (large)
32	391131	Pressure control solenoid seal (small)

Main Components and Functions

Transmission Main Components — Sectional View



Item	Part Number	Description
1	7902	Torque converter
2	7B164	Intermediate clutch (friction)
3	7B164	Reverse clutch (friction)
4	7B164	Forward clutch (friction)
5	7B164	Direct clutch (friction)
6	7F207	Forward clutch cylinder and shaft
7	7F351	Shaft — intermediate stub
8	7060	Output shaft
9	7A089	Planetary one-way clutch
10	7D095	Reverse clutch band
11	7F196	Overdrive band
12	7A089	Intermediate one-way clutch

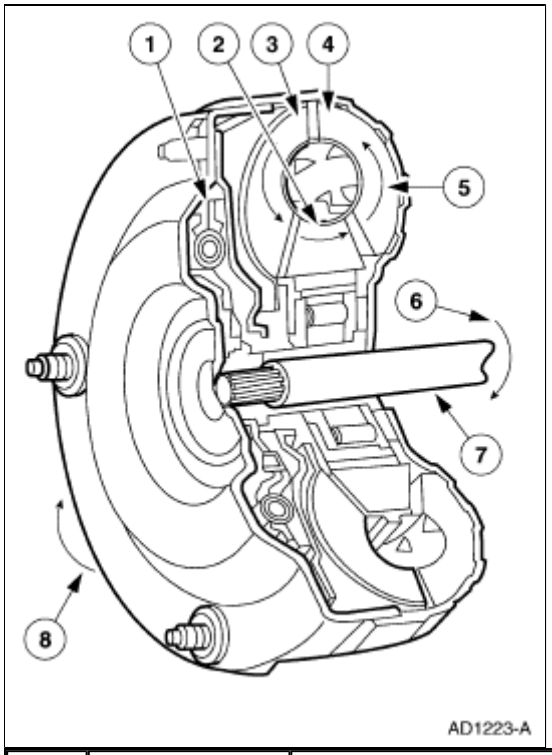
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine assembly
- reactor assembly
- clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)
3	—	Turbine (part of 7902)

4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the Ravigneaux geartrain components through the input shaft and forward clutch cylinder.

- The geartrain contains a Ravigneaux planetary set connected by dual pinion gears.
- By holding or driving certain components of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft. The ratios are as follows:

Gear Ratio	
1st	2.84 to 1
2nd	1.55 to 1
3rd	1.00 to 1
4th	0.70 to 1
Reverse	2.32 to 1

- Components of the geartrain can be held by bands or clutches and driven by clutches only.

The 4R70W uses:

- two bands.
- two one-way clutches (one roller, one mechanical diode).
- four friction clutches.

Planetary Gearset

The planetary gearset in the transmission is a Ravigneaux-type set consisting of the following components:

- forward clutch sun gear
- reverse clutch sun gear
- a pinion carrier
- long and short pinions
- output ring gear

Components are held or driven to produce forward and reverse gear ratios.

Input Shaft

The forward clutch cylinder and shaft transfers speed and torque from the converter turbine to the geartrain. This shaft is splined to the turbine on one end and to the forward clutch sun gear and stub shaft on the other end.

Stub Shaft

The stub shaft transfers power from the input shaft to the planet carrier (through the direct clutch) during third and fourth gear operation.

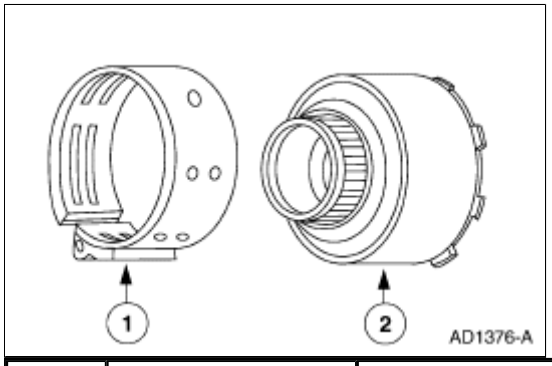
Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is driven by the ring gear of the planetary gearset.

Apply Components

There are eight apply components used to drive or hold the planetary gearset components.

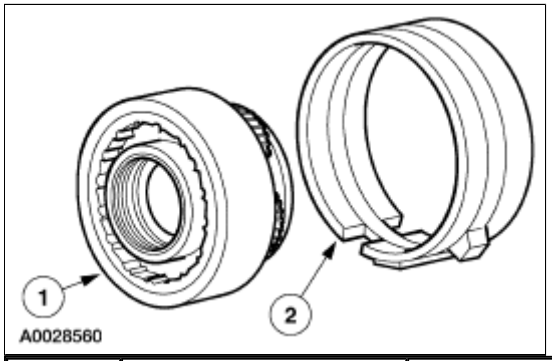
Band—Overdrive



Item	Part Number	Description
1	7F196	Overdrive band assembly
2	7D044	Reverse clutch drum assembly

The overdrive band holds the reverse clutch drum stationary in fourth gear and manual 2. This action causes the reverse sun gear to be held in these ranges.

Band—Low and Reverse

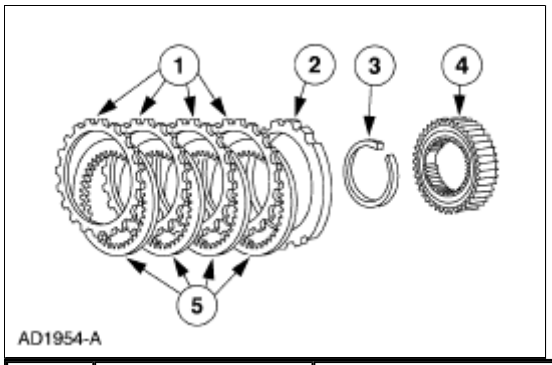


Item	Part Number	Description
1	7A398	Planetary assembly
2	7D095	Reverse band assembly

The low and reverse band holds the pinion carrier in reverse. The reverse band also applies in manual 1 position to provide engine braking.

Clutch—Intermediate

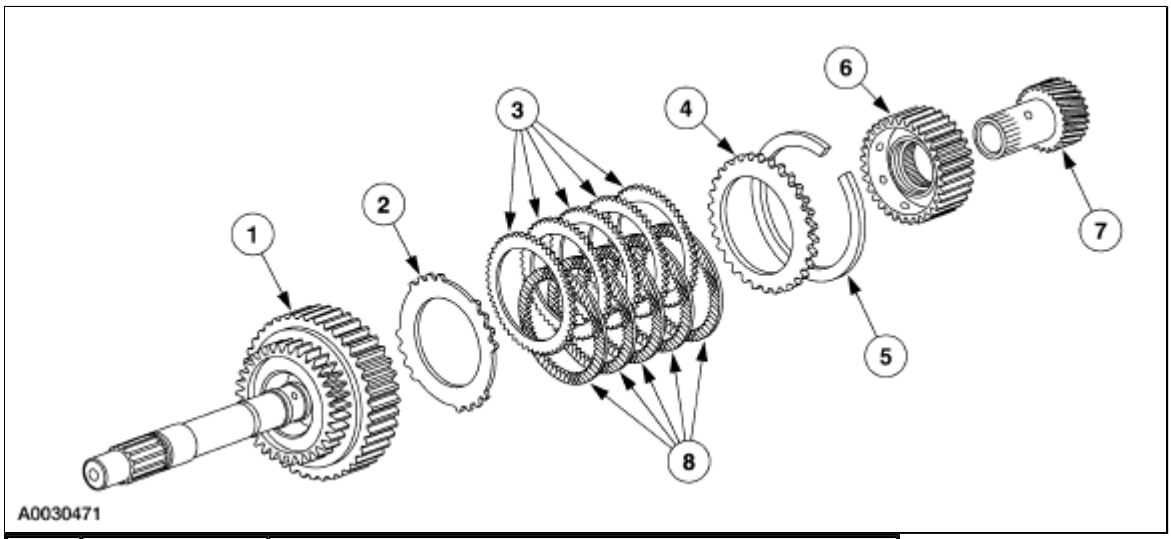
Intermediate Clutch Disassembled View



Item	Part Number	Description
1	7B442	Intermediate clutch plates (steel)
2	7B066	Intermediate clutch pressure plate
3	391267-S	Retaining ring
4	7A089	Intermediate one-way clutch assembly
5	7B164	Intermediate clutch plates (friction)

The intermediate clutch works with the intermediate one-way clutch to hold the reverse sun gear stationary in second gear. The intermediate clutch remains applied in third and fourth gears, but does not transmit power.

Clutch—Forward

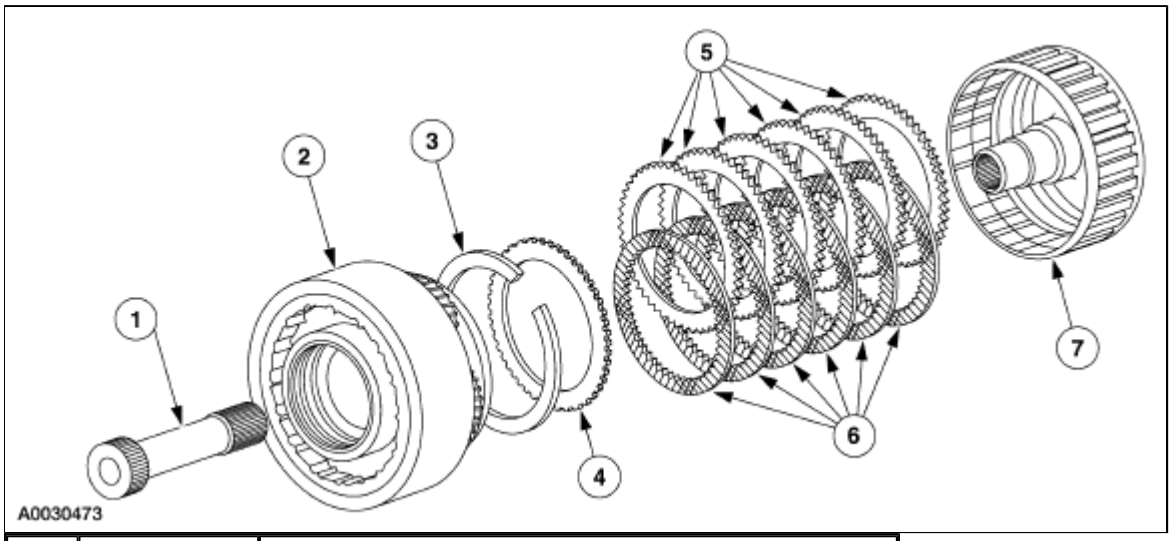


Item	Part Number	Description
1	7F207	Forward clutch cylinder and input shaft assembly
2	7E085	Rear clutch pressure plate spring
3	7B442	Forward clutch plate external spline (steel)
4	7B066	Forward clutch pressure plate
5	7D483	Snap ring — retaining (select fit)
6	7B067	Forward clutch hub
7	7A399	Forward clutch sun gear assembly

8	7B164	Forward clutch plate internal spline (friction)

The forward clutch couples the forward clutch cylinder and input shaft to the forward sun gear in first, second, and third gears. The forward clutch is not applied in fourth gear.

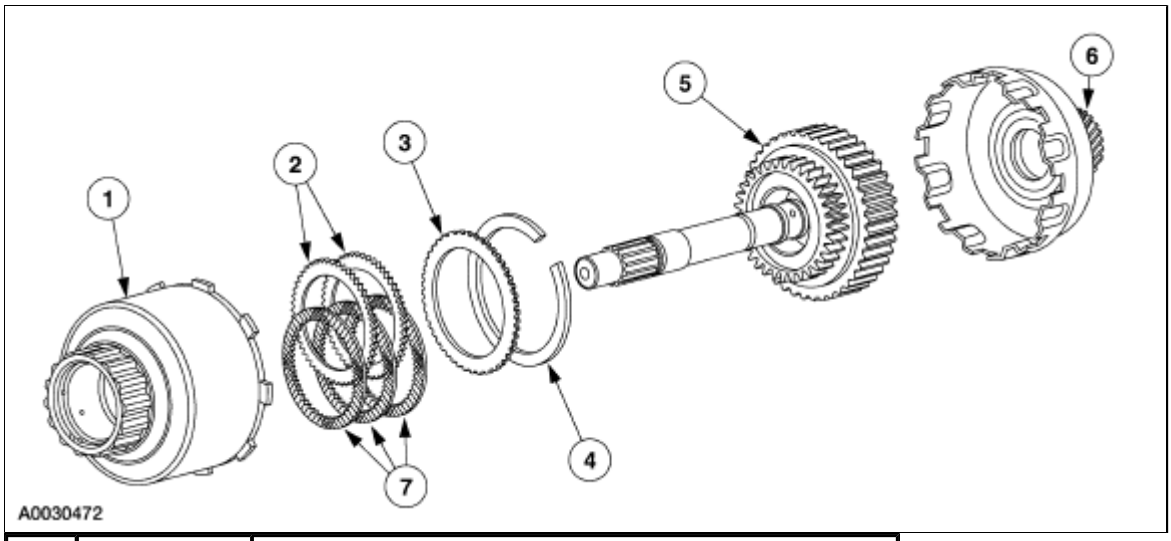
Clutch—Direct



Item	Part Number	Description
1	7F351	Intermediate stub shaft
2	7A398	Planetary assembly
3	7D483	Direct clutch pressure plate retaining ring (select fit)
4	7B066	Direct clutch pressure plate
5	7B442	Direct clutch plates external splined (steel)
6	7B164	Direct clutch plates internal splined (friction)
7	7F283	Direct clutch cylinder assembly

The direct clutch couples the input shaft to the planet carrier through the stub shaft in third and fourth gears.

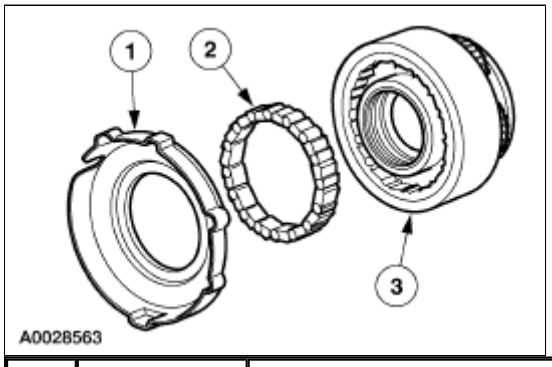
Clutch—Reverse



Item	Part Number	Description
1	7D044	Reverse clutch drum assembly
2	7B442	Reverse clutch plate external splined (steel)
3	7B066	Reverse clutch pressure plate (rear)
4	7D483	Reverse clutch pressure plate retaining ring (select fit)
5	7F207	Forward clutch cylinder and input shaft assembly
6	7A019	Reverse clutch sun gear assembly
7	7B164	Reverse clutch plate internal splined (friction)

The reverse clutch couples the input shaft to the reverse sun gear, applied in reverse range only.

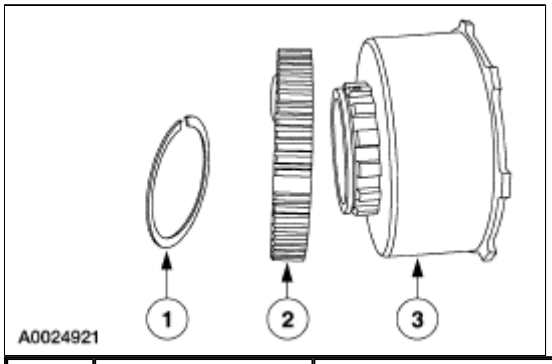
One-Way Clutch—Planetary (Low)



Item	Part Number	Description
1	7A130	Planetary gear support assembly
2	7A089	Planetary one-way clutch cage and spring roller assembly
3	7A398	Planetary assembly

The planetary (low) one-way clutch is a roller clutch that holds the planetary gearset in first gear, (D) and D ranges. During automatic coasting downshifts into first gear ((D) and D ranges), the planetary one-way clutch freewheels so there is no engine braking.

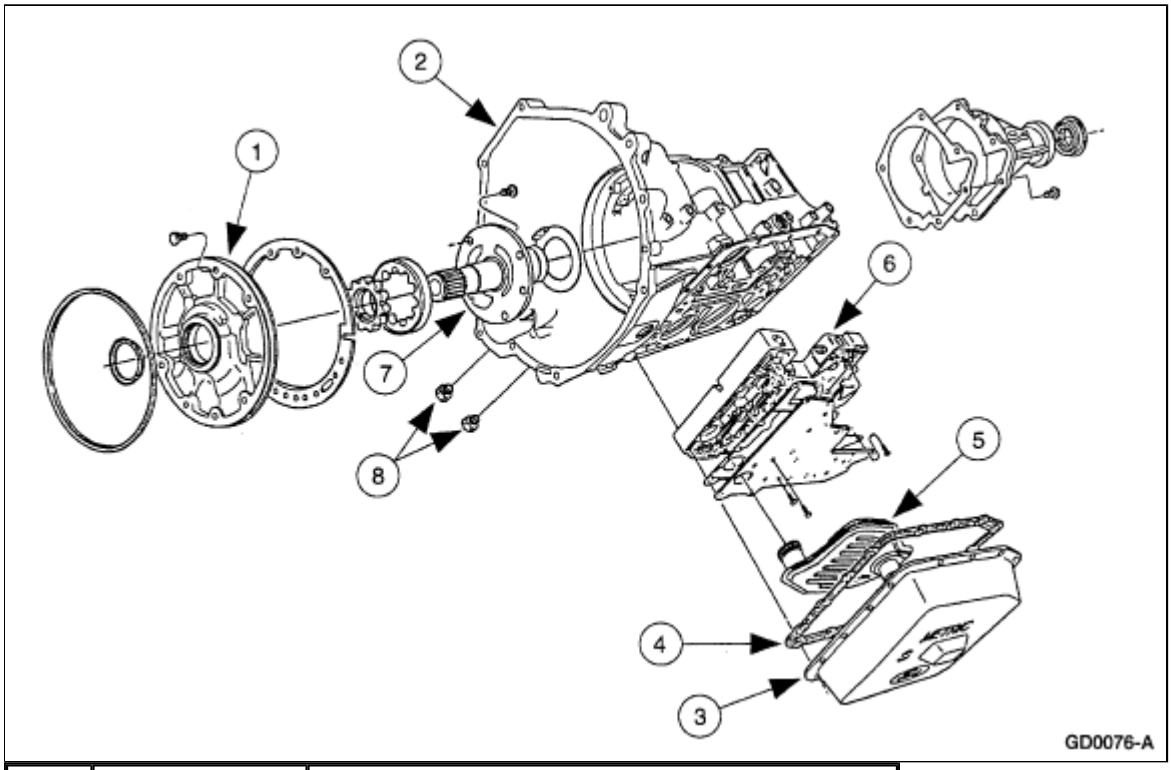
One-Way Clutch—Intermediate



Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum assembly

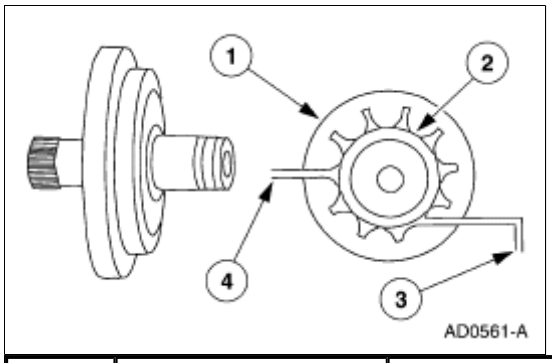
The intermediate one-way clutch works with the intermediate friction clutch to hold the reverse clutch drum and reverse sun gear stationary in second gear during acceleration. The intermediate one-way clutch freewheels in third gear and during coasting in second gear, (D) and D ranges.

Hydraulic System



Item	Part Number	Description
1	7A106	Front pump body assembly
2	7005	Case assembly
3	7A194	Transmission pan
4	7A191	Transmission pan gasket
5	7A098	Fluid filter and seal assembly
6	7A100	Main control assembly
7	7A108	Front pump support assembly
8	7D273	Fluid tube connector assembly (2 req'd)

Fluid Pump



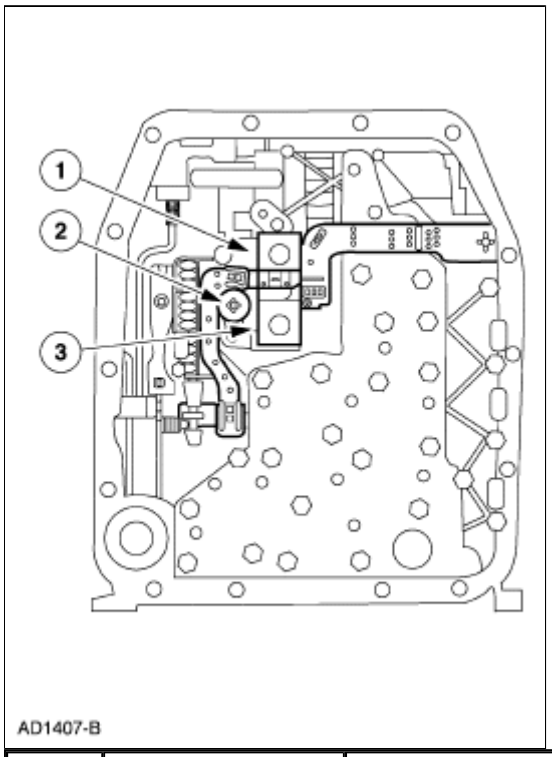
Item	Part Number	Description
1	—	Outer rotor (part of 7A103)
2	—	Inner rotor (part of 7A103)
3	—	Outlet
4	—	Inlet

The transmission uses a gerotor-type design front pump support and gear. The pump provides the volume of fluid needed to charge the torque converter, main control assembly, cooling system and lube system. Pump pressure is regulated by the main regulator valve. The pump has an internal boost circuit which is more efficient at lower engine speeds.

Filter

All fluid drawn from the transmission pan by the pump passes through the filter. The filter and its accompanying seal are part of the fluid path from the sump (pan) to the fluid pump.

Main Control

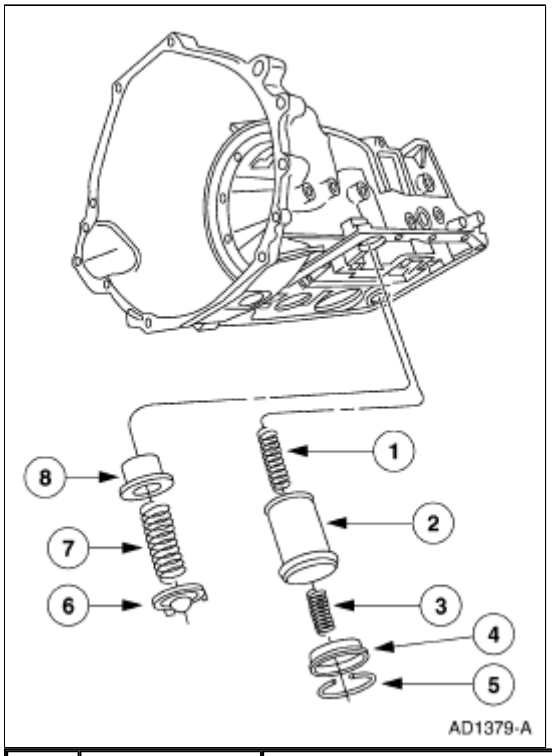


Item	Part Number	Description
1	—	Shift solenoid A (part of 7G484)
2	7G136	Torque converter clutch solenoid
3	—	Shift solenoid B (part of 7G484)

The main control valve body houses three electronic solenoids:

- two shift solenoids
- one torque converter clutch solenoid (TCC solenoid)

Accumulators



Item	Part Number	Description
1	7F284	Spring — 1-2 shift accumulator (model dependent)
2	7F251	Piston — 1-2 shift accumulator
3	7F284	Spring — 1-2 shift accumulator (model dependent)
4	7H300	Cover and seal assembly — 1-2 accumulator
5	7384	Ring — 2-1/16 retaining type HU internal
6	7B264	Retainer — 2-3 shift accumulator piston
7	7F285	Spring — 2-3 shift accumulator piston
8	7H292	Piston — 2-3 shift accumulator

The transmission uses two accumulators:

- 1-2 Accumulator — The 1-2 accumulator is used to soften the 1-2 shift by absorbing some of the

pressure directed to the intermediate clutch. Constant line pressure is applied to the middle section of the 1-2 accumulator piston, opposing the intermediate clutch pressure, until the pressure is high enough to overcome line pressure. The top of the piston is exhausted to the sump.

- 2-3 Accumulator — The 2-3 accumulator is used to soften the 2-3 shift by absorbing some of the direct clutch pressure. Forward clutch pressure is applied to the top side of the 2-3 accumulator piston, holding the piston down until clutch pressure is high enough to overcome it. The middle section of the piston is exhausted to the sump.

Transmission Electronic Control System

Electronic System Description

The powertrain control module (PCM) and its input/output network control the following transmission operations:

- shift timing
- line pressure (shift feel)
- torque converter clutch

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the PCM uses hydraulic solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Mass Air Flow (MAF) Sensor

The mass air flow sensor (MAF) measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module (PCM) to calculate injector pulse width. For transmission strategies the MAF sensor is used to regulate electronic pressure control EPC, shift and torque converter clutch scheduling.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module (PCM). Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)

The transmission control switch (TCS) is a momentary contact switch. When the switch is pressed, a signal is sent to the PCM to allow automatic shifts from first through fourth gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on) and electronic pressure control (EPC) circuit shorted (lamp flashing) or a monitored sensor failure.

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the output shaft ring gear, that sends a signal to the powertrain control module to indicate transmission output shaft speed. The OSS is used for torque converter clutch control, shift scheduling and to determine electronic pressure control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital TR sensor completes the start circuit in PARK and NEUTRAL, the back-up lamp circuit in REVERSE and the neutral sense circuit (4x4 only) in NEUTRAL. The digital TR sensor also opens and closes a set of four switches that are monitored by the powertrain control module (PCM) to determine the position of the manual lever (P, R, N, D, 2, 1).

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature (TFT) sensor is located on the lead frame assembly near the shift solenoids on the main control valve body. It is a temperature sensitive device called a thermistor. It sends a voltage signal to the PCM. The voltage signal varies with transmission fluid temperature. The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The PCM also inhibits (TCC) operation at low transmission fluid temperatures and corrects electronic pressure control.

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (VSS) is model dependent. Possible sources of vehicle speed input are, anti-lock brake sensor (ABS), a gear-driven vehicle speed sensor (VSS), or the transmission output shaft speed (OSS) sensor. On 4x4 applications with a manual shift transfer case, the transfer case speed sensor is the source of vehicle speed. The VSS signal is either an AC signal whose frequency changes with vehicle speed, or an SCP data message depending on the source. Some vehicles have both. The vehicle speed signal is an input to various vehicle sub-systems such as the powertrain control module (PCM), instrument cluster (speedometer and odometer), speed control systems, etc. The vehicle speed source must be operational to enter output state control mode for diagnostics.

Electronic Pressure Control (EPC) Solenoid

The electronic pressure control (EPC) solenoid regulates transmission pressure. EPC valve pressure is used to control line pressure.

Shift Solenoid — SSA, SSB

Two on/off shift solenoids provide gear selection of first through fourth gears by controlling the pressure to the three shift valves. One unit containing the two shift solenoids is located in the main control valve body. The shift solenoids are two-way normally open style.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
w/OD OFF				
1	1	ON	OFF	HD

2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 [a]	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed, the transmission will not downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically Controlled.

HD = Hydraulically Disabled.

Torque Converter Clutch (TCC) Solenoid

The torque converter clutch (TCC) solenoid is used to control the apply and release of the TCC.

4x4 Low (4x4L) Switch

The 4x4 low (4x4L) range switch is located on the transfer case cover. It provides an indication of when the 4x4 transfer case gear system is in the low range. The PCM then modifies shift schedule for 4x4L operation.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the powertrain control module (PCM) when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Electronic Ignition (EI) System

The electronic ignition consists of a crankshaft position sensor, two four tower ignition coils and the powertrain control module (PCM). The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the PCM. The PCM uses PIP signal in the transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and EPC pressure.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged, electronic pressure control (EPC) is adjusted by the PCM to compensate for additional load on the engine.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining electronic pressure control (EPC) pressures.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects temperature of engine coolant and supplies the information to the powertrain control module (PCM). The ECT sensor is used to control torque converter clutch (TCC) operation. The ECT is installed in the heater outlet fitting or cooling passage on the engine. For engine control applications, the ECT signal is used to modify ignition timing, EGR flow and air-to-fuel ratio as a function of engine coolant temperature.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module (PCM). The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To properly diagnose a concern have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- TSBs and OASIS Messages.
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for proper adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to Diagnosis By Symptom for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns • Check the fluid level and condition • Verify the concern by operating the vehicle • Check for non-factory-installed items and verify correct installation • Check the shift linkage adjustments • Check TSBs and OASIS messages for vehicle concerns • Carry out quick test both KOER and KOEO • Record all codes 1) Did you record any diagnostic trouble codes?	Yes	· REPAIR all hard diagnostic trouble codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this Workshop Manual.
	No	· REFER to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· CLEAR codes and CARRY OUT drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	· REFER to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· INSTALL the scan tool and CARRY OUT the output state control test, then GO to Step 6.
	No	· REFER to the hydraulic and mechanical routine to diagnose and REPAIR the concern, then GO to Step 7.
6) Was the transmission	Yes	· REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

concern corrected when the scan tool was installed?		manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).
	No	· REFER to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	· Get assistance from technical hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to properly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions as to when the concern occurs, for example:

- hot or cold vehicle temperature
- hot or cold ambient temperature
- vehicle driving conditions
- vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to verify the concern.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and performing the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission (7003).

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshift
- Downshift
- Coasting
- Engagement
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

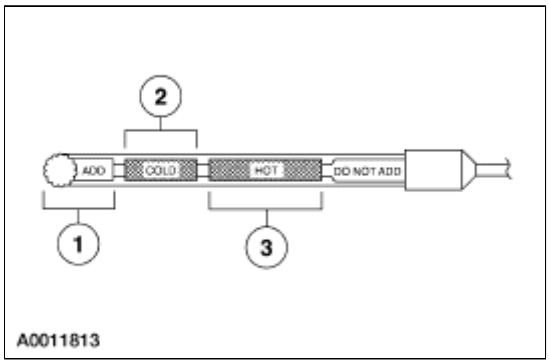
Fluid Level Check

CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid below the DO NOT DRIVE mark or internal failure could result.

NOTE: If vehicle has been operated for an extended period of time at highway speeds, city traffic, hot weather, or pulling a trailer, the fluid needs to cool down to obtain an accurate reading.

NOTE: The fluid level reading on the indicator will differ from operating and ambient temperatures. The correct reading should be within the normal operating temperature range. Under normal circumstances, the fluid level should be checked during normal maintenance. If the transmission starts to slip, shifts slowly, or has signs of fluid leaking, the fluid level should be checked.

1. With the transmission in (P) PARK, the engine at idle, foot pressed on the brake, move the range selector lever through each gear and allow engagement of each gear. Place the selector lever in the PARK position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.



Item	Description
1	Do Not Drive Mark
2	Fluid Level at Room Temperature 10°C-35°C (50°-95°F)
3	Fluid Level at Operating Temperature 66°C-77°C (150°F-170°F)

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission malfunction and/or damage. If an overfill reading is indicated, refer to Fluid Pan, Gasket and Filter in this section.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

CAUTION: The use of any other type of transmission fluid than specified could result in transmission malfunction and/or damage.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type refer to the General Specifications chart.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black or have a burnt odor.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter, coolers, and cooler lines.
7. Perform diagnostic checks and adjustments; refer to the Diagnosis by Symptom Index in this section.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to the driving conditions and obey all traffic laws.

The shift point road test and torque converter operation tests provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.

2. Operate vehicle with transmission range selector lever in (D) position.

3. **NOTE:** Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application) refer to the Automatic Transmission Specification Issue, available from Ford Customer Service Division.

   Apply minimum throttle and observe speeds at which upshift occurs and torque converter engages; refer to the 4R70W Shift Speeds chart in this section.

4. With the transmission in Overdrive (fourth gear), press the transmission control switch. The transmission should downshift to third gear. Release the accelerator pedal; engine braking should occur.

5. Press accelerator pedal to floor, wide open throttle (WOT). Transmission should shift from third to second gear, or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.

6. With the transmission in (D) position and speed above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from (D) position to manual 2 position and remove pressure from the accelerator pedal. Transmission should immediately downshift into second gear. With vehicle remaining in manual 2 position, move the transmission range selector lever into manual 1 position, and release accelerator pedal. Transmission should downshift into first gear at speeds approximately below 45-56 km/h (28-35 mph).

7. If transmission fails to upshift/downshift or torque converter clutch does not apply and release, refer to Diagnosis By Symptom in this section.

4R70W Shift Speeds

Throttle Position	Shift	MPH	Km/H
Light Throttle (TP Voltage 1.25 Volts)	1-2	9-15	14-24
	2-3	17-25	27-40
	3-4	34-45	55-72
Closed Throttle	4-3	25-21	40-33
	3-2	15-12	24-19
	2-1	8-6	13-10
Wide Open Throttle	1-2	35-42	56-68
	2-3	64-72	102-116
	3-2	60-65	97-105
	2-1	31-27	50-43

Torque Converter Diagnosis

Prior to torque converter installation, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of good torque converters (7902). Only after a complete diagnostic evaluation can the decision be made to install a new torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary inspection.
2. Know and understand the customer's concern.
3. Verify the condition — carry out the torque converter operation test.
4. Carry out diagnostic procedures.

- Carry out on-board diagnostics; refer to Diagnostics.
  - Repair all non-transmission related DTCs first.
  - Repair all transmission DTCs.
  - Rerun on-board diagnostic to verify repair.
- Carry out Line Pressure Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Stall Speed Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Diagnostic Routines. For additional information, refer to Diagnosis By Symptom in this section.
  - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required before changing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out Quick Test with scan tool. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Check for DTCs.
6. Connect a tachometer to the engine.
7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.
8. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.
9. Engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, see torque converter operation concerns. For additional

information, refer to Diagnosis By Symptom in this section.

10. If the vehicle stalls in (D) or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, see torque converter operation concerns. For additional information, refer to Diagnosis By Symptom in this section. If the vehicle does not stall in (D), refer to Diagnosis By Symptom in this section.

11. If the vehicle exhibits a vibration during the road test, complete the Road Test Evaluation Form. This form will aid the technician in determining the source of the vibration.

NOTE: The following is a list of common vehicle concerns that have been misdiagnosed as torque converter clutch shudder. For diagnosis of the following items, refer to the appropriate sections of the workshop manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- spark plugs - check for cracks, high resistance or broken insulators
- plug wires
- fuel injector - filter may be plugged
- fuel contamination - poor engine performance
- EGR valve - valve may let in too much exhaust gas and cause engine to run lean
- vacuum leak - engine will not get correct air/fuel mixture
- MAP/MAF sensor - improper air/fuel mixture
- HO2S sensor - too rich/lean air/fuel mixture
- fuel pressure - may be too low
- engine mounts -loose/damaged mounts can cause vibration concerns
- axle joints - check for vibration

Torque Converter Road Evaluation Form

1) Does the Torque Converter Engage/Disengage?	Yes	· GO to Step 2.
	No	· For further diagnosis, REFER to Diagnosis By Symptom — Torque Converter, No Apply Routine 240/340 and Always Applied Routine 241/341 found in this section. Repair as required, verify converter operation and then continue.
2) Does vibration occur during 3-4 or 4-3 shift at: light, medium, or heavy throttle?	Light	· May be torque converter clutch shudder. GO to Step 3.
	Medium	· May be torque converter clutch shudder. GO to Step 3.
	Heavy	· Not torque converter clutch shudder — converter does not engage due to PCM strategy. For further diagnosis, REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 found in this section.

3) Is the problem vehicle speed dependent (operating at steady speed, i.e., 64 km/h [40 mph] regardless of transmission range)? Verify by manually selecting 2nd, OD cancel, and OD.	Yes	· Not torque converter clutch shudder. For further diagnosis, REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 found in this section.
	No	· GO to Step 4.
4) Is the problem engine-rpm dependent (occurs at the same engine rpm independent of transmission gear)? Verify by holding same rpm in each transmission gear.	Yes	· Not torque converter clutch shudder. For further diagnosis, REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 found in this section.
	No	· GO to Step 5.
5) Does the problem occur in coast, steady speed, or reverse range?	Yes	· Not torque converter clutch shudder. For further diagnosis, REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 found in this section.
	No	· GO to Step 6.
6) Does vibration occur during extended light brake application?	Yes	· Not torque converter clutch shudder. For further diagnosis, REFER to Section 100-04 , Section 206-00 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 found in this section.
	No	· GO to Step 7.
7) If one of the driving modes in Step 2 identifies a vibration which is not present in Steps 3-6, then there is a strong possibility that the vibration is caused by the torque converter clutch function. Carry out the repair procedures as found under Disassembly/Assembly.		

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- electronic add-on items:
  - air conditioning
  - generator (alternator)
  - engine turbo
  - cellular telephone
  - cruise control
  - CB radio
  - linear booster
  - backup alarm signal
  - computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module (PCM), or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- Leaks; refer to Leak Inspection.
- Correct linkage adjustments; refer to Section 307-05 .

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those of the manual lever in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

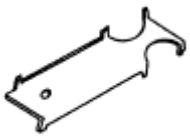
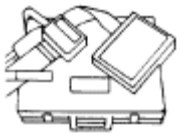
Refer to all technical service bulletins (TSB) and OASIS messages which pertain to the transmission concern and follow the procedure as described.

Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using the scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Diagnostics

Special Tool(s)

ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
	Transmission Tester 307-F016 (007-00130) or equivalent

ST1389-A	
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. DO NOT TAKE SHORT CUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics With Diagnostic Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual. These quick tests should be used to diagnose the powertrain control module (PCM) and should be carried out in order.

- **Quick Test 1.0 - Visual Inspection**
- **Quick Test 2.0 - Set Up**
- **Quick Test 3.0 - Key On, Engine Off (KOEO)**
- **Quick Test 4.0 - Continuous Memory**
- **Quick Test 5.0 - Key On, Engine Running (KOER)**
  - Special Test Mode
  - Wiggle Test
  - Output Test Mode
  - PCM Reset Mode
  - Clearing DTCs
  - OBD II Drive Cycle
- **Other Scan Tool Features**

For further information on other diagnostic testing features using the scan tool, refer to the Powertrain

Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode
- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

Output State Control (OSC) allows the technician to take control of certain parameters to function the transmission. For example, OSC allows the technician to shift the transmission only when he/she commands a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. Another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

NOTE: To operate OSC the digital transmission range (TR) sensor must be operational. No Diagnostic Trouble Codes (DTCs) related to the digital TR sensor can be present.

To operate OSC the vehicle speed source must be operational. No diagnostic codes (DTCs) related to this source can be present. The vehicle speed source can vary depending on vehicle configuration. Technicians should verify which input source is applicable for their vehicle application. The following are potential vehicle speed sources:

- anti-lock braking system (ABS)
- rear anti-lock braking system (RABS)
- output shaft speed (OSS) sensor

For manual 4x4 applications, the vehicle speed source is from the transfer case speed sensor.

- The vehicle requirements MUST BE MET when SENDING the OSC value. Refer to individual test modes for vehicle requirements.
- If the vehicle requirements are NOT MET when SENDING the OSC value, an ERROR MESSAGE will appear. When the ERROR MESSAGE is received, OSC is aborted and must be restarted.
- If AFTER SENDING an OSC value, and the vehicle requirements are no longer met, the PCM will cancel the OSC value and NO ERROR message will appear. Once the vehicle requirements are met again, the PCM will automatically SEND the previous OSC value without any additional actions required by the service technician.
- The OSC value XXX may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures

- Carry out visual inspection and vehicle preparation as required.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Output Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.
- Repair all digital TR Sensor DTCs.
- Repair all vehicle speed DTCs.
- Ensure that the vehicle speed sensor and digital TR Sensors are functional.
- Select "Active Command Modes."

- Select "Trans - Bench Mode or Trans - Drive Mode."

OSC — Transmission Bench Modes

The following Transmission Bench Modes may be used or required during diagnostics.

SSA, SSB and TCC in BENCH MODE

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA - Activates SSA OFF or ON.
- SSB - Activates SSB OFF or ON.
- Transmission Converter clutch (TCC) - Activates TCC OFF or ON.

OSC "SSA, SSB, TCC" BENCH MODE Operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- transmission range selector lever is in P.
- key is ON.
- engine is OFF.

OSC Command Values

- OFF - turns solenoid OFF.
- ON - turns solenoid ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for SSA, SSB and TCC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in BENCH MODE

The BENCH MODE is also used to test the functionality of the transmission's electronic pressure control. During BENCH MODE, the electronic pressure control (EPC) solenoid can ramp in increments of 103 kPa (15 psi) from zero to 620 kPa (90 psi) and 620 kPa (90 psi) to zero psi.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected values.
- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).

To carry out an EPC BENCH MODE pressure functionality test, install a pressure gauge in the EPC port. The following requirements are required to carry out this test:

- VSS and digital TR sensor operational.
- no VSS and digital TR sensor DTCs.
- transmission range selector lever in P.
- key ON.
- engine ON.
- engine speed at least 1,500 rpm for accurate EPC pressure measurement.

To carry out an EPC BENCH MODE solenoid circuit pinpoint test, the following requirements are required:

- VSS and digital TR sensor operational.
- no VSS and digital TR sensor DTCs.
- key ON.
- engine OFF.

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for EPC

Following operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."

- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC — Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GR_CM - allows upshifts or downshifts.
- TCC - engages or disengages the torque converter clutch.
- EPC - increases/decreases EPC pressure.

GR_CM in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GR_CM parameter allows the technician to choose the following options:

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.

OSC "GR_CM" Mode operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- engine is ON.
- TCC is OFF.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).

OSC Command Values

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for GR_CM

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - DRIVE MODE."

- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - GR_CM."
- Select Value "1-4."
- Press "SEND" to send command.
- Re-Select Value "1-4."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

TCC in DRIVE MODE

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC - activates TCC OFF and ON.
- ON - turns TCC solenoid ON.
- OFF - turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- engine is ON.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).

OSC "TCC ON" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- engine is ON.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).
- transmission is in 2nd gear or higher.
- TFT is between 15 and 135°C (60 and 275°F).
- brake is not applied "OFF" below 32 km/h (20 mph).
- Not an excessive load on engine (engine lugging).

OSC Command Values

- OFF - turns TCC OFF.
- ON - turns TCC ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in DRIVE MODE

This OSC function is used to increase the EPC pressure while testing the transmission shift functions. This OSC function can only increase the EPC pressure greater than what the PCM normally commands. If an OSC value, such as (75) or (90) psi is sent, the upshifts and downshifts should exhibit a firmer shift. Firmer shifts would indicate that the EPC pressure control works at higher pressures. The best test for the EPC is to use the BENCH MODE and a hydraulic pressure gauge. Using EPC in the BENCH MODE will confirm that the EPC works at both the higher and lower pressures.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected
    - 00 - sets EPC pressure to 00 kPa (00 psi).
    - 15 - sets EPC pressure to 103 kPa (15 psi).
    - 30 - sets EPC pressure to 206 kPa (30 psi).
    - 45 - sets EPC pressure to 310 kPa (45 psi).
    - 60 - sets EPC pressure to 411 kPa (60 psi).
    - 75 - sets EPC pressure to 517 kPa (75 psi).
    - 90 - sets EPC pressure to 620 kPa (90 psi).

OSC "EPC" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- transmission range selector lever is in O/D.
- pressure gauge is installed.
- key is ON.
- engine is ON.
- vehicle speed is greater than 3.2 km/h (2 mph).
- OSC value for EPC must be greater than what the PCM commands (see EPC PID).

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).

- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for EPC.

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Re-Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control and Accessing PIDs

To confirm that the OSC value was sent by the scan tool and the EEC has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PID:

OSC PARAMETER CHART

OSC Parameter	PID	Additional PIDs
SSA	SSA	SS1F
SSB	SSB	SS2F
TCC	TCC	TCCF, TCCMACT (do not use PID TCCMCMD during OSC)
EPC	EPC	—
GR_CM	GEAR	TRANRAT

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID remains the same as the value sent from OSC, then the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous TCC code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, refer to the Solenoid Application Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.
    - If the DTCs are still present, refer to the Diagnostic Trouble Code Chart. Repair all non transmission DTCs first as they can directly affect the operation of the transmission. Repeat the Quick Test and the Road Test to verify the correction. Erase the DTCs, carry out the Drive Cycle Test and repeat the Quick Test after completing repair on the DTC.
    - If the continuous test passes and a concern is still present, refer to Diagnosis By Symptom in this section, OASIS messages, and TSBs for concerns.

After On-Board Diagnostic

NOTE: The vehicle wiring harness, PCM and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Use the diagnostic trouble code chart for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the

vehicle wiring harness and the PCM are diagnosed as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the PCM wiring harness for tight connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Charts for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

Five Digit DTC	Component	Description	Condition	Symptom	Action
P0102 P0103 P1100 P1101	MAF	MAF concerns	MAF system has a malfunction which may cause a transmission concern.	High or low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a throttle position (TP) failure.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0112	IAT	IAT indicates 125°C (257°F) (grounded)	Voltage drop across IAT exceeds scale set for temperature 125°C (257°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit)	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (257°F)	Voltage drop across ECT exceeds scale set for temperature 125°C (257°F) (grounded).	Torque converter clutch will always be off, resulting in reduced fuel economy.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0118	ECT	ECT indicates -40°C (-40°F)	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0122 P0123 P1120	TP	TP concern	PCM has detected an error that may cause a transmission concern.	Harsh engagements, firm shift feel, abnormal shift schedule, torque converter clutch does not engage, torque converter clutch cycling.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

P0300- P0308 P0320 P0340 P1351- P1364	Electronic Ignition (EI)	EI systems concerns	EI system has a malfunction which may cause a transmission concern.	Harsh engagements and shifts, late WOT shifts, no torque converter clutch engagement.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1702	Digital TR	Intermittent DTC codes P0705 or P0708	Refer to DTC codes P0705 or P0708 condition.	Refer to DTC codes P0705 or P0708 symptom.	Go To Pinpoint Test C .
P1704	Digital TR	Digital TR circuit reading in between gear position during KOEO/KOER	Digital TR sensor or shift cable incorrectly adjusted; or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position.	Go To Pinpoint Test C .
P0705	Digital TR	Digital TR circuit failure	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure (harsh shifts). Defaults to (D) or D for all gear positions. In (D) position trans, stuck in D or manual 2.	Go To Pinpoint Test C .
P0708	Digital TR	Digital TR sensor circuit TR3A open	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure. Defaults to (D)or D for all gear ranges.	Go To Pinpoint Test C .
P1705	Digital TR	Digital TR self test was not carried out in PARK or NEUTRAL	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C .
P0720	OSS	Insufficient input from output shaft speed sensor	PCM detected a loss of OSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque converter clutch activation.	Go To Pinpoint Test E .
P0721	OSS	OSS sensor signal noisy	PCM has detected an erratic OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E .
P0722	OSS wiring	Insufficient input from OSS	PCM has detected a loss of OSS signal.	Harsh shifts, abnormal shift schedule, no torque	Go To Pinpoint Test E .

				converter clutch engagement.	
P0741 **	TCC, internal components	TCC slippage detected	The PCM picked up an excessive amount of slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation. Flashing Transmission Control Indicator Lamp (TCIL).	Refer to Diagnosis By Symptom in this section.
P0743 *	TCC, wiring, PCM	TCC solenoid circuit failure during on-board diagnostic	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages.	Go To Pinpoint Test A .
P0750 *	SSA, wiring, PCM	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0751	SSA, wiring, PCM	Shift solenoid A functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode manual lever position.	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0753	SSA, wiring, PCM	SSA electrical failure	SSA circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid On/Off Chart. May flash TCIL.	Go To Pinpoint Test A .
P0755 *	SSB, wiring, PCM	SSB solenoid circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0758 *	SSB, wiring, PCM	SSB electrical circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid On/Off Chart. May flash TCIL.	Go To Pinpoint Test A .
P1714	SSA, internal components	SSA malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation	Go To Pinpoint Test F .

				Chart.	
P1715	SSB	SSB malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0756	SSB	SSB functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode and manual lever position.	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0781 **	SSA or internal parts	1-2 shift error	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0782 **	SSA, SSB or internal parts	2-3 shift error	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0783 **	SSA, SSB or internal parts	3-4 shift error	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
—	TCIL	TCIL circuit failure	TCIL circuit open or shorted.	Failed on, OD cancel mode on. No flashing TCIL for EPC failure or sensor. Failed off, OD cancel mode never indicated. No flashing TCIL for EPC sensor failure.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1116	ECT	ECT out of on-board	ECT temperature higher or lower than	Rerun on-board diagnostic at normal	Refer to the Powertrain

		diagnostic range	expected during KOEO and KOER.	operating temperature.	Control/Emissions Diagnosis (PC/ED) manual.
P1124	TP	TP voltage high/low for on-board diagnostic	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1460	A/C	A/C clutch cycling pressure switch error	A/C or defrost on condition may result from A/C clutch being on during on-board diagnostic.	DTC set during on-board diagnostic, repeat with A/C off. Failed on, EPC pressure slightly low with A/C off.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	PCM	PCM detected internal error	—	—	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed	Brake ON/OFF circuit failure.	Failed on or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed off or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	Brake not actuated during on-board diagnostic	Brake not cycled during KOER.	Failed off or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed off or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0713	TFT, wiring, PCM	-40°C (-40°F) indicated TFT sensor circuit open	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	Firm shift feel.	Go To Pinpoint Test B .
P1711	TFT	TFT out of on-board diagnostic range	Transmission not at operating temperature during on-board diagnostic.	Warm vehicle to normal operating temperature.	Go To Pinpoint Test B .
P0712	TFT, wiring, PCM	157°C (315°F) indicated TFT sensor circuit grounded	Voltage drop across TFT sensor exceeds scale set for temperature of 157° C (315°F).	Firm shift feel.	Go To Pinpoint Test B .
P1713	TFT wiring	TFT continually	TFT sensor in range	Firm shift feel.	Go To Pinpoint Test

	PCM	reading cold	low failure.	Substitute ECT for TFT	B .
P1783	TFT	Transmission over temperature condition indicated	Transmission fluid temperature exceeded 127°C (270°F).	Increase in EPC pressure.	Go To Pinpoint Test B .
P1718	TFT, wiring, PCM	TFT continually reading hot	TFT sensor in range high failure.	Firm shift feel. Substitute ECT for TFT.	Go To Pinpoint Test B .
P0740	TCC, wiring, PCM	TCC electrical failure	TCC circuit fails to provide voltage drop across solenoid. Circuit open, shorted or PCM driver failure during on-board diagnostics.	Short circuit, engine stalls in SECOND ((D), 2 range) at low speeds with brake applied. Open circuit, torque converter clutch never engages. May flash TCIL.	Go To Pinpoint Test A .
P1740	TCC	TCC malfunction	Mechanical failure of the solenoid detected.	Failed on — Engine stalls in 2nd (O/D, Manual 2 ranges) at low idle speeds with brake applied. Failed off — Torque Converter never applies.	Go To Pinpoint Test F .
P1741 **	TCC, internal components	Excessive torque converter clutch engagement error	Excessive variations in slip (engine speed surge) across the torque converter clutch.	Engine rpm oscillation is present in 3rd gear.	Go To Pinpoint Test A .
P1742	TCC, internal components	TCC solenoid failed on	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1743	TCC, internal components	TCC solenoid failed on	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1744	TCC	TCC	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation.	Refer to Diagnosis By Symptom in this section.
P1746 *	EPC, wiring, PCM	EPC solenoid open circuit	Voltage through EPC solenoid is checked. An error will be noted if tolerance is exceeded.	Open circuit causes maximum EPC pressure, harsh engagements and shifts.	Go To Pinpoint Test D .
P1747	EPC, wiring,	EPC solenoid	Voltage through	Short circuit causes	Go To Pinpoint Test

*	PCM	circuit failure, shorted circuit or output driver	EPC solenoid is checked. An error will be noted if tolerance is exceeded.	minimum EPC pressure (minimum capacity) and limits engine torque (alternate firm).	D .
P1760	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	PCM detected a loss of EPC during operation.	Unexpected reduction in engine torque.	Go To Pinpoint Test D .
P1780	TCS	TCS not changing states	TCS not cycled during self-test. TCS circuit open or shorted.	Rerun on-board diagnostic and cycle switch. No OD cancel when switch is cycled.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1781 [1]	4x4 low switch	4x4 low switch closed	4x4 low switch closed or 4x4 low indicator lamp circuit open.	Failed on — early shift schedules in 4x2 and 4x4 HI range. Failed off — shifts delayed in 4x4 low. [1]	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1729	4x4L	4x4 low switch failure	4x4 low switch failure during normal vehicle operation.	Early shifts, harsh shifts, increase in electronic pressure control valve.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1728	Trans	Transmission slip error	The PCM has detected an excessive amount of slippage during normal operation.	Transmission slippage erratic or no torque converter clutch operation.	Refer to Diagnosis By Symptom in this section.

* Output circuit check, generated only by electrical symptoms.
** May also be generated by some other non-electric transmission hardware system.
[1] If the 4x4 low indicator light fuse is blown, the transmission will shift according to the 4x4 low shift scheduling regardless of the transfer case position.

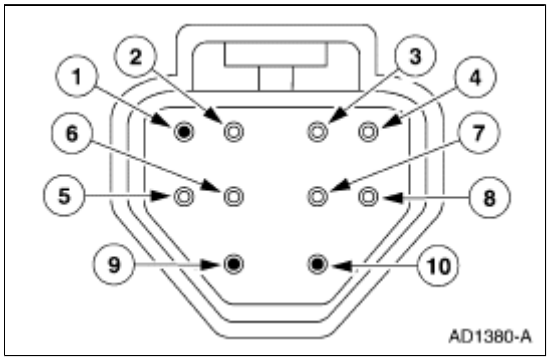
Rotunda Transmission Tester

The Rotunda Transmission Tester is used to diagnose the digital transmission range sensor and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Rotunda Transmission Tester allows separation of the vehicle electronics from transmission electronics. For additional information, refer to the Rotunda Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test
- Voltage Test - PARK/NEUTRAL, REVERSE Lamp, and Optional Circuits

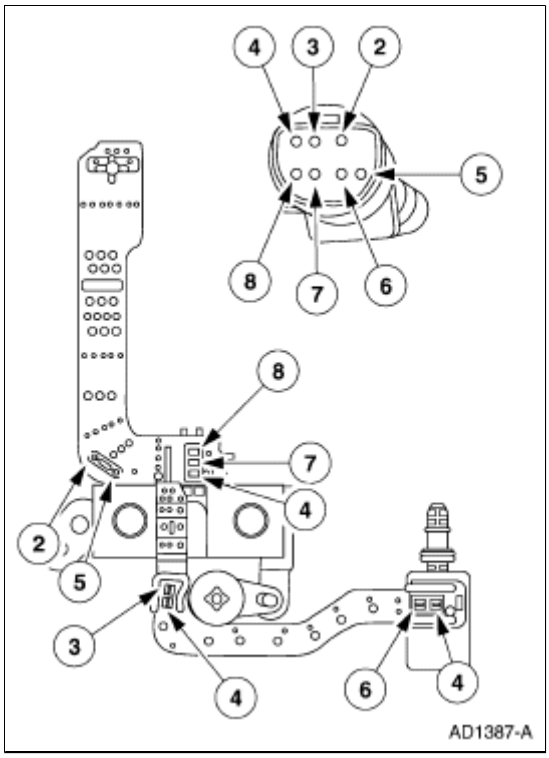
Transmission Connector Layouts

Transmission Vehicle Harness Connector



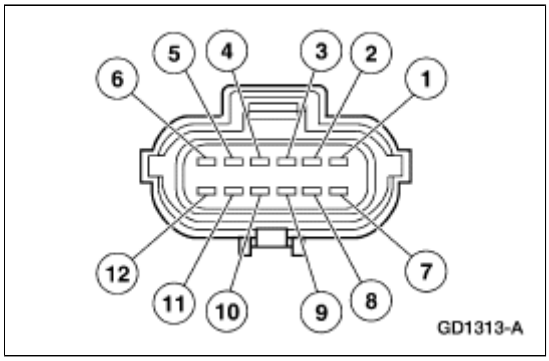
Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return
3	—	Torque Converter Clutch (TCC) Solenoid
4	—	Vehicle Power
5	—	Transmission Fluid Temperature (TFT) Input
6	—	Electronic Pressure Control (EPC) Solenoid
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

Transmission Internal Harness Connector



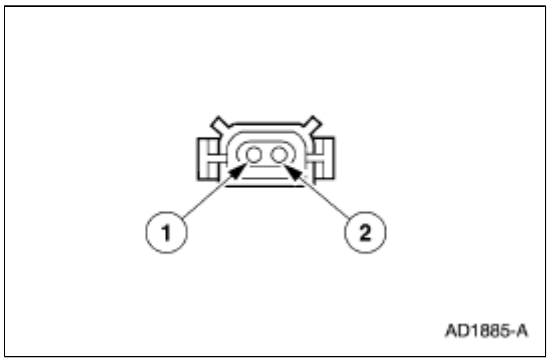
Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return Transmission Fluid Temperature (TFT)
3	—	Torque Converter Clutch (TCC)
4	—	Vehicle Power Shift Solenoid
5	—	Transmission Fluid Temperature (TFT)
6	—	Electronic Pressure Control
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

Digital Transmission Range (TR) Sensor Connector



Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return
3	—	TR3A
4	—	TR1
5	—	TR2
6	—	TR4
7	—	NOT USED
8	—	NOT USED
9	—	Fused Power Feed
10	—	Starter Control
11	—	Reverse
12	—	Starter to Starter Interrupt Relay

Output Shaft Speed (OSS) Sensor Harness Connector



Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed (OSS) Sensor
2	—	Signal Return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	PID: TR	PID: TR_D				PID: TR_V (volts)
		TR4	TR3A	TR2	TR1	TR3A (PCM Pin 64 to sigrtn)
PARK	P/N	0	0	0	0	0.0 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D [a]	1	1	1	0	1.3 - 1.8 Volts

OVERDRIVE	O/D [a]	1	1	1	1	1.3 - 1.8 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 2	Man 2	1	0	0	1	0.0 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 1	Man 1	0	0	1	1	0.0 Volts

[a] Will read "Drive" if O/D is canceled.

A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open Digital TR switch, 0= Closed Digital TR switch.
D. Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
    - **Voltages for TR1, TR2, TR4:**
    - 0 = 0.0 volts.
    - 1 = 9.0 - 14.0 volts.
    - **Voltage for TR3A:**
    - 0 = 0.0 volts.
    - 1 = 1.3 - 1.8 volts.
    - 1.8 - 5.0 volts = Invalid reading (open in wires or bad resistor in digital TR sensor).

Wiggle Test Information For Open/Shorts

- TR4, TR3A, TR2, and TR1 are all closed in PARK. PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
- TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present, unplug the transmission harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire from the PCM vehicle harness. If the short is still present, then the PCM has an internal failure. Otherwise the failure is in the vehicle harness.

Pinpoint Tests — OSC Equipped Vehicles

Any time an electrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
(D)				
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
[a] 1	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed the transmission will downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically controlled.

HD = Hydraulically disabled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck off.

SSA ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	2	2	2
2	2	2	2
3	3	2*	2*
4	3	2*	2*

*No engine braking.

SSB ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	2	2	2
3	2	2	2
4	1	1	1

Shift Solenoid Failure Mode Chart "Always On"

Failed on due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck on.

SSA ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	1	1	1
3	4	2*	2*
4	4	2*	2*

*No engine braking.

SSB ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear	Actual Gear		

Commanded	Obtained		
1	4	2*	2*
2	3	2*	2*
3	3	2*	2*
4	4	2*	2*

*No engine braking.

PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH SOLENOIDS

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC). **NOTE:** Refer to the Transmission Internal Harness Illustration preceding these pinpoint tests. **NOTE:** Refer to the Transmission Vehicle Harness Connector Illustration preceding these pinpoint tests.	
A1 ELECTRONIC DIAGNOSTICS	
1 2 4 Scan Tool 5 6 Diagnostic Data Link	3 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding.

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does vehicle enter Trans-Bench Mode?**

→ **Yes**
GO to A2 .

→ **No**
REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

A2 WIGGLE TEST

1 Select PIDs to be monitored.

PID Command	PID Actual
SSA	SS1F
SSB	SS2F
TCC	TCCF

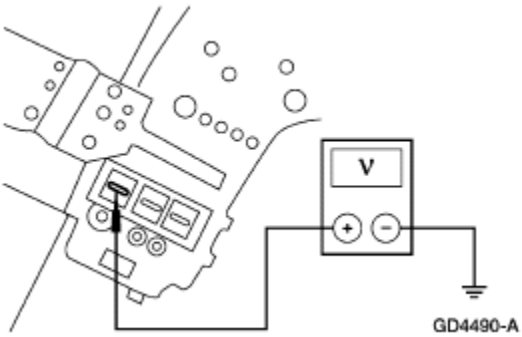
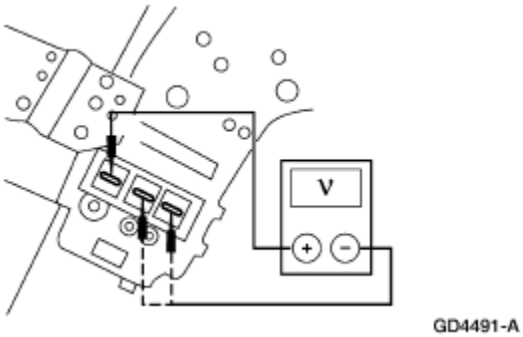
2 Select "ON" to turn suspect solenoid on.

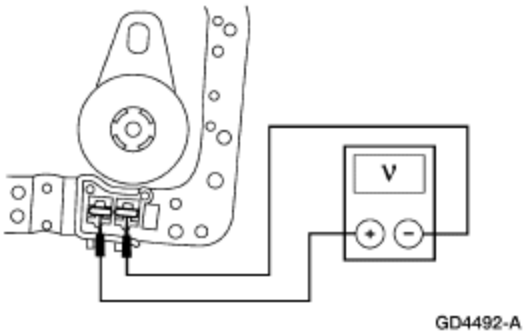
3 Press "SEND".

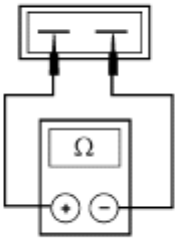
4 Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes.

5 Select "OFF" to turn solenoid off.

	6 Press "SEND". • **Does the suspect solenoid(s) fault state change?** → **Yes** REPAIR open or short in the vehicle harness or connector. → **No** GO to A3 .
A3 SOLENOID FUNCTIONAL CHECK	
	1 Monitor each solenoid state. 2 Turn each solenoid ON and OFF. • **Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard?** → **Yes** GO to A4 . → **No** GO to A5 .
A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)	
	1 Carry out OSC Trans-Drive Mode. 2 Select GR_CM for Shift Solenoids or follow procedures for GR_CM as listed. 3 Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode as listed. • **Does the transmission upshift and downshift or torque converter engage/disengage when commanded?** → **Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose shift or torque converter concern. → **No** GO to A5 .
A5 CHECK FOR BATTERY VOLTAGE	
	1 Remove transmission fluid pan.

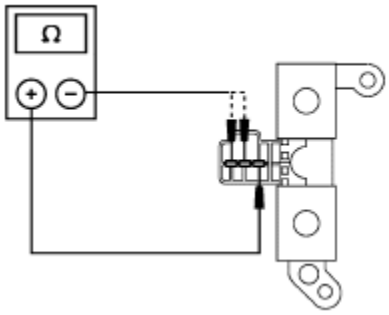
3 4  	2 Visually inspect the lead frame and connectors for damage. 4 Measure the voltage with the positive lead to VPWR solenoid pin and negative lead to a good ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A6 . → **No** CHECK for open or short circuit in harness, or solenoid.
A6 ELECTRICAL SIGNAL CHECK	
1  2 Trans-Bench Mode	1 Measure the voltage with the positive lead connected to VPWR solenoid pin and the negative lead to the signal pin of the appropriate solenoid. 3 Select Parameter SSA, SSB or TCC. 4 Select "ON". 5 Press "SEND".

	6 Turn the solenoids ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
7  GD4492-A	7 Measure the voltage with the positive lead to VPWR pin and the negative lead to the TCC pin.
8	8 Select Parameter TCC.
	9 Select "ON".
	10 Press "SEND".
	11 Turn the solenoid ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
	12 Select "OFF", press "SEND".
	• **Does the voltage and solenoid state change?**
	→ **Yes** GO to A7 .
	→ **No** CHECK for open or short circuit in harness, solenoid or a PCM concern.
A7 CHECK SOLENOID RESISTANCE AT SOLENOID	
1	
	2 Disconnect the appropriate solenoid from the lead frame.
3	3 Measure the solenoid resistance between the pins of the solenoid.



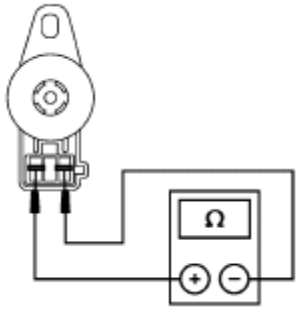
GD3386-A

4



AD1391-A

5



AD1392-A

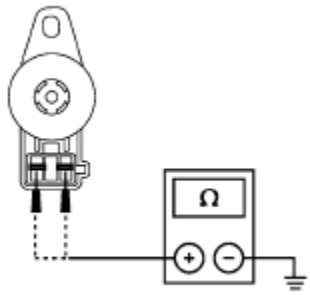
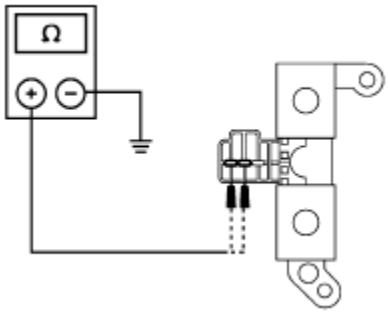
6 Measure the resistance for each solenoid (SSA, SSB or TCC) as follows:

Solenoid	Resistance (ohms)
SSA	20-30
SSB	20-30
TCC	10-16

- **Are the resistances correct?**

→ **Yes**
GO to A8 .

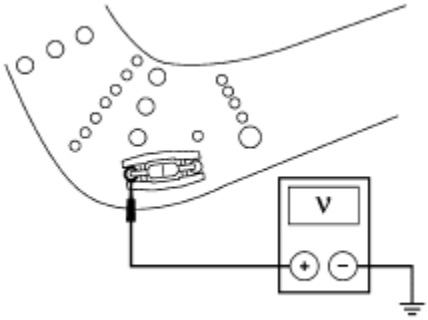
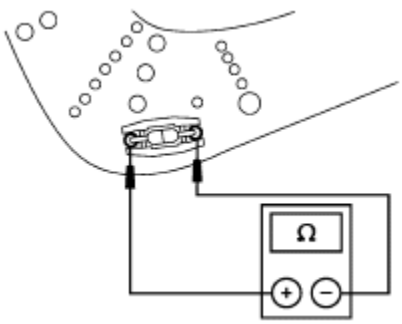
→ **No**
INSTALL a new solenoid.

A8 CHECK SOLENOID FOR SHORT TO GROUND	
1  AD1393-A 2  AD1394-A	1 Check for continuity between engine ground and appropriate solenoid pin with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity). **Solenoid** / **Terminal** SSA / +/- SSB / +/- TCC / +/- • **Is there continuity?** → **Yes** INSTALL a new solenoid. → **No** REFER to Diagnosis By Symptom in this section for diagnosis of shift or torque converter concerns.

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS	
2 	1 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding.

Scan Tool 3 7 PIDs; TFT, TFTV	4 Select Diagnostic Data Link. 5 Select PCM. 6 Select PID/Data Monitor and Record. • **Does the vehicle enter PID/Data Monitor and Record?** → **Yes** GO to B2 . → **No** REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
B2 WARM-UP/COOL-DOWN CYCLE	
	1 While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. • **Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?** → **Yes** If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating. If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector.

	→ **No** GO to B3 .
B3 ELECTRICAL SIGNAL CHECK	
1 4  GD4493-A	2 Remove transmission fluid pan. 3 Visually inspect the lead frame and connectors for damage. 4 Measure the voltage with the positive lead to positive TFT at sensor pin and negative lead to a good ground. • **Is the voltage present?** → **Yes** GO to B4 . → **No** CHECK for open or short circuit in vehicle harness, internal harness or a PCM concern.
B4 CHECK RESISTANCE OF TFT SENSOR	
1 Transmission Harness 2  AD1396-A	2 Measure the resistance between the positive TFT and negative TFT pins at transmission connector, using the following: **Transmission Fluid Temperature** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 967K - 284K -19 to -1 / -3 - 31 / 284K - 100K 0 - 20 / 32 - 68 / 100K - 37K

	21 - 40 | 69 - 104 | 37K - 16K 41 - 70 | 105 - 158 | 16K - 5K 71 - 90 | 159 - 194 | 5K - 2.7K 91 - 110 | 195 - 230 | 2.7K - 1.5K 111 - 130 | 231 - 266 | 1.5K - 0.8K 131 - 150 | 267 - 302 | 0.8K - 0.54K • **Is the resistance correct?** → **Yes** REFER to Diagnosis By Symptom in this section to diagnose an overheating concern. → **No** INSTALL a new internal harness (sensor is part of harness).

PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding these pinpoint tests. **NOTE:** Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	
C1 VERIFY DIAGNOSTIC TROUBLE CODES	
1 2 	3 **NOTE:** DTC codes P0705 and P0708 cannot be set by an incorrectly adjusted digital TR sensor. Carry out on board diagnostic test. • **Are only DTC codes P0705, P0708 present?** → **Yes** GO to C4.

	→ **No** GO to C2 .
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
3 	1 Check to make sure the digital TR sensor harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. 2 Apply the parking brake. 4 Disconnect the shift cable/linkage from the manual lever. 5 Verify that the digital TR Sensor Alignment Tool fits in the appropriate slots. • **Is the digital TR sensor adjustment OK?** → **Yes** GO to C3 . → **No** ADJUST the digital TR sensor. PLACE transmission range selector lever in P and CLEAR DTCs. REPEAT OBD Tests.GO to C3 .
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
2 	1 Place the manual lever in the overdrive position. 3 Re-connect the shift cable/linkage. 4 Verify that the shift cable/linkage is adjusted OK. REFER to Section 307-05 . • **Is the shift cable/linkage adjusted OK?** → **Yes** GO to C4 . → **No** ADJUST the shift cable/linkage. REFER to Section 307-05 .
C4 CHECK ELECTRICAL SIGNAL OPERATION	

1

2

Digital TR Sensor

2 **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.**

Press the button and pull out on the digital TR harness connector.

3 Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.

- **Are the connector, pins and harness OK?**

→ **Yes**
REPAIR as required. CLEAR DTCs and REPEAT OBD Tests.

→ **No**
If diagnosing a DTC, GO to C5 .

If diagnosing a starting concern or a reversing lamp concern, GO to C10 .

C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)

1

2

Scan Tool

3

Digital TR Sensor

4

5

TR PIDS TR, TR_D, TR_V

6 Move transmission range selector lever into each gear and stop.

7 Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708.

8 Compare the PIDs to the Digital Transmission Range (TR) Sensor Diagnosis Chart.

- **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis chart, and does the TR_D PID remain steady when the harness is wiggled, the sensor is tapped, or the vehicle driven?**

→ **Yes**
The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis.

→ **No**
If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent.

GO to C6 .

C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION

1

Digital TR Sensor

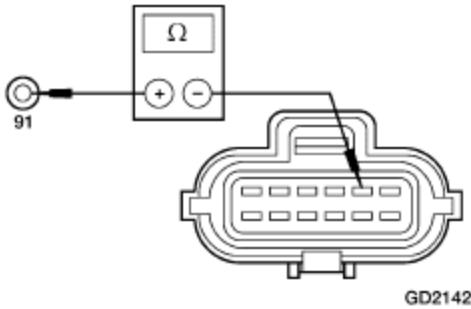
2

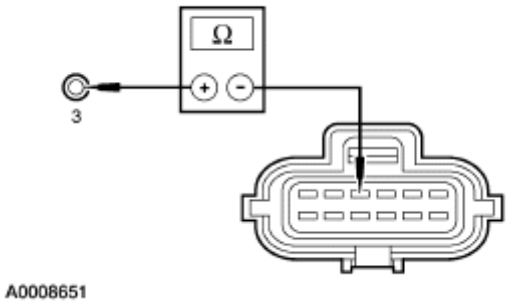
TR-E Cable to Transmission Tester

3

TR-E Cable to Digital TR Sensor

1 **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.**

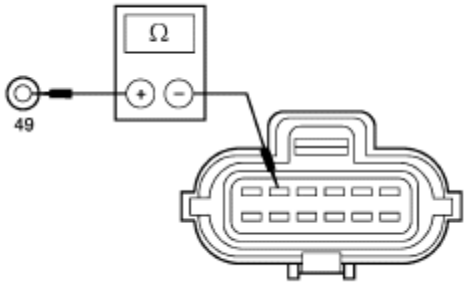
	4 Place the Digital TR Overlay onto Transmission Tester. 5 Carry out Sensor Test as instructed on the Digital TR Overlay. • **Does the status lamp on the tester TRS-E cable match the selected gear positions?** → **Yes** Concern is not in the digital TR sensor, GO to C7 . → **No** INSTALL a new digital TR sensor. CLEAR DTCs and REPEAT OBD Tests.
C7 CHECK PCM HARNESS CIRCUITS FOR OPENS	
1 2 Powertrain Control Module (PCM) 4 Digital TR Sensor 6  GD2142-A 7	3 Inspect for damaged or pushed-out pins, corrosion or loose wires. 4 **CAUTION: Do not pry the connector. This will damage the connector and result in a transmission concern.** Disconnect the digital TR sensor connector. 5 Install the EEC-V 104-Pin Breakout Box. 6 Measure the resistance between the PCM Test Pin 91 at the EEC-V 104-Pin Breakout Box and signal return circuit Pin 2 at digital TR sensor connector harness side. 7 Measure the resistance between the PCM Test Pin 3 at the EEC-V 104-Pin Breakout



A0008651

Box and TR1 circuit Pin 4 at digital TR sensor connector harness side.

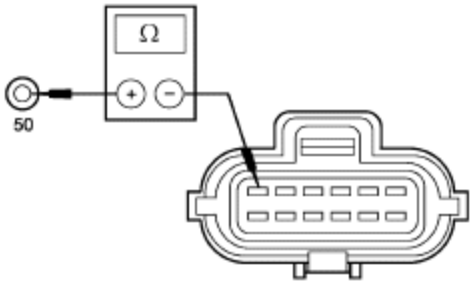
8



GD2144-A

8 Measure the resistance between the PCM Test Pin 49 at the EEC-V 104-Pin Breakout Box and TR2 circuit Pin 5 at digital TR sensor connector harness side.

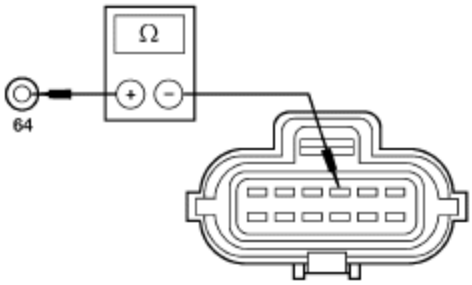
9



GD2145-A

9 Measure the resistance between the PCM Test Pin 50 at the EEC-V 104-Pin Breakout Box and TR4 circuit Pin 6 at digital TR sensor connector harness side.

10

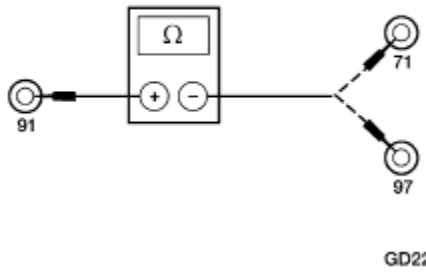
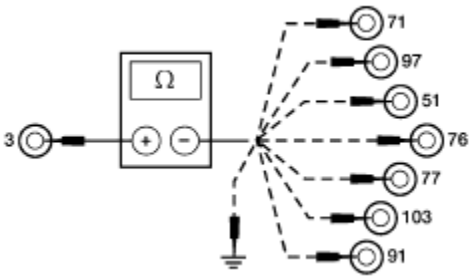
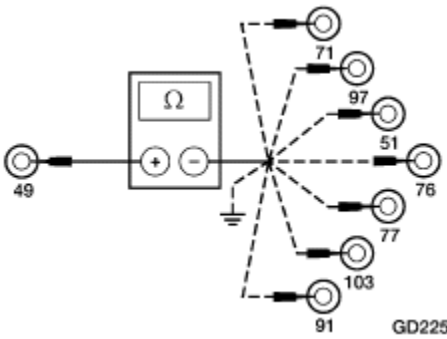
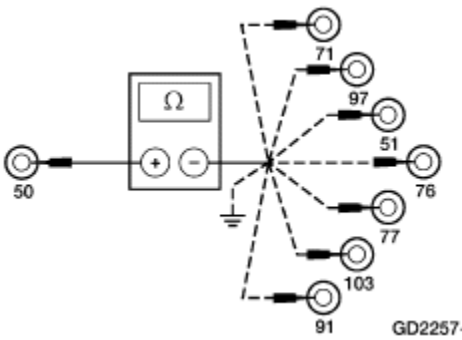


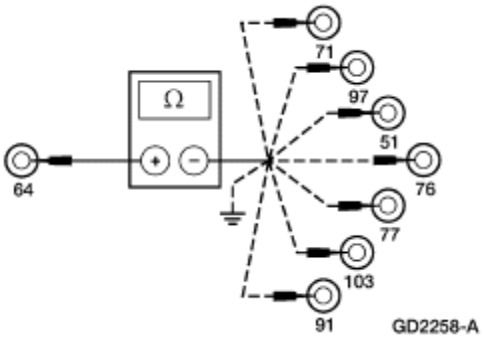
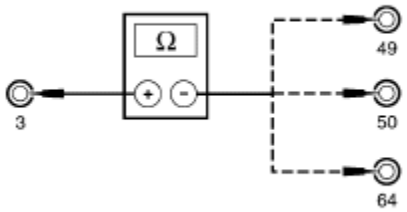
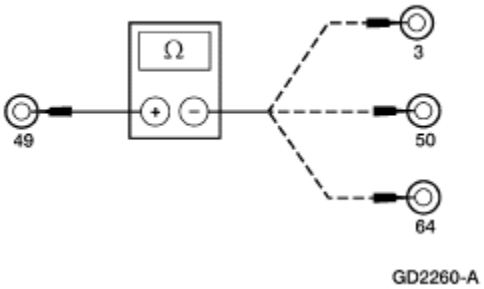
GD2146-A

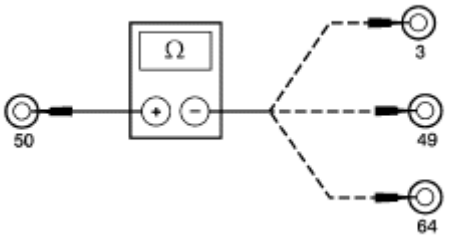
10 Measure the resistance between the PCM Test Pin 64 at the EEC-V 104-Pin Breakout Box and TR3A circuit Pin 3 at digital TR sensor connector harness side.

- **Are all resistances less than 5 ohms?**

→ **Yes**
GO to C8 .

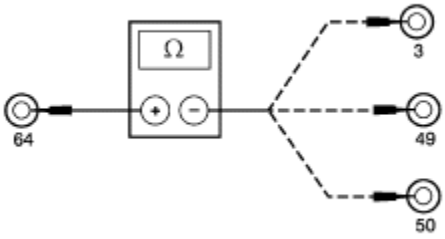
	→ **No** REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.
C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER	
1  GD2254-A	1 Measure the resistance between PCM Test Pin 91 and Test Pins 71 and 97 at the EEC-V 104-Pin Breakout Box.
2  GD4496-A	2 Measure the resistance between PCM Test Pin 3 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.
3  GD2256-A	3 Measure the resistance between PCM Test Pin 49 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.
4  GD2257-A	4 Measure the resistance between PCM Test Pin 50 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.

5  	5 Measure the resistance between PCM Test Pin 64 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground. • **Are all resistances greater than 10,000 ohms?** → **Yes** GO to C9 . → **No** REPAIR short circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS	
1  	1 Measure the resistance between Test Pin 3 and Pins 49, 50, and 64 at the EEC-V 104-Pin Breakout Box.
2  	2 Measure the resistance between Test Pin 49 and Pins 3, 50, and 64 at the EEC-V 104-Pin Breakout Box.
3	3 Measure the resistance between Test Pin 50 and Pins 3, 49, and 64 at the EEC-V 104-Pin Breakout Box.



GD2261-A

4



GD2262-A

4 Measure the resistance between Test Pin 64 and Pins 3, 49, and 50 at the EEC-V 104-Pin Breakout Box.

- **Are all the resistances greater than 10,000 ohms?**

→ **Yes**
INSTALL a new PCM. REFER to Section 303-14 . RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

→ **No**
REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR

1

TRS-E Cable to Transmission

2

TRS-E Cable to Digital TR Sensor

3 Place the Digital TR Overlay onto Transmission Tester.

4 Carry out Switch Test as instructed on the

	Digital TR Overlay. • **Does the status lamp on the tester indicate RED for the correct gear position?** → **Yes** Concern is not in the digital TR sensor. For starting system concerns, REFER to Section 303-06 . For reversing lamp concerns, REFER to Section 417-01 . For optional circuits, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. → **No** INSTALL a new digital TR sensor. Clear DTCs. REPEAT OBD Tests.

PINPOINT TEST D: ELECTRICAL PRESSURE CONTROL (EPC) SOLENOID

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Internal Harness Illustration preceding these pinpoint tests. **NOTE:** Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
1 2 3 4 Scan Tool 5 6	3 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding.

Diagnostic Data Link

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does the vehicle enter the Trans-Bench Mode?**

→ **Yes**
GO to D2 .

→ **No**
REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

D2 SOLENOID FUNCTIONAL TEST

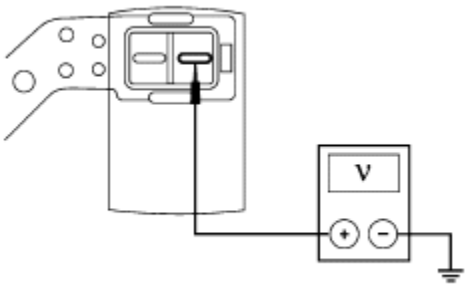
1 Install 2,060 kPa (300 psi) pressure gauge into EPC tap.

2 Monitor pressure gauge.

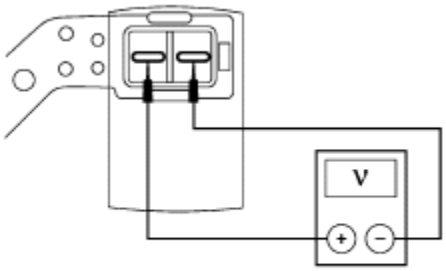
3

Parameter; EPC

4 Select value - 15, 30, 45, 60, 70 or 90 psi.

8 XXX	5 Press "SEND". 6 Select another value "0-90 psi". 7 Press "SEND". 9 Press "SEND". • **Does the pressure reading match the commanded pressure?** → **Yes** CLEAR DTCs. REPEAT OBD Tests. → **No** GO to D3 .
D3 CHECK FOR BATTERY VOLTAGE	
3 4  GD4494-A	1 Remove transmission fluid pan. 2 Visually inspect the lead frame connectors for damage. 4 Measure the voltage with positive lead to VPWR solenoid pin and negative lead to a good ground. • **Is voltage greater than 10 volts?** → **Yes** GO to D4 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the OBD Tests.

D4 ELECTRICAL SIGNAL CHECK

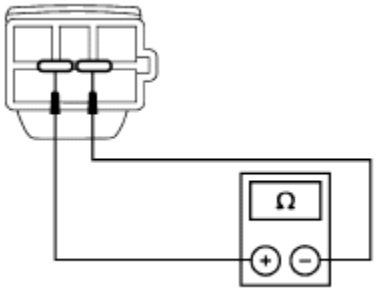
1  GD4495-A	1 Measure the voltage with positive lead connected to VPWR solenoid pin and connect negative lead to the signal pin of the EPC solenoid.
	2 Turn the solenoids ON and OFF, while monitoring the voltage reading, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click).
3 Trans-Bench Mode	
4 Parameter EPC	
	5 Select a value "0-90 psi". 6 Press "SEND". 7 Select another value "0-90 psi". 8 Press "SEND".
9 XXX	
	10 Press "SEND". • **Does the voltage and solenoid state change?** → **Yes** GO to D5 . → **No** CHECK for open or short circuit in harness or PCM.

D5 CHECK SOLENOID RESISTANCE AT SOLENOID

1

Transmission Harness

2



AD1399-A

2 Measure the resistance between the pins of the solenoid.

3 Measure the resistance of the EPC solenoid.

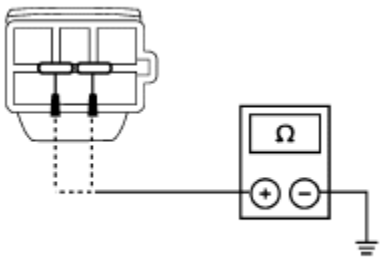
- **Is the resistance between 2.48 and 5.66 ohms?**

→ **Yes**
GO to D6 .

→ **No**
INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.

D6 CHECK SOLENOID FOR SHORT TO GROUND

1



AD1400-A

1 Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).

- **Is there continuity?**

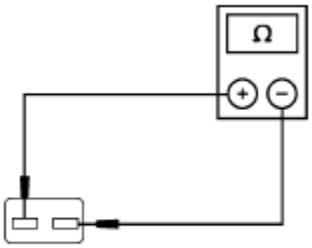
→ **Yes**
INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.

→ **No**
REFER to Diagnosis by Symptom Index in this

	section for diagnosis of pressure concerns.

PINPOINT TEST E: OUTPUT SHAFT SPEED (OSS) SENSORS

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Output Shaft Speed (OSS) Sensor Harness Connector illustration preceding these pinpoint tests.	
E1 ELECTRONIC DIAGNOSTICS	
2 Scan Tool 3 4 Diagnostic Data Link 5 PCM	1 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. 6 Select PID/Data Monitor and Record. 7 Select the PID OSS. • **Does vehicle enter PID/Data Monitor and Record?** → **Yes** GO to E2 . → **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
E2 DRIVE CYCLE TEST	

	1 While monitoring the OSS Speed PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. • **Does the OSS Speed PID increase and decrease with engine and vehicle speed?** → **Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section. → **No** If the OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector. If the sensor signal is steady, GO to E3.
E3 CHECK RESISTANCE OF OSS SENSOR	
2  AD1084-B	1 Disconnect the vehicle harness connector from the OSS sensor. 2 Measure the resistance between the OSS sensor pins. • **Is the resistance between 334-759 ohms?** → **Yes** REFER to Diagnosis by Symptom Index for concern diagnosis. → **No** INSTALL a new OSS sensor.

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740.	
F1 ELECTRONIC DIAGNOSIS	
1 Scan Tool	2 Carry out KOEO test. • **Are only DTCs P1714, P1715, P1740 present?** → **Yes** REPAIR the other DTCs first. CLEAR DTCs and CARRY OUT Transmission Drive Cycle Test. REPEAT Quick Test. → **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code Charts in this section for code description. GO to F2.
F2 TRANSMISSION DRIVE CYCLE TEST	
	1 Carry out transmission drive cycle test. 2 Carry out On-Board Diagnostic Test. • **Does the vehicle upshift and downshift OK?** → **Yes** GO to F3. → **No** REFER to Diagnosis By Symptom in this section to diagnose shift concerns.
F3 RETRIEVE DTCS	
1 Scan Tool	2 Carry out KOEO test until continuous DTCs have been displayed. • **Are DTCs P1714, P1715, P1740 still present?** → **Yes** INSTALL a new PCM. REFER to Section 303-14. ROAD TEST and REPEAT Quick Test.

	→ **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.

Pinpoint Tests — OSC Equipped Vehicles

Any time an electrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
(D)				
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
[a] 1	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed the transmission will downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically controlled.

HD = Hydraulically disabled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck off.

SSA ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	2	2	2
2	2	2	2
3	3	2*	2*
4	3	2*	2*

*No engine braking.

SSB ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	2	2	2
3	2	2	2
4	1	1	1

Shift Solenoid Failure Mode Chart "Always On"

Failed on due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck on.

SSA ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	1	1	1
3	4	2*	2*
4	4	2*	2*

*No engine braking.

SSB ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear	Actual Gear		

Commanded	Obtained		
1	4	2*	2*
2	3	2*	2*
3	3	2*	2*
4	4	2*	2*

*No engine braking.

PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH SOLENOIDS

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC). **NOTE:** Refer to the Transmission Internal Harness Illustration preceding these pinpoint tests. **NOTE:** Refer to the Transmission Vehicle Harness Connector Illustration preceding these pinpoint tests.	
A1 ELECTRONIC DIAGNOSTICS	
1 2 4 Scan Tool 5 6 Diagnostic Data Link	3 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding.

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does vehicle enter Trans-Bench Mode?**

→ **Yes**
GO to A2 .

→ **No**
REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

A2 WIGGLE TEST

1 Select PIDs to be monitored.

PID Command	PID Actual
SSA	SS1F
SSB	SS2F
TCC	TCCF

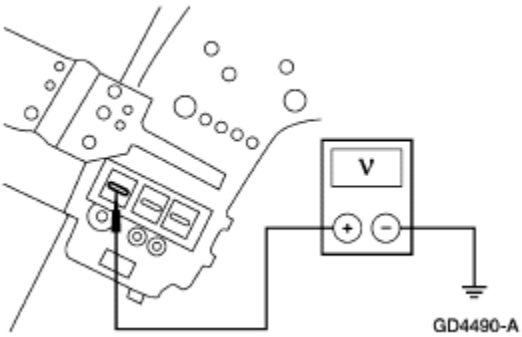
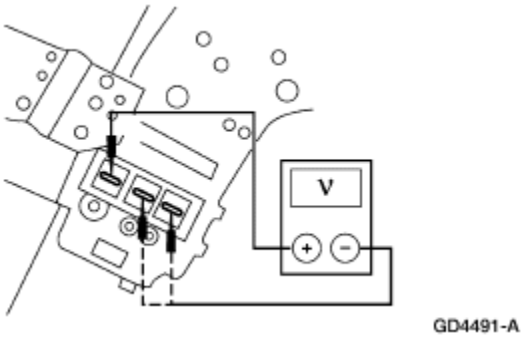
2 Select "ON" to turn suspect solenoid on.

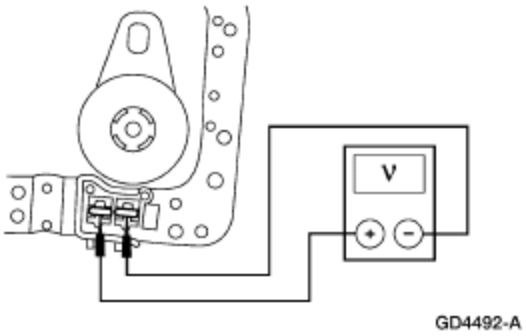
3 Press "SEND".

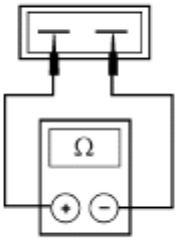
4 Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes.

5 Select "OFF" to turn solenoid off.

	6 Press "SEND". • **Does the suspect solenoid(s) fault state change?** → **Yes** REPAIR open or short in the vehicle harness or connector. → **No** GO to A3 .
A3 SOLENOID FUNCTIONAL CHECK	
	1 Monitor each solenoid state. 2 Turn each solenoid ON and OFF. • **Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard?** → **Yes** GO to A4 . → **No** GO to A5 .
A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)	
	1 Carry out OSC Trans-Drive Mode. 2 Select GR_CM for Shift Solenoids or follow procedures for GR_CM as listed. 3 Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode as listed. • **Does the transmission upshift and downshift or torque converter engage/disengage when commanded?** → **Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose shift or torque converter concern. → **No** GO to A5 .
A5 CHECK FOR BATTERY VOLTAGE	
	1 Remove transmission fluid pan.

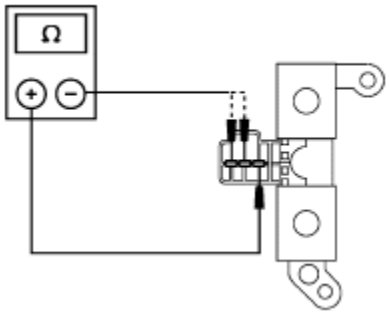
3 4  	2 Visually inspect the lead frame and connectors for damage. 4 Measure the voltage with the positive lead to VPWR solenoid pin and negative lead to a good ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A6 . → **No** CHECK for open or short circuit in harness, or solenoid.
A6 ELECTRICAL SIGNAL CHECK	
1  2 Trans-Bench Mode	1 Measure the voltage with the positive lead connected to VPWR solenoid pin and the negative lead to the signal pin of the appropriate solenoid. 3 Select Parameter SSA, SSB or TCC. 4 Select "ON". 5 Press "SEND".

	6 Turn the solenoids ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
7  GD4492-A	7 Measure the voltage with the positive lead to VPWR pin and the negative lead to the TCC pin.
8	8 Select Parameter TCC.
	9 Select "ON".
	10 Press "SEND".
	11 Turn the solenoid ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
	12 Select "OFF", press "SEND".
	• **Does the voltage and solenoid state change?**
	→ **Yes** GO to A7 .
	→ **No** CHECK for open or short circuit in harness, solenoid or a PCM concern.
A7 CHECK SOLENOID RESISTANCE AT SOLENOID	
1	
	2 Disconnect the appropriate solenoid from the lead frame.
3	3 Measure the solenoid resistance between the pins of the solenoid.



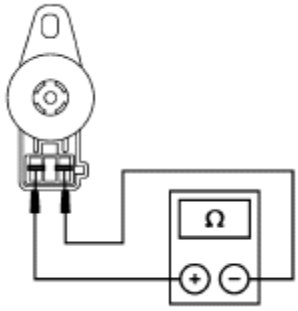
GD3386-A

4



AD1391-A

5



AD1392-A

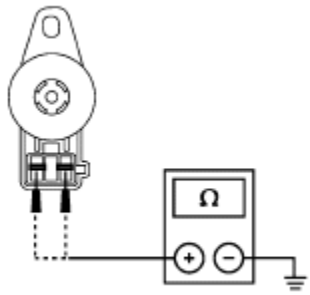
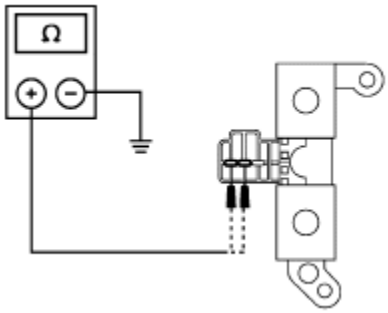
6 Measure the resistance for each solenoid (SSA, SSB or TCC) as follows:

Solenoid	Resistance (ohms)
SSA	20-30
SSB	20-30
TCC	10-16

- **Are the resistances correct?**

→ **Yes**
GO to A8 .

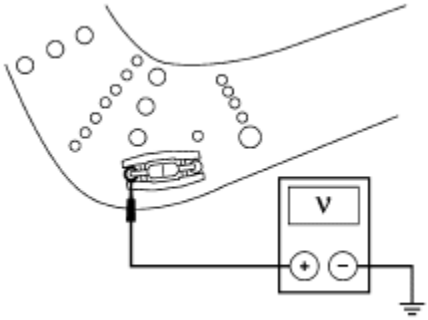
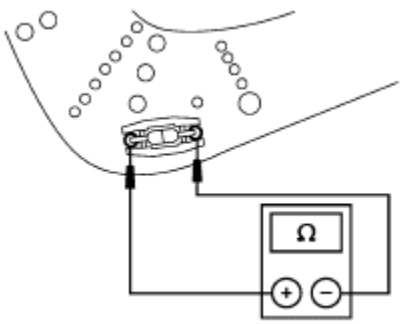
→ **No**
INSTALL a new solenoid.

A8 CHECK SOLENOID FOR SHORT TO GROUND	
1  AD1393-A 2  AD1394-A	1 Check for continuity between engine ground and appropriate solenoid pin with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity). **Solenoid** / **Terminal** SSA / +/- SSB / +/- TCC / +/- • **Is there continuity?** → **Yes** INSTALL a new solenoid. → **No** REFER to Diagnosis By Symptom in this section for diagnosis of shift or torque converter concerns.

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS	
2 	1 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding.

Scan Tool 3 7 PIDs; TFT, TFTV	4 Select Diagnostic Data Link. 5 Select PCM. 6 Select PID/Data Monitor and Record. • **Does the vehicle enter PID/Data Monitor and Record?** → **Yes** GO to B2 . → **No** REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
B2 WARM-UP/COOL-DOWN CYCLE	
	1 While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. • **Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?** → **Yes** If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating. If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector.

	→ **No** GO to B3 .
B3 ELECTRICAL SIGNAL CHECK	
1 4  GD4493-A	2 Remove transmission fluid pan. 3 Visually inspect the lead frame and connectors for damage. 4 Measure the voltage with the positive lead to positive TFT at sensor pin and negative lead to a good ground. • **Is the voltage present?** → **Yes** GO to B4 . → **No** CHECK for open or short circuit in vehicle harness, internal harness or a PCM concern.
B4 CHECK RESISTANCE OF TFT SENSOR	
1 Transmission Harness 2  AD1396-A	2 Measure the resistance between the positive TFT and negative TFT pins at transmission connector, using the following: **Transmission Fluid Temperature** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 967K - 284K -19 to -1 / -3 - 31 / 284K - 100K 0 - 20 / 32 - 68 / 100K - 37K

	21 - 40 | 69 - 104 | 37K - 16K 41 - 70 | 105 - 158 | 16K - 5K 71 - 90 | 159 - 194 | 5K - 2.7K 91 - 110 | 195 - 230 | 2.7K - 1.5K 111 - 130 | 231 - 266 | 1.5K - 0.8K 131 - 150 | 267 - 302 | 0.8K - 0.54K • **Is the resistance correct?** → **Yes** REFER to Diagnosis By Symptom in this section to diagnose an overheating concern. → **No** INSTALL a new internal harness (sensor is part of harness).

PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding these pinpoint tests. **NOTE:** Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	
C1 VERIFY DIAGNOSTIC TROUBLE CODES	
1 2 	3 **NOTE:** DTC codes P0705 and P0708 cannot be set by an incorrectly adjusted digital TR sensor. Carry out on board diagnostic test. • **Are only DTC codes P0705, P0708 present?** → **Yes** GO to C4.

	→ **No** GO to C2 .
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
3 	1 Check to make sure the digital TR sensor harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. 2 Apply the parking brake. 4 Disconnect the shift cable/linkage from the manual lever. 5 Verify that the digital TR Sensor Alignment Tool fits in the appropriate slots. • **Is the digital TR sensor adjustment OK?** → **Yes** GO to C3 . → **No** ADJUST the digital TR sensor. PLACE transmission range selector lever in P and CLEAR DTCs. REPEAT OBD Tests.GO to C3 .
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
2 	1 Place the manual lever in the overdrive position. 3 Re-connect the shift cable/linkage. 4 Verify that the shift cable/linkage is adjusted OK. REFER to Section 307-05 . • **Is the shift cable/linkage adjusted OK?** → **Yes** GO to C4 . → **No** ADJUST the shift cable/linkage. REFER to Section 307-05 .
C4 CHECK ELECTRICAL SIGNAL OPERATION	

1

2

Digital TR Sensor

2 **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.**

Press the button and pull out on the digital TR harness connector.

3 Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.

- **Are the connector, pins and harness OK?**

→ **Yes**
REPAIR as required. CLEAR DTCs and REPEAT OBD Tests.

→ **No**
If diagnosing a DTC, GO to C5 .

If diagnosing a starting concern or a reversing lamp concern, GO to C10 .

C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)

1

2

Scan Tool

3

Digital TR Sensor

4

5

TR PIDS TR, TR_D, TR_V

6 Move transmission range selector lever into each gear and stop.

7 Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708.

8 Compare the PIDs to the Digital Transmission Range (TR) Sensor Diagnosis Chart.

- **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis chart, and does the TR_D PID remain steady when the harness is wiggled, the sensor is tapped, or the vehicle driven?**

→ **Yes**
The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis.

→ **No**
If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent.

GO to C6 .

C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION

1

Digital TR Sensor

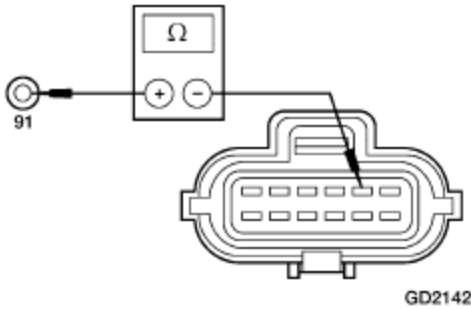
2

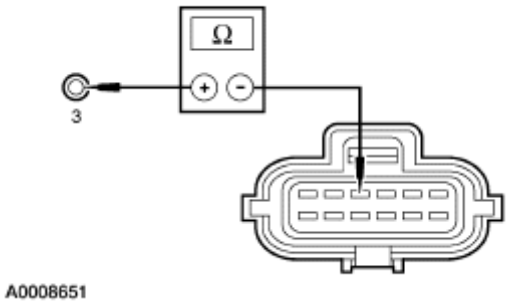
TR-E Cable to Transmission Tester

3

TR-E Cable to Digital TR Sensor

1 **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.**

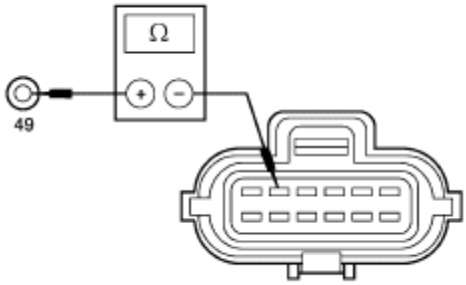
	4 Place the Digital TR Overlay onto Transmission Tester. 5 Carry out Sensor Test as instructed on the Digital TR Overlay. • **Does the status lamp on the tester TRS-E cable match the selected gear positions?** → **Yes** Concern is not in the digital TR sensor, GO to C7 . → **No** INSTALL a new digital TR sensor. CLEAR DTCs and REPEAT OBD Tests.
C7 CHECK PCM HARNESS CIRCUITS FOR OPENS	
1 2 Powertrain Control Module (PCM) 4 Digital TR Sensor 6  GD2142-A 7	3 Inspect for damaged or pushed-out pins, corrosion or loose wires. 4 **CAUTION: Do not pry the connector. This will damage the connector and result in a transmission concern.** Disconnect the digital TR sensor connector. 5 Install the EEC-V 104-Pin Breakout Box. 6 Measure the resistance between the PCM Test Pin 91 at the EEC-V 104-Pin Breakout Box and signal return circuit Pin 2 at digital TR sensor connector harness side. 7 Measure the resistance between the PCM Test Pin 3 at the EEC-V 104-Pin Breakout



A0008651

Box and TR1 circuit Pin 4 at digital TR sensor connector harness side.

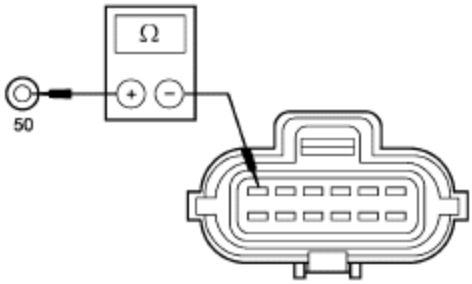
8



GD2144-A

8 Measure the resistance between the PCM Test Pin 49 at the EEC-V 104-Pin Breakout Box and TR2 circuit Pin 5 at digital TR sensor connector harness side.

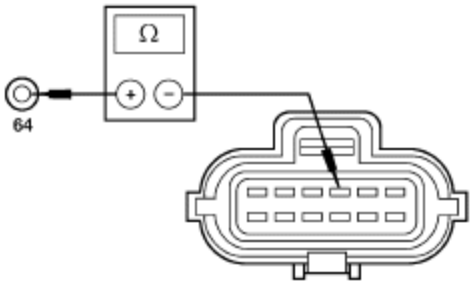
9



GD2145-A

9 Measure the resistance between the PCM Test Pin 50 at the EEC-V 104-Pin Breakout Box and TR4 circuit Pin 6 at digital TR sensor connector harness side.

10

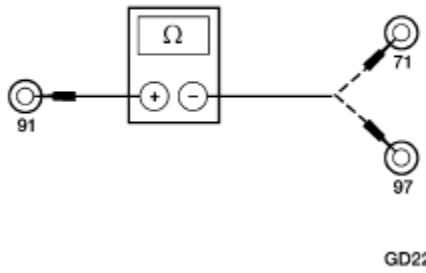
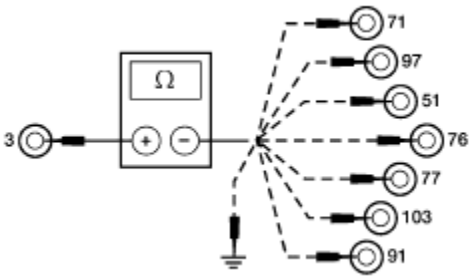
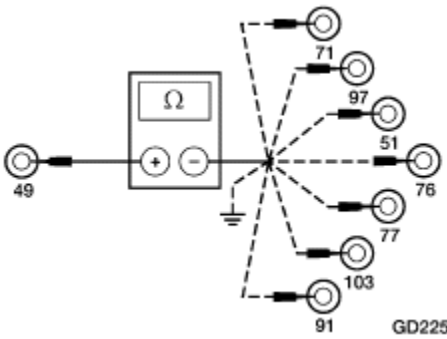
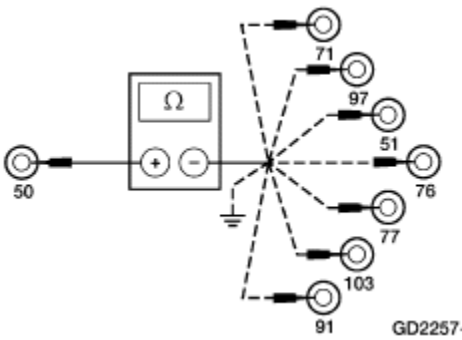


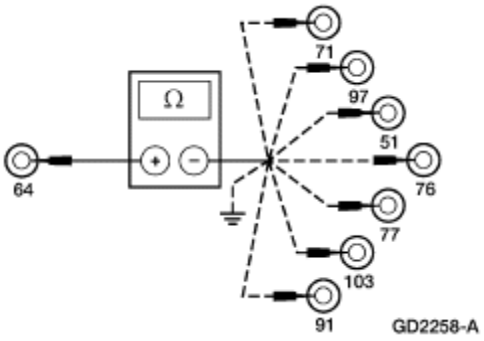
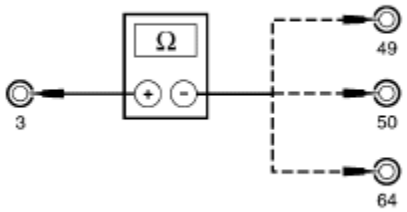
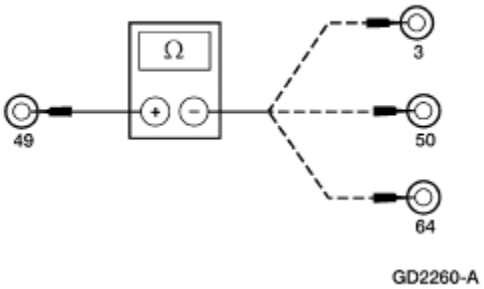
GD2146-A

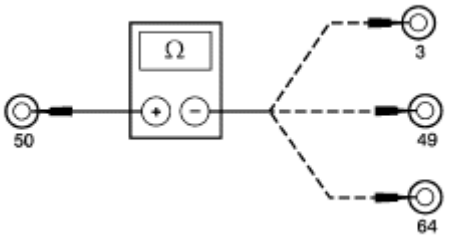
10 Measure the resistance between the PCM Test Pin 64 at the EEC-V 104-Pin Breakout Box and TR3A circuit Pin 3 at digital TR sensor connector harness side.

- **Are all resistances less than 5 ohms?**

→ **Yes**
GO to C8 .

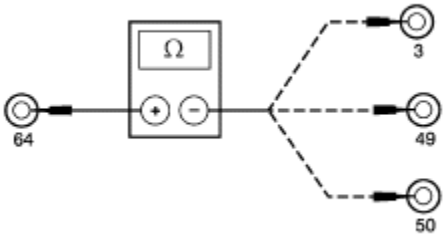
	→ **No** REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.
C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER	
1  GD2254-A	1 Measure the resistance between PCM Test Pin 91 and Test Pins 71 and 97 at the EEC-V 104-Pin Breakout Box.
2  GD4496-A	2 Measure the resistance between PCM Test Pin 3 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.
3  GD2256-A	3 Measure the resistance between PCM Test Pin 49 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.
4  GD2257-A	4 Measure the resistance between PCM Test Pin 50 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground.

5  	5 Measure the resistance between PCM Test Pin 64 and Test Pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V 104-Pin Breakout Box and chassis ground. • **Are all resistances greater than 10,000 ohms?** → **Yes** GO to C9 . → **No** REPAIR short circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS	
1  	1 Measure the resistance between Test Pin 3 and Pins 49, 50, and 64 at the EEC-V 104-Pin Breakout Box.
2  	2 Measure the resistance between Test Pin 49 and Pins 3, 50, and 64 at the EEC-V 104-Pin Breakout Box.
3	3 Measure the resistance between Test Pin 50 and Pins 3, 49, and 64 at the EEC-V 104-Pin Breakout Box.



GD2261-A

4



GD2262-A

4 Measure the resistance between Test Pin 64 and Pins 3, 49, and 50 at the EEC-V 104-Pin Breakout Box.

- **Are all the resistances greater than 10,000 ohms?**

→ **Yes**
INSTALL a new PCM. REFER to Section 303-14 . RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

→ **No**
REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR

1

TRS-E Cable to Transmission

2

TRS-E Cable to Digital TR Sensor

3 Place the Digital TR Overlay onto Transmission Tester.

4 Carry out Switch Test as instructed on the

	Digital TR Overlay. • **Does the status lamp on the tester indicate RED for the correct gear position?** → **Yes** Concern is not in the digital TR sensor. For starting system concerns, REFER to Section 303-06 . For reversing lamp concerns, REFER to Section 417-01 . For optional circuits, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. → **No** INSTALL a new digital TR sensor. Clear DTCs. REPEAT OBD Tests.

PINPOINT TEST D: ELECTRICAL PRESSURE CONTROL (EPC) SOLENOID

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Internal Harness Illustration preceding these pinpoint tests. **NOTE:** Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
1 2 3 4 Scan Tool 5 6	3 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding.

Diagnostic Data Link

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does the vehicle enter the Trans-Bench Mode?**

→ **Yes**
GO to D2 .

→ **No**
REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

D2 SOLENOID FUNCTIONAL TEST

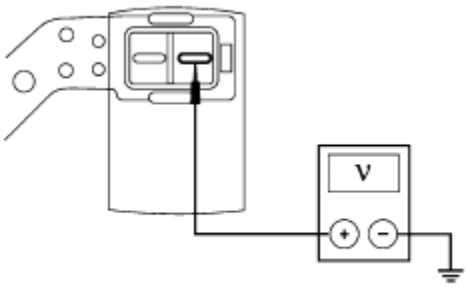
1 Install 2,060 kPa (300 psi) pressure gauge into EPC tap.

2 Monitor pressure gauge.

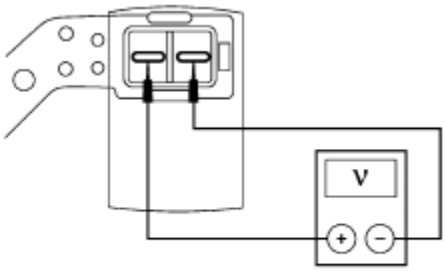
3

Parameter; EPC

4 Select value - 15, 30, 45, 60, 70 or 90 psi.

8 XXX	5 Press "SEND". 6 Select another value "0-90 psi". 7 Press "SEND". 9 Press "SEND". • **Does the pressure reading match the commanded pressure?** → **Yes** CLEAR DTCs. REPEAT OBD Tests. → **No** GO to D3 .
D3 CHECK FOR BATTERY VOLTAGE	
3 4  GD4494-A	1 Remove transmission fluid pan. 2 Visually inspect the lead frame connectors for damage. 4 Measure the voltage with positive lead to VPWR solenoid pin and negative lead to a good ground. • **Is voltage greater than 10 volts?** → **Yes** GO to D4 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the OBD Tests.

D4 ELECTRICAL SIGNAL CHECK

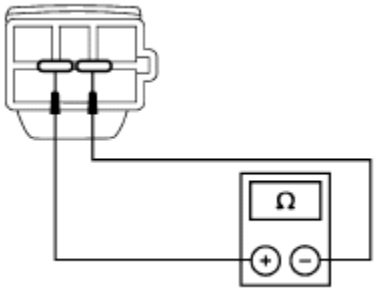
1  GD4495-A	1 Measure the voltage with positive lead connected to VPWR solenoid pin and connect negative lead to the signal pin of the EPC solenoid.
	2 Turn the solenoids ON and OFF, while monitoring the voltage reading, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click).
3 Trans-Bench Mode	
4 Parameter EPC	
	5 Select a value "0-90 psi". 6 Press "SEND". 7 Select another value "0-90 psi". 8 Press "SEND".
9 XXX	
	10 Press "SEND". • **Does the voltage and solenoid state change?** → **Yes** GO to D5 . → **No** CHECK for open or short circuit in harness or PCM.

D5 CHECK SOLENOID RESISTANCE AT SOLENOID

1

Transmission Harness

2



AD1399-A

2 Measure the resistance between the pins of the solenoid.

3 Measure the resistance of the EPC solenoid.

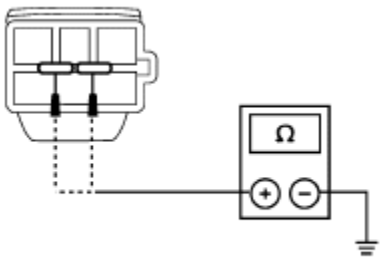
- **Is the resistance between 2.48 and 5.66 ohms?**

→ **Yes**
GO to D6 .

→ **No**
INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.

D6 CHECK SOLENOID FOR SHORT TO GROUND

1



AD1400-A

1 Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).

- **Is there continuity?**

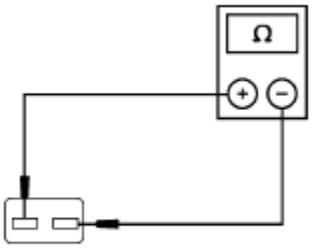
→ **Yes**
INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.

→ **No**
REFER to Diagnosis by Symptom Index in this

	section for diagnosis of pressure concerns.

PINPOINT TEST E: OUTPUT SHAFT SPEED (OSS) SENSORS

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Output Shaft Speed (OSS) Sensor Harness Connector illustration preceding these pinpoint tests.	
E1 ELECTRONIC DIAGNOSTICS	
2 Scan Tool 3 4 Diagnostic Data Link 5 PCM	1 Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. 6 Select PID/Data Monitor and Record. 7 Select the PID OSS. • **Does vehicle enter PID/Data Monitor and Record?** → **Yes** GO to E2 . → **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
E2 DRIVE CYCLE TEST	

	1 While monitoring the OSS Speed PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. • **Does the OSS Speed PID increase and decrease with engine and vehicle speed?** → **Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section. → **No** If the OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector. If the sensor signal is steady, GO to E3.
E3 CHECK RESISTANCE OF OSS SENSOR	
2  AD1084-B	1 Disconnect the vehicle harness connector from the OSS sensor. 2 Measure the resistance between the OSS sensor pins. • **Is the resistance between 334-759 ohms?** → **Yes** REFER to Diagnosis by Symptom Index for concern diagnosis. → **No** INSTALL a new OSS sensor.

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740.	
F1 ELECTRONIC DIAGNOSIS	
1 Scan Tool	2 Carry out KOEO test. • **Are only DTCs P1714, P1715, P1740 present?** → **Yes** REPAIR the other DTCs first. CLEAR DTCs and CARRY OUT Transmission Drive Cycle Test. REPEAT Quick Test. → **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code Charts in this section for code description. GO to F2.
F2 TRANSMISSION DRIVE CYCLE TEST	
	1 Carry out transmission drive cycle test. 2 Carry out On-Board Diagnostic Test. • **Does the vehicle upshift and downshift OK?** → **Yes** GO to F3. → **No** REFER to Diagnosis By Symptom in this section to diagnose shift concerns.
F3 RETRIEVE DTCS	
1 Scan Tool	2 Carry out KOEO test until continuous DTCs have been displayed. • **Are DTCs P1714, P1715, P1740 still present?** → **Yes** INSTALL a new PCM. REFER to Section 303-14. ROAD TEST and REPEAT Quick Test.

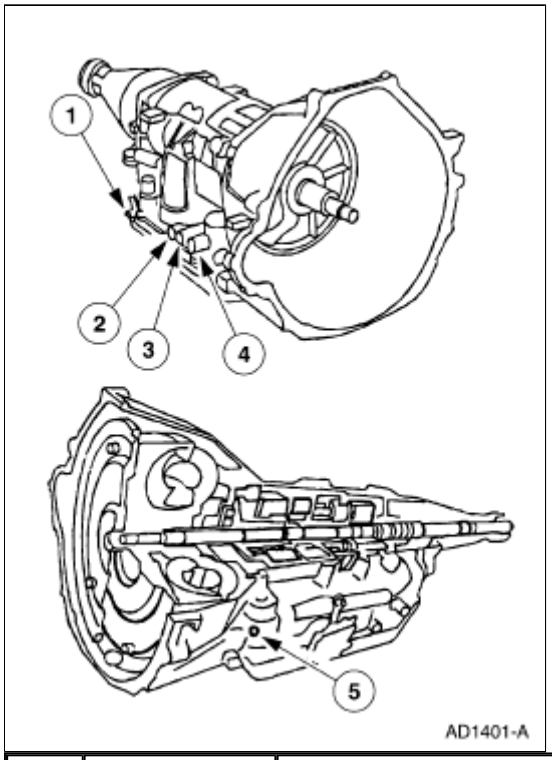
	→ **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.

Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.



Item	Part Number	Description
1	—	Direct clutch pressure tap
2	—	Forward clutch pressure tap
3	—	Electronic pressure control (EPC) pressure tap
4	—	Intermediate clutch pressure tap
5	—	Line pressure tap

Line Pressure Test

CAUTION: Carry out the line pressure test prior to carrying out the stall speed test. If the line pressure is low at stall, do not carry out stall speed test or further transmission damage will occur. Do not maintain WOT in any transmission range for more than five seconds.

This test verifies that the line pressure is within specification.

1. Connect pressure gauge to line pressure tap.

2. Start engine and check line pressures. Refer to the Line Pressure Chart to determine if line pressure is within specification.

Line Pressure Chart

Application	Range	Idle		WOT Stall	
		EPC	Line Pressure	EPC	Line Pressure
	P, N, OD, 2, 1	35-103 kPa (5-15 psi)	310-537 kPa (45-78 psi)	572-641 kPa (83-93 psi)	1103-1448 kPa (160-210 psi)
	R	35-103 kPa (5-15 psi)	441-675 kPa (64-98 psi)	572-675 kPa (83-98 psi)	1427-1875 kPa (207-272 psi)

Clutch Pressure Chart

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap [1]	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	483-620 kPa (70-90 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
2	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	483-620 kPa (70-90 psi)	0-34 kPa (0-5 psi)
3	310-379 kPa (45-55 psi)	724-862 kPa (105-125 psi)	655-793 kPa (95-115 psi)	689-827 kPa (100-120 psi)	655-793 kPa (95-115 psi)
4	241-310 kPa (35-45 psi)	620-758 kPa (90-110 psi)	0-34 kPa (0-5 psi)	586-724 kPa (85-105 psi)	551-689 kPa (80-100 psi)

[1] EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch apply pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

3. Place the ignition switch in the OFF position. If line pressure is not within specification, check EPC pressure.

4. Connect pressure gauge to EPC pressure tap.

5. Start engine and check EPC pressure. Use the line pressure chart for specifications.

6. If EPC pressure is not within specification, carry out Pinpoint Test E to diagnose EPC operation. If EPC operation is OK, see the line pressure diagnosis chart for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High at Idle — All Positions	• Wiring Harnesses • Run Quick Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. • EPC Solenoid • Main Regulator Valve
Low at Idle — All Positions	• Low Fluid Level • Control Bodies • Excessive Leakage in Pump • Damaged Gaskets on Separator Valve • Damaged Separator Plate • Restricted Inlet Filter • Case Bolts • Loose Main Body • Case • Sticking Main Regulator Valve • Damaged Inlet Tube Seal on Inlet Filter
Low in Park Only	• Valve Body • Low/Reverse Servo
Low in Reverse Only	• Separator Plate • Low/Reverse Servo or Valve Bodies • Reverse Clutch
Low in Neutral Only	• Valve Body
Low in Overdrive Only	• Forward Clutch • Valve Body
Low in 1st Position	• Forward Clutch • Valve Body • Low/Reverse Servo
Low in 2nd Position	• Intermediate Clutch • Valve Bodies • Forward Clutch

Stall Speed Test

WARNING: Apply the parking brake firmly while carrying out each stall test.

CAUTION: Carry out line pressure test prior to carrying out stall test. If the line pressure is low at stall, do not carry out stall test or further transmission damage will occur.

The stall speed test checks:

- torque converter clutch operation and installation.
- holding ability of the forward clutch.
- reverse clutch (the low-reverse bands).
- planetary one-way clutch.
- engine driveability.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the parking brake firmly for each stall speed test.

1. Find the specified stall rpm for the vehicle; see the stall speed diagnosis chart. Use a grease pencil to mark the rpm on the dial of a tachometer.

Stall Speed Chart

Engine	Stall Speed RPM
5.0L	2481-2904

2. Connect a tachometer to the engine.

3. **NOTE:** If the rpm recorded by the tachometer exceeds the maximum limits, release the accelerator pedal immediately because clutch or band slippage is indicated.

   In each of the following ranges (D), 2, 1, R, press the accelerator pedal to the floor and hold it just long enough to let the engine get to wide open throttle (WOT). While making this test, do not hold the throttle open for more than 5 seconds at a time.

4. Note the results in each range.

5. After each range, move the shift control selector lever to Neutral and run the engine at 1000 rpm for about 15 seconds to cool the torque converter before making the next test.

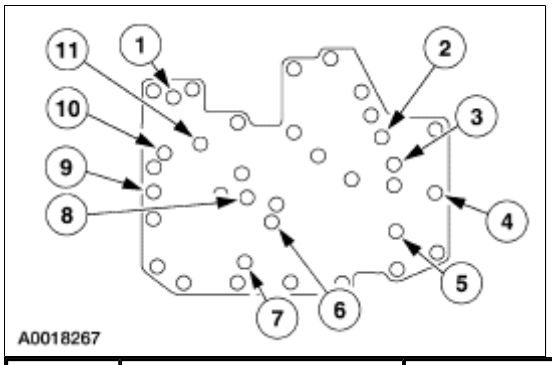
6. Refer to the stall speed diagnosis chart for corrective actions.

Stall Speed Diagnosis Chart

Selector Position	Stall Speeds High	Stall Speeds Low
(D)	Planetary One-Way Clutch	
(D), 2 and 1	Forward Clutch or Intermediate Clutch	
(D), 2, 1 and R	Carry Out Pressure Test	Torque Converter Stator One-Way Clutch or Engine Performance
R	Reverse Clutch or Low Reverse Band or Servo	

Air Pressure Tests

Transmission Air Test Plate



Item	Part Number	Description
1	—	Converter bypass
2	—	Direct clutch
3	—	Forward clutch
4	—	2-3 accumulator, top
5	—	2-3 accumulator, bottom
6	—	Reverse servo
7	—	Overdrive servo, apply
8	—	Overdrive servo, release
9	—	Intermediate clutch
10	—	Reverse clutch
11	—	1-2 accumulator, apply

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the malfunction.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated 276 kPa (40 psi) maximum air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the clutch component applies. There should be no hissing sound when the component is applied.

Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

1. Drain transmission fluid and remove the transmission fluid pan.

2. Remove the main control valve body.

3. Install transmission test plate and gasket. Tighten bolts to 10 Nm (89 lb/in).

4. **NOTE:** Do not apply air to the test plate vent hole.

   Apply air to the appropriate clutch port (refer to the Transmission Air Test Plate illustration). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or

check balls are leaking a hissing sound may be heard.

If the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates clutches simultaneously, inspect the fluid passages in the case.

If air pressure applied to the accumulator fails to operate an accumulator, remove and inspect case passages and piston.

Clutch Pressure Test

The Clutch Pressure Test will diagnose a low-pressure condition or leakage in a clutch circuit. A difference of 103 kPa (15 psi) or more between the clutch pressure and line pressure will prevent a normal shift.

1. **CAUTION: Pressure gauges affect the shift quality of the transmission. Care must be taken not to accelerate or decelerate rapidly. Possible transmission failure can result.**

   Attach 0-2068 kPa (0-300 psi) pressure gauges to the line pressure tap and the appropriate clutch pressure tap according to Band/Clutch Application Chart 601. Gauges must be accurate enough to distinguish a 103 kPa (15 psi) difference. (If this test is done in conjunction with a control pressure test, pressure gauges will be attached to all pressure taps.) Have sufficient flexible hose available to read the gauges in the vehicle.

2. Drive the vehicle. When pressure is applied to the clutch, note the difference between the line pressure gauge and the corresponding clutch pressure gauge.

3. If the difference in pressures is less than 103 kPa (15 psi), the corresponding clutch circuit does not have a pressure loss. The gauges on the line pressure tap and appropriate clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause.

4. If the difference is greater than 103 kPa (15 psi), there is a leak in the corresponding clutch pressure circuit. The gauges on the line pressure tap and clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause. Carry out the appropriate procedure to correct the clutch leak problem.

Leakage Inspection

CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Check the fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check the VSS plug or VSS sensor O-ring (model dependent). If leakage is found install a new O-ring.

Check fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, install new parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring, then tighten the fitting to maximum specification.

If the leak continues, install a new cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and the cooler line fittings in this section; refer to Section 307-02 .

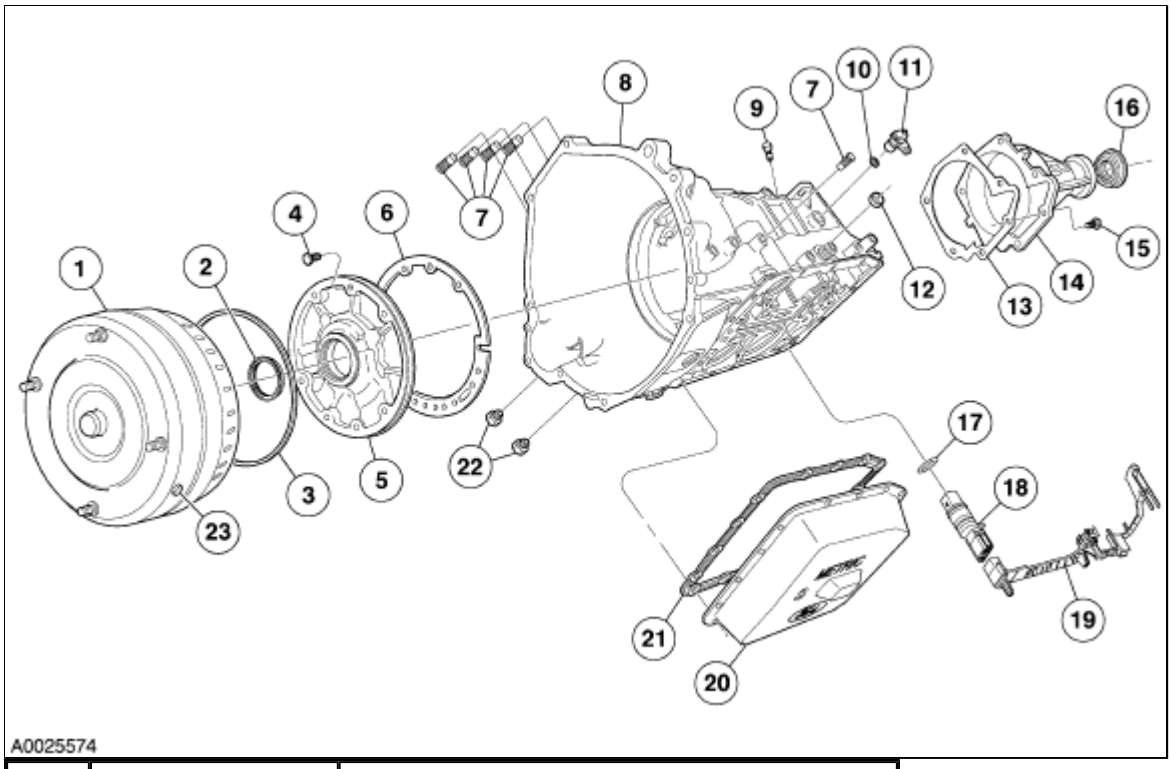
Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines for the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the oil cooler tank. If the cooler is leaking and or will not hold pressure, install a new cooler.

If leakage is found at the transmission range selector lever, install a new seal.

If leakage is found at the transmission internal harness connector, install a new O-ring.

4R70W External Sealing

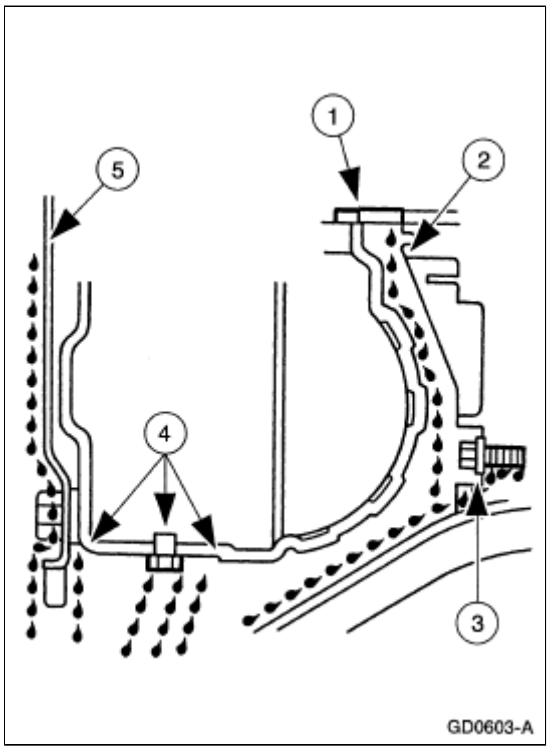


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump seal
3	7A248	Front pump seal
4	N605789-S101	Bolt
5	7A106	Front pump body assembly
6	7A136	Pump gasket
7	390318-S2	Pipe plug — 1/8 — 27 Dryseal tapered
8	7005	Case
9	7034	Vent
10	N811757-S100	Speed sensor seal
11	7H103	Output shaft speed (OSS) sensor
12	7B498	Manual control lever seal assembly
13	7086	Extension housing gasket
14	7A039	Extension housing
15	N803737-S1101	Bolt — M8-1.25 x 30
15	N606047-S101	Bolt — M8-1.25 x 70
15	N803521-S1101	Bolt — M8-1.25 x 1.25 x 0.54
15	N811524-S101	Bolt — M8-1.25 x 42
16	7052	Oil seal
17	7Z276	Seal — bulkhead assembly
18	7G276	Bulkhead assembly wiring connector

19	7G276	Molded lead frame
20	7A194	Transmission fluid pan
21	7A191	Gasket
22	7D273	Fluid tube connector
23	87650-S2	Converter drain plug

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.

3. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

4. Fluid leakage from the converter drain plug, (model dependent) converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter on the back face of the flexplate and in the converter housing only near the flexplate. Fluid leaks from the torque converter

will leave a ring of fluid around the inside of the torque converter housing.

5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

a. Leakage at the engine valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
d. Leakage at engine oil pressure sensor.

Leak Check Test

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak.

2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist; refer to Section 100-02 and run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light Used With 12 Volt Master UV Diagnostic Inspection Kit

Oil soluble aniline or fluorescent dyes premixed at the rate of 2.5ml (1/2 teaspoon) of dye powder to 0.235L (1/2 pint) of transmission fluid have proved helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the fluid cooler leaks into the engine cooling system. A black light must be used with the fluorescent dye solution.

Transmission Fluid Cooler

CAUTION: Whenever a transmission has been disassembled to install new parts, the cooler bypass valve (CBV), all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use a suitable the torque converter/fluid cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

Transmission Fluid Cooler Flow Test

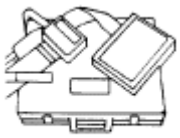
NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to Section 307-05 for adjustments.

1. Remove fluid level indicator from fluid filler tube.
2. Place funnel in fluid filler tube.
3. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Remove the cooler return line (top fitting) from the fitting on the transmission case.
5. Connect one end of a hose to the cooler return line and route other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the safety stands and lower the vehicle. Insert end of hose into the funnel.
7. Start the engine and run it at idle with the transmission in NEUTRAL.
8. When fluid flows from the hose in a steady stream, a liberal amount of fluid should be observed. "Liberal" is about 1 liter (1 quart) delivered in 15 seconds. If a liberal flow is observed, the test is complete.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter outlet fitting (bottom fitting) on the transmission case.
10. Repeat steps 6 and 7. If flow is now approximately 1 liter (1 quart) in 15 seconds, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section. If the flow is still not approximately 1 liter (1 quart) in 15 seconds, repair or install pump and or converter.

For the installation of new transmission fluid cooler or tubes, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

ST1565-A	Pressure Gauge 307-004 (T57L-77820-A)
ST1392-A	AOD-E Transmission Test Plate 307-246 (T92P-7006-A)
 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950) or equivalent
ST1632-A	TRS-E Cable 418-F107 (007-00111) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418–F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
ST1389-A	Transmission Tester 007-00130 or equivalent
	Digital TRS Sensor Overlay 007-00131 or equivalent

ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent

The Diagnosis by Symptom charts give the technician diagnostic information, direction, and suggest possible components, using a symptom as a starting point.

The Diagnosis by Symptom charts are divided into two categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the Concern/Symptom that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:

a. preliminary inspections.
b. verifications of condition.
c. checking the fluid levels.
d. carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   Begin with the Electrical Routine, if indicated. Follow the reference or action required statements. Always carry out the on-board diagnostic tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable

cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Title	Routines	
	Electrical [1]	Hydraulic/Mechanical
Engagement Concerns		
No Forward	201	301
No Reverse	202	302
Harsh Reverse	203	303
Harsh Forward	204	304
Delayed/Soft Reverse	205	305
Delayed/Soft Forward	206	306
Shift Concerns		
Some/All Shifts Missing	210	310
Timing Concerns		
—Early/Late	211	311
—Erratic/Hunting	212	312
Feel		
—Soft/Slipping	213	313
—Harsh	214	314
No 1st Gear, Engages in Higher Gear	215	315
No Manual 1st Gear	216	316
No Manual 2nd Gear	217	317
Torque Converter Operation Concerns		
No Apply	240	340
Always Applied/Stalls Vehicle	241	341
Cycling/Shudder/Chatter	242	342
Other Concerns		
No Engine Braking in 2nd Gear, Manual 2nd or Manual 1st Position	250	350
Gearshift Lever Efforts High	251	351
External Leaks	252	352
Poor Vehicle Performance	253	353
Noise/Vibration in Forward or Reverse	254	354
Engine Will Not Crank	255	355
No Park (P) Range	256	356
Overheating	257	357

[1] Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect as under Fluid Condition Check; refer to Verification of Condition.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure	· Check pressure at line and forward clutch tap. Refer to Line Pressure Chart for specification. If pressures are low, check the following components: oil filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve, manual valve — stuck, damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect gaskets for damage and install a new gasket.
· 2-3 accumulator and seals damaged	· Inspect piston, seals and bore for damage. Repair as required.
· Pressure regulator valve	· Inspect the diameter for wear.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect for porosity and leaks. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect seals for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect seals for damage. Repair as required.

· Check balls damaged, missing, mislocated, not seating correctly	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged or worn	· Check for abnormal wear, damage. Repair as required.
One-Way Clutch Assembly (Planetary)	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
Output Shaft	
· Damaged	· Inspect for damage. Repair as required.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line pressure tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse servo, pump assembly, reverse clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
· Loose bolts	· Tighten bolts to specifications.
· Gasket damaged	· Inspect for damage and install a new gasket.
Low/Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring	

damaged	
· Anchor pins (case) damaged	
Pump Assembly	
· Loose bolts	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged or worn	
Low/Reverse Band	
· Band, servo, anchor pins damaged or worn	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, transmission fluid temperature (TFT) sensor, electronic pressure control (EPC) solenoid	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test, EPC test and Pinpoint Tests B and D. Repair as required. Clear DTCs, road test and repeat Self-Test.
303 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· High line pressure, high EPC pressure	· Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If high, check the following components: main controls, oil filter and seal assembly.
Fluid Filter and Seal Assembly	

· Plugged or damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· No. 6 shuttle ball, No. 5 check ball, manual valve, main regulator valve stuck, damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gasket damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage, contamination. Carry out EPC test in Routine No. 203. Repair as required.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
· Anchor pins (case) damaged	
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring piston damaged, worn	
Low Reverse Band	
· Band, servo, anchor pin damaged or worn	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test, EPC test and Pinpoint Tests B and D. Repair as required. Clear DTCs, road test and repeat Self-Test.
304 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.

· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· High forward clutch pressure, high line pressure, high EPC pressure	· Check pressure at line, EPC and forward pressure taps. Refer to Line Pressure Chart for specifications. If pressures are high, check the following possible components: main controls, pump assembly.
Main Controls	
· Main regulator valve, 2-3 accumulator seal/retainer stuck, damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC test in Routine 204. Repair as required.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect for porosity/leaks. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Check balls missing or damaged	· Inspect for mislocation, poor seating, damage. Install a new forward clutch cylinder.
· Friction element damaged or worn	· Inspect for damage. Repair as required.
· Forward clutch wave spring damaged	· Inspect for damage. Repair as required.
· Forward clutch return spring damaged	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
305 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as

	necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: main controls, pump assembly, reverse clutch assembly, reverse servo.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
	· Filter seal damaged
Main Controls	
· No. 6 shuttle ball, 1-2 accumulator seals, manual valve, main regulator valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks/ball missing or leaking	· Inspect pump assembly. Install new as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Install new components as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring and piston damaged, worn	
Low Reverse Band	
· Damaged, worn	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action

206 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure, low EPC pressure	· Check pressure at line, forward clutch and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls and pump assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve stuck or damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and repair as required.
· 2-3 or 1-2 accumulator, bore damaged or stuck	· Inspect for damage. Repair as required.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Repair as required.
· Gaskets damaged	· Inspect for damage. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check balls missing, damaged	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged, worn	· Check for damage. Repair as required.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, output shaft speed (OSS) sensor, digital TR sensor	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A, C, and E. Repair as required. Clear DTCs, road test and repeat Self-Test.
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 220/320 ■ Shift 2-3, Routine 221/321 ■ Shift 3-4, Routine 222/322 ■ Shift 4-3, Routine 223/323 ■ Shift 3-2, Routine 224/324 ■ Shift 2-1, Routine 225/325

Shift Concerns: Timing Concerns — Early/Late

Possible Component	Reference/Action
211 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, EPC solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A, B, D, and E. Repair as required. Clear DTCs, road test and repeat Self-Test.
311 — HYDRAULIC/MECHANICAL ROUTINE	
Other	
· Tire size change, axle ratio change	· Verify vehicle has original equipment. Refer to Certification Label and Safety Standard Certification Label. Changes in tire size or axle ratio will affect shift timing.
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	

· Line pressure, EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If not OK, check the main controls. If OK, refer to the shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· EPC solenoid, stuck or damaged hydraulically or mechanically	· Inspect for damage, contamination. Carry out EPC tests in Routine No. 211. Repair as required.
· Valves, accumulators, seals stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen (in valve body) blocked or damaged	· Clean or install a new screen.

Shift Concerns: Timing Concerns — Erratic/Hunting

Possible Component	Reference/Action
212 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, torque converter clutch (TCC) solenoid, digital TR sensor, output shaft speed (OSS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Pinpoint Tests A, C, and E . Repair as required. Clear DTCs, road test and repeat Self-Test.
312 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Main Controls	
· Valves, accumulators, seals, assembled wrong, stuck or damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen (in valve body) blocked or damaged	· Clean or install a new screen.
Torque Converter Clutch	
· Torque converter	· Refer to Torque Converter Operation Concerns: Cycling/Shudder/Chatter Hydraulic/Mechanical Routine 342.
Specific Shifts	
	· Refer to the following shift routine(s) for further diagnosis:

	■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325

Shift Concerns: Feel — Soft/Slipping

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests D and E. Repair as required. Clear DTCs, road test and repeat Self-Test.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressures at line and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to main controls. If pressures are OK and a specific shift is soft/slipping, refer to the following routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· 1-2 accumulator, main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage and contamination. Carry out EPC tests in Routine 213. Repair as required.

Shift Concerns: Feel — Harsh

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle	· Carry out Self-Test. Refer to the Powertrain Control/Emissions

wiring harnesses, PCM, EPC solenoid, OSS	Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests D and E. Repair as required. Clear DTCs, road test and repeat Self-Test.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· High line pressure, high EPC pressure	· Check pressures at line and EPC taps. See the to Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to Main Controls. If pressures are OK and a specific shift is harsh, refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· 1-2 accumulator, main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC tests in Routine 214. Repair as required.

Shift Concerns: No 1st Gear, Engages In Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital transmission range TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and C. Repair as required. Clear DTCs, road test and repeat Self-Test.
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check for which pressures are on and refer to Band/Clutch Application Chart 601 and corresponding routines.

• Forward Off, Intermediate Off, Direct X • Forward Off, Intermediate X, Direct Off • Forward Off, Intermediate X, Direct X • Forward X, Intermediate Off, Direct X • Forward X, Intermediate X, Direct Off • Forward X, Intermediate X, Direct X • Forward X, Intermediate Off, Direct Off	■ 324, 301 ■ 325, 301 ■ 323, 324, 325, 301 ■ 324 ■ 325 ■ 323, 324, 325 ■ Refer to appropriate mechanical diagnosis.
Mechanical	
· Bands, clutches or seals damaged or worn	· Refer to Transmission Disassembly and Assembly.

X = pressure applied

Shift Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and C. Repair as required. Clear DTCs, road test and repeat Self-Test.
316 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure, low EPC pressure	· Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse clutch assembly and reverse servo assembly.
Fluid Filter and Seal Assembly	
· Plugged or damaged	· Install a new filter and seal assembly.
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, low servo modulator valve stuck, damaged	· Inspect for damage. Repair as required.

or assembled incorrectly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
	· Servo cover retaining ring assembled incorrectly
	· Anchor pins (case) damaged

Shift Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and C. Repair as required. Clear DTCs, road test and repeat Self-Test.
317 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, 3-4 capacity modulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Shift Concerns: 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and E. Repair as required. Clear DTCs, road test and repeat Self-Test.

320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Intermediate clutch pressure, line pressure	· Check pressure at line and intermediate clutch taps; see the line pressure chart for specifications. If not OK, check the main controls.
Main Controls	
· 1-2 shift valve, 1-2 accumulator valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· Shift solenoid SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 8 ball not seating	· Inspect for damage. Repair as required.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
Intermediate Clutch Assembly	
· Seals damaged	· Inspect for damage. Repair as required.
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged or worn	· Inspect for damage. Repair as required.
Intermediate One-Way Clutch Assembly	
· Not holding or damaged	· Inspect for damage. Repair as required.
Planetary One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.

Shift Concerns: 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	

Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and E . Repair as required. Clear DTCs, road test and repeat Self-Test.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Direct clutch pressure	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not OK, check the main controls.
Main Controls	
· 2-3 shift valve, check ball No. 9 or No. 3, solenoid pressure regulator valve, 2-3 modulator valve, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Shift solenoid SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Output shaft seals damaged or cup plug leaking or missing	· Inspect for damage and repair as required.
· 2-3 accumulator damaged or stuck	· Inspect piston seal and bore for damage. Repair as required.
· Solenoid screen (in main control) blocked or damaged	· Clean or install a new screen.
Intermediate One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
Output Shaft	
· Seal rings damaged	· Inspect for damage. Repair as required.
· Cup plug damaged or missing	
Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball not seating	· Inspect for damage. Repair as required.
· Return spring assembly damaged	· Inspect for damage. Repair as required.
Case	
· Output shaft rear seals leaking or damaged	· Inspect for damage. Repair as required. Inspect case for damaged seal area. If damaged, install a new case.

Shift Concerns: 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A and E. Repair as required. Clear DTCs, road test and repeat Self-Test.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Forward clutch pressure, direct clutch pressure, line pressure	· Check line, direct and forward clutch pressures at appropriate taps; refer to Line Pressure Chart for specifications. If pressures are out of specification, check main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator valve, 1-2 and 2-3 shift valves stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA or SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo rod and piston cushion spring or seals damaged	· Inspect for damage. Repair as required.
· No. 2, No. 4, No. 7 and No. 9 check balls damaged or missing	· Inspect for damage. Repair as required.
· Solenoid screen (in main control) blocked or damaged	· Clean or install a new screen.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage. Install new gaskets as required.
OD Band	
· OD band and reverse clutch drum	· Inspect for damage. Repair as required.

assembly damaged, worn or assembled incorrectly	
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 4-3 Shift (Automatic)

Possible Component	Reference/Action
223 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
323 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Forward clutch pressure, line pressure	· Check line and forward clutch at pressure taps; refer to Line Pressure Chart for specifications. If out of specification, check the main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator, 1-2 and 2-3 shift valves stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Check balls No. 2, No. 7, No. 9 damaged, missing or not seating correctly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo, seal, rod damaged	· Inspect for damage. Repair as required.
· Solenoid screen (in main control) blocked or damaged	· Clean or install a new screen.
Pump	

· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Seal rings damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Overdrive Band	
· OD band and reverse clutch assembly damaged, worn or assembled incorrectly	· Inspect for damage. Repair as required.
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
· Forward clutch piston and return spring damaged	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 3-2 Shift (Automatic)

Possible Component	Reference/Action
224 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
324 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Direct clutch	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not within specification, check the main controls.
Main Controls	
· 2-3 shift valve stuck or damaged	· Inspect for damage. Repair as required.
· Check balls damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Intermediate One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction element damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.

Shift Concerns: 2-1 Shift (Automatic)

Possible Component	Reference/Action
225 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
325 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Intermediate clutch	· Check pressure at intermediate clutch tap; refer to Line Pressure Chart for specifications. If not within specifications, check main controls and pump.
Main Controls	
· 1-2 shift valve, 1-2 accumulator solenoid pressure regulator valve stuck, damaged or assembled wrong	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage; repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump	
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Porosity/cross leaks	· Inspect for leak/porosity. Install a new pump as required.
Intermediate Clutch Assembly	
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· End clearance incorrect	· Inspect and correct; refer to Transmission Assembly.
Intermediate One-Way Clutch	

· Damaged	· Inspect for damage. Repair as required.
Planetary One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.

Torque Converter Operation Concerns: No Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests B and E. Repair as required. Clear codes, road test and repeat Self-Test.
340 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If pressure is low, check EPC and main regulator valve. If within specifications, check the main controls.
Main Controls	
· Solenoid pressure regulator valve, manual valve, bypass clutch control valve and plunger, converter pressure limit valve, drain back valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen (in valve body) blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks, balls leaking	· Inspect for porosity/leaks, ball missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	

· Seals damaged	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Leakage, friction material damaged, internal seals damaged	· Inspect torque converter. Repair or install a new or remanufactured torque converter as required.

Torque Converter Operation Concerns: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests B and A. Repair as required. Clear DTCs, road test and repeat Self-Test.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Drain back valve, torque converter clutch (TCC) and plunger stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· No. 7 ball incorrect seating	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Ball missing, leaking, porosity/cross leaks	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter Assembly	
· No end clearance	· Inspect converter and install a new or remanufactured torque converter as required.
· Piston plate damaged or stuck to cover	· If cover is heat-stained, install a new converter.

Torque Converter Operation Concerns: Cycling/Shudder/Chatter

Possible Component	Reference/Action

242 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid Condition	
	· Inspect fluid condition. If burnt, drain fluid and converter. Install a new fluid and filter assembly. Bring vehicle to normal operating temperature. Carry out Transmission Drive Cycle Test. Carry out Transmission Self-Test. If condition still exists, continue diagnostics.
Main Controls	
· Solenoid pressure regulator valve, No. 7 check ball, bypass clutch control valve and plunger, converter pressure limit valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen (in valve body) blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks, missing balls or leaking	· Inspect for porosity/leaks or missing balls. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter	
· Excessive end clearance	· Inspect converter. Install a new or re-manufactured torque converter as required.

Other Concerns: No Engine Braking In 2nd Gear, Manual 2nd Or Manual 1st Position

Possible Component	Reference/Action
250 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
350 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	

· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, gaskets, 3-4 capacity modulator valve, stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· OD servo assembly damaged or stuck	· Inspect cover, piston and seal for damage. Repair as required.
Overdrive	
· Reverse band, manual 1st (only) damaged	· Inspect for damage. Repair as required.
· OD band, reverse clutch drum assembly worn or damaged	· Inspect for damage. Repair as required.
· Intermediate one-way assembly damaged	· Inspect for damage. Repair as required.
Reverse Band (Manual 1st Only)	
· Damaged or incorrectly adjusted	· Inspect for damage. Repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
351 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Manual Lever	
· Retaining pin damaged, nut loose, detent spring bent or damaged or Park mechanism damaged	· Inspect for damage. Repair as required.
Main Controls	
· Manual valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, sensor seals leaking (digital TR, OSS, vehicle speed sensor (VSS) or transmission connector)	· Inspect for leakage and repair as required.
352 — HYDRAULIC/MECHANICAL ROUTINE	
Seals, Gaskets	
· Converter, pump, pan, extension housing gasket/seal, manual lever, fluid level indicator tube	· Locate source of leak. Repair as required.
Other	
· Cooler fitting, pressure taps, converter drain plug, band anchor pins, cooler lines, case porosity, case cracked	· Locate source of leak. Repair as required.
· Vent blocked or damaged	· Check vent for damage or blockage. Repair as required.

Other Concerns: Poor Vehicle Performance

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, shift solenoids, digital TR sensor, torque converter clutch (TCC) solenoid, transmission fluid temperature (TFT) sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Tests A, B and C. Repair as required. Clear codes, road test and repeat Self-Test. Also refer to Routines 241/341 Torque Converter Operation Concern: Always Applied.
353 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Verify Proper Shift Scheduling and Engagements	
· See Reference/Action	· Go to the appropriate diagnostic routines.
Torque Converter Clutch Always Applied	
· See Reference/Action	· Go to Hydraulic/Mechanical Routine 241/341.
Torque Converter Clutch	
· Damaged	· Inspect torque converter. Install a new converter as outlined.

Other Concerns: Noise/Vibration — Forward Or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
354 — HYDRAULIC/MECHANICAL ROUTINE	
For Noises/Vibrations That Change With Engine Speed	
· Converter components	· Locate source of disturbance. Repair as required.
· Fluid level (low) pump cavitation	
· Pump assembly	
· Engine drive accessories	
· Cooler lines grounding out	
· Flexplate	
For Noises/Vibrations That Change With Vehicle Speed	
· Engine mounts loose or damaged	· Locate source of disturbance and repair as required.
· Driveline concerns: ■ U-joints ■ Rear axle ■ Suspension ■ Modifications 1st Gear: ■ Low one-way clutch ■ Gearset ■ Friction elements	· Refer to the following shift routine(s) for further diagnosis:Shift 1-2, Routine 320 Shift 2-3, Routine 321 Shift 3-4, Routine 322 Shift 4-3, Routine 323 Shift 3-2, Routine 324 Shift 2-1, Routine 325 Torque Converter Cycling 242/342
· 2nd Gear: ■ Intermediate one-way clutch ■ Intermediate clutch piston bleed hole out of 12 o'clock position ■ Friction elements	
· 3rd Gear: ■ Torque converter ■ Case to planet support spring ■ Friction elements	
· 4th Gear:	

■ Gear set ■ Friction elements ■ Torque converter	
· Reverse: ■ Gear set ■ Friction elements	
· Output shaft splines worn or damaged	
Other Noises/Vibrations	
· Main controls, valve resonance	· Locate source of disturbance and repair as required.
· Shift cable: ■ Vibration ■ Grounding ■ Cooler lines ■ Grounding	

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out Pinpoint Test C . Repair and adjust as required.
· Electrical inputs/outputs, vehicle wiring harnesses, engine starting system hardware, digital TR sensor	
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Damaged or incorrectly adjusted	

Other Concerns: No Park (P) Range

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing
· Damaged or incorrectly adjusted	

	transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Park Mechanism	
· Output shaft ring, parking brake pawl, parking pawl return spring, park rod guide cup, parking pawl shaft, parking pawl actuating rod, manual lever detent spring damaged or assembled incorrectly	· Inspect for damage or incorrect assembly and repair as required.

Other Concerns: Overheating

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
Refer to Routine 240/340, Torque Converter Operation Concern: No Apply	
357 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Cooler Lines	
· Damaged, blocked or reversed	· Inspect for damage and correct installation. Repair as required.
Vehicle Concerns Causing Engine Overheating	
	· Refer to Section 303-03 .
Main Controls	
· Drain back valve, torque clutch control valve, converter limit valve stuck, damaged or assembled incorrectly	· Inspect for damage and repair as required.
Torque Converter	
· No apply	· Refer to Routine 240/340.

Transmission Fluid Cooler — Backflushing and Cleaning

1. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   Conduct backflushing with a suitable torque converter/fluid cooler cleaner. Test your equipment to make sure that a vigorous fluid flow is present before proceeding. Install a new filter in the flush equipment if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler lines, connect two additional rubber hoses to the transmission end of the steel transmission cooler lines as described below.
   - Connect the cleaner tank pressure line to the steel transmission cooler return line (longest line).
   - Connect a tank return hose to the steel transmission cooler pressure line (shorter line). Place the outlet end of this hose in the solvent tank reservoir.

3. Turn on solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling switch on and off will help dislodge contaminants in cooler system).

4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.

5. Use compressed air to blow out the cooler(s) and lines (blow air into the transmission cooler return line) until all solvent is removed.

6. Remove the rubber return hose from the remaining steel cooler line.

Fluid Pan, Gasket and Filter

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. Normal maintenance requires periodic automatic transmission fluid changes. If a major repair, such as a clutch, band, bearing, etc., is required, the automatic transmission will also have to be removed for repair. At this time, the torque converter, transmission cooler and tubes must be thoroughly flushed to remove any dirt. The transmission fluid needs to be changed if evidence of fluid contamination is found. When used under continuous or severe conditions, the transmission and torque converter should be drained and refilled with fluid as specified.

2. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   CAUTION: Use of a fluid other than specified could result in transmission failure.

   Refer to the vehicle certification label affixed to the LH front door lock face panel or door pillar for the transmission code.

3. When filling a dry transmission and torque converter, refer to General Specifications chart in this section for capacity. Check the fluid level.

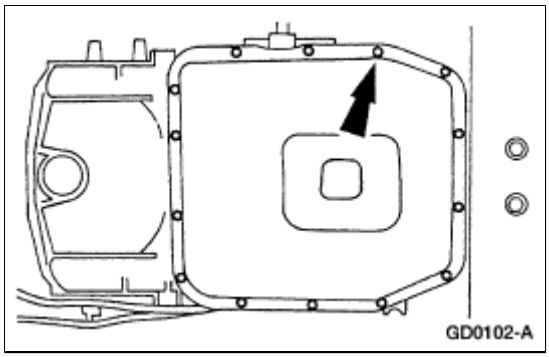
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

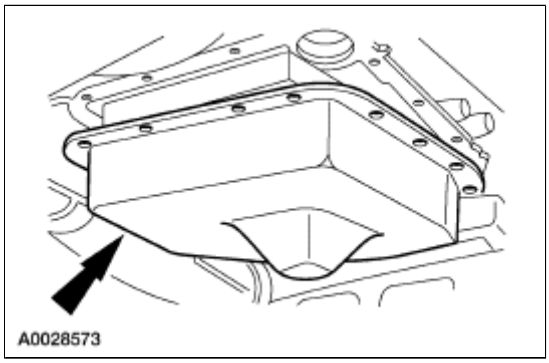
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Place a drain pan under the transmission fluid pan.

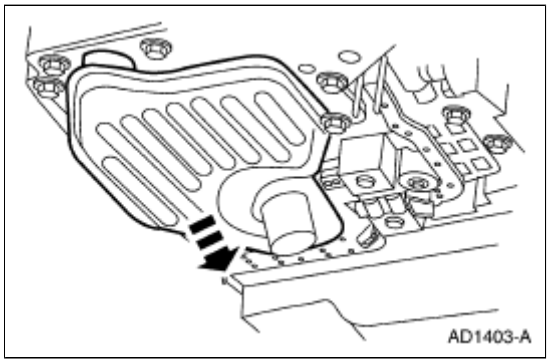
4. Drain transmission fluid.
   - Loosen the transmission fluid pan bolts and allow fluid to drain. After fluid is drained remove the bolts.



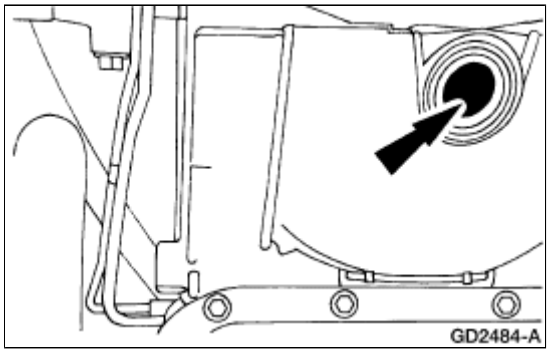
5. Remove the transmission fluid pan and transmission fluid pan gasket.



6. Pull down evenly and remove the transmission fluid filter and seal.

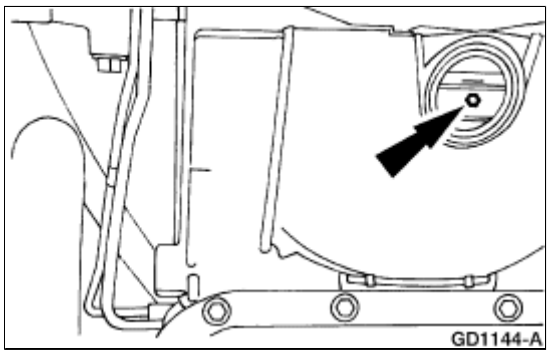


7. Remove torque converter housing plug.

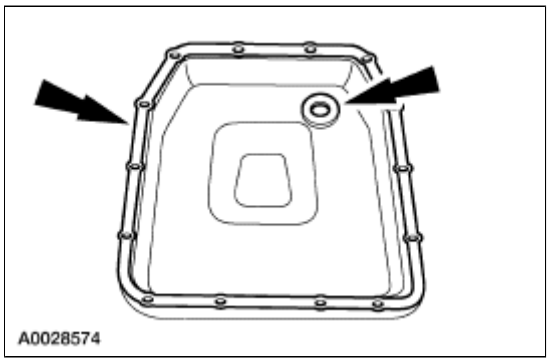


8. Remove the torque converter drain plug and drain the torque converter.

- Rotate the crankshaft to access the drain plug.



9. Clean and inspect the transmission fluid pan, gasket and magnet.

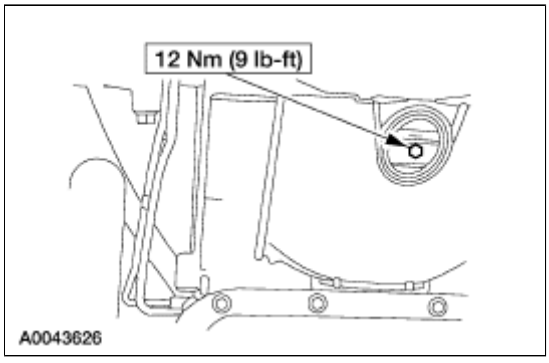


10. Flush the fluid cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

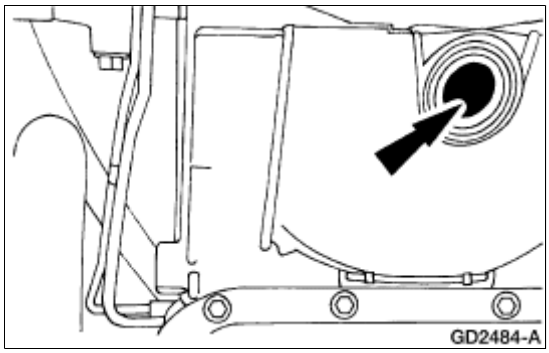
Installation

1. **NOTE:** A new torque converter drain plug must be used.

   Install the torque converter drain plug.



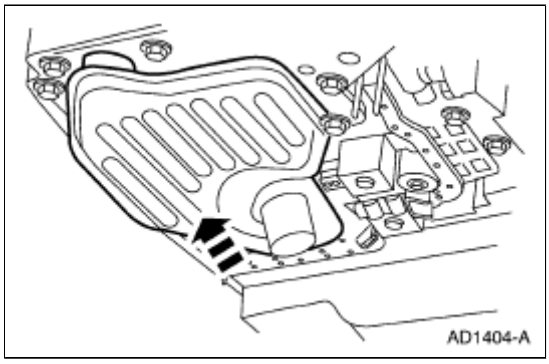
2. Install the torque converter housing plug.



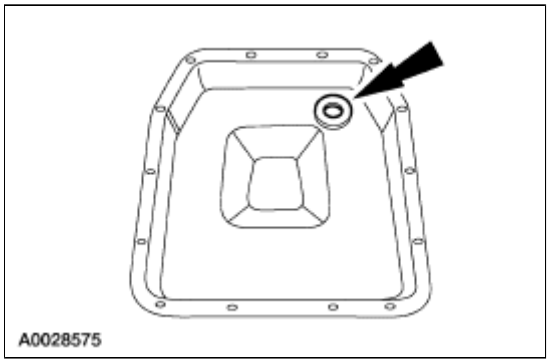
3. **CAUTION: If installing a new filter, and the seal remains in the main control bore, carefully use a small screwdriver to remove the seal. Use care not to damage the main control bore.**

   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Install a new fluid filter and seal as required.

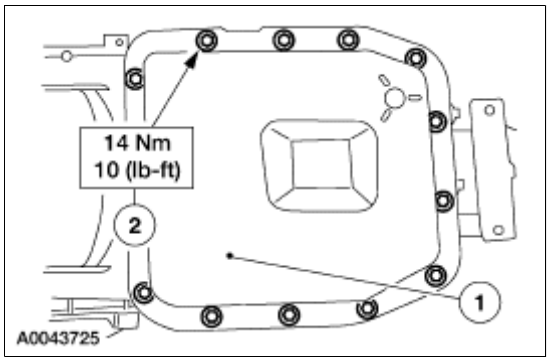


4. Position the pan magnet into the transmission fluid pan.



5. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage; if not damaged, the gasket should be reused.

   Install the transmission fluid pan and gasket.
   1. Position the transmission fluid pan and gasket.
   2. Install the transmission fluid pan bolts.



6. Lower the vehicle.

7. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

8. **NOTE:** When filling a dry transmission and converter, start with a minimum of 4.7 liters (5 quarts).

   Fill the transmission to the correct level with clean automatic transmission fluid.

Main Control Valve Body

Special Tool(s)

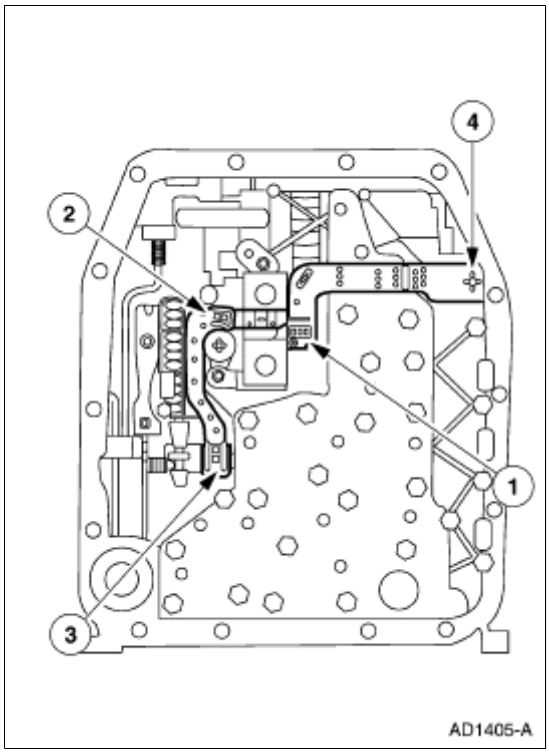
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

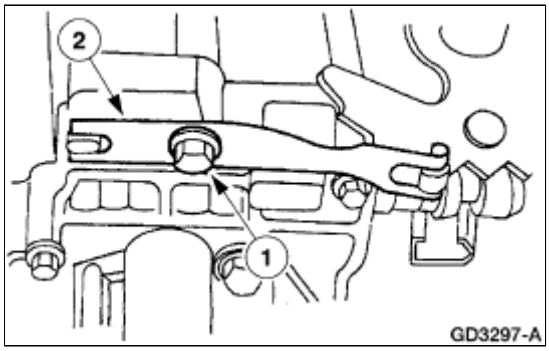
1. Drain transmission fluid and remove the transmission fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter .

2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

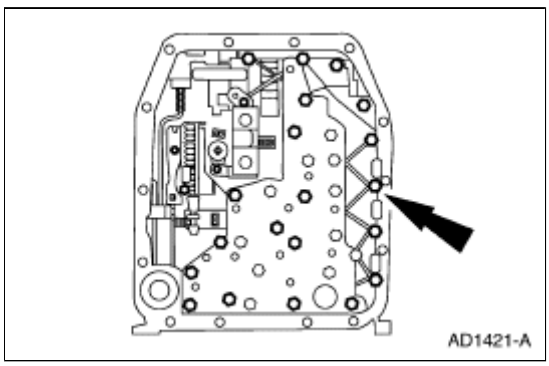
   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.



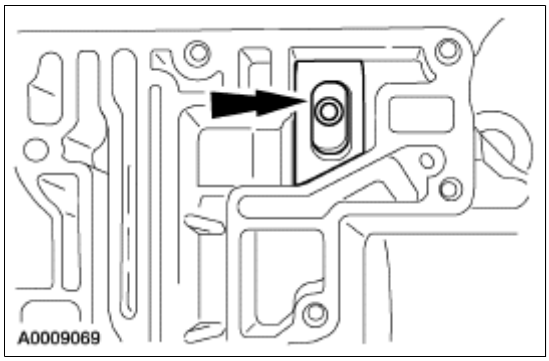
3. Remove the manual control valve detent lever spring.
    1. Remove the bolt.
    2. Remove the manual control valve detent lever spring.



4. Remove the 24 valve body to case bolts.



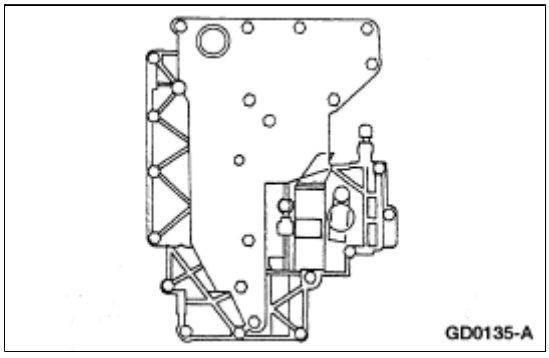
5. Remove the main control valve body and discard the pump outlet screen.



Installation

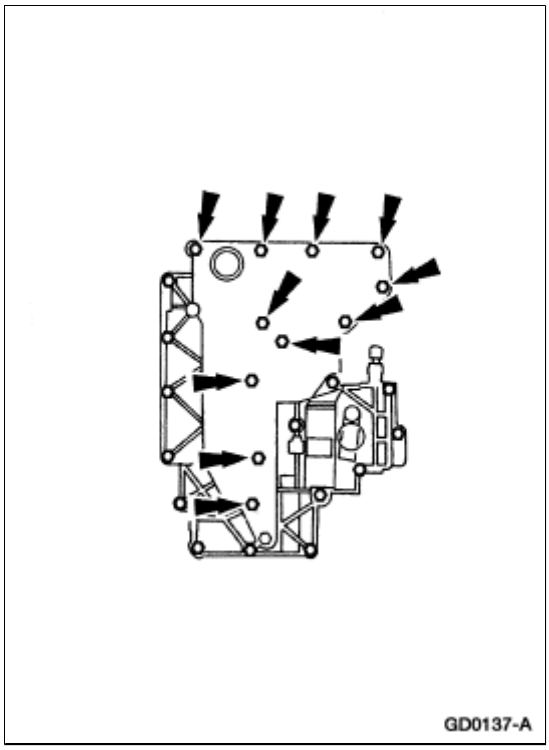
1. **NOTE:** Make sure that the drive pin of the manual valve detent lever assembly engages the manual valve in the correct location prior to installing the bolts.

   Position the main control valve body gasket and main control valve body using the two alignment bolts as a guide.



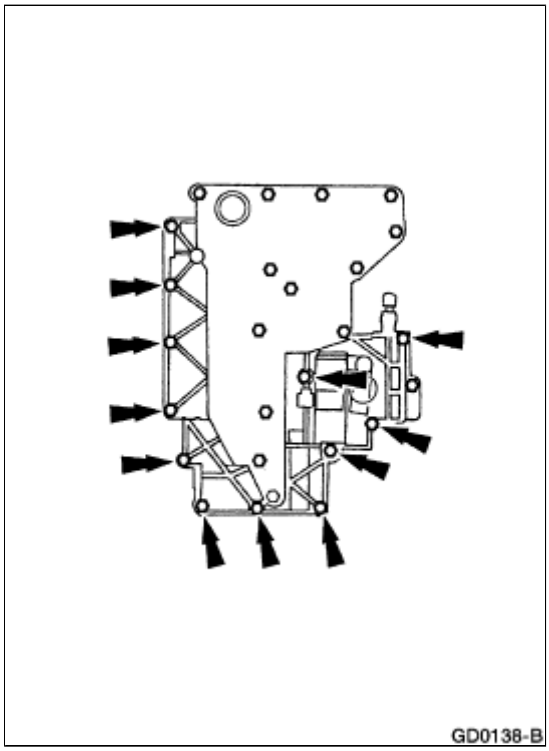
2. **NOTE:** The main control valve body bolts will be tightened in later steps.

   Loosely install the bolts.

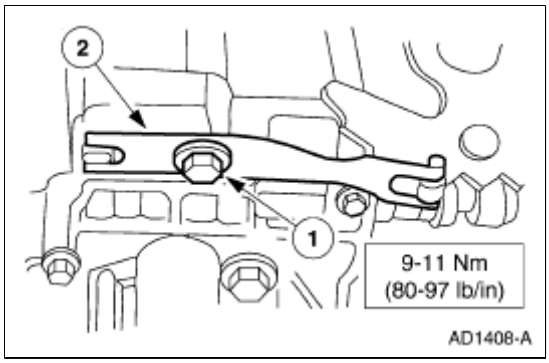


3. **NOTE:** The main control valve body bolts will be tightened in later steps.

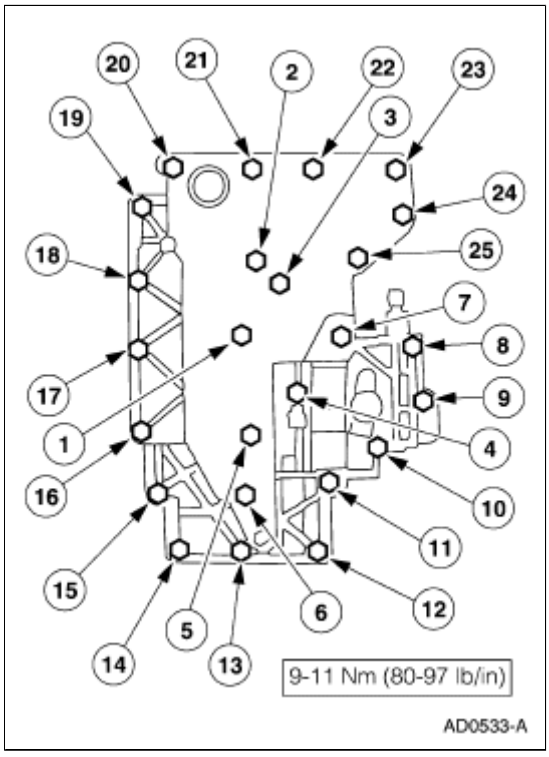
   Loosely install the bolts.



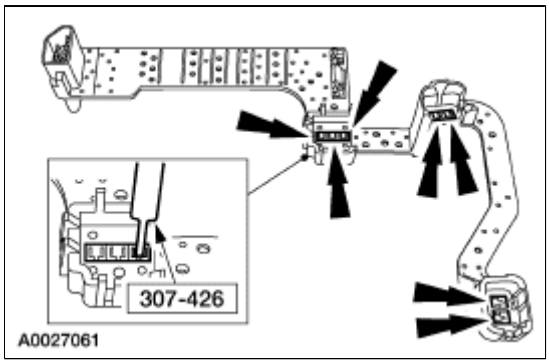
4. Install the manual control valve detent lever spring.
   1. Position the manual control valve detent lever spring.
   2. Install the bolt.



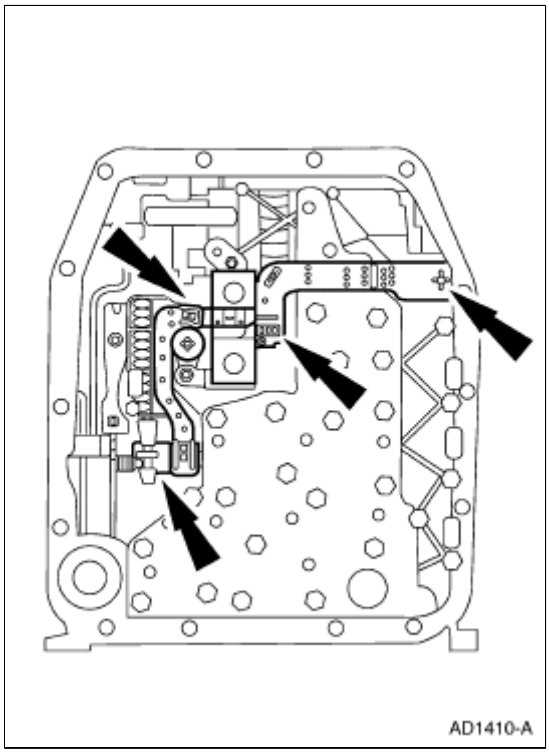
5. Tighten the main control valve body bolts in the sequence shown.



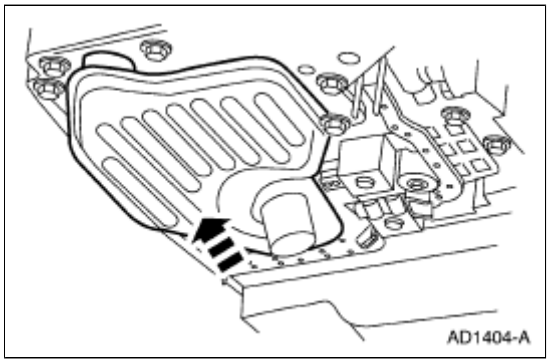
6. Inspect the lead frame for damage.
   - Using the special tool, check all lead frame solenoid connections.
   - If the special tool passes through any lead frame connector pins, install a new lead frame.



7. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector.
    - Connect the EPC solenoid.
    - Connect the TCC.
    - Connect the shift solenoid SSA and SSB.

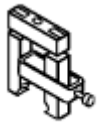


8. Install the transmission filter and pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.



Extension Housing Seal and Gasket

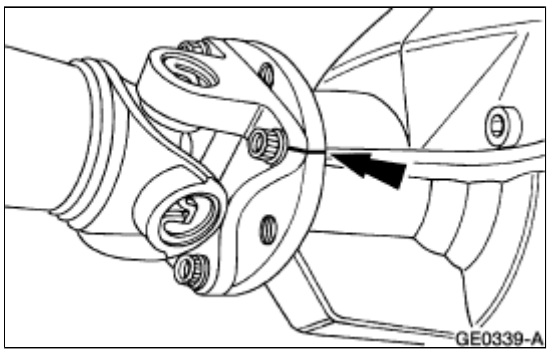
Special Tool(s)

ST1188-A	Installer, Transmission Extension Housing Fluid Seal 308-002 (T61L-7657-A)
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)

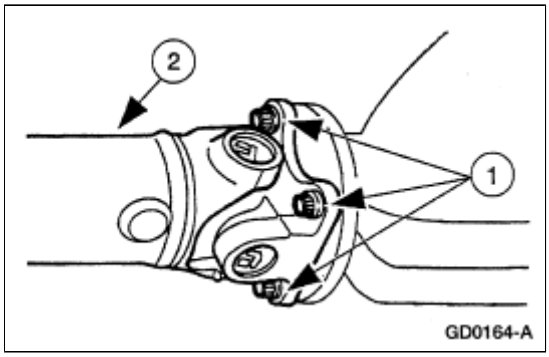
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
4. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they may be installed in their original positions.

   Mark the driveshaft flange and the rear companion flange for correct alignment during assembly.

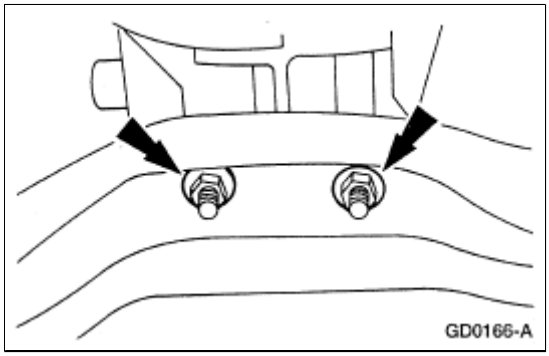


5. Remove the rear driveshaft.
    1. Remove the four bolts.
    2. Remove the rear driveshaft.

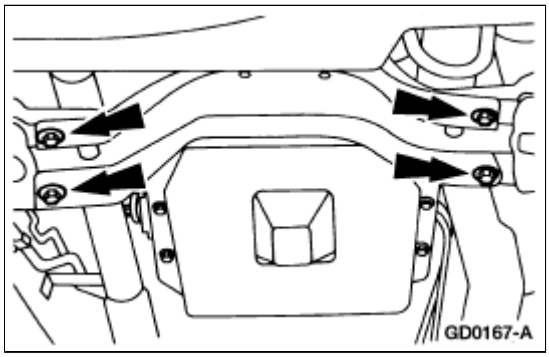


6. Use high-lift jack to support the transmission.

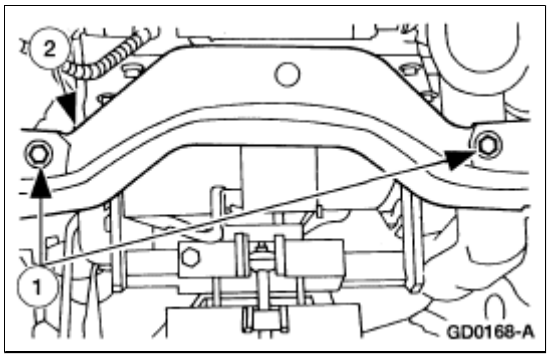
7. Remove the nuts.



8. Remove the bolts.

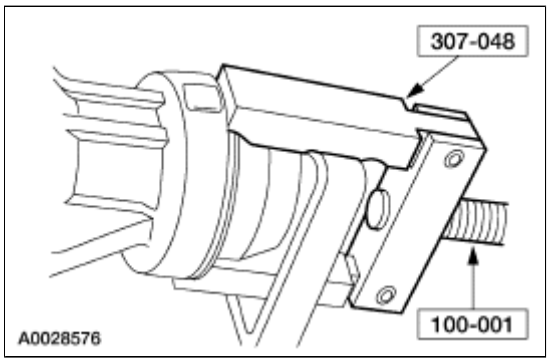


9. Remove the transmission crossmember.
    1. Remove the bolts.
    2. Remove the transmission crossmember.

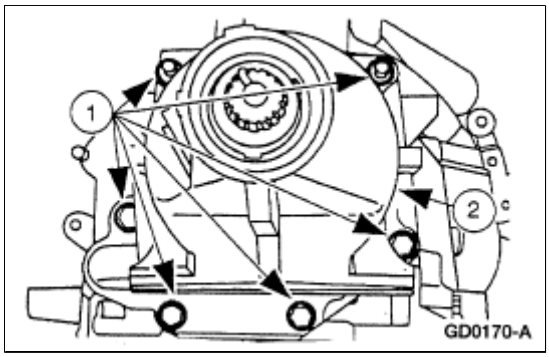


10. Lower the transmission to access the extension housing bolts.

11. Using the special tool remove the extension housing seal.

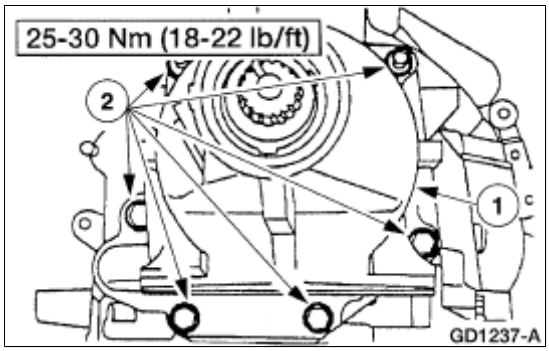


12. Remove the extension housing and gasket.
    1. Remove the bolts and nuts.
    2. Remove the extension housing and gasket.

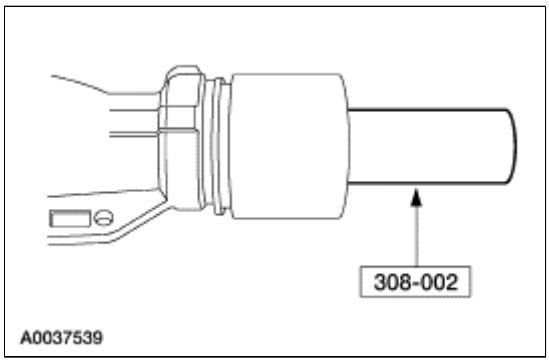


Installation

1. Install the extension housing and gasket.
    1. Position the extension housing gasket and the extension housing.
    2. Install the bolts and nuts.

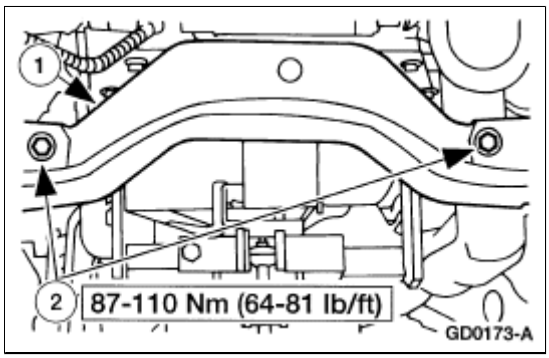


2. Using the special tool, install the new extension housing seal.

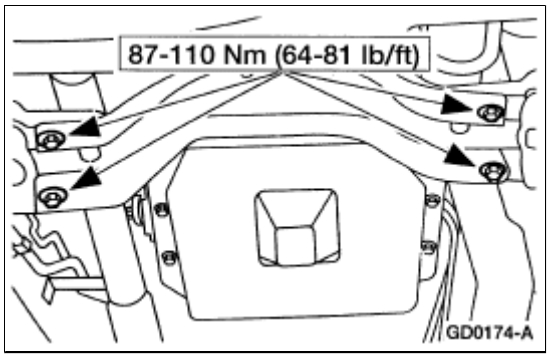


3. Raise and position the transmission.

4. Install the transmission crossmember.
    1. Position the transmission crossmember.
    2. Install the bolts.

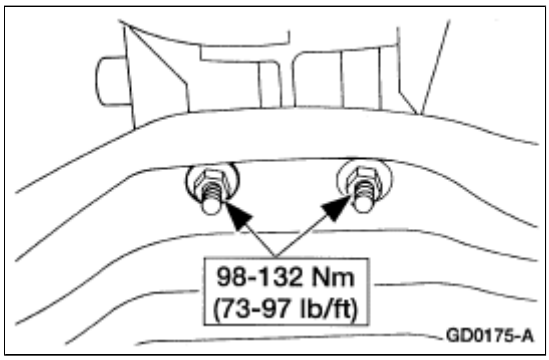


5. Install the transmission crossmember bolts.



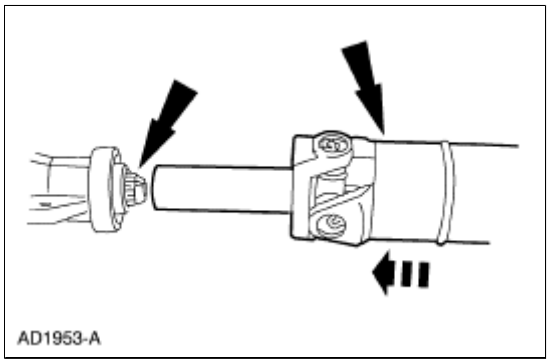
6. Remove the high-lift transmission jack.

7. Install the nuts.

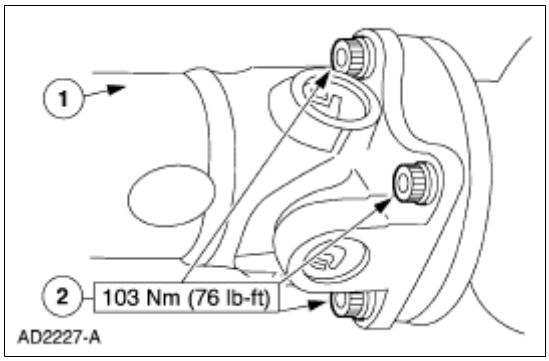


8. **NOTE:** The output shaft and the driveshaft are a balanced assembly.

   Install the drive shaft.
   - Align the yellow dots and position the driveshaft on the transmission.



9. Install the rear driveshaft.
   1. Position the driveshaft.
   2. Install the four bolt.



10. Lower the vehicle.

11. Connect the battery ground cable.

12. Fill the transmission with clean automatic transmission fluid and inspect for correct operation. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

Electronic Pressure Control (EPC) Solenoid

Special Tool(s)

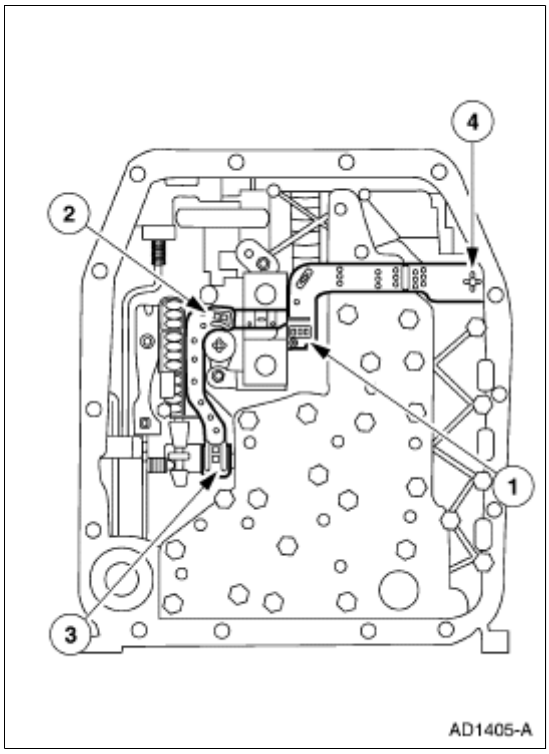
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

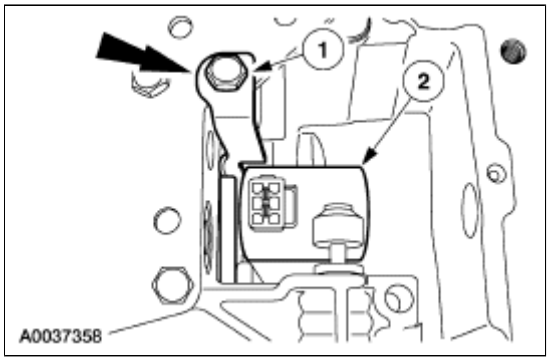
1. Remove the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.

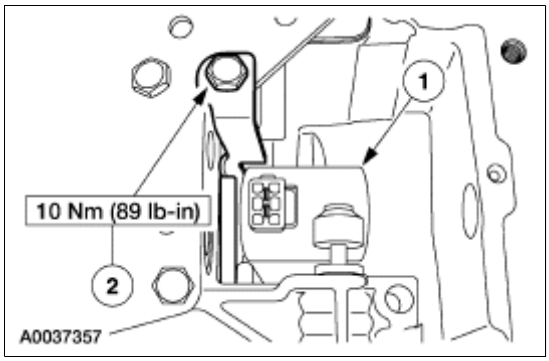


3. Remove the EPC solenoid.
    1. Remove the bolt and EPC solenoid bracket.
    2. Remove the EPC solenoid.

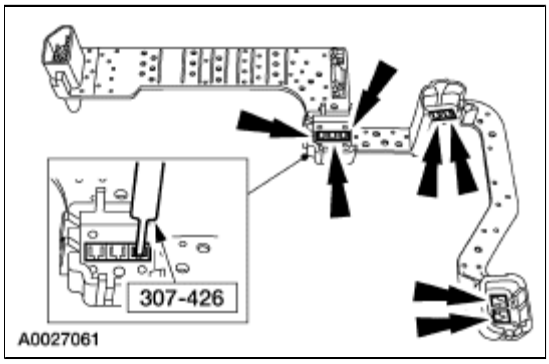


Installation

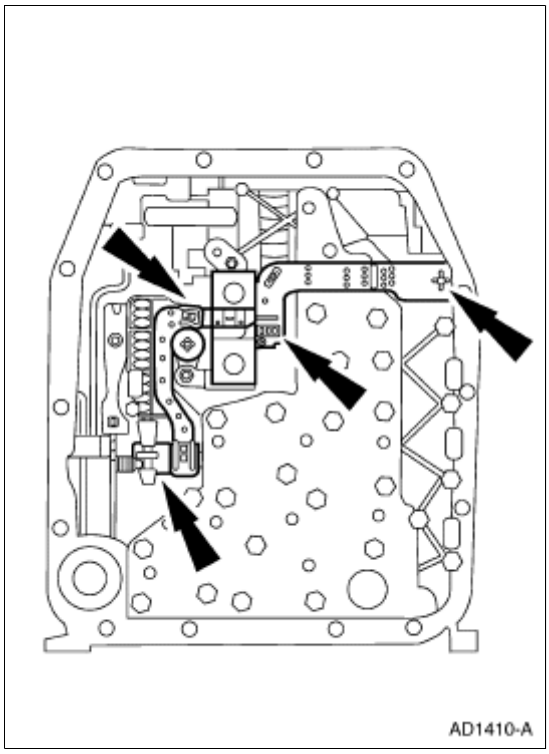
1. Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



2. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



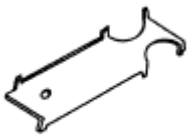
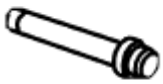
3. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



4. Install the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

Manual Control Lever Shaft and Seal

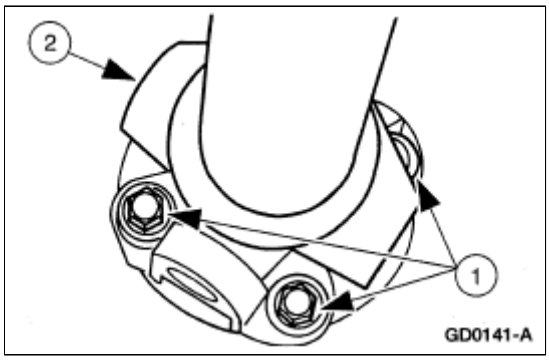
Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)

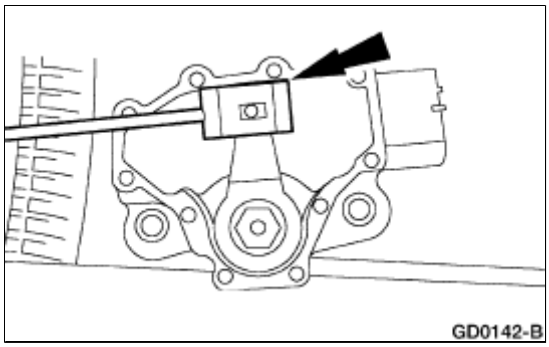
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** Mark the driveshaft flange and rear axle pinion flange for correct alignment during installation.

   On 4x4 vehicles, remove the front driveshaft.
   1. Remove the eight front driveshaft bolts (four each end).
   2. Remove the front driveshaft.

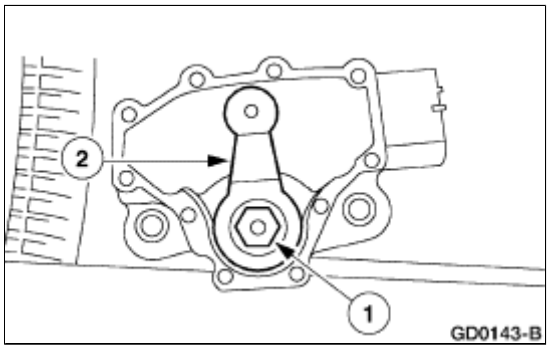


4. Drain the transmission fluid and remove the fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
5. Disconnect digital TR sensor electrical connector.
6. Disconnect the transmission shift linkage.

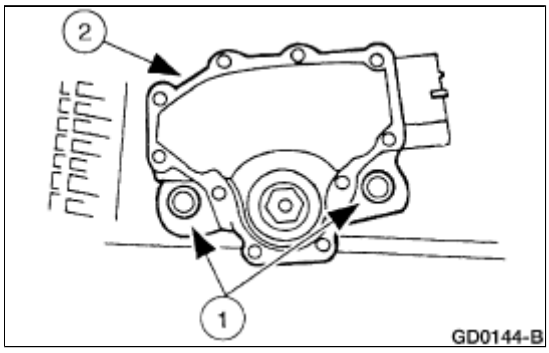


7. **CAUTION: Discard outer manual control lever shaft nut. Do not reuse. The old nut will not retain torque specification.**

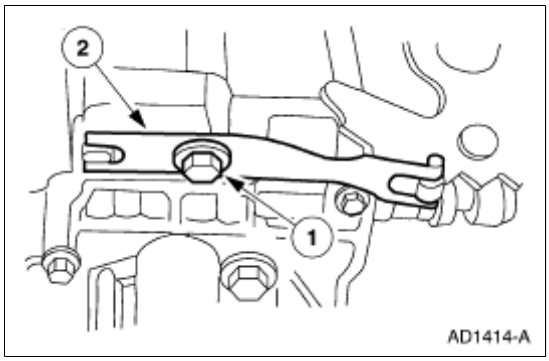
   Remove the manual control lever.
   1. Remove the outer manual control lever shaft nut.
   2. Remove the manual control lever.



8. Remove the digital transmission range TR sensor.
   1. Remove the two bolts.
   2. Remove the digital TR sensor.

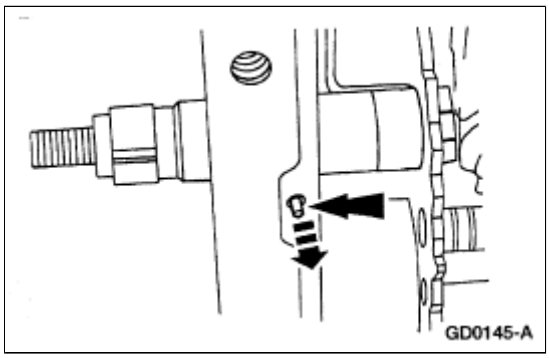


9. Remove the manual control valve detent lever spring.
   1. Remove the bolt.
   2. Remove the manual control valve detent lever spring.

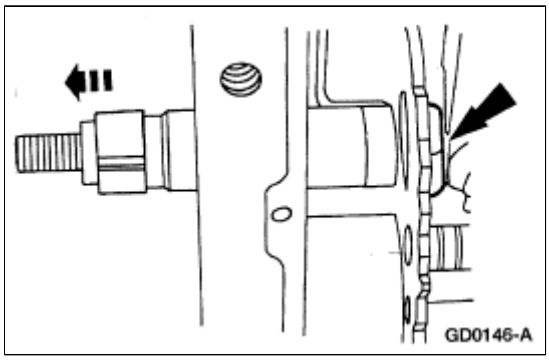


10. **NOTE:** Use a shop cloth to protect the transmission case surface.

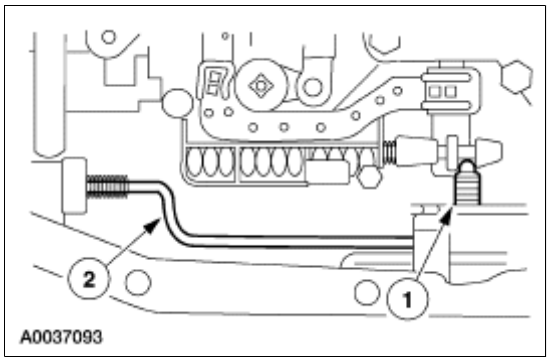
    Remove the manual lever shaft retaining pin.



11. Remove the inner manual control lever shaft nut and slide the manual control lever shaft out of the case.

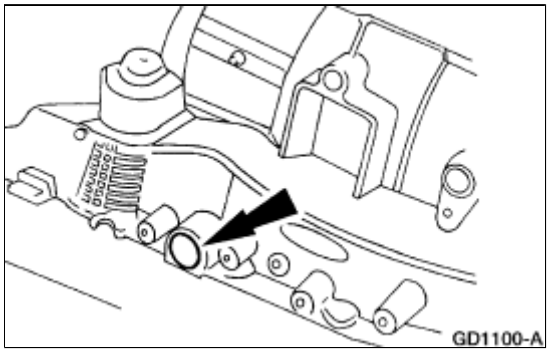


12. Remove the parking lever actuating rod.
    1. Remove the manual valve detent lever.
    2. Remove the parking lever actuating rod.



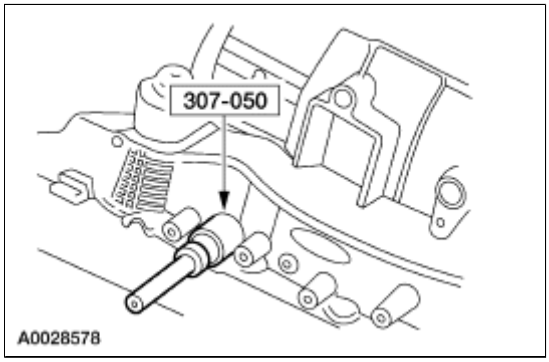
13. **CAUTION: Use care not to damage the manual control lever shaft bore. The new seal can leak.**

    Remove the manual control lever shaft seal.

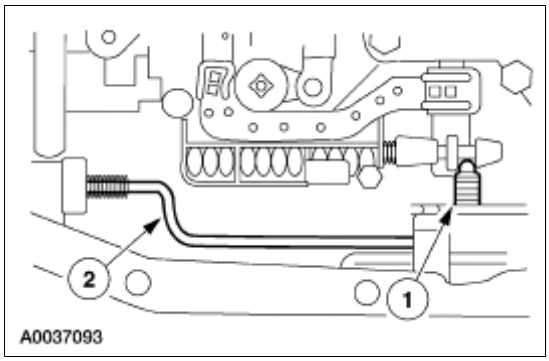


Installation

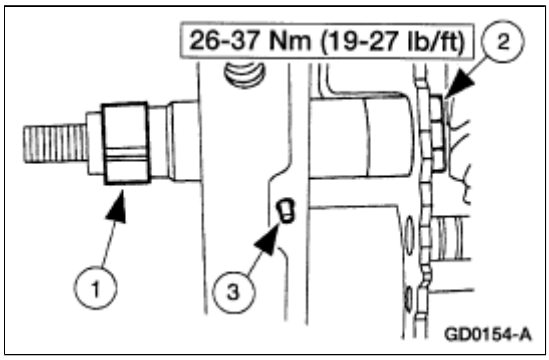
1. Using the special tool, install the manual control lever seal.



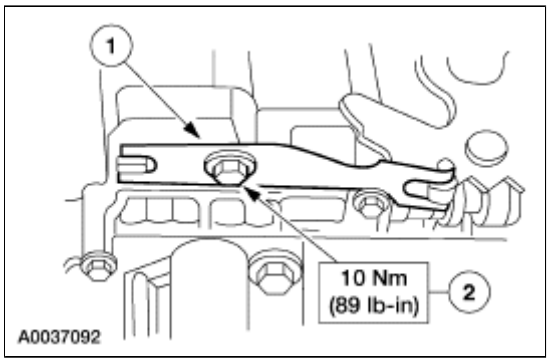
2. Install the parking lever actuating rod.
    1. Install the manual valve detent lever.
    2. Install the parking lever actuating rod.



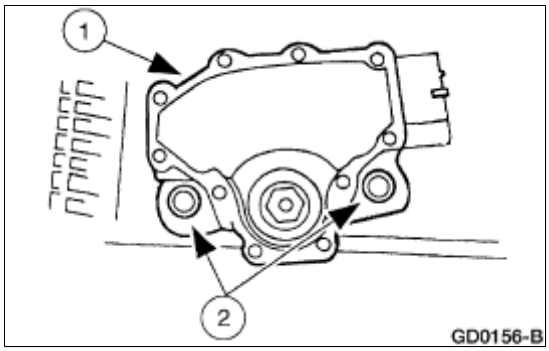
3. Install the manual control lever shaft.
    1. Install the manual control lever shaft.
    2. Install the inner manual control lever shaft nut.
    3. Install the manual lever shaft retaining pin.



4. Install the manual valve detent lever spring.
    1. Position the manual valve detent lever spring.
    2. Install the manual valve detent lever spring bolt.

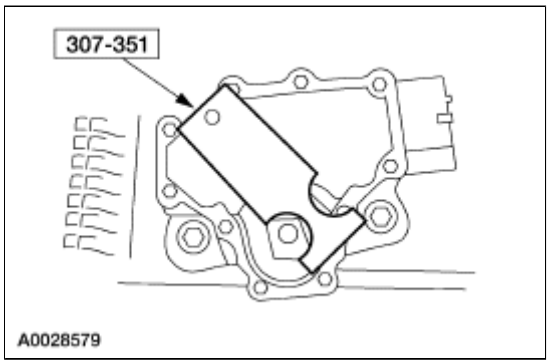


5. Install the digital TR sensor.
    1. Install the digital TR sensor.
    2. Loosely install the bolts.

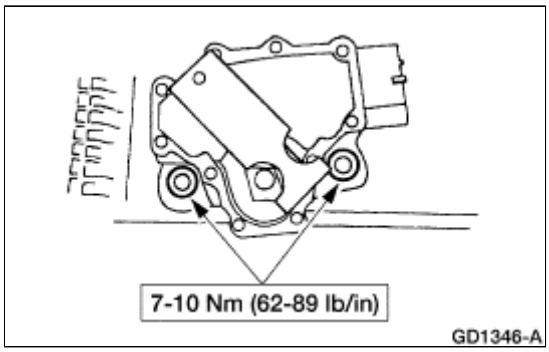


6. **NOTE:** Manual shift lever must be in the neutral position.

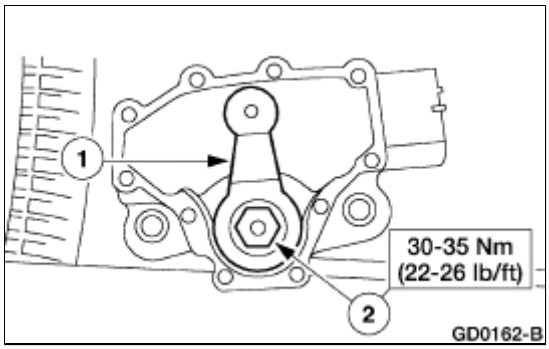
   Using the special tool, align the digital TR sensor slots. The tool is designed to fit snug.



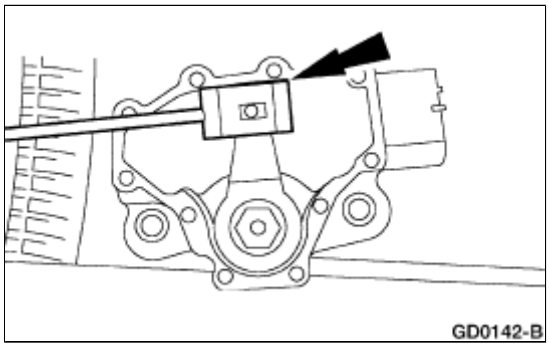
7. Tighten the bolts.



8. Install the manual control lever.
   1. Position the manual control lever.
   2. Install a new manual lever shaft outer nut.



9. With manual lever in overdrive, connect the shift control cable.

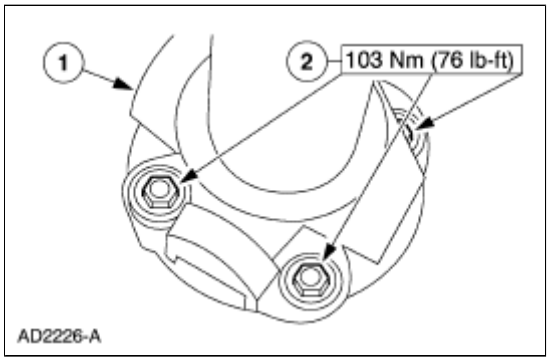


10. Install digital TR sensor electrical connector.

11. Install the filter and transmission fluid pan.

12. **NOTE:** To maintain initial driveshaft balance, align the index marks made during removal.

    On 4x4 vehicles, install the front driveshaft.
    1. Position the front driveshaft.
    2. Install the eight front driveshaft bolts (four each end).



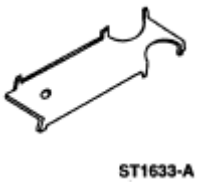
13. Lower the vehicle.

14. Connect the battery ground cable.

15. Fill the transmission with clean automatic transmission fluid and inspect for correct operation. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

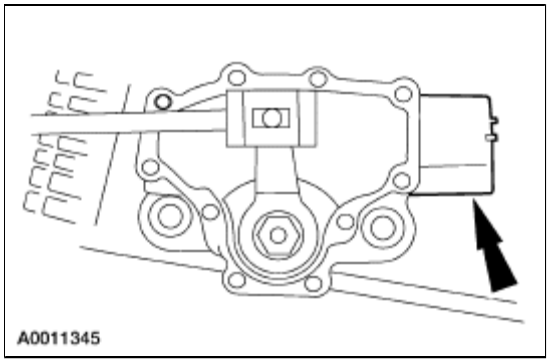
Digital Transmission Range (TR) Sensor

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

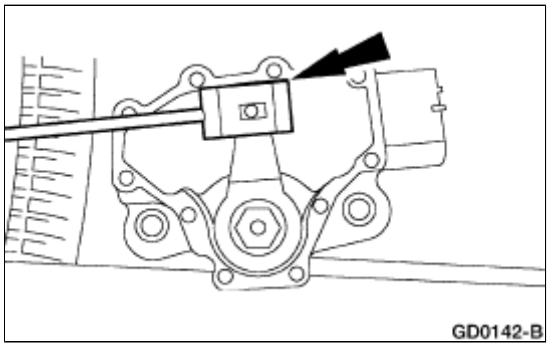
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the digital TR electrical connector.



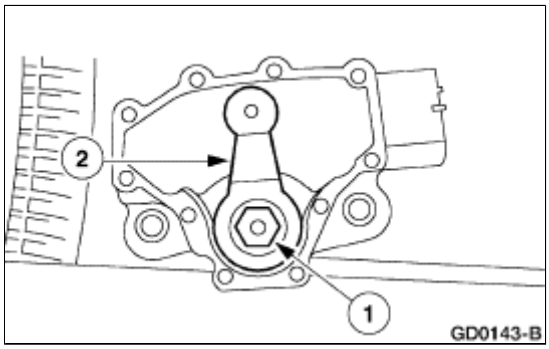
4. **CAUTION: Do not pry on the swivel tube to disconnect the transmission shift linkage.**

   Disconnect the manual lever shift control cable.

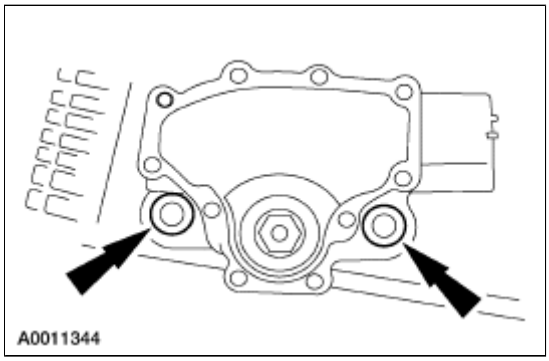


5. **CAUTION: Discard outer manual control lever shaft nut. Do not reuse. The old nut will not retain torque specification.**

   Remove the manual control lever.
   1. Remove the nut.
   2. Remove the lever.

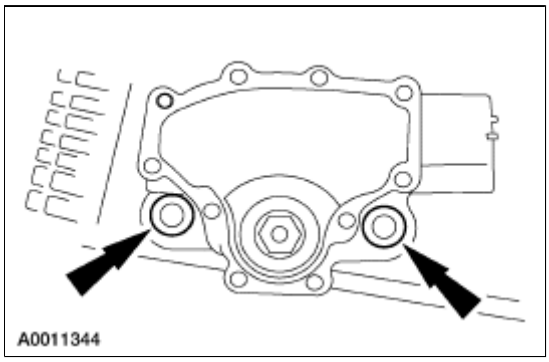


6. Remove the digital TR sensor bolts and the TR sensor.



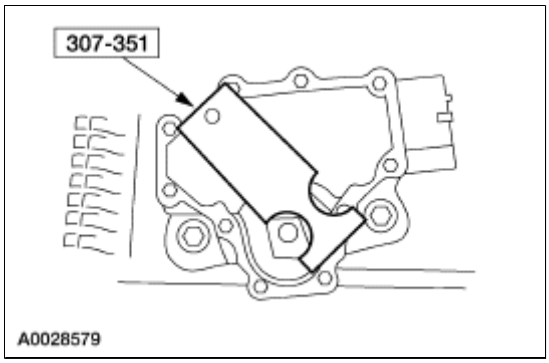
Installation

1. Install the digital TR sensor and loosely install the bolts.

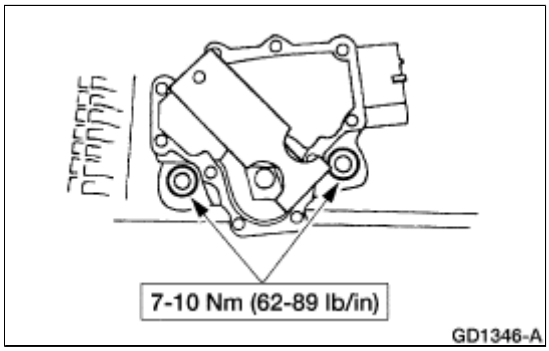


2. **NOTE:** Manual shift lever must be in the neutral position.

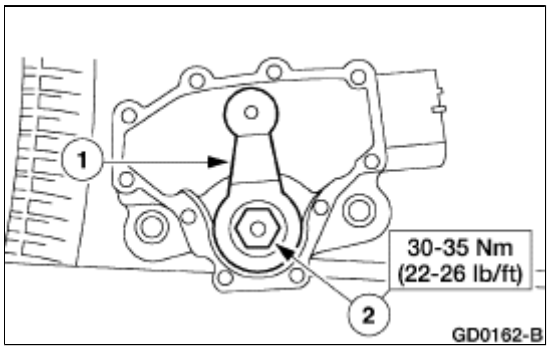
   Using the special tool, align the digital TR sensor slots. The tool is designed to fit snug.



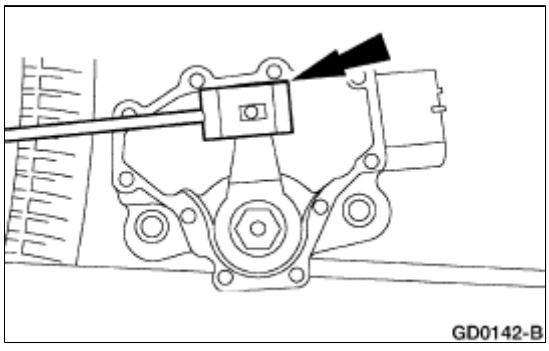
3. Tighten the bolts.



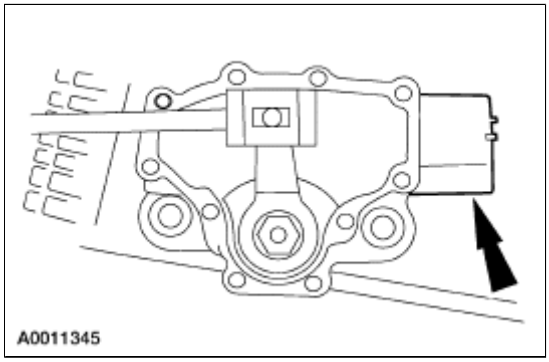
4. Install the manual control lever.
    1. Position the manual control lever.
    2. Install a new manual lever shaft outer nut.



5. With the manual lever in overdrive connect the shift lever control cable.



6. Install the digital TR sensor electrical connector.



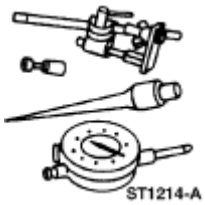
7. Lower the vehicle.

8. **NOTE:** When the battery is disconnect and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

Reverse Servo Assembly

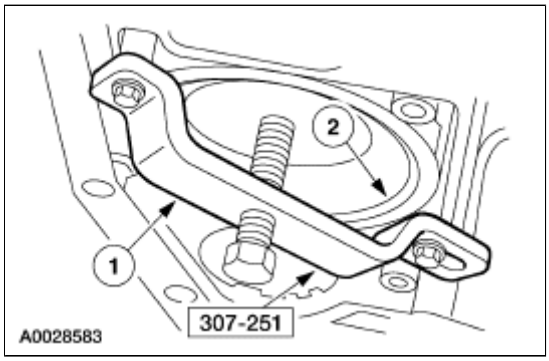
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)

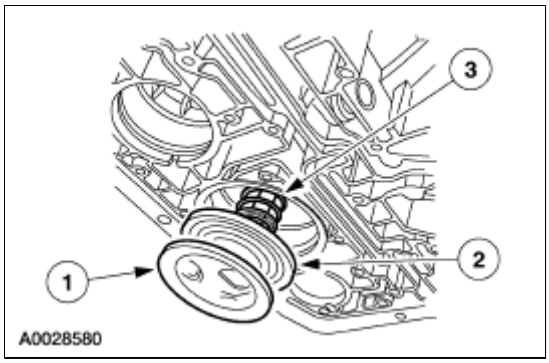
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Using the special tool, remove the reverse band servo retaining ring.
    1. Compress the servo spring.
    2. Remove the reverse band servo retaining ring.



3. Remove the reverse servo assembly.
    1. Remove the reverse band servo cover.
    2. Remove the reverse band servo piston and rod.
    3. Remove the reverse band servo spring.

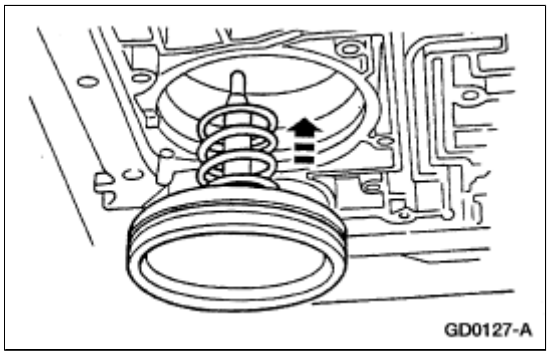


Installation

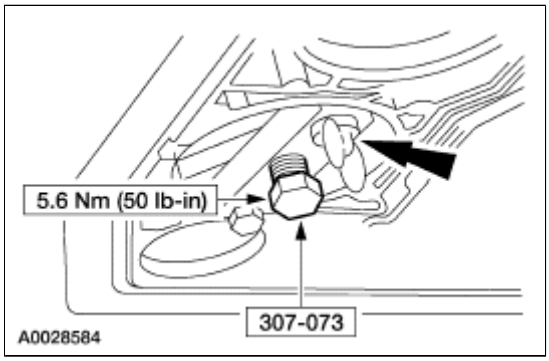
NOTE: This is not an ordinary installation procedure and does not compensate for band wear.

1. **NOTE:** Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

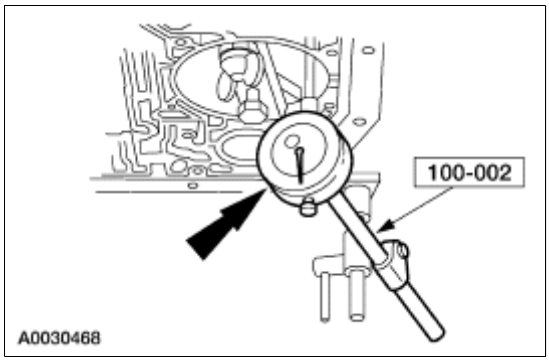
   Install the reverse servo return spring and piston.
   - Do not install the piston cover.



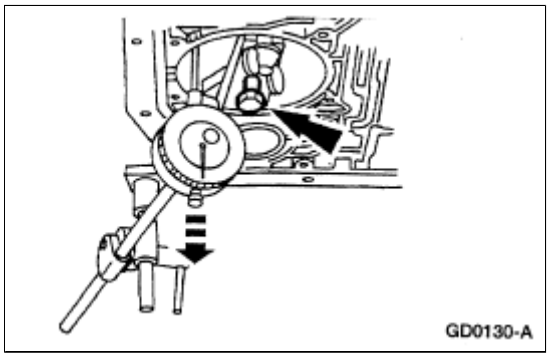
2. Install the special tool and tighten the band apply bolt.



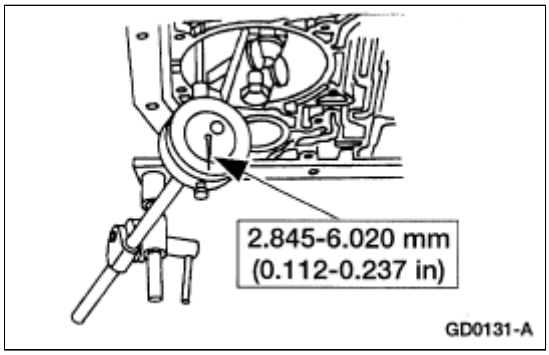
3. Attach the special tool to the transmission.
   - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



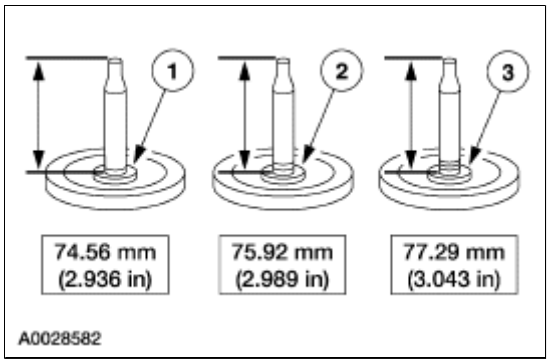
4. Loosen the bolt until the piston stops against the tool.



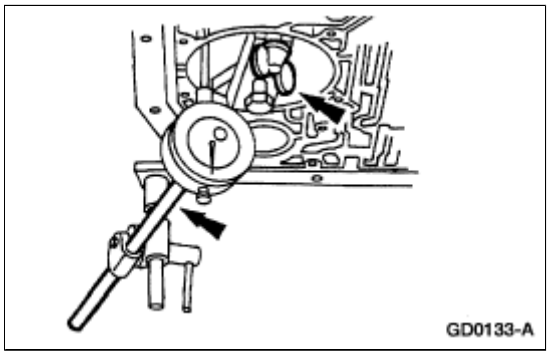
5. Verify that the amount of piston travel on the dial indicator is within specification.



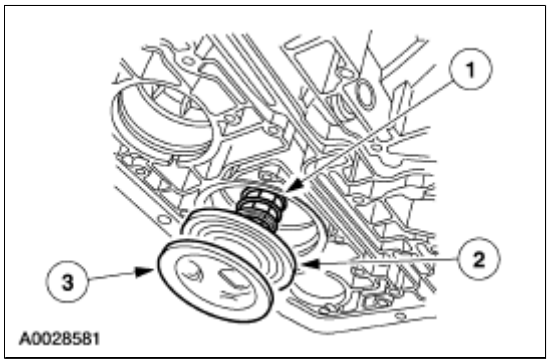
6. If piston travel is not within specification, select and install the correct servo piston assembly to bring the servo piston travel within specification.
    1. One groove
    2. Two groove
    3. Three groove



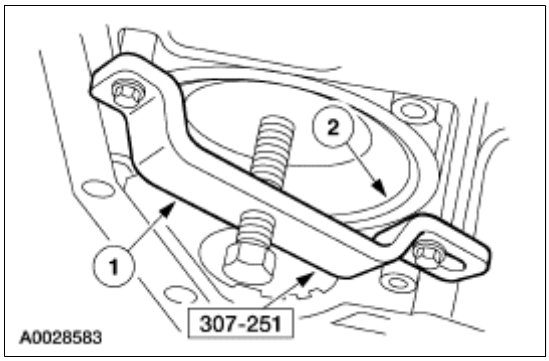
7. Remove the dial indicator and servo selection tool.



8. Install the correct reverse servo assembly.
    1. Install the reverse band servo spring.
    2. Install the reverse band servo piston and rod.
    3. Install the reverse band servo cover.



9. Using the special tool, install the reverse servo retaining ring.
    1. Compress the servo spring.
    2. Install the reverse band servo retaining ring.



10. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Overdrive Servo

Special Tool(s)

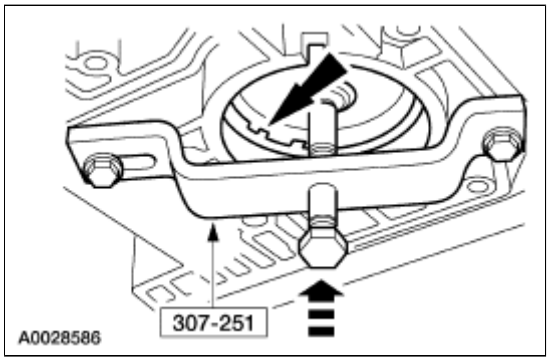
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)

Removal

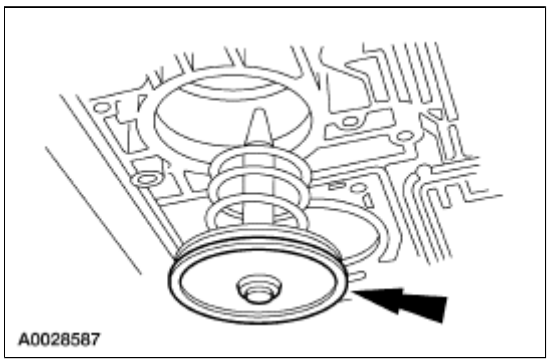
1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. **NOTE:** If the tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on overdrive servo internal retaining ring.

   Using the special tool, compress the servo spring to remove the overdrive servo retaining ring.

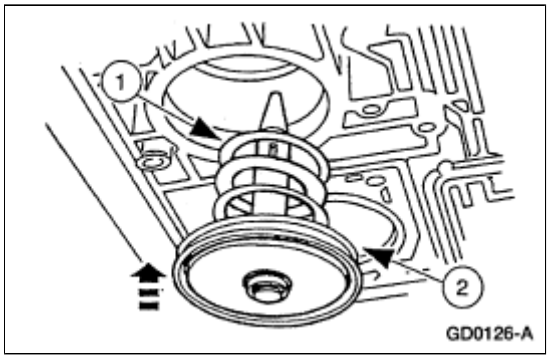


3. Remove the overdrive servo piston and return spring.

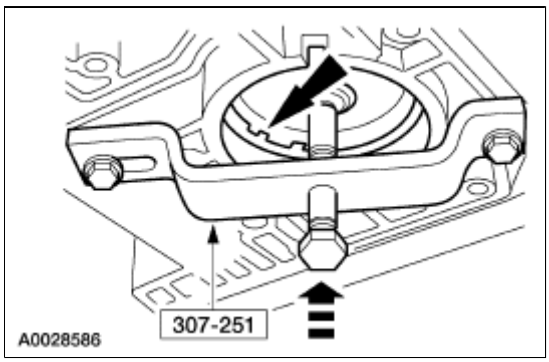


Installation

1. Install the overdrive servo piston assembly.
    1. Install the overdrive servo piston return spring.
    2. Install the overdrive servo piston assembly.



2. Use the special tool to install the overdrive servo piston retaining ring.

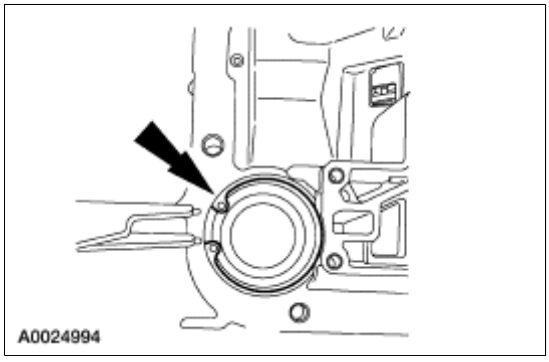


3. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

1-2 Accumulator

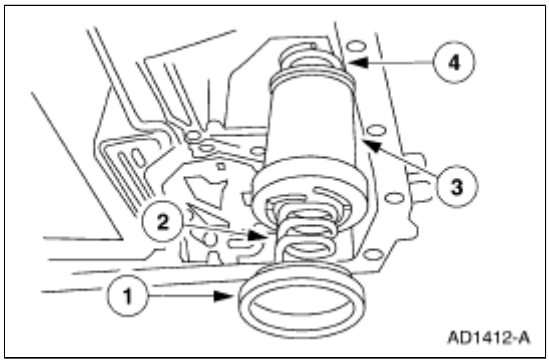
Removal

1. Compress the 1-2 accumulator cover and remove the accumulator piston retaining ring.



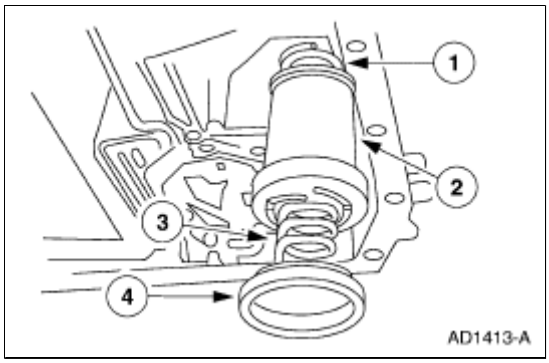
2. **NOTE:** Note the location of the 1-2 accumulator springs for reference during assembly.

   Remove the 1-2 accumulator.
   1. Remove the 1-2 accumulator cover.
   2. Remove the lower 1-2 accumulator spring.
   3. Remove the accumulator piston.
   4. Remove the upper 1-2 accumulator spring.

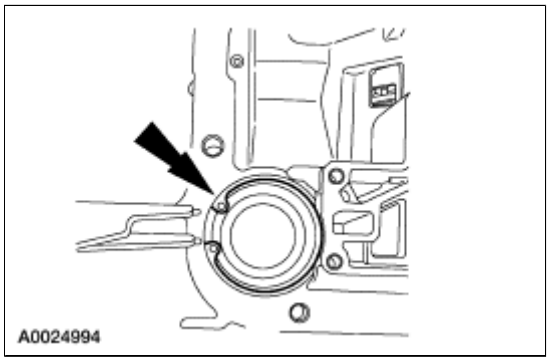


Installation

1. Install the 1-2 accumulator.
   1. Install the 1-2 accumulator upper spring.
   2. Install the accumulator piston.
   3. Install the 1-2 accumulator lower spring.
   4. Install the cover and seal assembly.



2. Compress the accumulator and install the accumulator piston retaining ring.

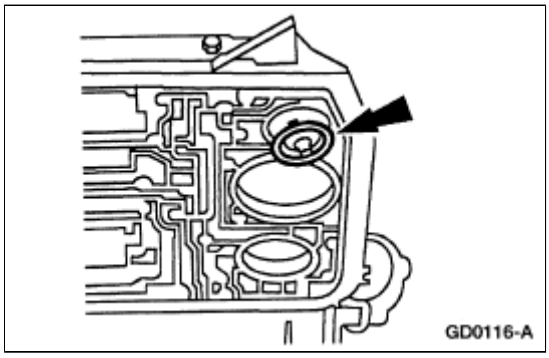


2-3 Accumulator

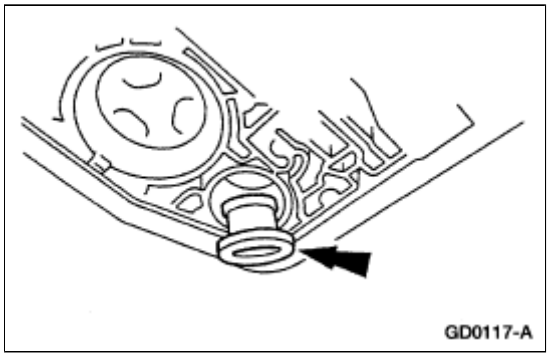
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Remove the 2-3 accumulator piston retainer.

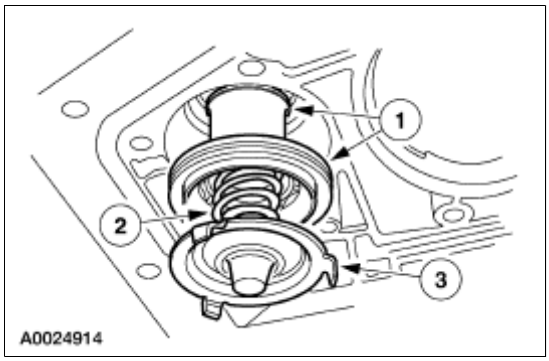


3. Remove the accumulator piston and spring.



Installation

1. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.

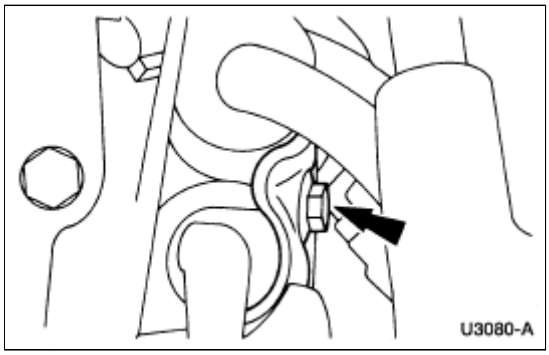


2. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

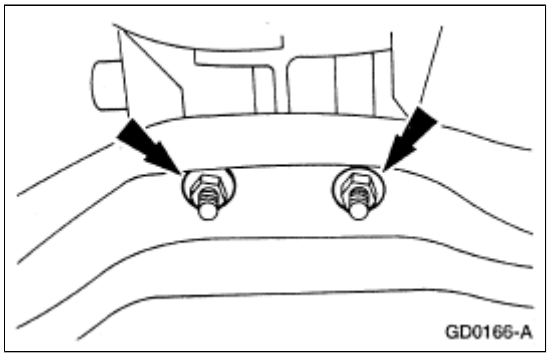
Transmission Insulator and Retainer

Removal

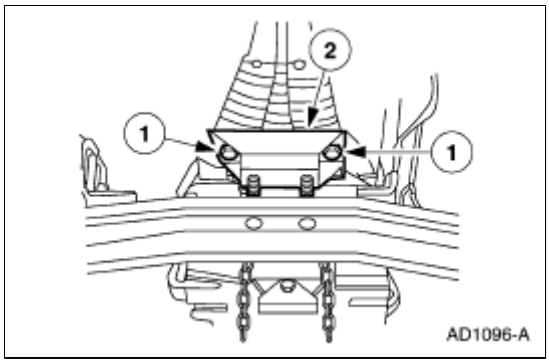
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
3. Remove the support insulator bracket bolt.



4. Use High-Lift Transmission Jack to support the transmission and remove the nuts.

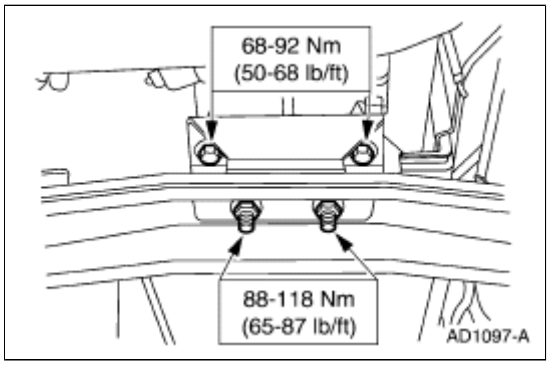


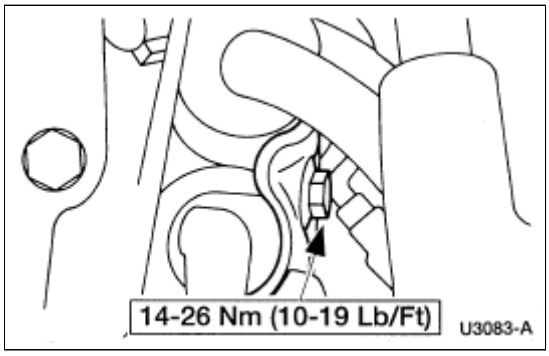
5. Raise the transmission enough for studs to clear the crossmember.
    1. Remove the bolts.
    2. Remove the transmission insulator.



Installation

1. To install, reverse the removal procedure.

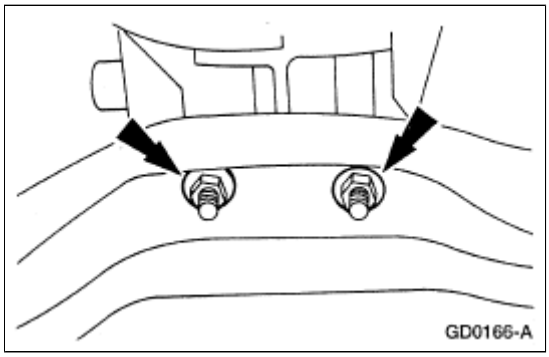




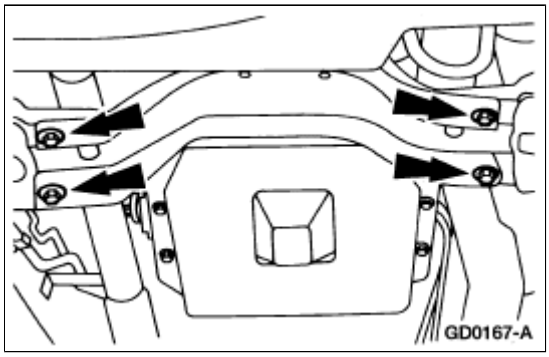
Transmission Support Crossmember

Removal

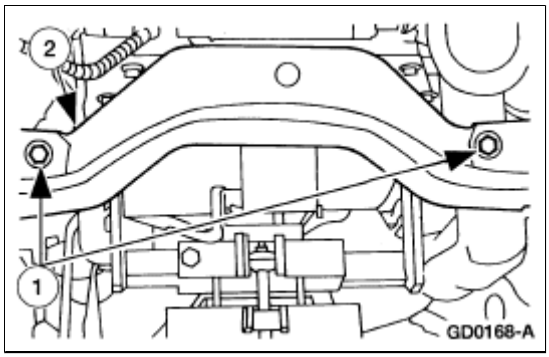
1. Raise and support the vehicle; refer to Section 100-02 .
2. Use High Lift Transmission Jack to support the transmission.
3. Remove the nuts from the transmission support insulator.



4. Remove the bolts.

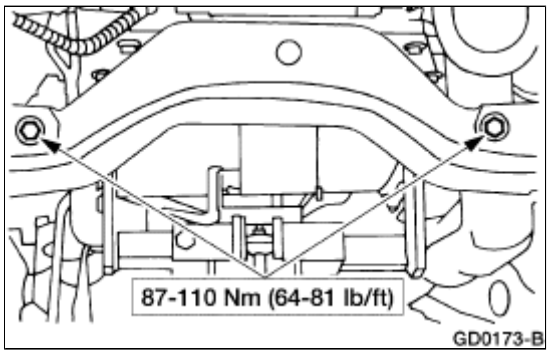


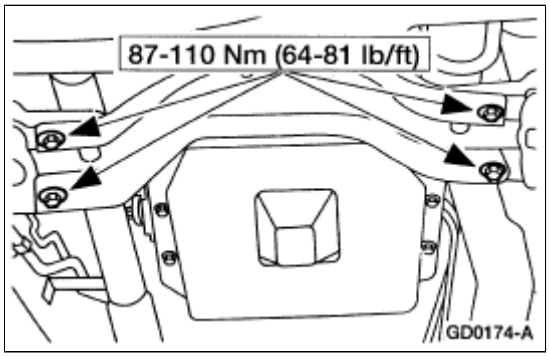
5. Remove the transmission crossmember.
    1. Remove the bolts and nuts.
    2. Remove the crossmember.

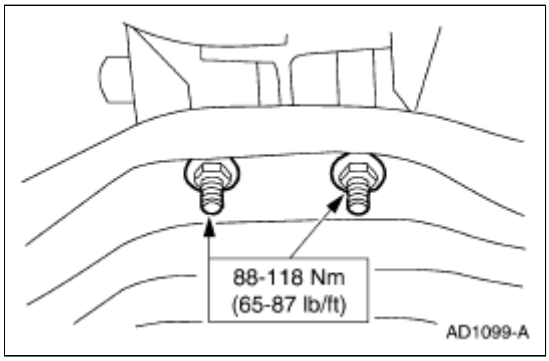


Installation

1. Follow the removal procedure in reverse order.







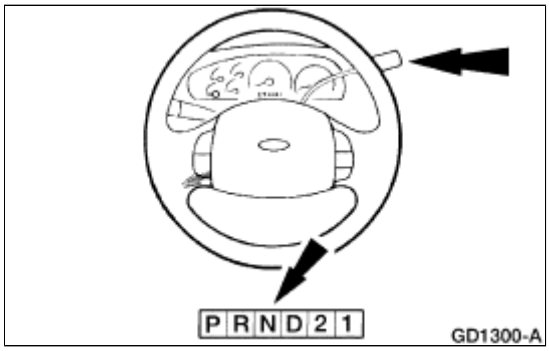
Transmission

Special Tool(s)

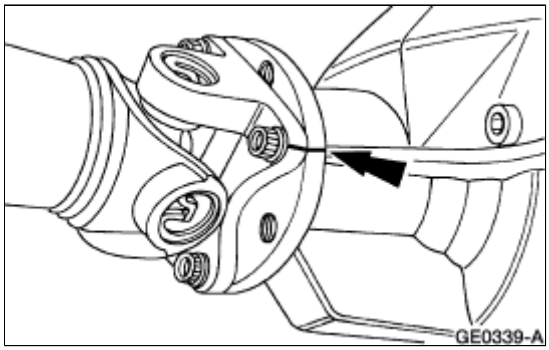
ST1636-A	Torque Converter Holding Tool 307-346 (T97T-7902-A)

Removal

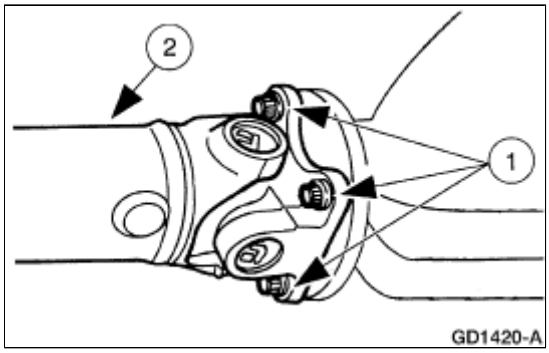
1. Place the selector lever in the NEUTRAL position.



2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. If transmission disassembly is required, drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
5. On 4WD vehicles remove the transfer case. For additional information, refer to Section 308-07B .
6. Mark the driveshaft flange and rear axle companion flange for correct alignment during installation.

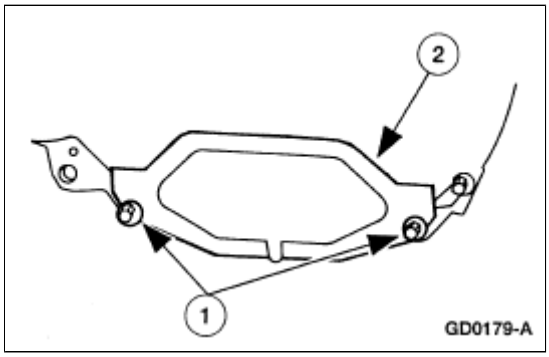


7. Remove the rear driveshaft.
    1. Remove the four bolts.
    2. Remove the driveshaft.

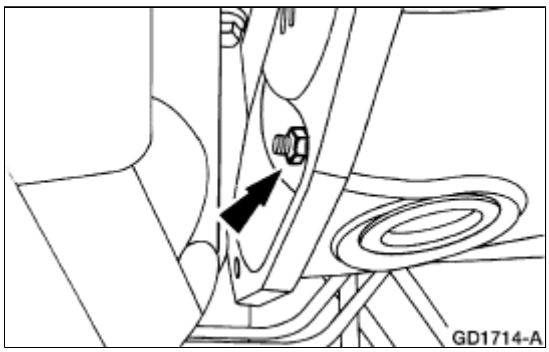


8. Remove the starter motor. For additional information, refer to Section 303-06 .

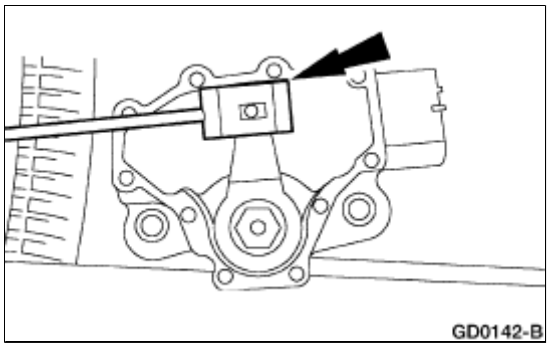
9. Remove the transmission inspection cover.
    1. Remove the two bolts.
    2. Remove the transmission inspection cover.



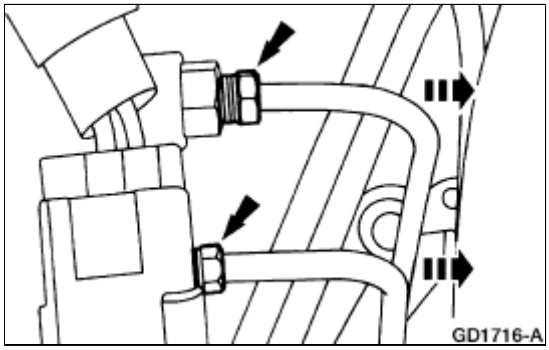
10. Remove the nuts from the torque converter.
    - Rotate the crankshaft/flexplate assembly to access all the nuts.



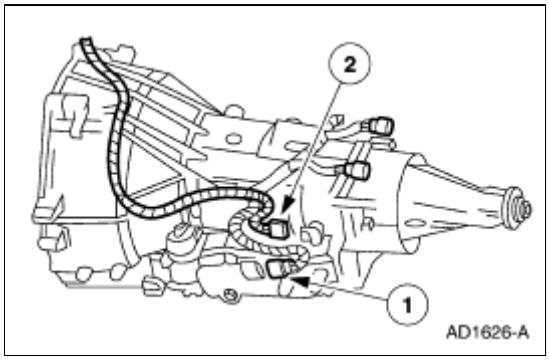
11. Disconnect the transmission shift linkage.



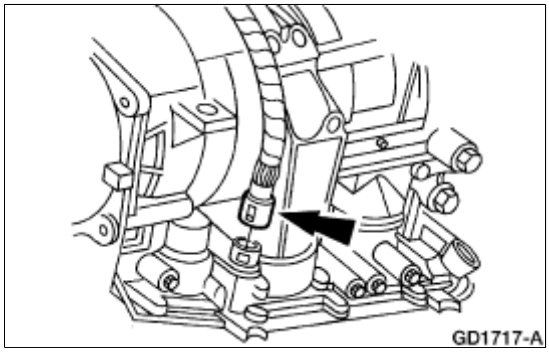
12. Disconnect the transmission cooler lines.



13. Disconnect the transmission electrical connectors.
    1. Disconnect the digital transmission range (TR) sensor.
    2. Disconnect the output shaft speed (OSS) sensor.

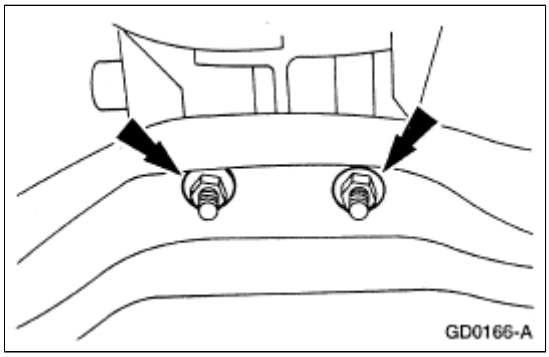


14. Disconnect the solenoid body assembly electrical connector.

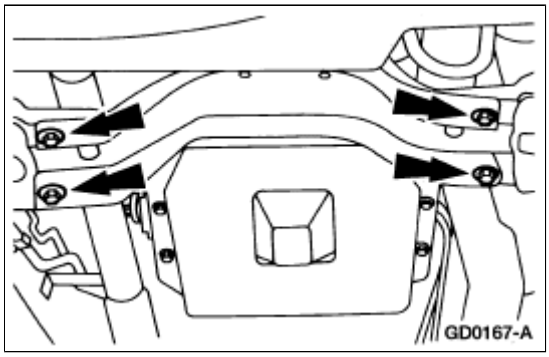


15. Position the High-Lift Transmission Jack under the transmission.

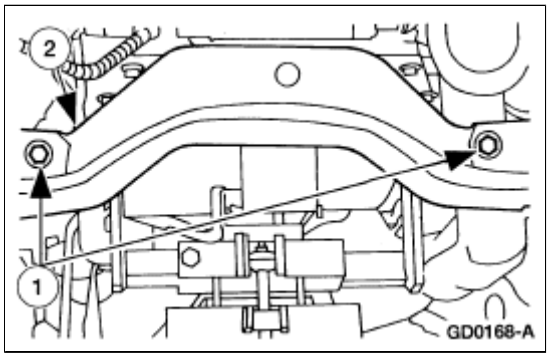
16. Remove the nuts.



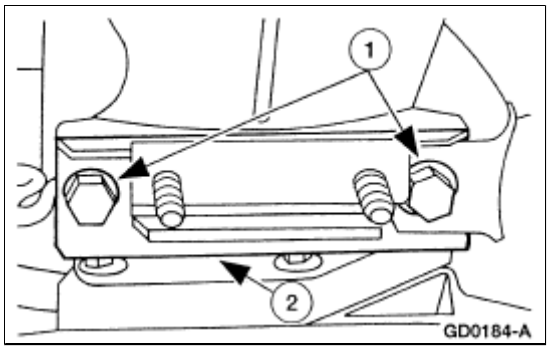
17. Remove the bolts.



18. Remove the transmission crossmember.
    1. Remove the bolts.
    2. Remove the transmission crossmember.

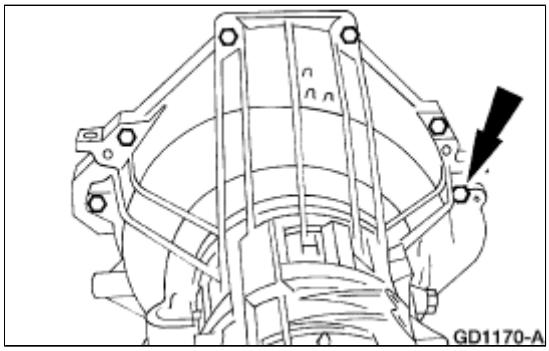


19. Remove the transmission mount.
    1. Remove the bolts.
    2. Remove the transmission mount.

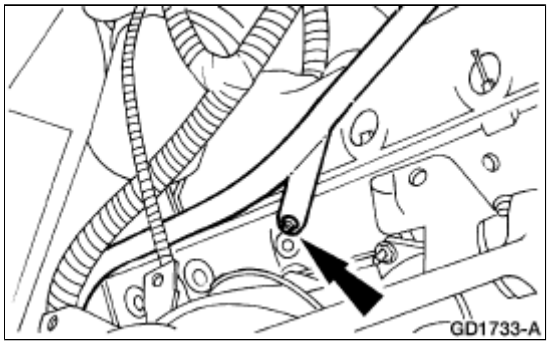


20. Remove the exhaust. For additional information, refer to Section 309-00 .

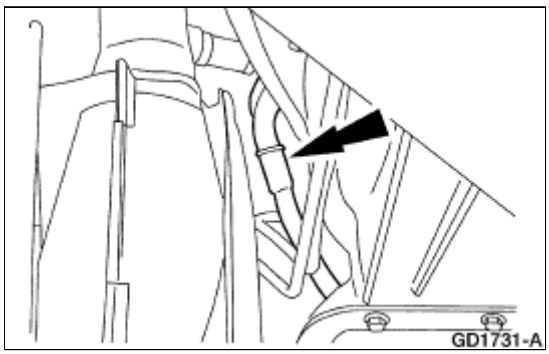
21. Remove the bolts.



22. Remove the transmission fill tube bolt from the back of the (RH) cylinder head.

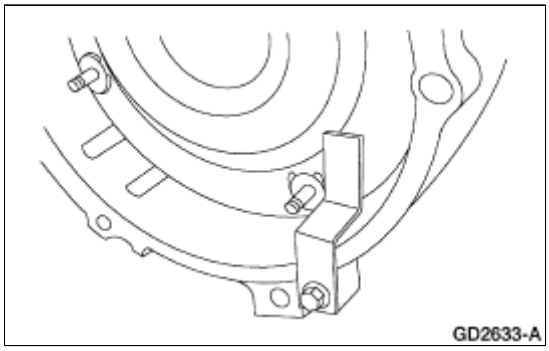


23. Remove the transmission fluid fill tube.



24. **WARNING: The torque converter is heavy and may result in injury if it falls out of the transmission. Secure the torque converter in the transmission.**

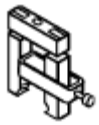
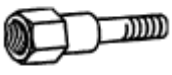
    Install the Torque Converter Holding Tool.

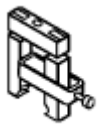


25. Lower the transmission from the vehicle. Carry out the transmission fluid cooler backflushing and cleaning procedure. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

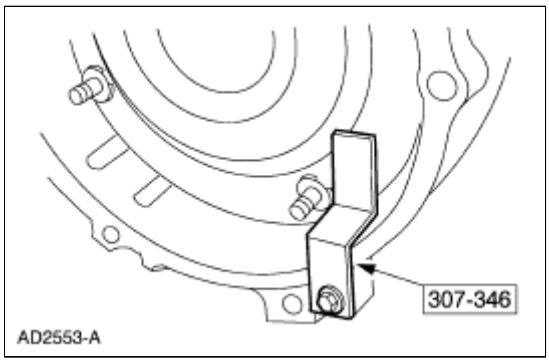
Transmission

Special Tool(s)

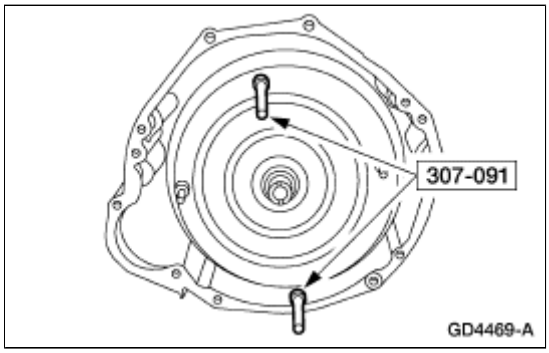
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)
ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1208-A	Remover, Transmission Fluid Pump 307-221 (T89T-70010-A)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)

 ST1192-A	Remover, Torque Converter Fluid Seal 307-309 (T94P-77001-BH)
ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)

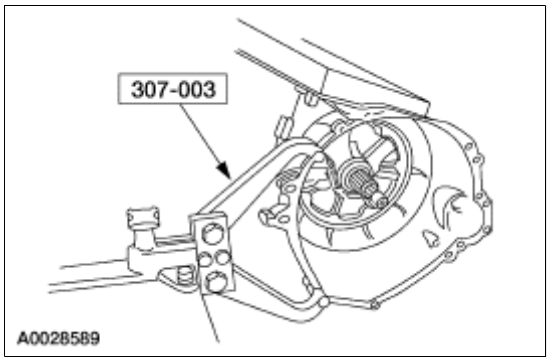
1. Remove the special tool.



2. Using the special tools, remove torque converter.

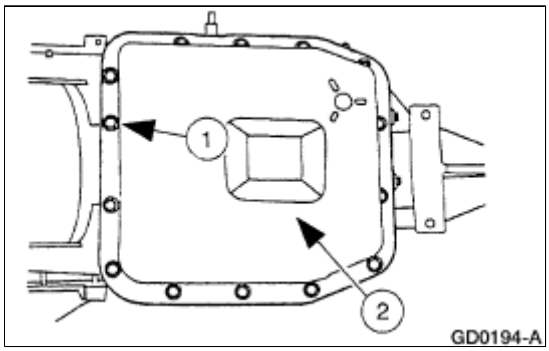


3. Using the special tool, mount the transmission to the bench.

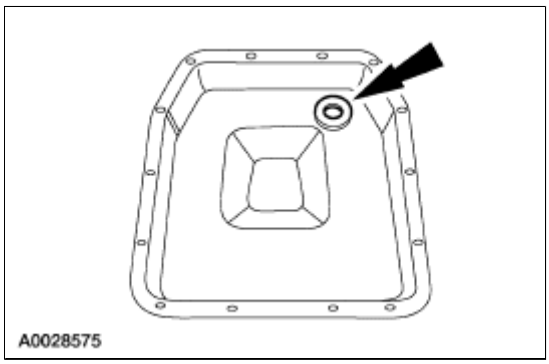


4. **NOTE:** If the transmission fluid pan gasket is not damaged, it may be reused.

   Remove the transmission fluid pan and transmission fluid pan gasket.
   1. Remove the bolts.
   2. Remove the transmission fluid pan and transmission fluid pan to case gasket.



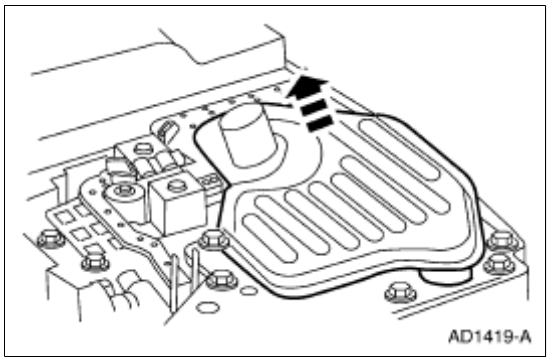
5. Clean the transmission fluid pan and pan magnet.



6. **CAUTION: If installing a new filter, and grommet remains in the main control bore, carefully use a small screwdriver to remove the grommet. Use care not to damage the main control bore.**

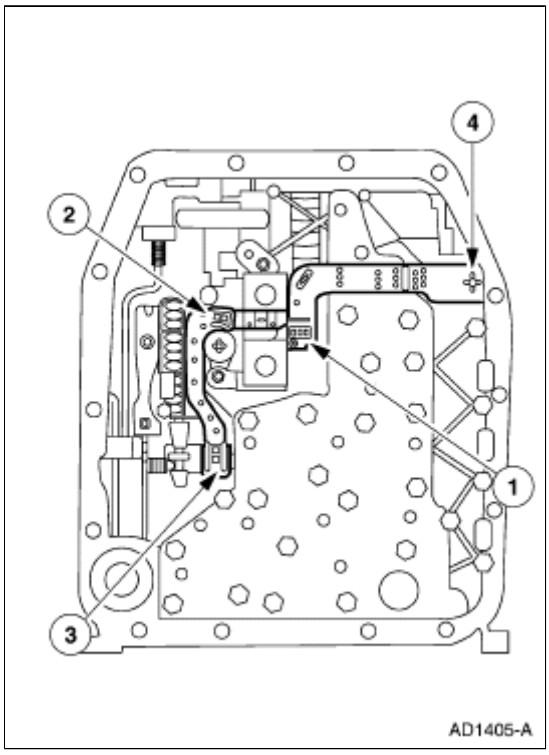
   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Remove the fluid filter and grommet.

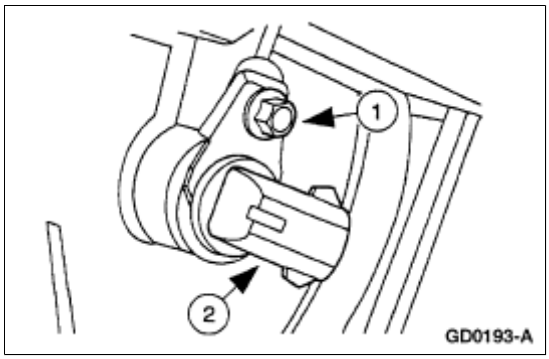


7. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

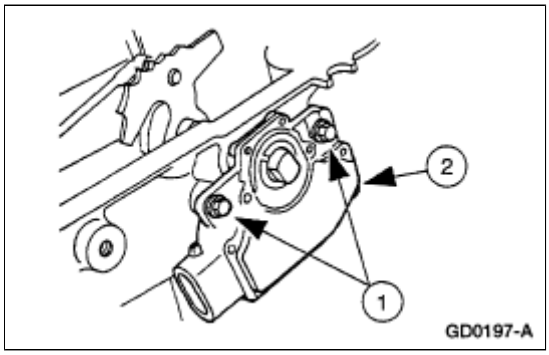
   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.



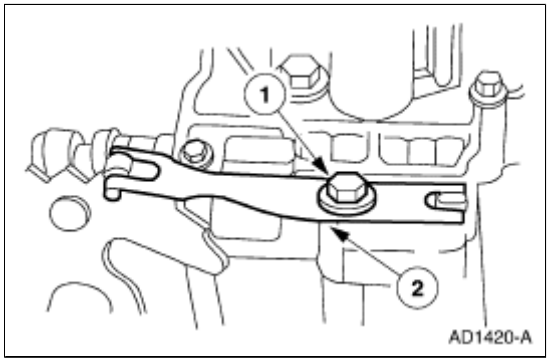
8. Remove the output shaft speed (OSS) sensor.
   1. Remove the bolt.
   2. Remove the OSS sensor.



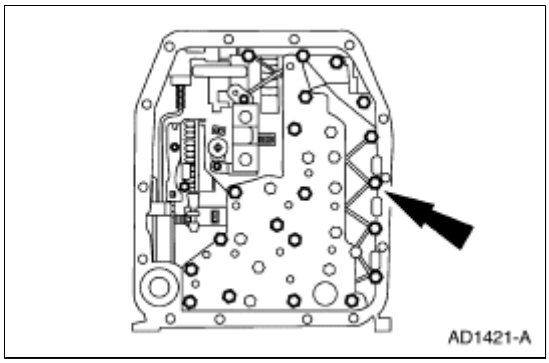
9. Remove the digital transmission range (TR) sensor.
    1. Remove the bolts.
    2. Remove the digital TR sensor.



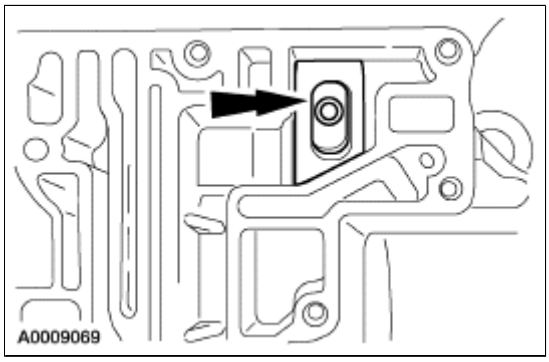
10. Remove the manual control valve detent lever spring.
    1. Remove the bolt.
    2. Remove the manual control valve detent lever spring.



11. Remove the 24 main control valve body bolts and the main control valve body.

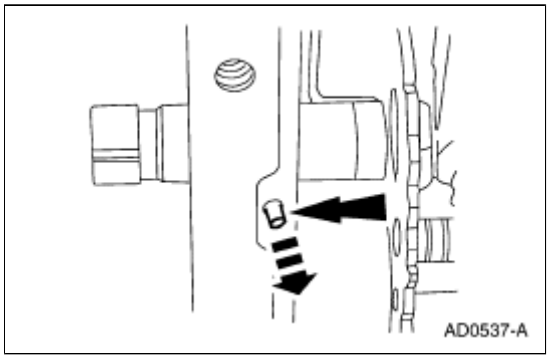


12. Remove and discard the pump outlet screen.

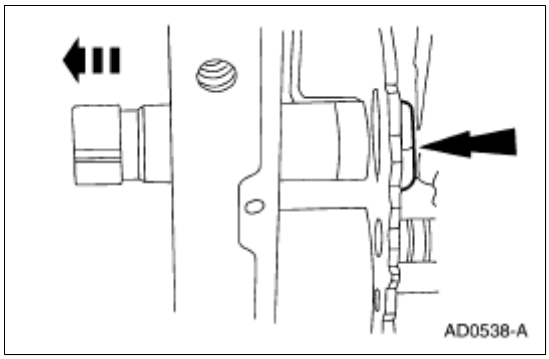


13. **NOTE:** Use a shop cloth to protect the transmission case surface.

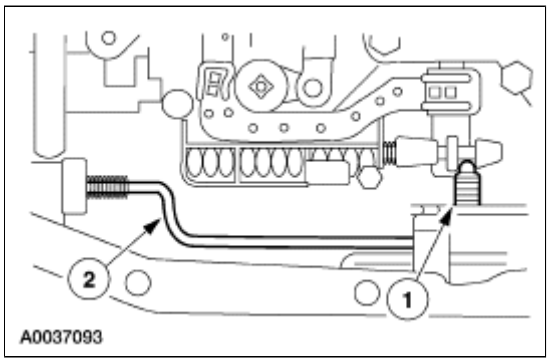
    Remove the manual lever shaft retaining pin.



14. Remove the manual lever shaft inner nut.
    - Slide the manual control lever shaft out of the case while removing the inner nut.

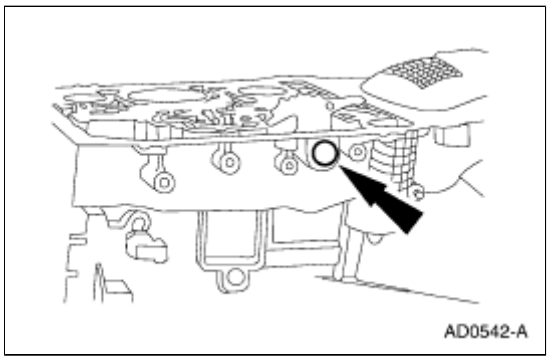


15. Remove the parking lever actuating rod.
    1. Remove the manual valve detent.
    2. Remove the parking lever actuating rod.

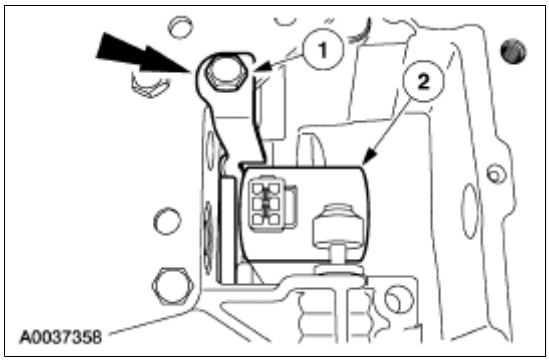


16. **CAUTION: Use care not to damage the manual control lever shaft bore. If the bore is damaged the new seal may leak.**

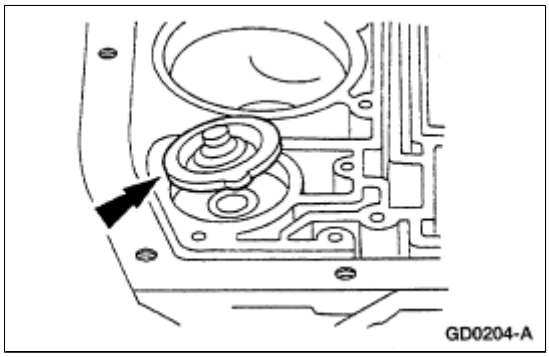
    Remove the manual control lever shaft seal.



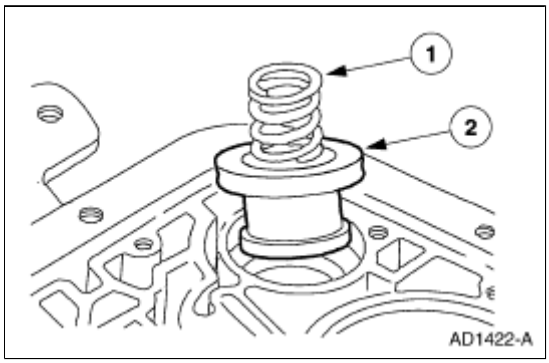
17. Remove the EPC solenoid.
    1. Remove the bolt and EPC solenoid bracket.
    2. Remove the EPC solenoid.



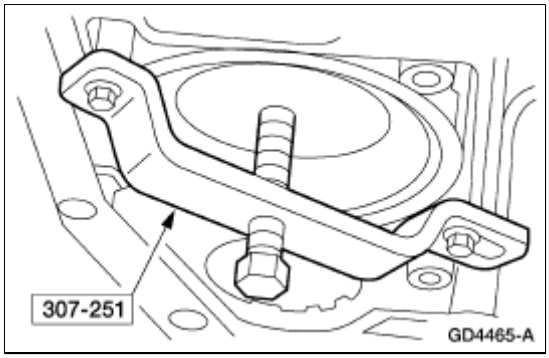
18. Remove the 2-3 accumulator spring retainer.



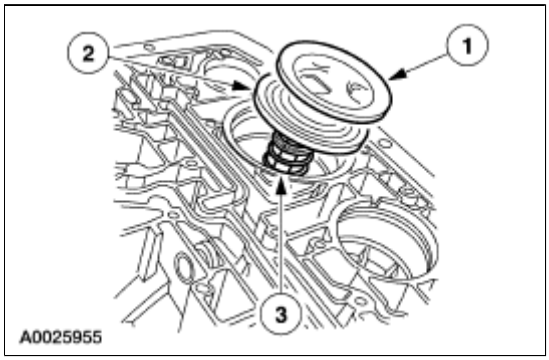
19. Remove the 2-3 accumulator piston.
    1. Remove the 2-3 accumulator spring.
    2. Remove the 2-3 accumulator piston.



20. Using the special tool, remove the reverse band servo retaining ring.

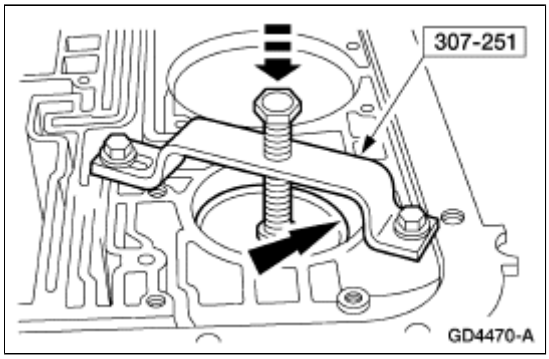


21. Remove the reverse servo assembly.
    1. Remove the reverse band servo cover.
    2. Remove the reverse band servo piston and rod.
    3. Remove the reverse band servo spring.

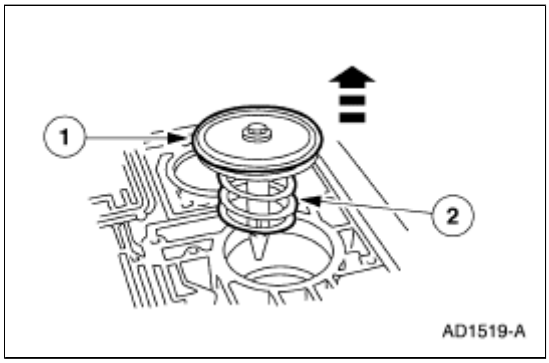


22. **NOTE:** If tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on internal retaining ring.

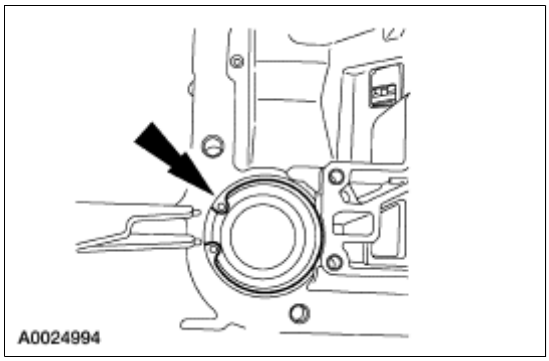
    Using the special tool, compress the piston spring, then remove the overdrive servo piston retainer.



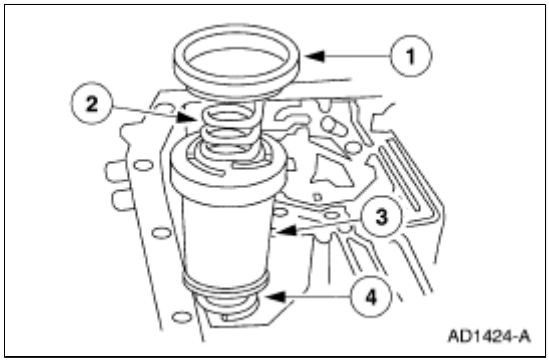
23. Remove the overdrive servo piston.
    1. Remove the overdrive servo piston.
    2. Remove the overdrive servo piston return spring.



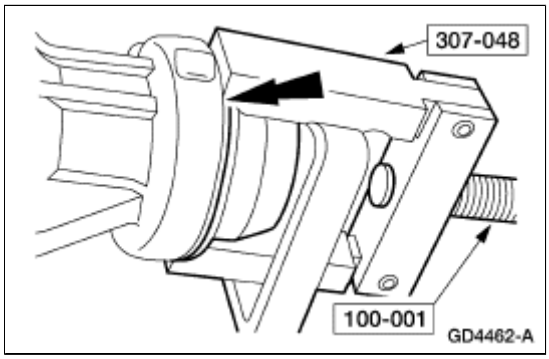
24. Compress the 1-2 accumulator cover and remove the retaining ring.



25. Remove the 1-2 accumulator upper spring.
    1. Remove the 1-2 accumulator spring cover.
    2. Remove the 1-2 accumulator lower spring.
    3. Remove the 1-2 accumulator.
    4. Remove the 1-2 accumulator upper spring.

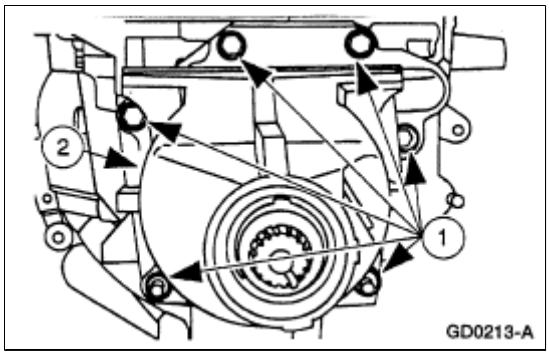


26. Using the special tools, remove the extension housing seal.

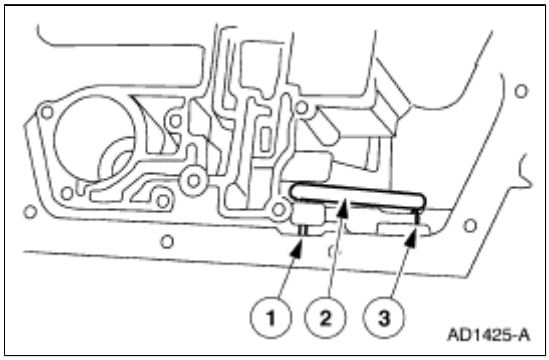


27. **NOTE:** These bolts have been coated with a sealant. High break torque may be required to remove these bolts.

    Remove the extension housing.
    1. Remove the four bolts and two nuts.
    2. Remove the extension housing and the extension housing gasket.



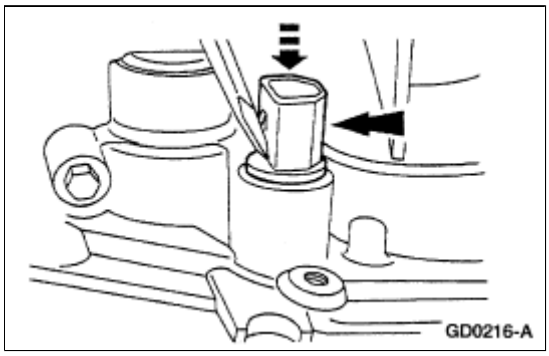
28. Remove the parking pawl.
    1. Remove the parking pawl shaft.
    2. Remove the parking pawl return spring.
    3. Remove the parking pawl.



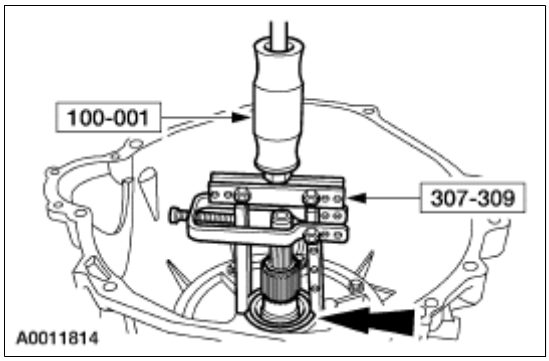
29. Rotate the transmission to the vertical position with the output shaft towards the floor.

30. **CAUTION: Extreme care must be taken during transmission connector removal. Do not use a hammer on the connector body.**

    Place a screwdriver on the flat portion of the connector and push the connector out through the bottom of the case.

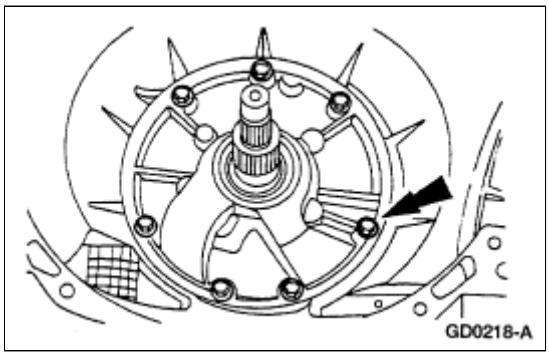


31. Using the special tools, remove the front pump seal.

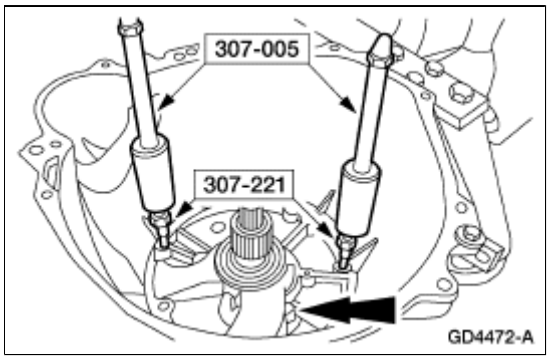


32. **NOTE:** These bolts have been coated with sealant. High break torque may be required to remove the bolts.

    Remove the bolts.

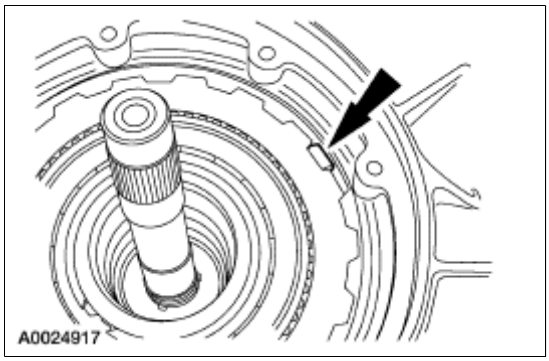


33. Using the special tools, remove the front pump support.



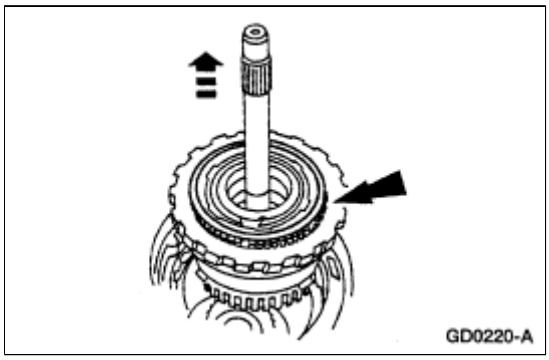
34. Remove and discard the pump gasket.

35. Remove the intermediate anti-rattle clip, if equipped.

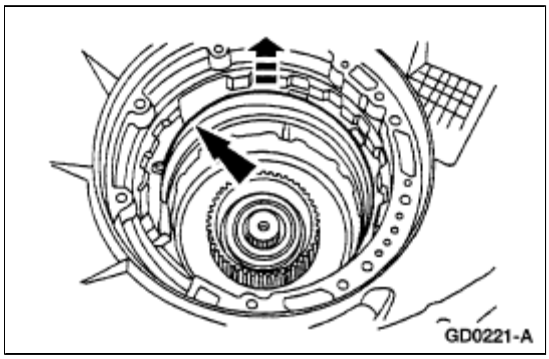


36. **CAUTION: Remove the assembly carefully to prevent damage to the overdrive band friction material by the reverse clutch drive lugs.**

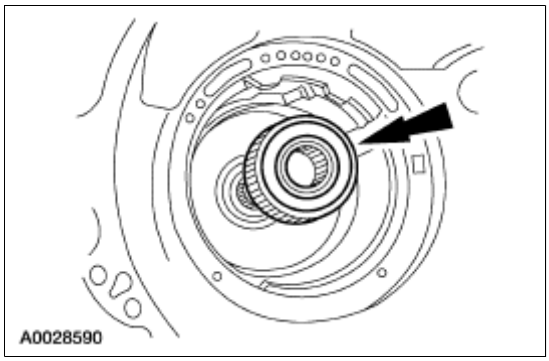
    Remove the following components as an assembly:
    - Intermediate clutch pack.
    - Intermediate one-way clutch.
    - Reverse clutch.
    - Forward clutch assembly.



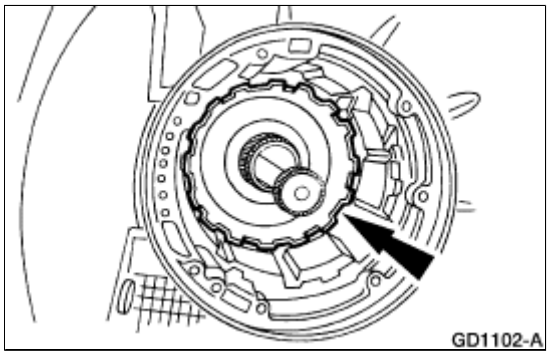
37. Disengage and remove the overdrive band.



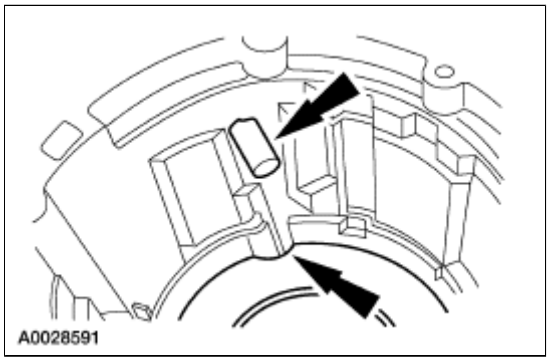
38. Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.



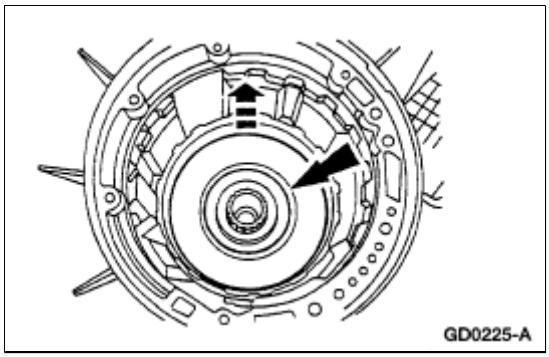
39. Remove the intermediate stub shaft.



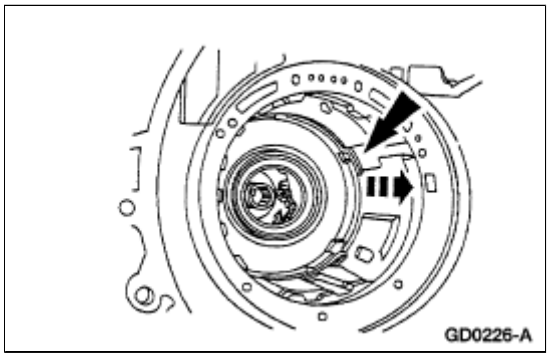
40. Align the reverse sun shell with the overdrive band anchor pin for removal.



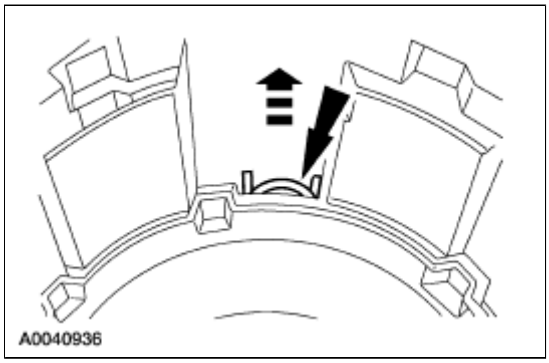
41. Remove the following components as an assembly:
    - Forward clutch sun gear.
    - No. 5 forward clutch sun gear bearing.
    - Reverse clutch sun gear.
    - No. 4 forward clutch hub bearing.



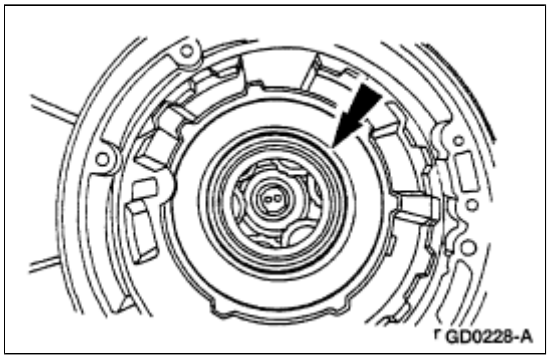
42. Remove the center support retaining ring and note location for assembly.



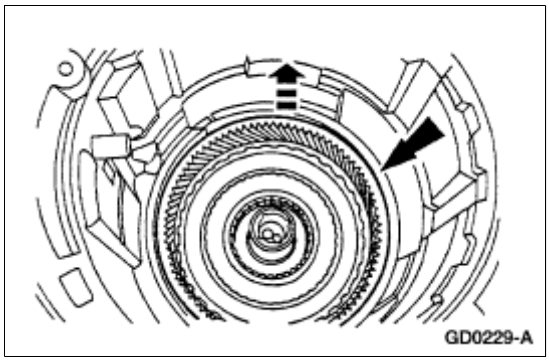
43. Remove the case to planet support spring.



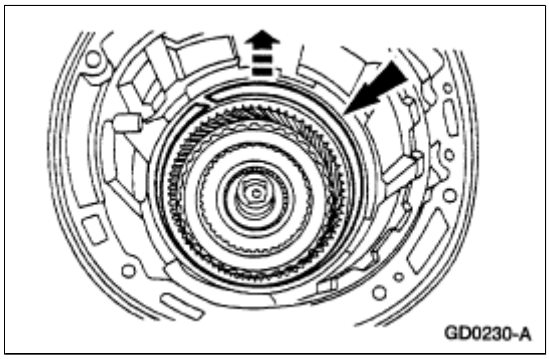
44. Remove the planetary gear support and planetary as an assembly.



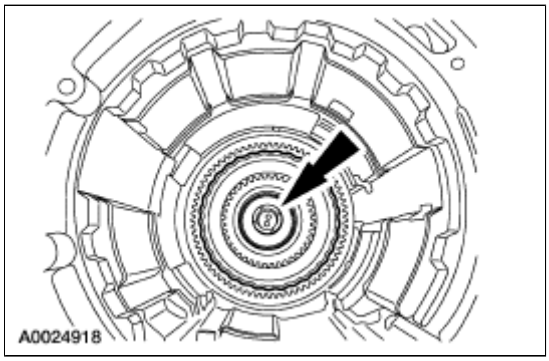
45. Remove the reverse clutch band.



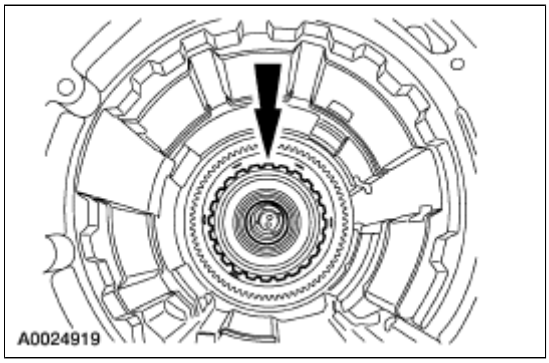
46. Remove the retaining ring.



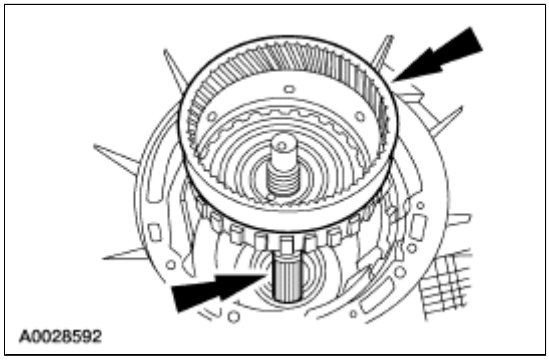
47. Remove the direct clutch pack.



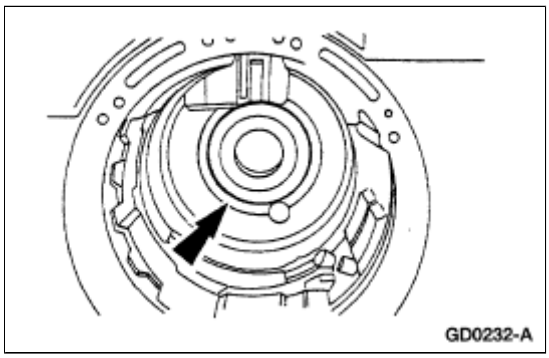
48. Remove the No. 8 bearing.



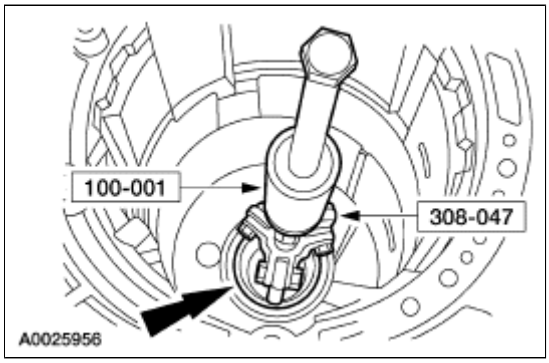
49. Remove the output shaft, output shaft ring gear assembly and direct clutch.



50. Remove the No. 9 case rear bearing.



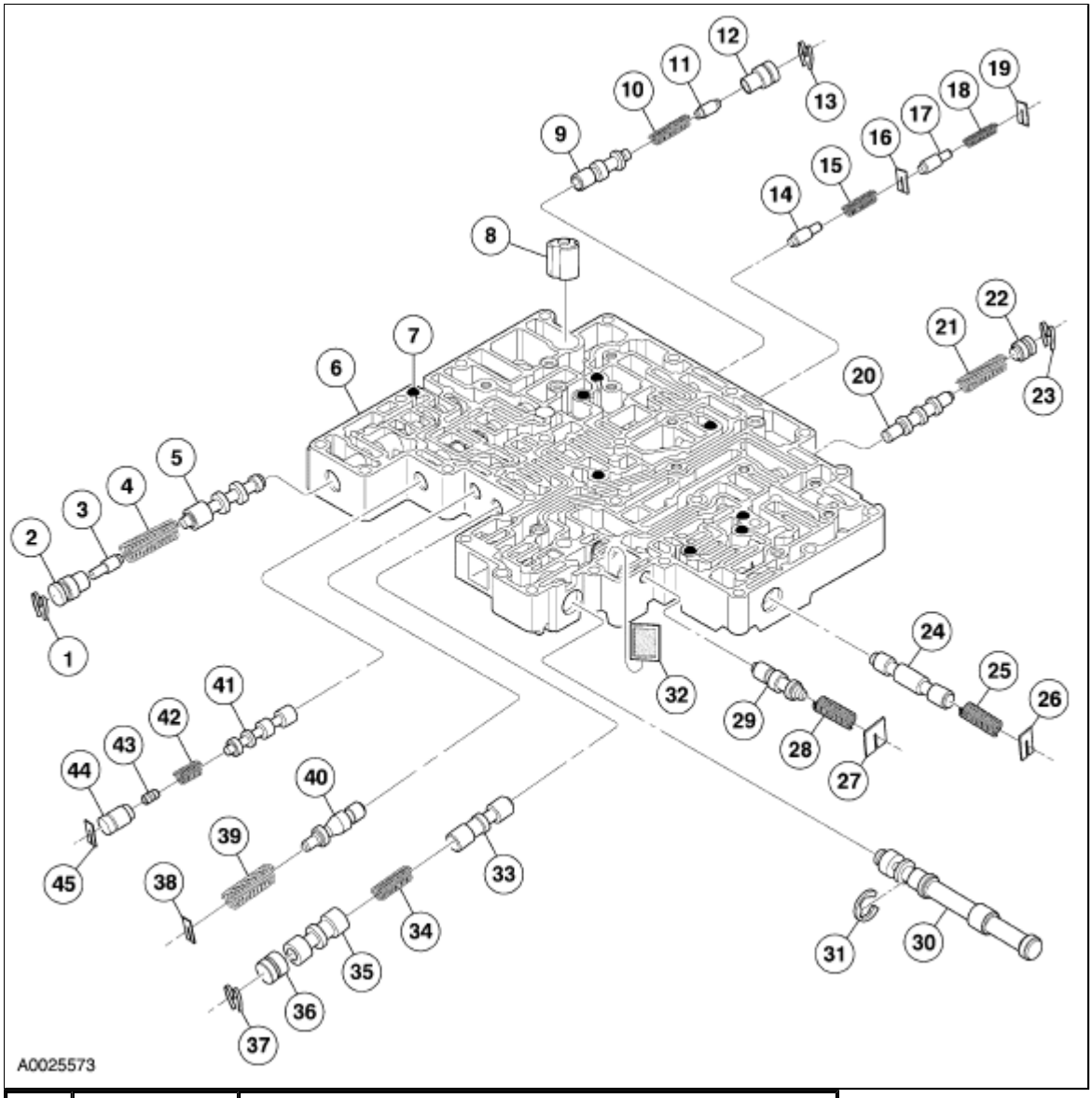
51. Inspect and if necessary, use the special tools to remove the rear case bushing.



Main Control Valve Body

Disassembly

Main Control Valve Body — Disassembled View

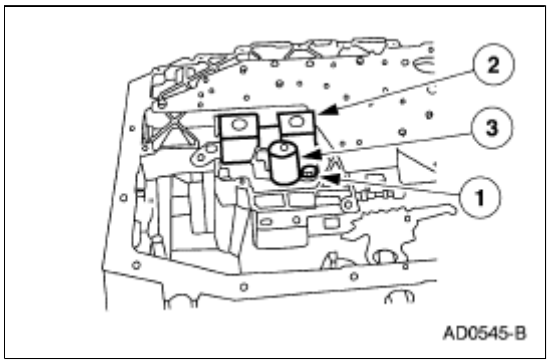


Item	Part Number	Description
1	—	Valve plug retainer (part of 7A100)
2	—	Main pressure booster valve sleeve (part of 7A100)
3	—	Main pressure booster valve (part of 7A100)
4	—	Main pressure regulator valve spring (part of 7A100)
5	—	Main regulator valve (part of 7A100)

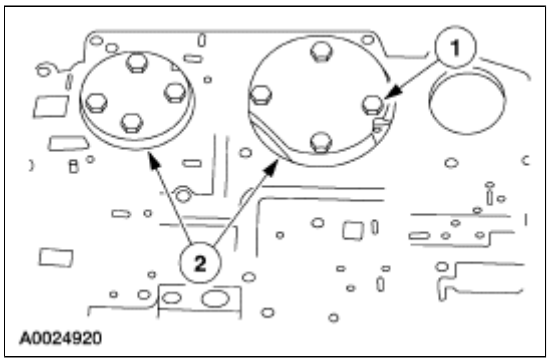
6	7A100	Main control valve body assembly
7	7E195	Check ball (8 req'd)
8	7H171	Converter drain back valve
9	—	Pressure regulator valve (part of 7A100)
10	—	Pressure regulator valve spring (part of 7A100)
11	—	Regulator boost plunger (part of 7A100)
12	—	Regulator boost sleeve (part of 7A100)
13	—	Valve retainer (part of 7A100)
14	—	Capacity modulator valve (part of 7A100)
15	—	Capacity modulator valve spring (part of 7A100)
16	—	Spring retaining plate (part of 7A100)
17	—	Capacity modulator valve (part of 7A100)
18	—	Capacity modulator valve spring (part of 7A100)
19	—	Spring retaining plate (part of 7A100)
20	—	3-4 shift valve (part of 7A100)
21	—	3-4 shift valve spring (part of 7A100)
22	—	Valve retainer plug (part of 7A100)
23	—	Valve plug retainer (part of 7A100)
24	—	2-3 backout valve (part of 7A100)
25	—	2-3 backout valve spring (part of 7A100)
26	—	Spring retaining plate (part of 7A100)
27	—	Spring retaining plate (part of 7A100)
28	—	Pressure regulator valve spring (part of 7A100)
29	—	Pressure regulator valve (part of 7A100)
30	—	Control manual valve (part of 7A100)
31	—	Retaining ring (part of 7A100)
32	—	Solenoid screen
33	—	1-2 shift valve (part of 7A100)
34	—	2-3 shift valve spring (part of 7A100)
35	—	2-3 valve (part of 7A100)
36	—	Valve retaining plug (part of 7A100)
37	—	Valve plug retainer (part of 7A100)
38	—	Spring retaining plate (part of 7A100)
39	—	Pressure regulator valve spring (part of 7A100)
40	—	Pressure regulator valve (part of 7A100)
41	—	Bypass clutch control valve (part of 7A100)
42	—	Bypass clutch control valve spring (part of 7A100)
43	—	Bypass clutch control valve plunger (part of 7A100)
44	—	Bypass clutch control plunger sleeve (part of 7A100)

45	—	Control valve plate (part of 7A100)

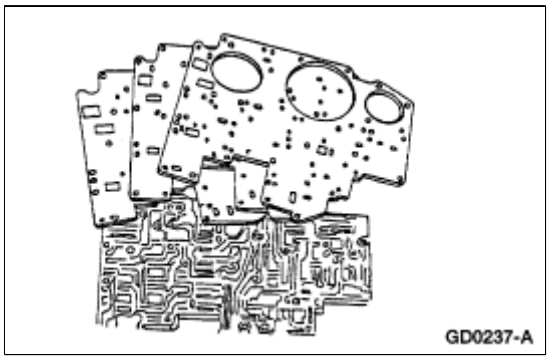
1. Remove the torque converter clutch (TCC) solenoid and the shift solenoid.
    1. Remove the bolt.
    2. Remove the shift solenoid.
    3. Remove the TCC solenoid.



2. Remove the two reinforcement plates.
    1. Remove the bolts.
    2. Remove the plates.

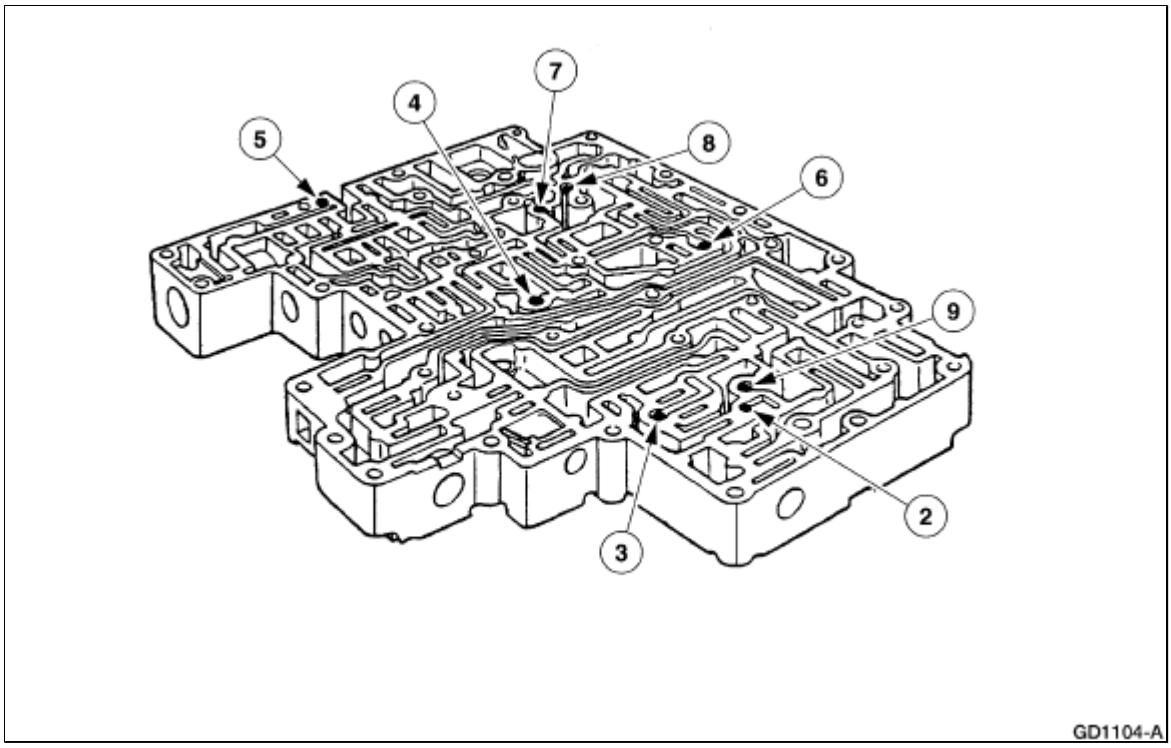


3. Remove the separator plate and discard the gaskets.

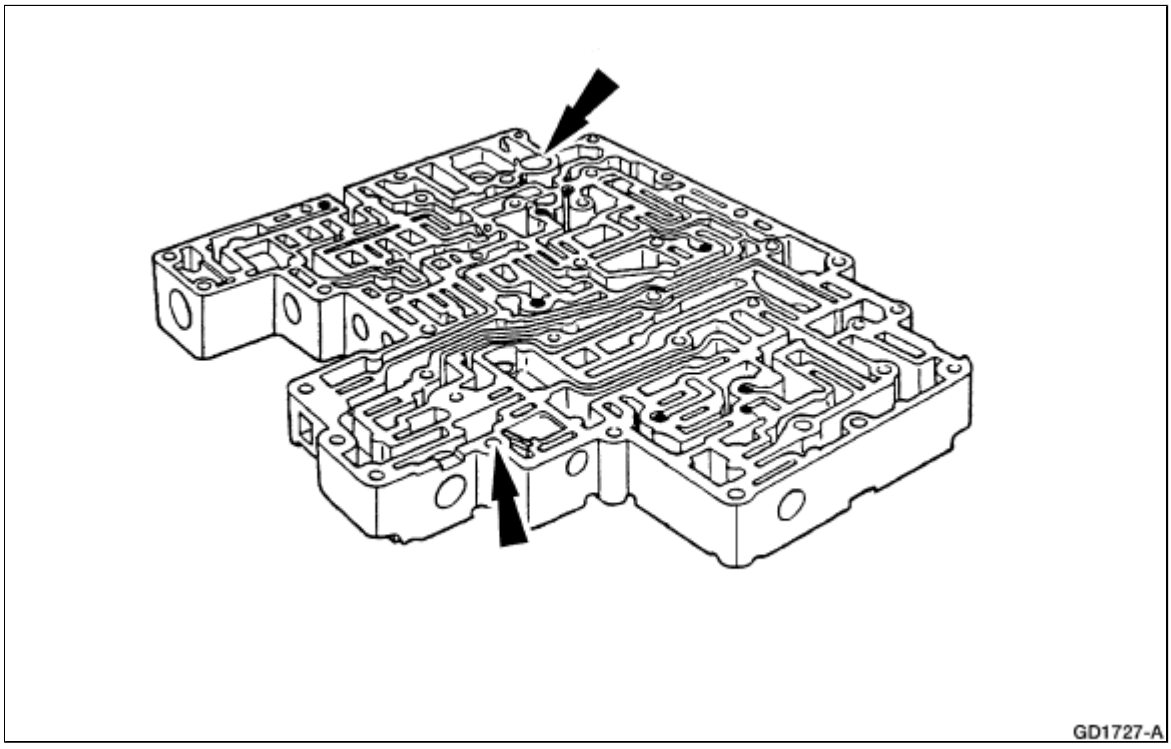


4. **NOTE:** Note the location of the eight coasting booster valve shuttle balls for assembly.

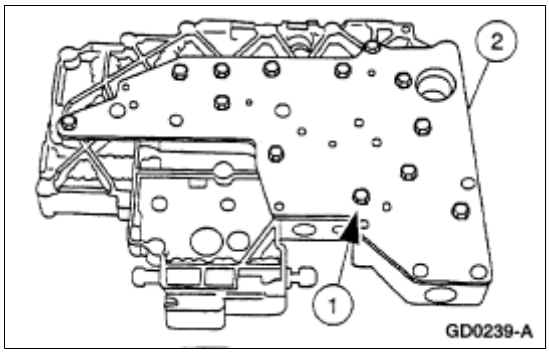
   Remove the eight coasting booster valve shuttle balls.



5. Remove the converter drain back valve and solenoid pressure supply screen.



6. Remove the main control valve body cover plate.
    1. Remove the 13 bolts.
    2. Remove the valve body cover plate and gasket.



Assembly

1. **CAUTION: Before beginning assembly, carry out and inspect the following:**

   When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

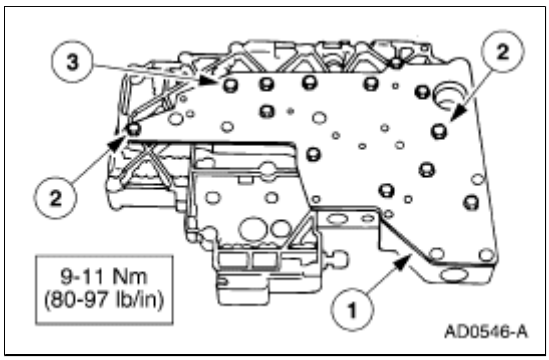
   All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

   When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

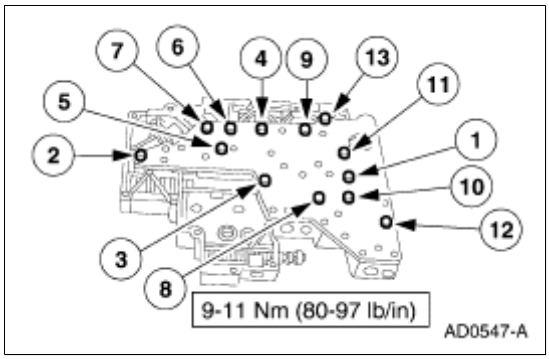
   Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

   Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

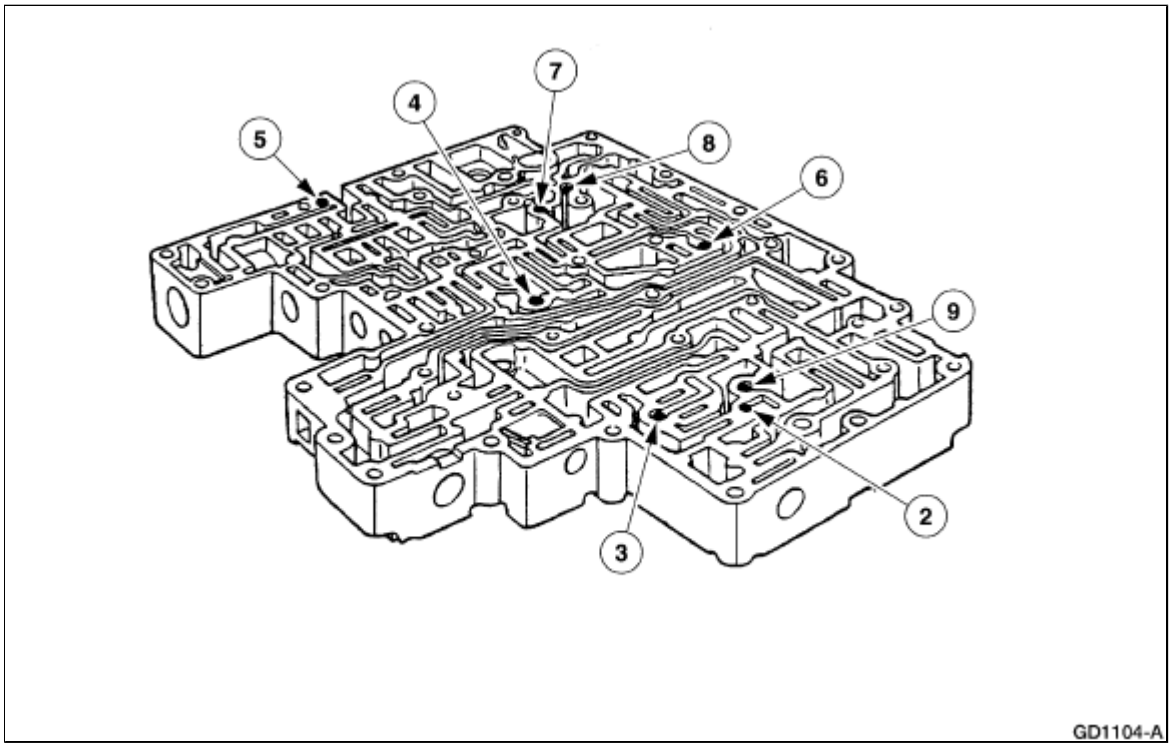
   Install the valve body cover plate.
   1. Position the valve body cover plate gasket and cover plate.
   2. Install the two guide pin bolts.
   3. Install the bolts.



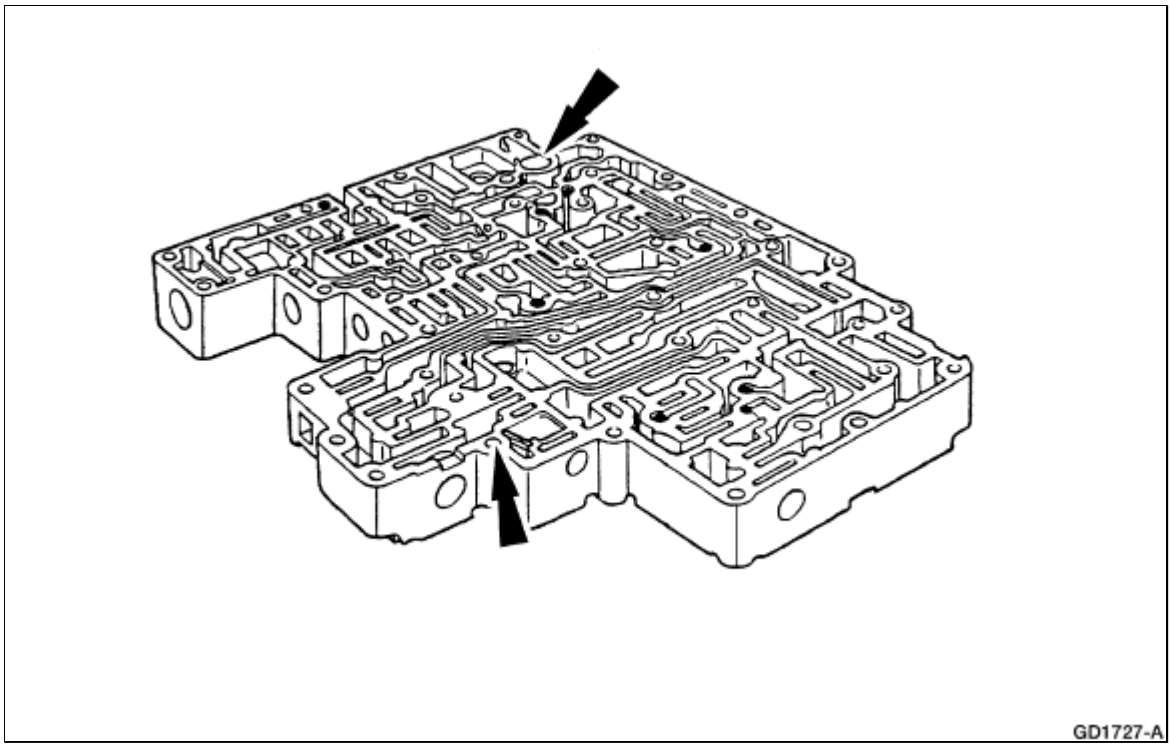
2. Tighten the bolts in the sequence shown.



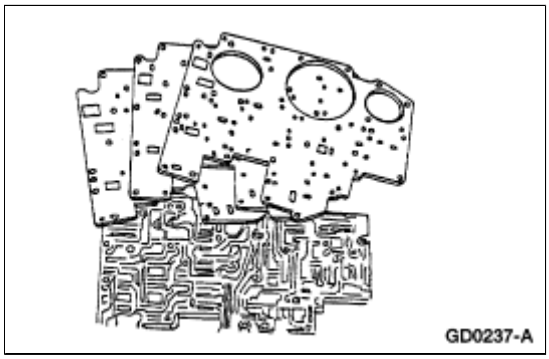
3. Install the eight coasting booster valve shuttle balls.



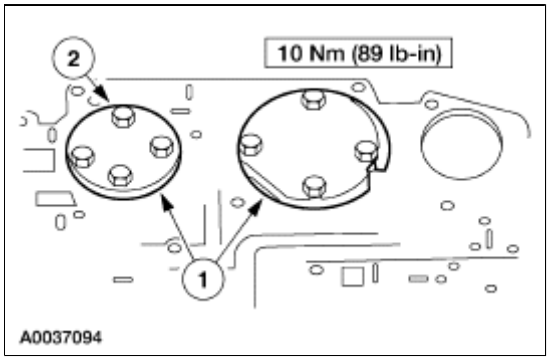
4. Install the converter drain back valve and solenoid pressure supply screen.



5. Install the separator plate and gaskets.



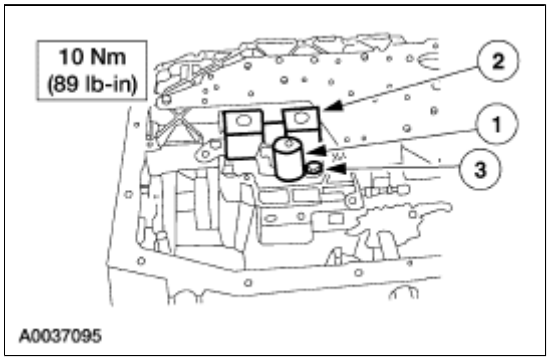
6. Install the two reinforcement plates.
    1. Position the plates.
    2. Install the bolts.



7. **NOTE:** Inspect the shift solenoid O-rings and TCC solenoid O-rings for damage.

Install the shift solenoid.

1. Position the TCC solenoid.
2. Position the shift solenoid.
3. Install the bolt.

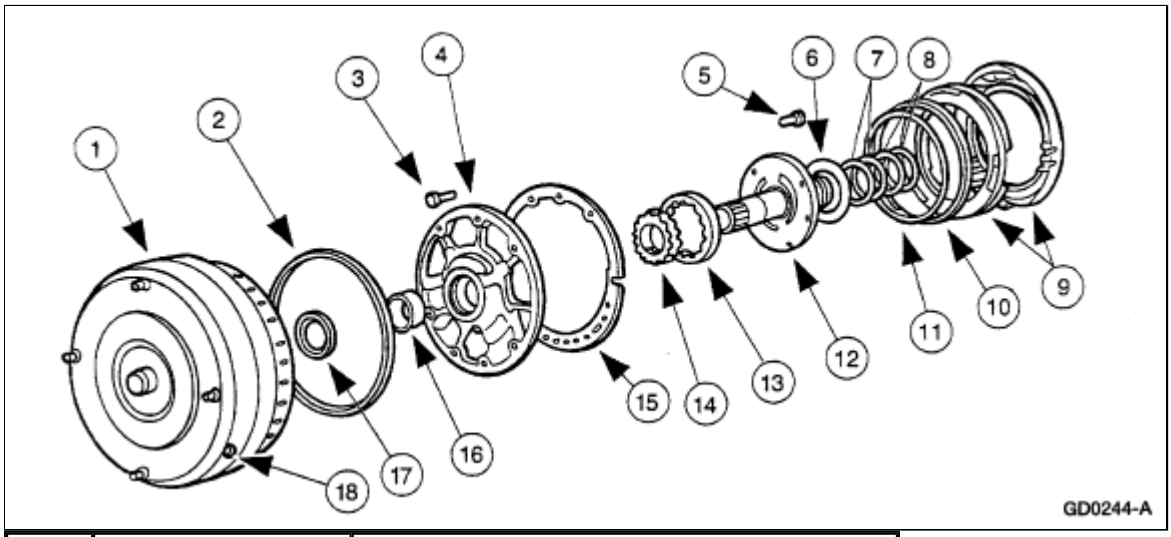


Pump and Intermediate Clutch Piston

Special Tool(s)

ST1189-A	Installer, Front Pump Fluid Seal 307-014 (T63L-77837-A)
ST1914-A	Protector, Piston Seal 307-339 (T95L-77005-A)

Pump and Intermediate Clutch Piston — Disassembled View

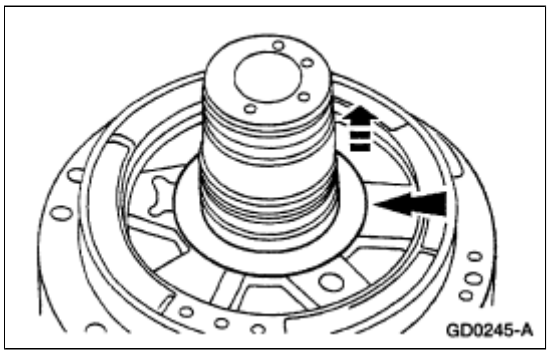


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump O-ring
3	N605789-S101	Bolt
4	—	Pump body assembly
5	N605787-S1000	Front pump support bolt
6	7D014	No. 1 pump support thrust washer
7	7D020	Reverse clutch cylinder seal
8	7D019	Forward clutch cylinder seal

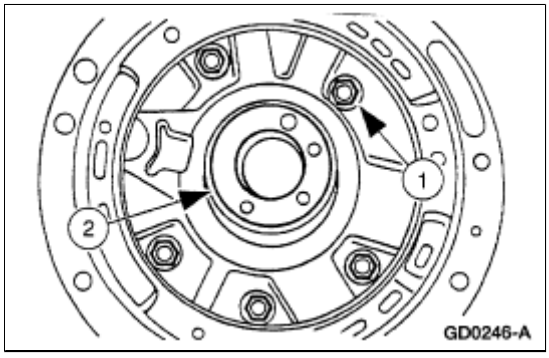
9	7E005	Intermediate clutch piston
10	7F224	Intermediate clutch piston outer seal
11	7F225	Intermediate clutch piston inner seal
12	7A108	Pump support
13	—	Pump outer gerotor gear
14	—	Pump inner gerotor gear
15	7A136	Pump gasket
16	—	Pump bushing
17	7A248	Pump inner seal
18	391855-S100	Converter drain plug

Disassembly

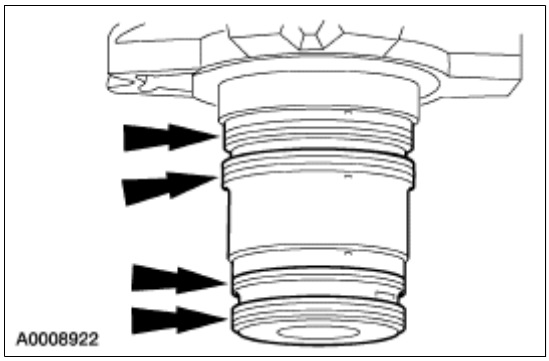
1. Remove the No. 1 selective pump support thrust washer.



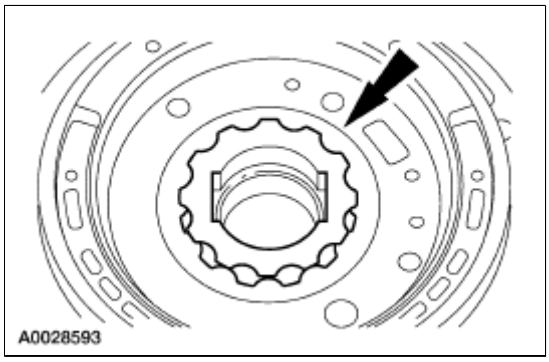
2. Remove the front pump support.
    1. Remove the bolts.
    2. Remove the front pump support.



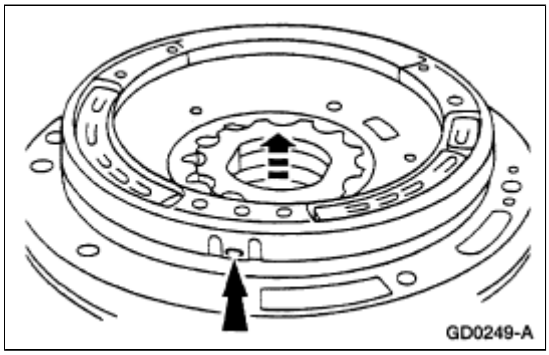
3. Remove the seal rings.



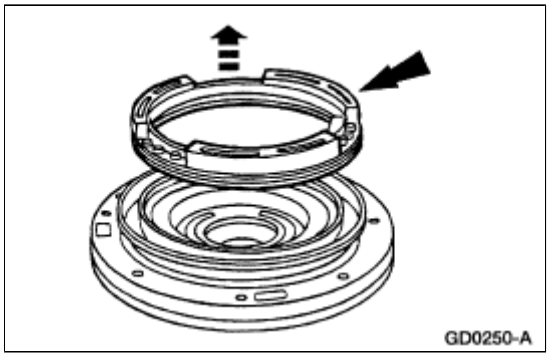
4. Remove the inner and outer pump gerotor gears.



5. Carefully pry spring retainer tabs and remove the spring retainer assembly.

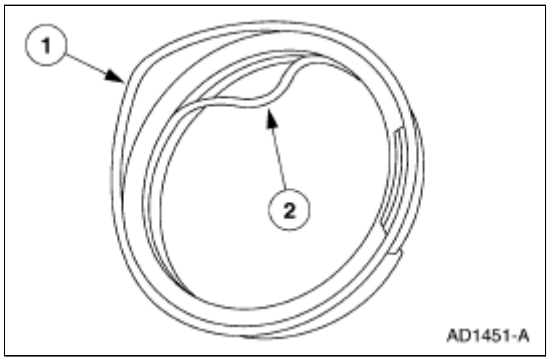


6. Remove the intermediate clutch piston.

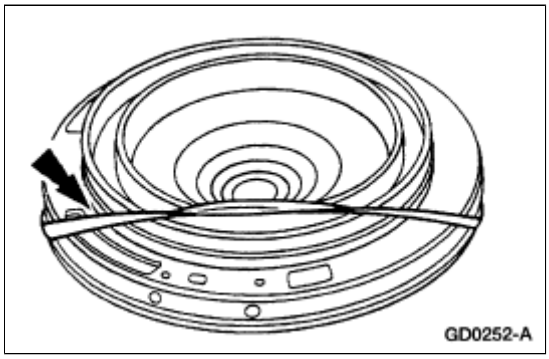


7. Remove the clutch piston seals.

1. Remove the intermediate clutch piston outer seal.
2. Remove the intermediate clutch piston inner seal.

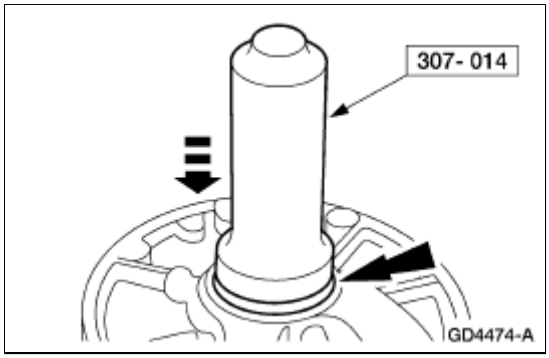


8. Remove and discard the front pump seal.

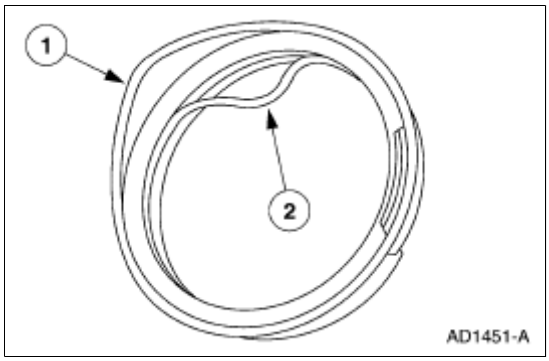


Assembly

1. Using the special tool, install the front pump seal assembly.

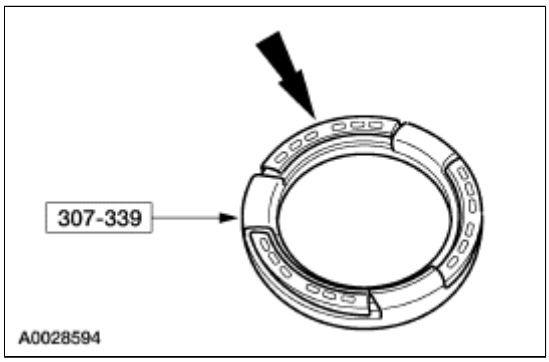


2. Install the clutch piston seals.
    1. Install the intermediate clutch piston outer seal.
    2. Install the intermediate clutch piston inner seal.

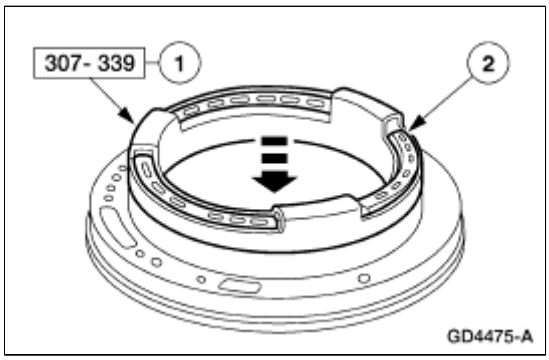


3. **NOTE:** Coat the intermediate clutch piston outer seal, inner seal and pump body with petroleum jelly.

   Install the intermediate clutch piston into the special tool.



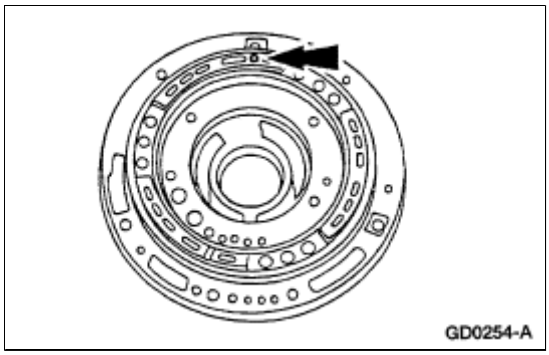
4. Using the special tool, install the intermediate clutch piston.
   1. Position the intermediate clutch piston and the special tool onto the pump body.
   2. Push the intermediate clutch piston to the bottom of the pump body bore, exerting even pressure and remove the special tool.



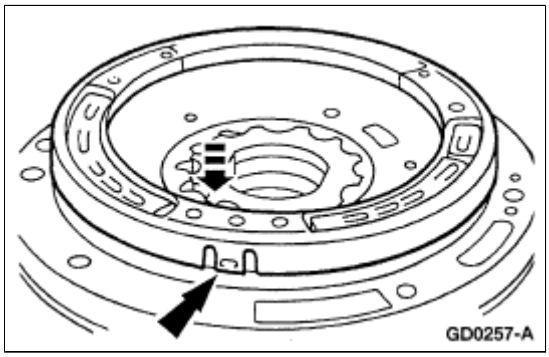
5. **CAUTION: The piston bleed hole must be located at 12 o'clock position (towards the top of the transmission). Shift problems may occur if installed incorrectly.**

   NOTE: The piston bleed hole is the only round hole in the pump body.

   Locate the piston bleed hole.

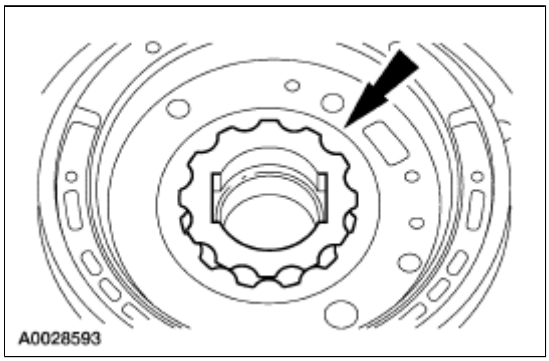


6. Install by snapping the spring retainer assembly on pump body.



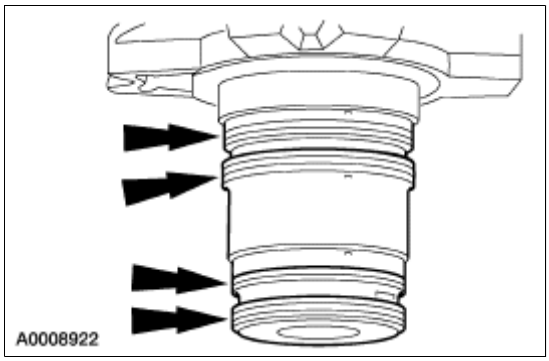
7. **NOTE:** The flats on the inner fluid pump gear have steps that must face the pump body or damage will result.

   Install the inner and outer fluid pump gerotor gears.

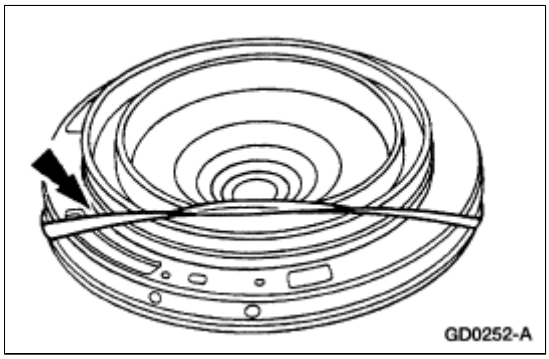


8. **NOTE:** The reverse clutch cylinder seal rings are larger than the forward clutch cylinder seals.

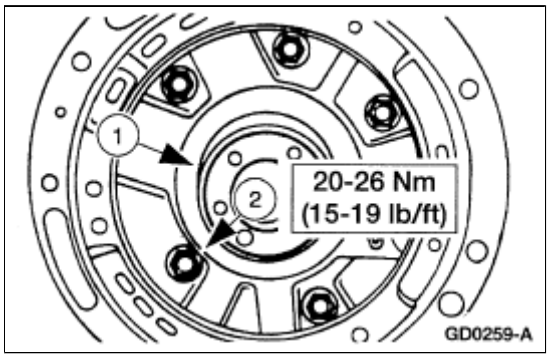
   Install the seal rings.



9. Install a new front pump seal.

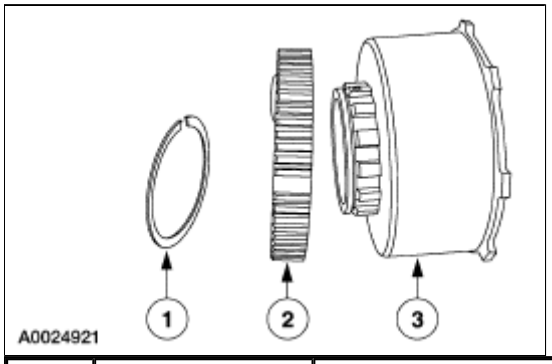


10. Assemble the front pump.
    1. Position the pump support to the pump body assembly.
    2. Install the bolts.



Intermediate One-Way Clutch

Intermediate Clutch Cylinder Disassembled View

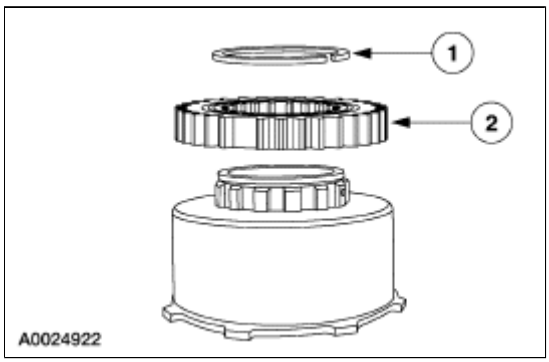


Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum

Disassembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

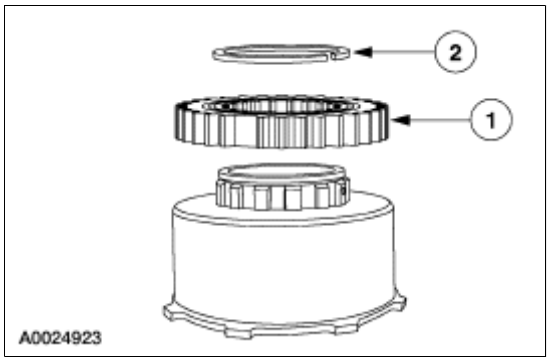
   Remove the intermediate one-way clutch.
   1. Remove the snap ring.
   2. Remove the intermediate one-way clutch.



Assembly

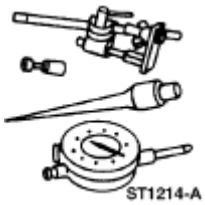
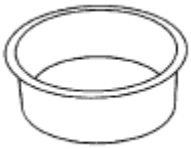
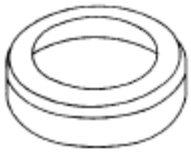
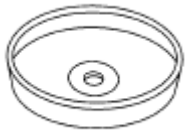
1. **NOTE:** The intermediate one-way clutch must rotate counterclockwise when installed on the reverse clutch drum and will make a ratchet sound.

   Install the intermediate one-way clutch.
   1. Install the intermediate one-way clutch.
   2. Install the snap ring.


2
1
A0024923

Reverse Clutch

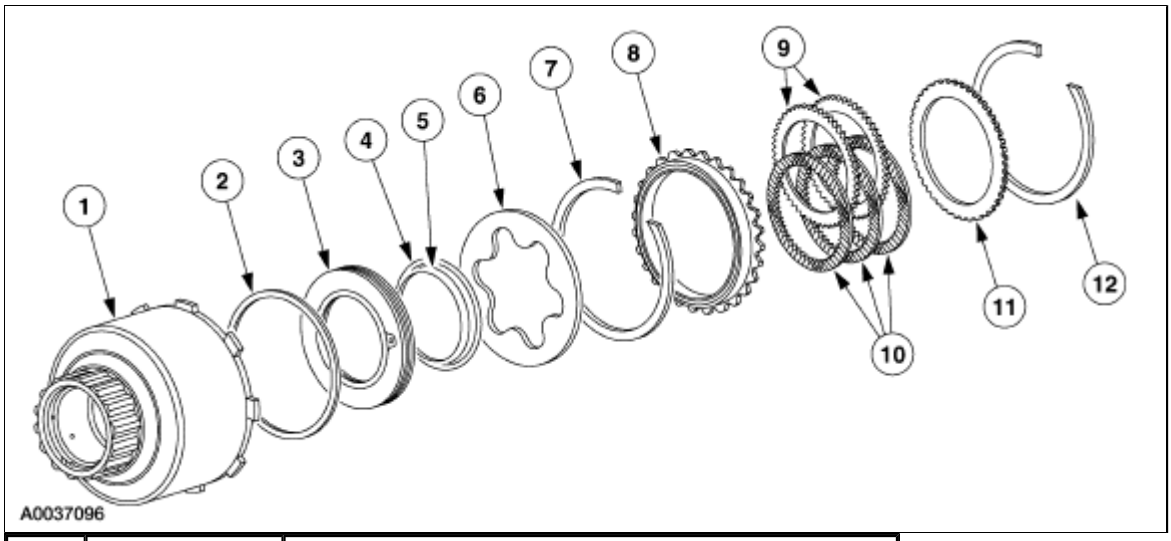
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1206-A	Protector, Transmission Reverse Clutch Outer Fluid Seal 307-424
 ST1207-A	Protector, Transmission Reverse Clutch Inner Fluid Seal 307-425
 ST1198-B	Compressor, Clutch Spring 307-086 (T80L-77405-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Reverse Clutch Disassembled View



Item	Part Number	Description
1	7D044	Reverse clutch drum
2	7D403	Reverse clutch piston outer seal
3	7D402	Reverse clutch piston
4	7D404	Reverse clutch piston inner seal
5	7D256	Reverse clutch piston spring pressure ring
6	7B070	Reverse clutch piston spring
7	7A577	Reverse clutch piston spring ring
8	7B066	Reverse clutch front pressure plate
9	7B442	Reverse clutch external spline plates (steel)
10	7B164	Reverse clutch internal spline plates (friction)
11	7B066	Reverse clutch rear pressure plate
12	7D483	Reverse clutch retaining ring (select fit)

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

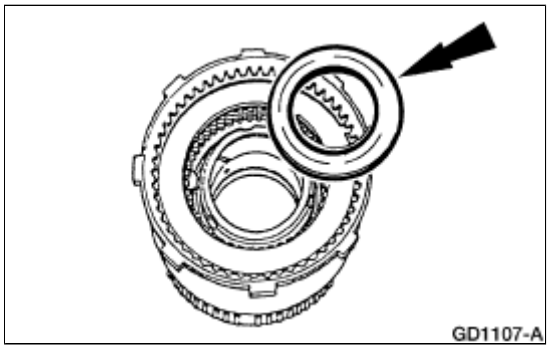
2. Check fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.

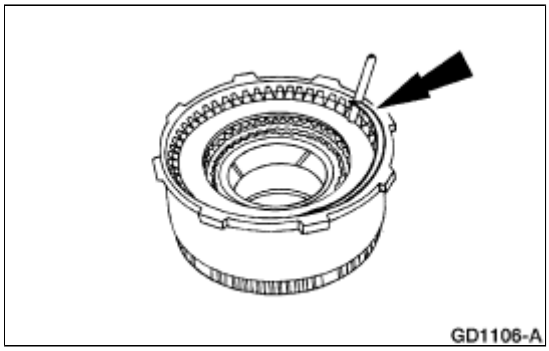
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

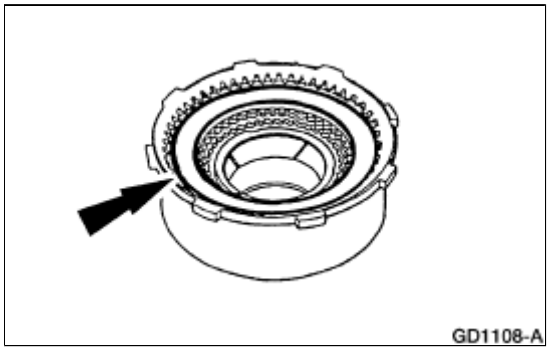
6. Check clutch hub thrust surfaces for scores and clutch hub splines for wear.
7. Remove the No. 2 forward clutch bearing.



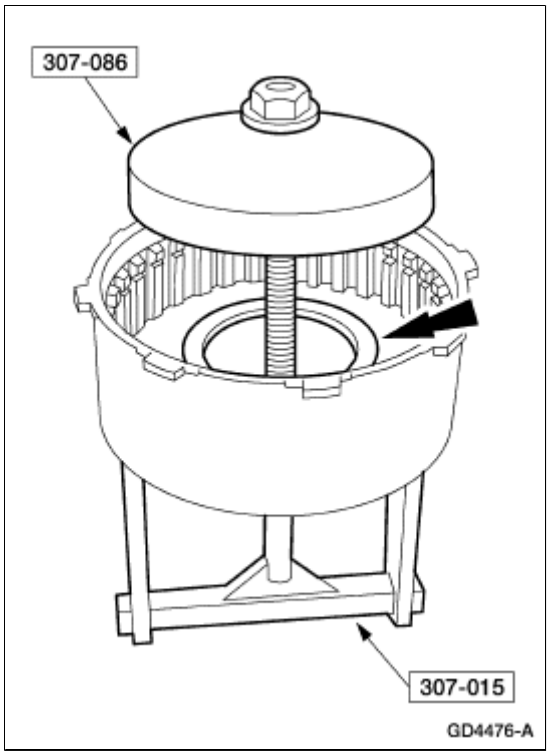
8. Remove the reverse clutch selective retaining ring.



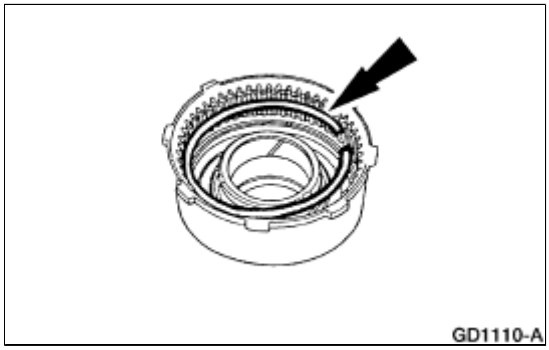
9. Remove the reverse clutch pack.



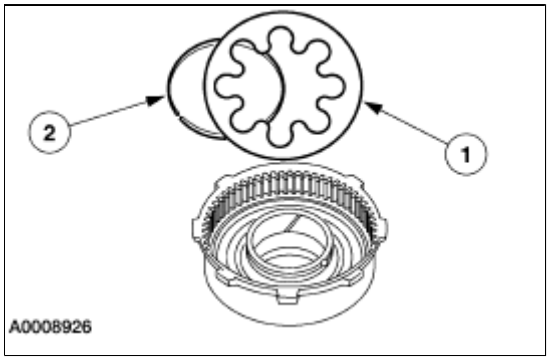
10. Using the special tools, compress the reverse clutch piston spring.



11. Remove the reverse clutch piston spring retaining ring.



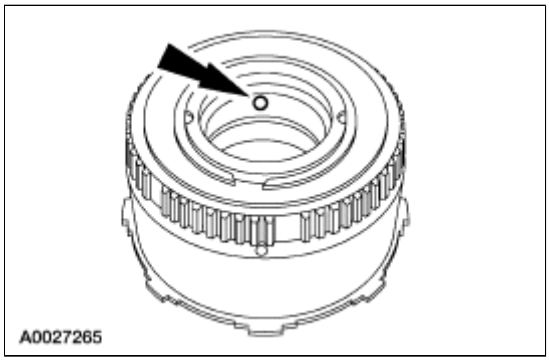
12. Remove the reverse clutch piston spring pressure ring.
    1. Remove the reverse clutch piston spring.
    2. Remove the reverse clutch piston spring pressure ring.



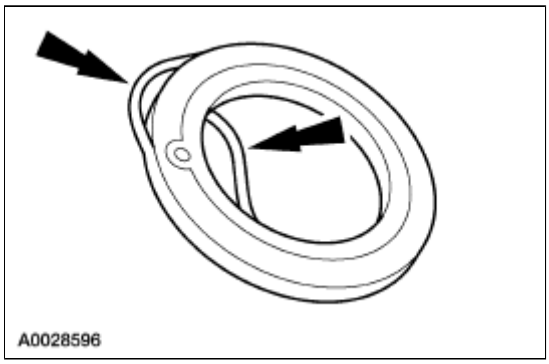
13. **NOTE:** To ease reverse clutch piston removal, it may be necessary to apply air pressure to the

reverse clutch drum. Block the opposite hole.

Remove the reverse clutch piston.



14. Remove the reverse clutch piston inner and outer seals.



Assembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

   Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

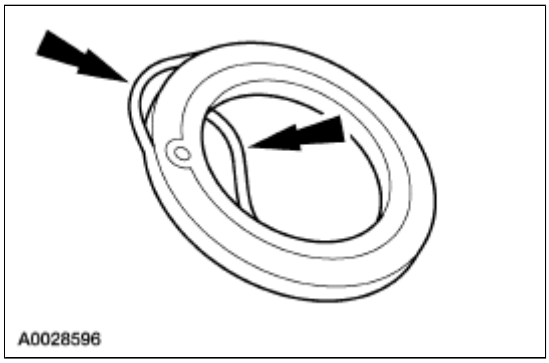
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

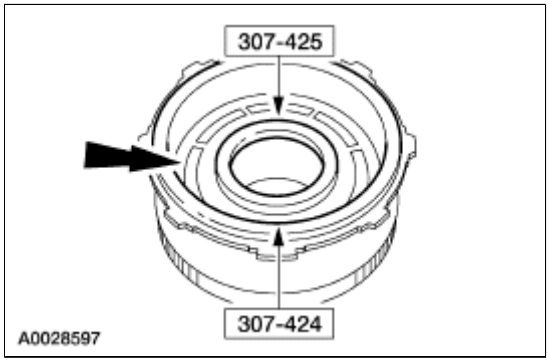
7. **NOTE:** The piston check ball must be present and moving freely.

   Install a new reverse clutch piston inner and outer seals.



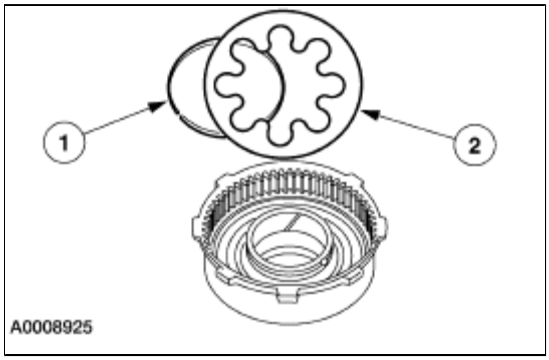
8. **NOTE:** Coat the reverse clutch piston inner seal, outer seal, drum sealing area and special tools with petroleum jelly.

   Using the special tools, install the reverse clutch piston using even pressure to push it to the bottom of the reverse clutch drum.

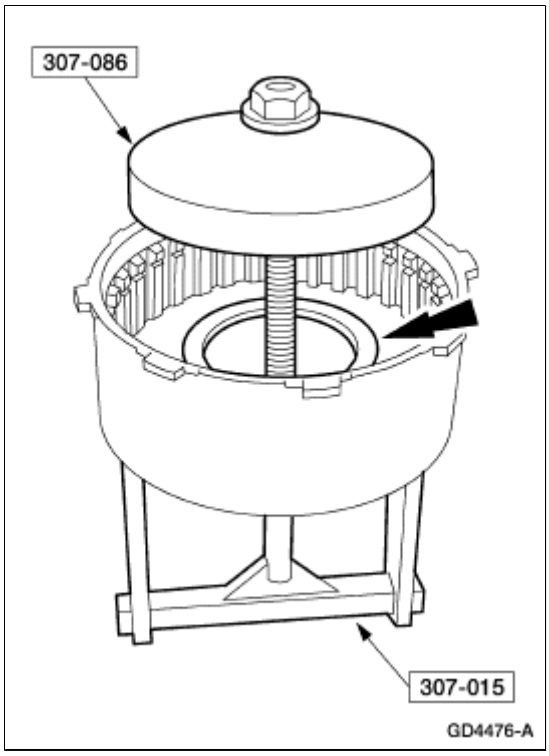


9. **NOTE:** The dished side of the reverse clutch piston spring must face the reverse clutch piston.

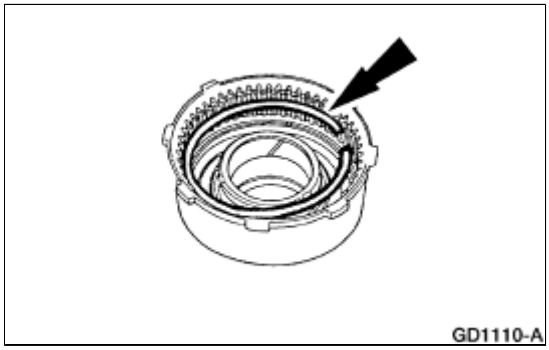
   Install the reverse clutch piston spring.
   1. Install the reverse clutch piston spring pressure ring.
   2. Install the reverse clutch piston spring.



10. Using the special tools, compress the reverse clutch piston spring.



11. Install the reverse clutch piston spring retaining ring.

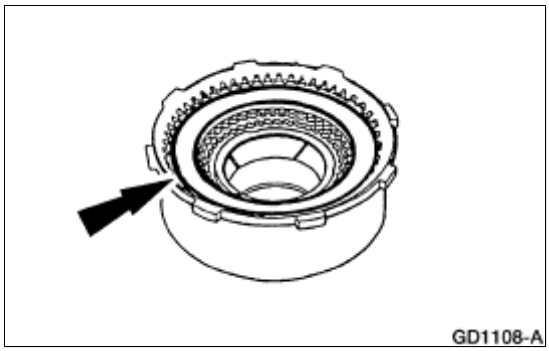


12. Remove the special tool.

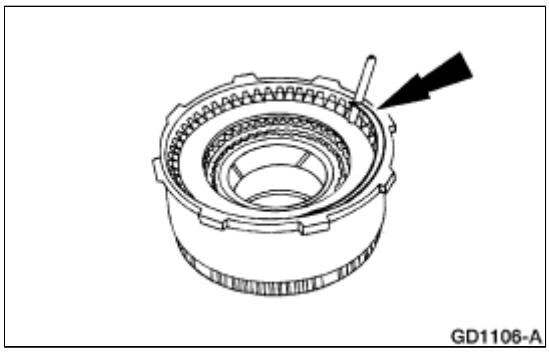
13. **CAUTION: Install the pressure plates with the flat sides facing the clutch pack.**

    NOTE: Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

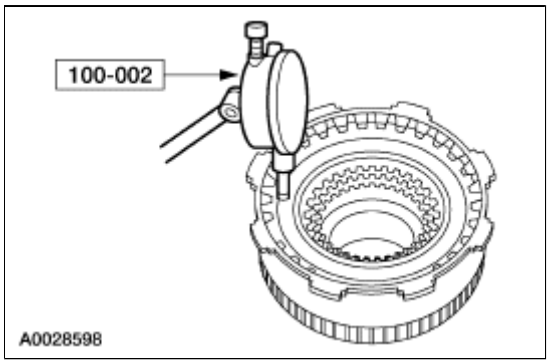
    Install the reverse clutch front pressure plate, clutch pack and reverse clutch rear pressure plate.



14. Install the reverse clutch pressure plate retainer snap ring.



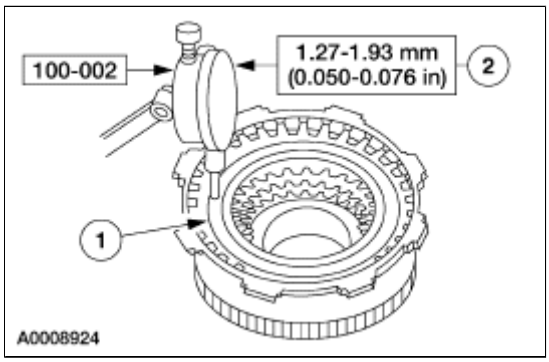
15. Install the special tool on the reverse clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.



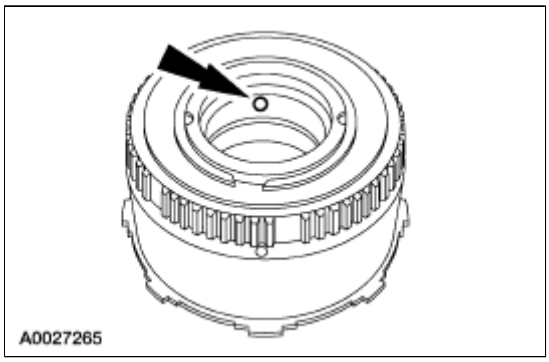
16. Using the special tool check the reverse clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the reverse clutch pressure plate retainer.
    2. Read the dial indicator.
        - If clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Rings

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.23-2.33 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

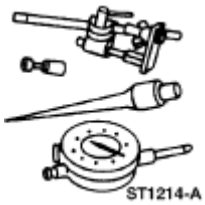


17. Check the clutch for correct operation.
    - Apply air pressure to the reverse clutch drum. The clutch should be heard and felt to work without leakage.



Forward Clutch Cylinder

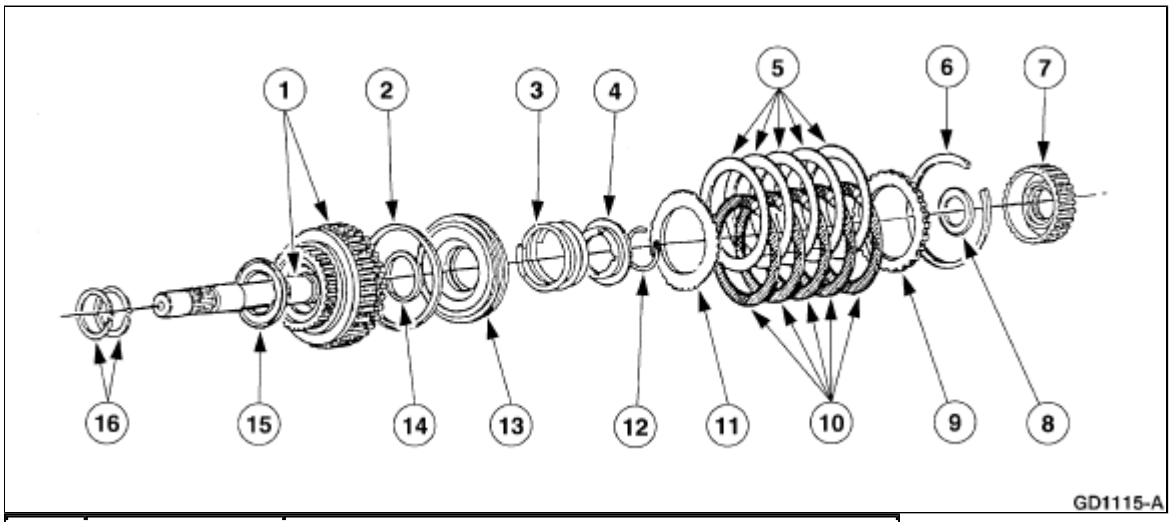
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
ST1191-A	Protector, Transmission Forward Clutch Outer Fluid Seal 307-423
ST1209-A	Compressor, Clutch Spring 307-096 (T81P-70235-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Forward Clutch — Disassembled View



Item	Part Number	Description
1	7F207	Forward clutch cylinder and shaft
2	7A548	Forward clutch piston outer seal
3	7A480	Forward clutch piston return spring
4	7A527	Forward clutch retainer return spring
5	7B442	Forward clutch external spline plate (steel)
6	7D483	Retaining snap ring
7	7B067	Forward clutch hub
8	7F231	No. 3 forward clutch hub front bearing
9	7B066	Forward clutch pressure plate
10	7B164	Forward clutch internal spline plates (friction)
11	7E085	Forward clutch pressure spring
12	388099-S	Retaining snap ring
13	7A262	Forward clutch piston
14	7C099	Forward clutch piston inner seal
15	7A166	No. 2 forward clutch bearing
16	7B497	Input shaft seal

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all the fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Replace the spring (including wave spring) if distorted or cracked.

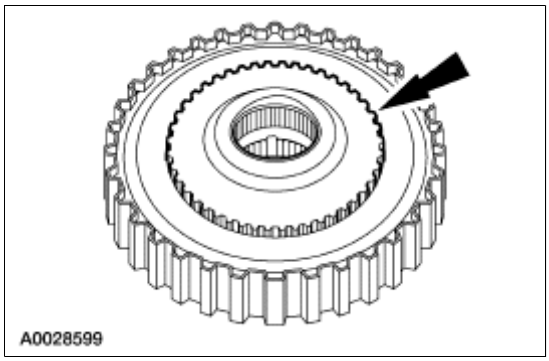
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored or burred.

5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

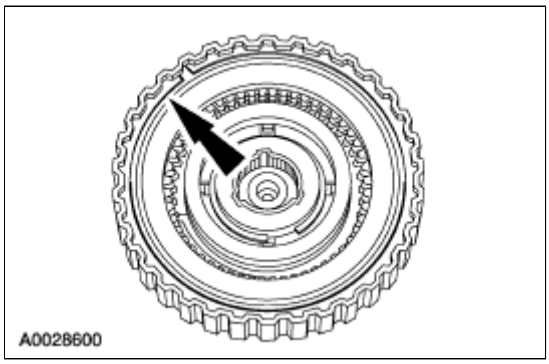
7. **NOTE:** The forward clutch hub may remain in the shell during disassembly.

   Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.

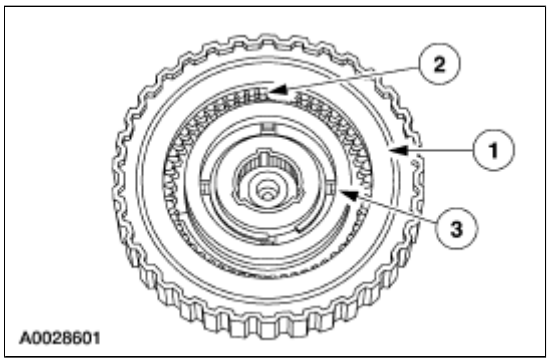


8. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Remove the clutch pack selective retaining ring.

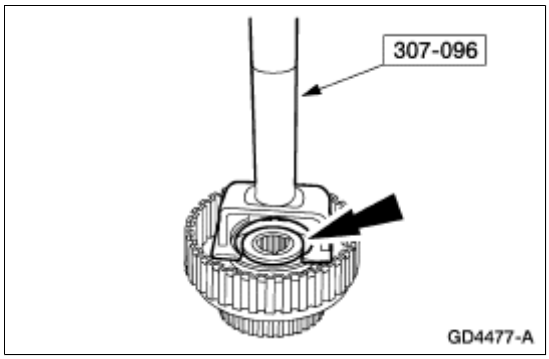


9. Remove the following components.
   1. Remove the pressure plate.
   2. Remove the clutch pack.
   3. Remove the pressure spring.



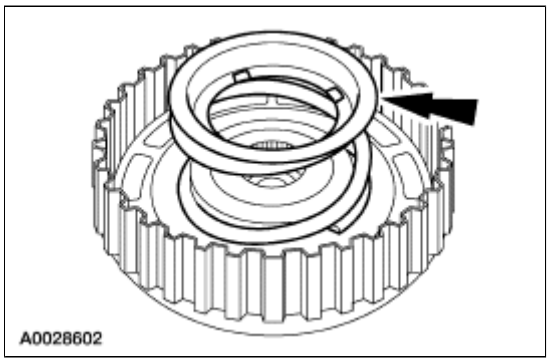
10. **CAUTION: Apply only enough pressure to release pressure on the retaining ring. If too much pressure is applied, the spring may break.**

    Using the special tool, remove the forward clutch retaining ring.



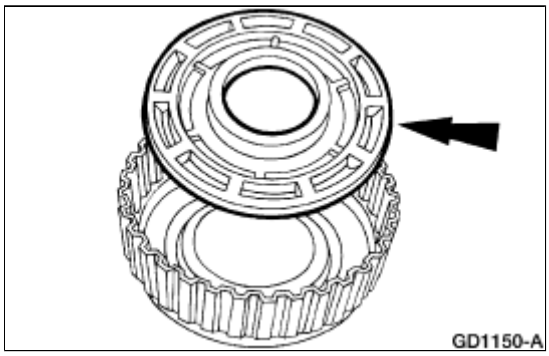
11. Slowly release the press and remove the forward clutch from the press.

12. Remove the forward clutch retainer and the return spring.

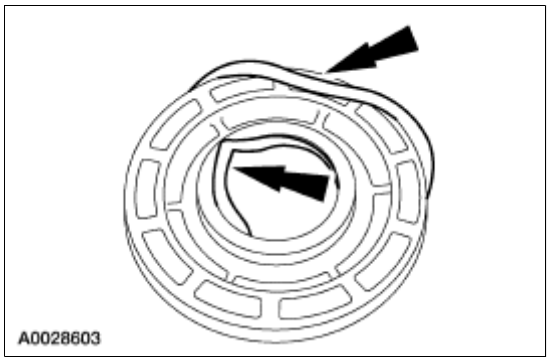


13. **NOTE:** Air pressure may be required to remove the forward clutch piston.

    Remove the forward clutch piston.

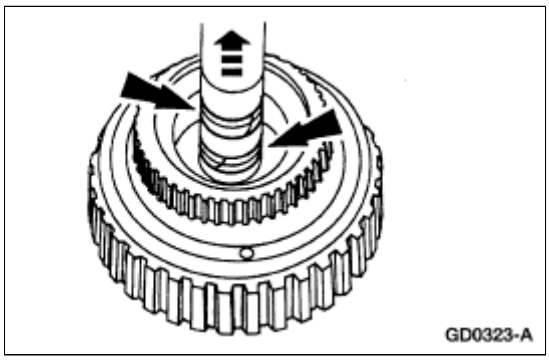


14. Remove the inner and outer forward clutch piston seals.

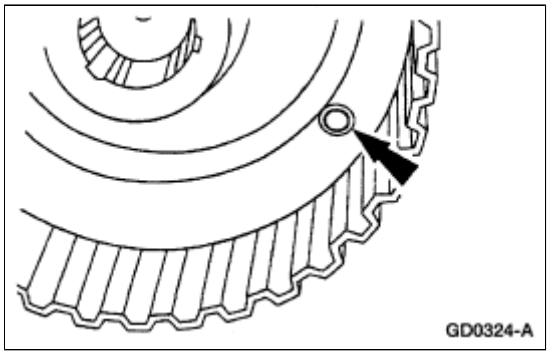


15. **NOTE:** The seals are solid seals but will be replaced with scarf cut seals.

    Remove the forward clutch input shaft seals.



16. Make sure the check ball in the clutch cylinder is free and clean. Check for proper seating.



Assembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Replace the spring (including the wave spring) if distorted or cracked.

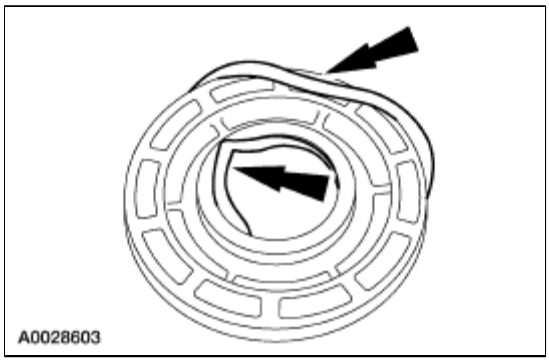
4. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.

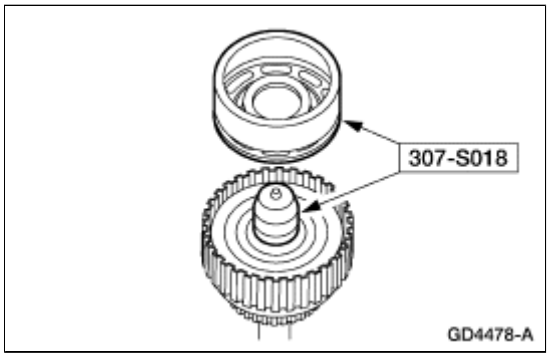
7. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Install the inner and outer forward clutch piston seals. Note the direction of the sealing rings before installation.

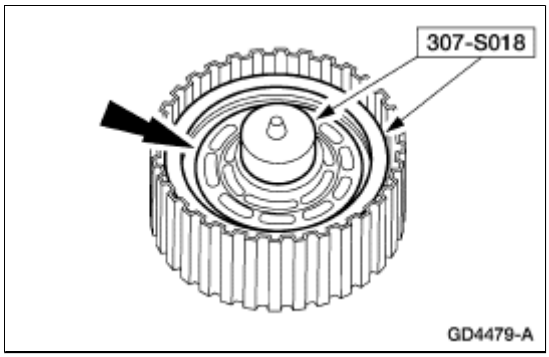


8. **NOTE:** Coat the piston seals and clutch drum sealing area with petroleum jelly.

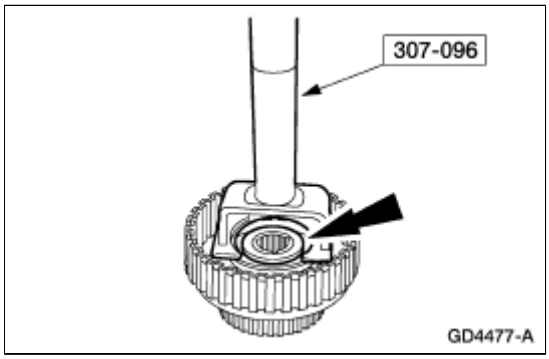
   Position the special tools on the clutch piston.



9. Using the special tools, install the forward clutch piston into the clutch drum.
   - Push the piston to the bottom of the drum using even pressure.



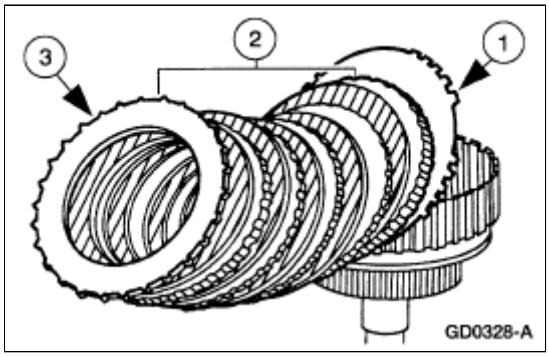
10. Using the special tool, compress the piston return spring and install the retaining ring.



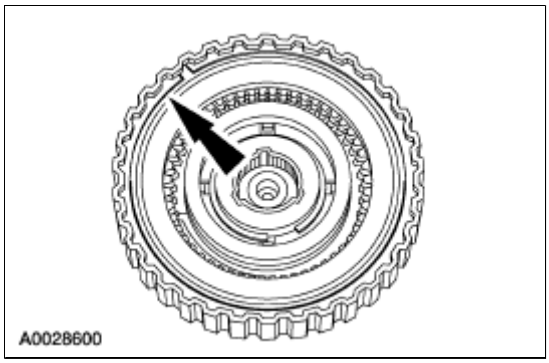
11. Slowly release the press pressure and remove the forward clutch.

12. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

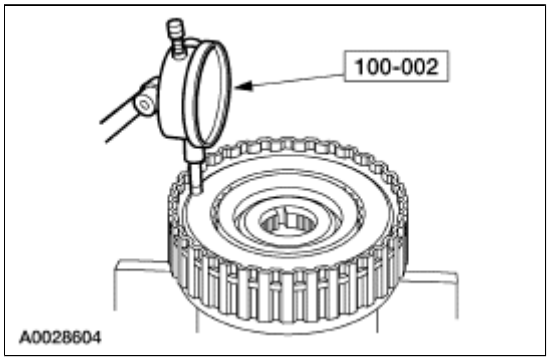
    Install the clutch pack assembly.
    1. Install the pressure ring.
    2. Install the clutch pack.
    3. Install the pressure plate.



13. Install the clutch pack retaining ring.



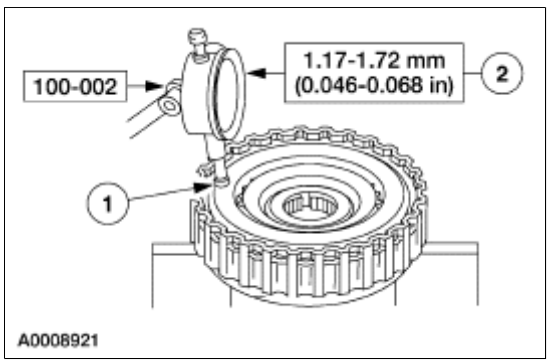
14. Install the special tool on the forward clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.



15. Check the clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the clutch pressure plate retainer.
    2. Read the dial indicator.
        - If the clearance is not within specifications, install the correct size retaining ring.

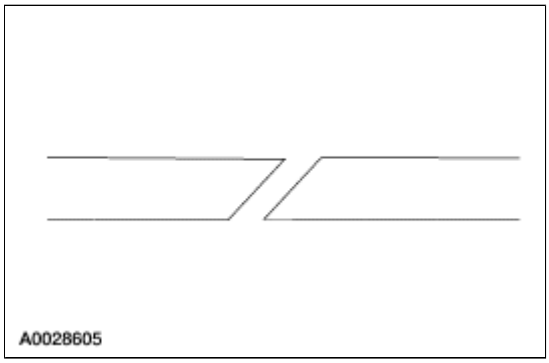
Selective Retaining Ring

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.23-2.69 mm (0.086-0.106 inch)
2.59-2.69 mm (0.102-0.106 inch)

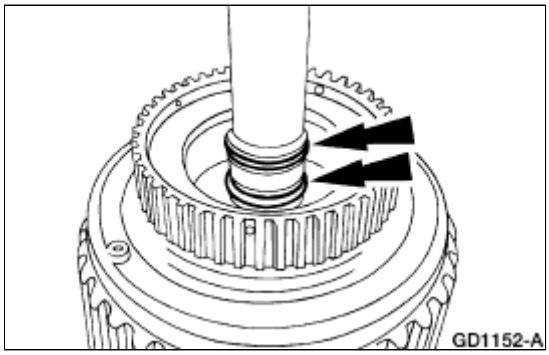


16. **NOTE:** Make sure the scarf-cut seals are mated correctly.

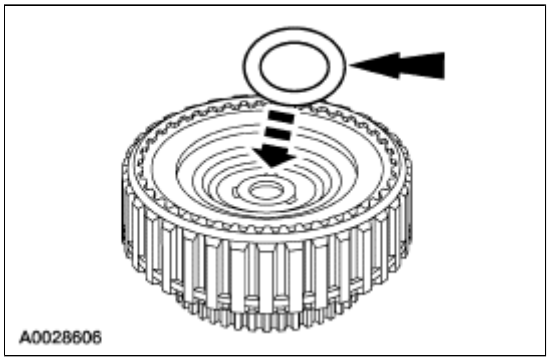
    Slide the two scarf-cut seals on the input shaft.



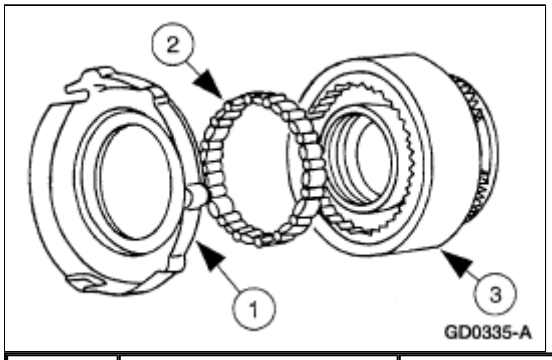
17. Install the two scarf-cut seals on input shaft.



18. Install the No. 3 forward clutch hub front bearing and the forward clutch hub.



Planetary Gear Support Assembly and Planetary One-Way Clutch

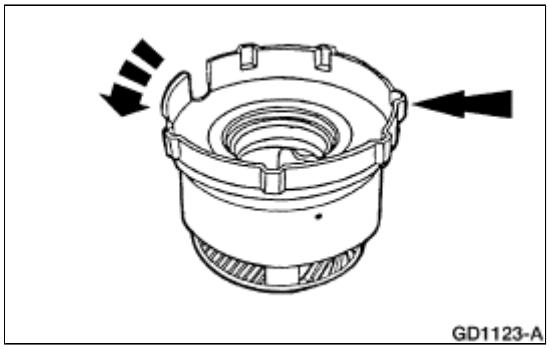


Item	Part Number	Description
1	7A130	Planetary gear support
2	7A089	Planetary one-way clutch
3	7A398	Planetary assembly

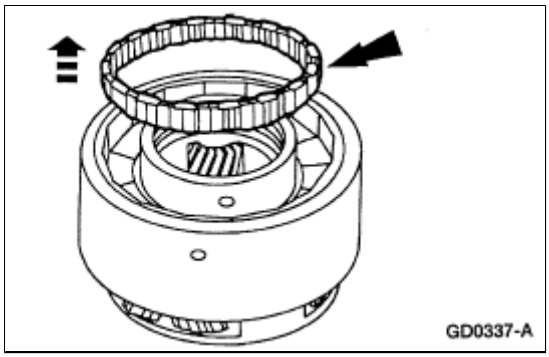
Disassembly and Assembly

1. **NOTE:** Inspect the outer and inner races for scores or damaged surface areas where rollers contact the races. Inspect the rollers and springs for excessive wear or damage. Inspect the spring and cage for bent or damaged spring retainers.

   Rotate the center support counterclockwise and lift to remove the planetary gear support.



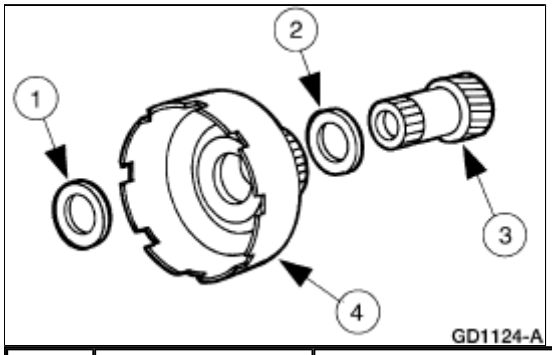
2. Remove the planetary one-way clutch.



3. To assemble, reverse the disassembly procedure.

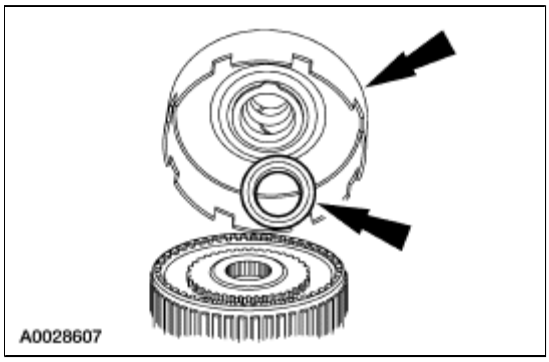
Reverse Sun Gear

Disassembly

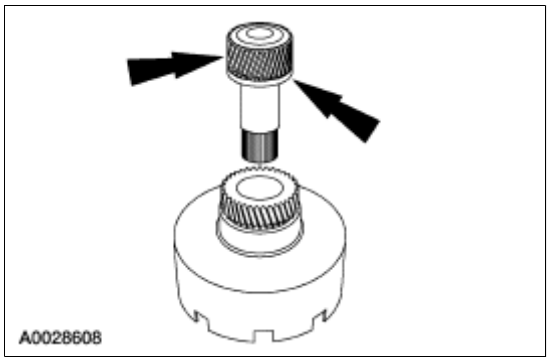


Item	Part Number	Description
1	7C096	Forward clutch hub bearing No. 4
2	7F244	Forward clutch sun gear bearing No. 5
3	7A399	Forward clutch sun gear
4	7A019	Reverse sun gear assembly

1. Remove the reverse clutch sun gear assembly and the No. 4 forward clutch hub bearing and race.



2. Remove the forward clutch sun gear assembly and the No. 5 forward clutch sun gear bearing and race.

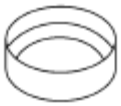


Assembly

1. The forward clutch sun gear and reverse sun gear assembly are assembled as part of the transmission assembly procedure.

Output Shaft and Direct Clutch Cylinder

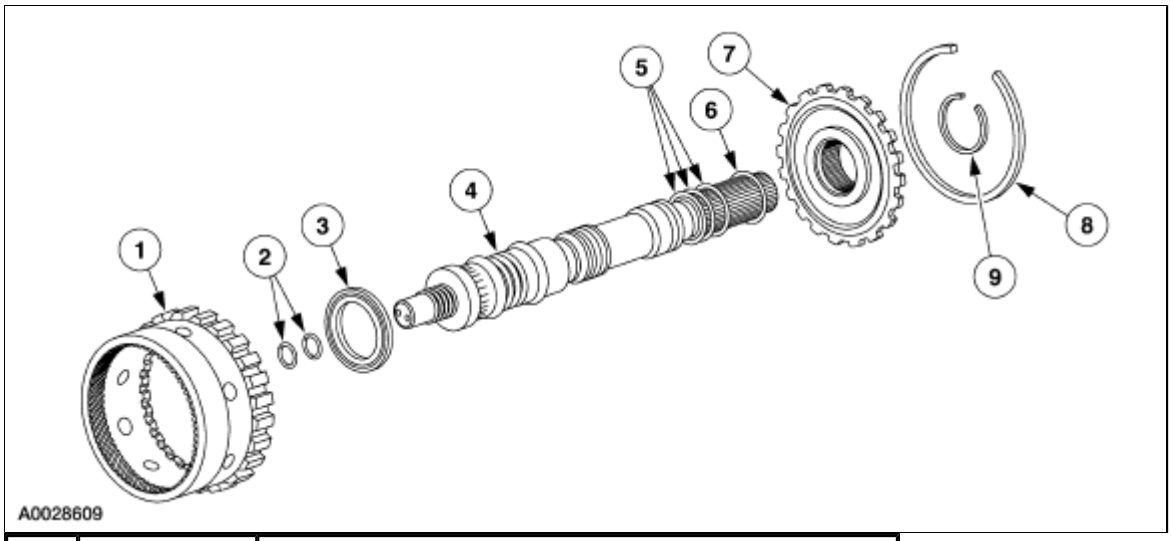
Special Tool(s)

ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
ST1204-A	Protector, Piston Seal 307-080 (T80L-77234-A)
 ST1901-A	Protector, Transmission Direct Clutch Outer Fluid Seal 307-422

Material

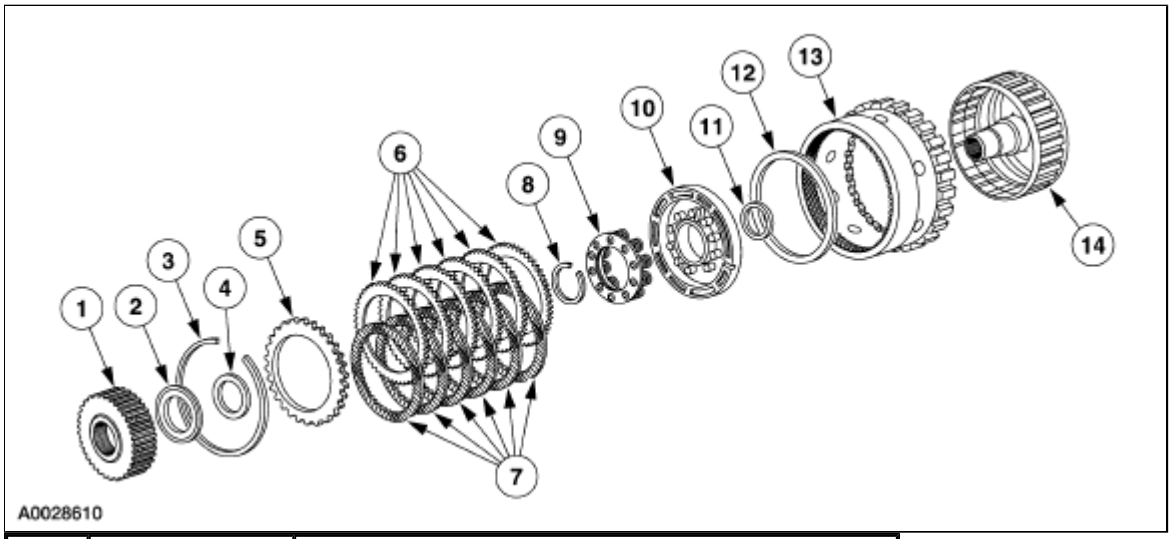
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Output Shaft, Direct Clutch Cylinder and Ring Gear Disassembled View



Item	Part Number	Description
1	7A233	Output shaft ring gear assembly
2	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
3	7F240	Direct clutch outer bearing and race assembly No. 8
4	7060	Output shaft
5	7F273	Output shaft to case seal (3 req'd)
6	87054-S94	O-ring seal
7	7D164	Output shaft hub
8	97713-S	Retaining snap ring
9	7C122	Snap ring

Direct Clutch Disassembled View



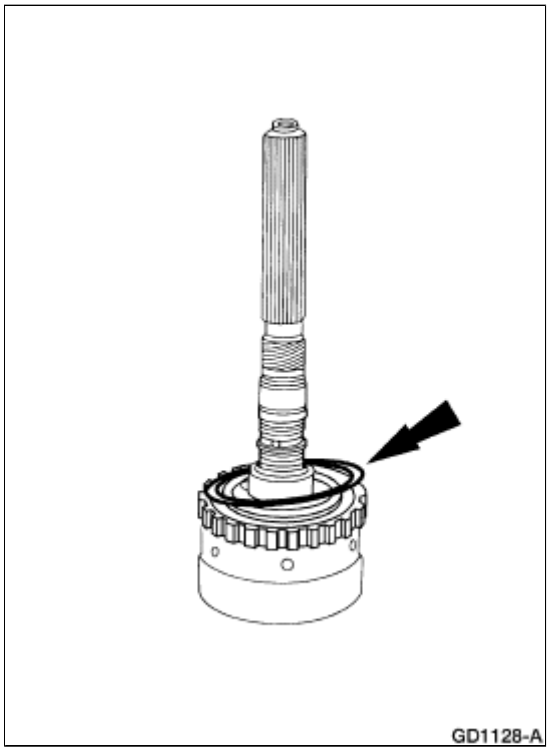
Item	Part Number	Description
1	7F236	Direct clutch hub
2	7F243	No. 7 direct clutch bearing

3	7D483	Direct clutch pressure plate retaining ring
4	7F237	Direct clutch inner bearing support
5	7B066	Direct clutch pressure plate
6	7B442	Direct clutch external spline plates (steel)
7	7B164	Direct clutch internal spline plates (friction)
8	388104-S2	Retaining ring
9	7F235	Direct clutch retainer and spring assembly
10	7A262	Direct clutch piston
11	7C099	Direct clutch piston inner seal
12	7A548	Direct clutch piston outer seal
13	7A233	Output shaft ring gear
14	7F283	Direct clutch cylinder

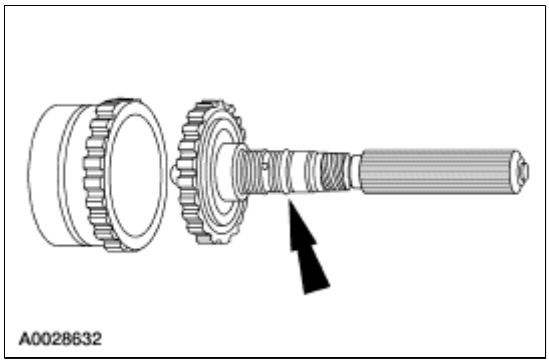
Disassembly

1. **NOTE:** The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear during the assembly procedure.

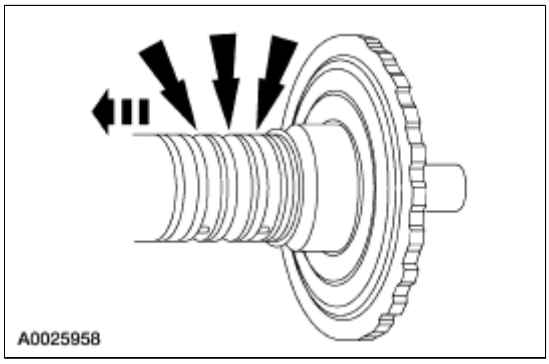
   Remove the ring gear snap ring.



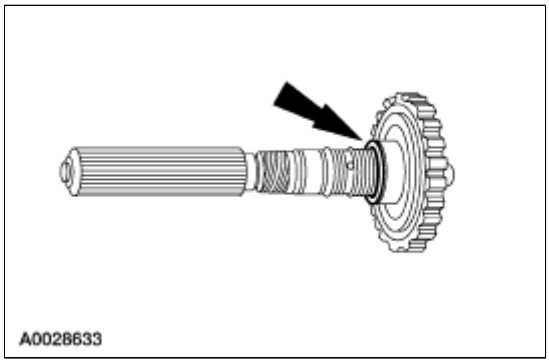
2. Separate the ring gear and output shaft.



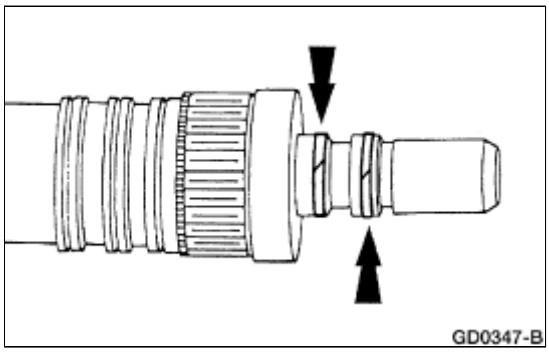
3. Remove the three output shaft seal rings.



4. Remove the output shaft hub snap ring and the output shaft hub.

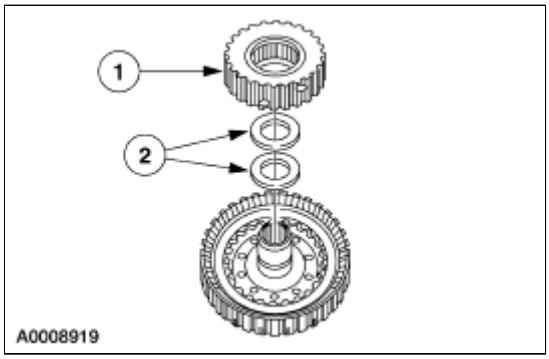


5. Remove the two direct clutch seal rings.



6. Remove the No. 7 direct clutch inner bearing support.

1. Remove the direct clutch hub.
2. Remove the No. 7 direct clutch inner bearing support.



7. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

8. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

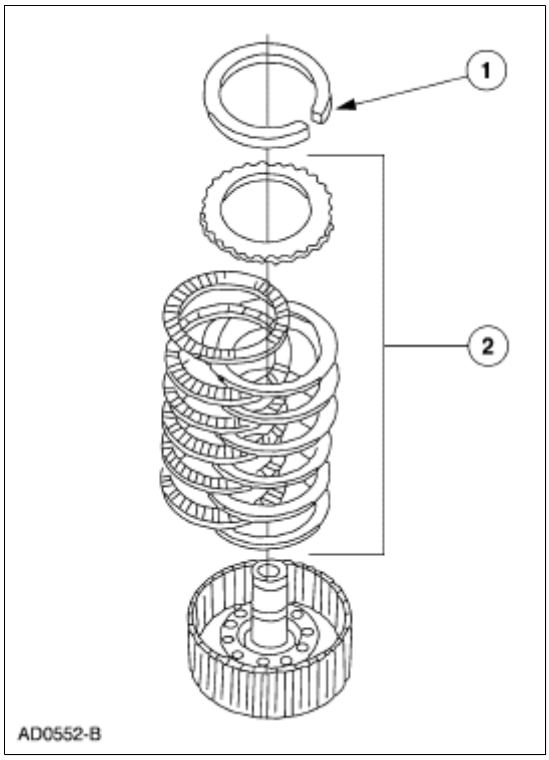
9. Check clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

10. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

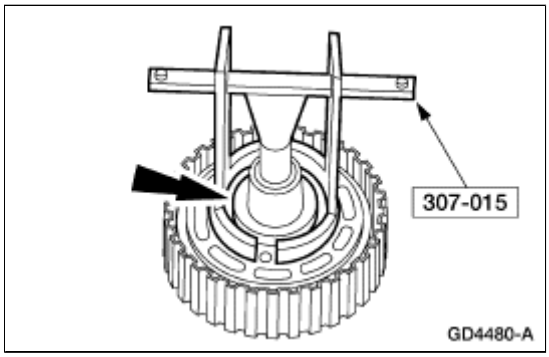
11. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.

12. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

13. Remove the direct clutch pack.
    1. Remove the selective retaining ring.
    2. Remove the direct clutch pack.



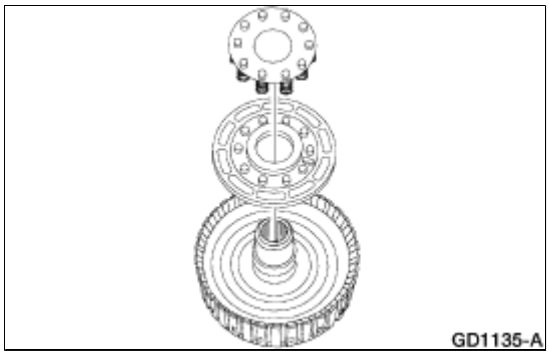
14. Using the special tool, compress the piston return spring and remove the snap ring.



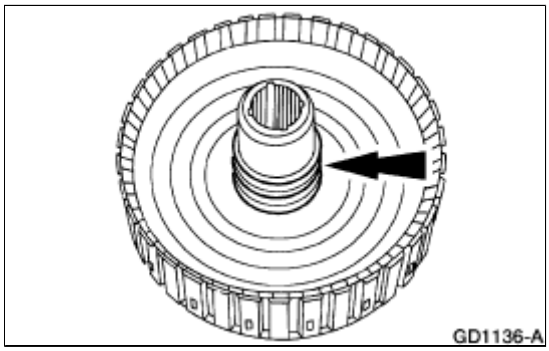
15. **WARNING: Wear safety glasses when using compressed air.**

NOTE: If necessary, use regulated compressed air 207 kPa (30 psi) max pressure to remove the clutch piston.

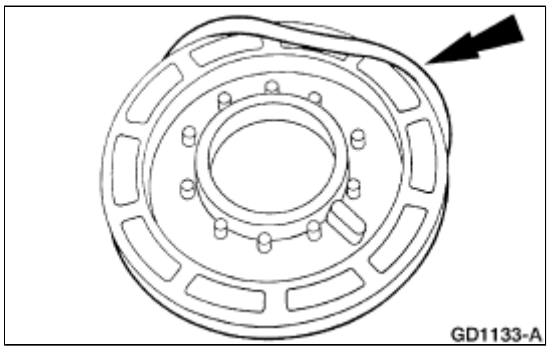
Remove the support and spring assembly and piston.



16. Remove the inner piston seal.



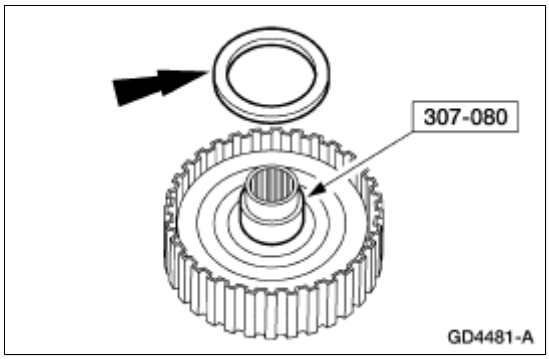
17. Remove the outer piston seal.



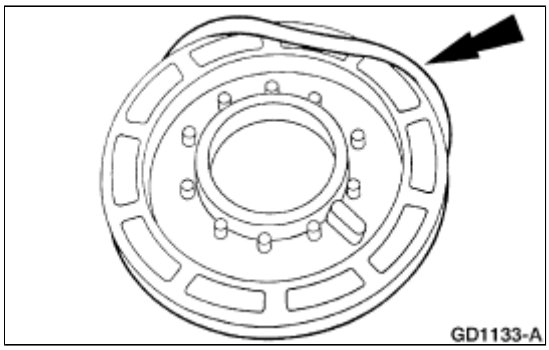
Assembly

1. **NOTE:** Lubricate direct clutch piston inner seal and seal protector with petroleum jelly.

   Using the special tool, install the inner piston seal.
   - Install the seal with sealing lip facing down.

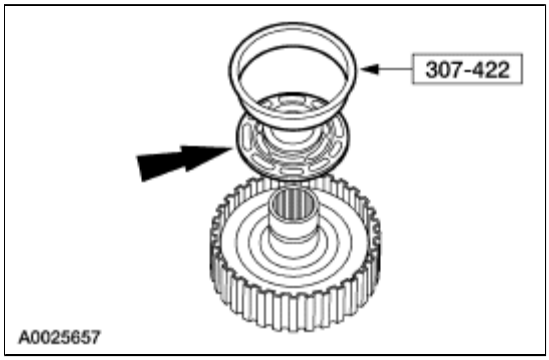


2. Install the clutch piston outer seal so that when the piston is installed the sealing lip points toward the bottom of the cylinder.



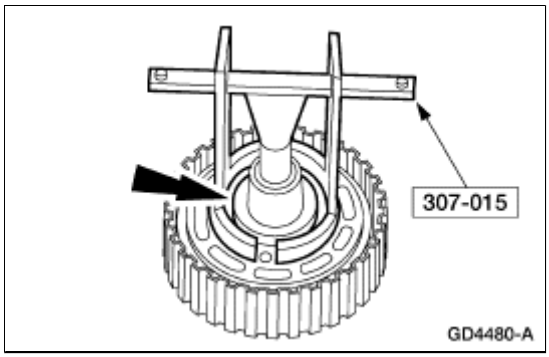
3. **NOTE:** Coat the inner and outer direct clutch piston seals, clutch cylinder sealing area and piston inner sealing area with petroleum jelly.

   Using the special tool, install the direct clutch piston.



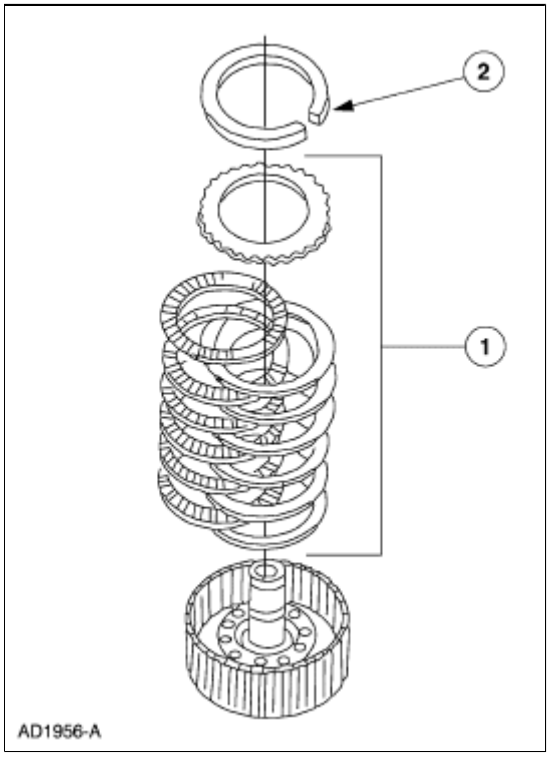
4. Install the piston return spring and retainer assembly.

5. Using the special tool, compress the piston return spring and install the retaining ring.



6. **NOTE:** Before assembly, soak new clutch discs in clean automatic transmission fluid for 15 minutes.

   Install the clutch pack retaining ring.
   1. Alternate external spline (steel) plates and internal spline (friction) plates, starting with a steel plate and ending with the friction plate.
   2. Install the clutch pack retaining ring.

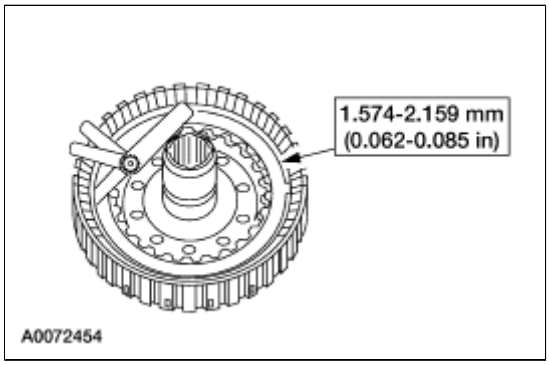


7. Use a feeler gauge to check the clearance between the clutch pack selective retaining ring and the pressure plate.
   - If the clearance is not within specifications, install the correct size retaining ring and recheck the clearance.

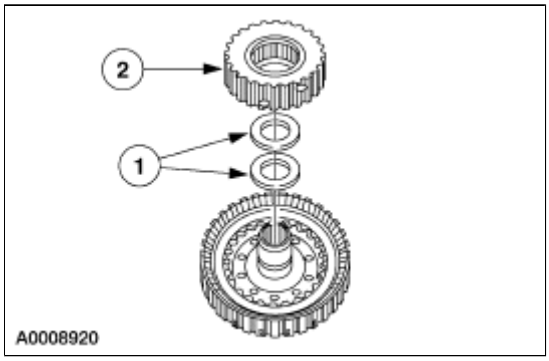
Selective Retaining Ring

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 in)

2.59-2.69 mm (0.102-0.106 inch)



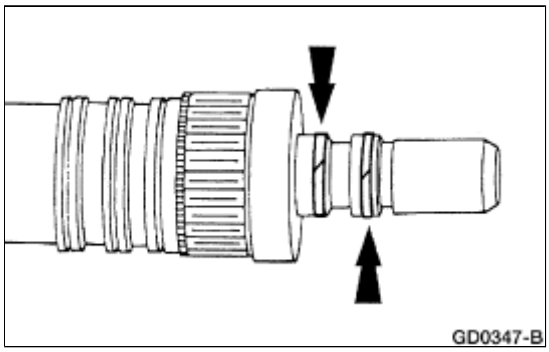
8. Install the direct clutch hub.
    1. Install the No.7 direct clutch inner bearing support.
    2. Install the direct clutch hub.



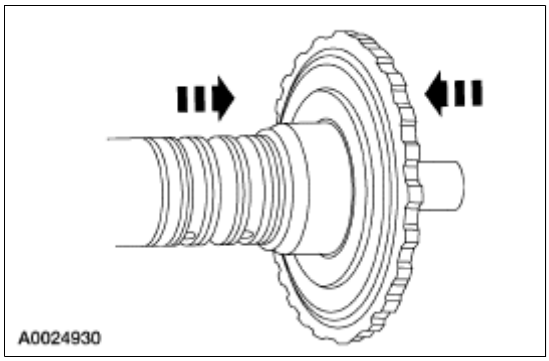
NOTE: Inspect the output shaft bearing surfaces for scores. Inspect the output shaft splines for wear. Inspect all bushings.

9. **CAUTION: Make sure the seals are lapped correctly. Internal damage may occur.**

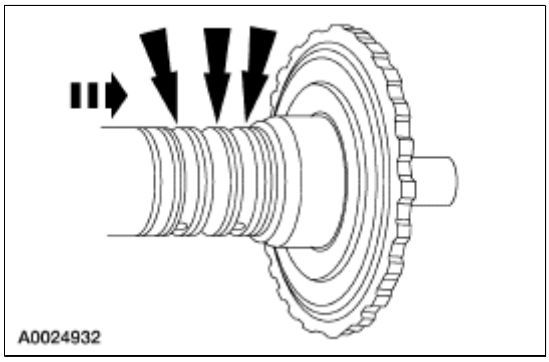
    Install the two direct clutch seal rings.



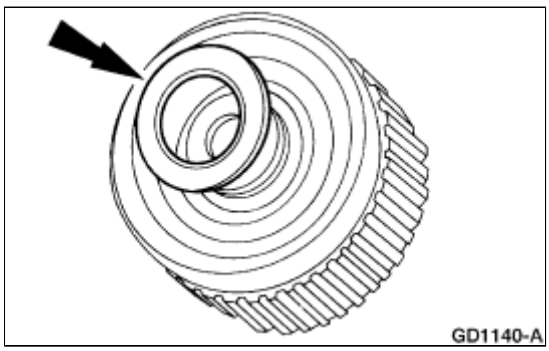
10. Install the output shaft hub.
    - Position the output shaft hub.
    - Install the retaining ring.



11. Install the three output shaft seal rings.

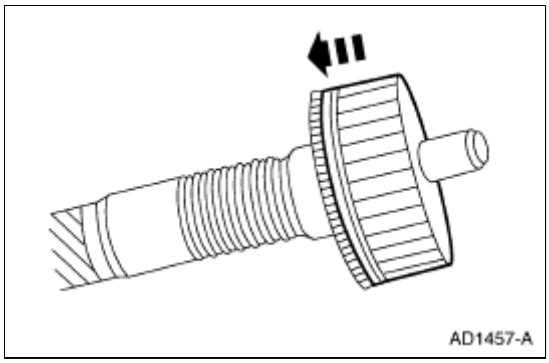


12. Install the No. 8 needle bearing on the direct clutch cylinder.



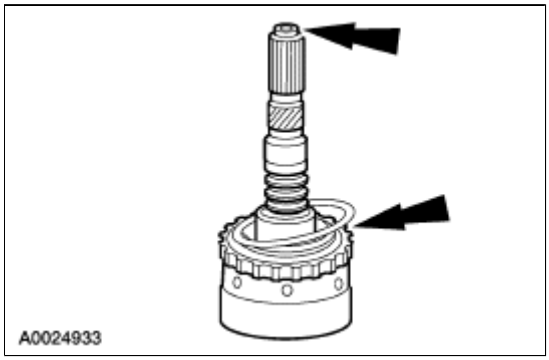
13. **NOTE:** Direct clutch cylinder may be installed after the output shaft ring gear is installed to the output shaft hub.

    Assemble the direct clutch on the output shaft.



14. **CAUTION: The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear.**

Align the index marks on output shaft and the output shaft ring gear and install the ring gear on the output shaft.



Torque Converter

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - Converter stud or studs, impeller hub or bushing are damaged.
    - Discoloration (due to overheating).
    - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
        - One-Way Clutch Check
        - End Play Check
        - Stator to Turbine Interference Check
        - Stator to Impeller Interference Check
        - Torque Converter Leak Check
    - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
        - Major metallic failure.
        - Multiple clutches or clutch plate failures.
        - Sufficient component wear which results in metallic contamination.

Torque Converter Cleaning And Inspection

1. If the torque converter (7902) is being replaced, continue with Substep 2 of Step 2.

2. If the torque converter is not being replaced, the following procedures must be performed:
    1. The torque converter must be thoroughly cleaned.
        - Torque converters with drain plugs can be cleaned by using Torque Converter/Oil Cooler Cleaner.
        - Torque converters without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with new fluid specified for transmission, and reinstall.
    2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing; refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    3. All cooler lines must be thoroughly cleaned by backward and forward flushing; refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    4. All Cooler Bypass Valves (CBV), if equipped, must be thoroughly cleaned.
    5. Carry out the Transmission Fluid Cooler Flow Test.
    6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, the fluid cooler, cooler bypass valve, and/or cooler lines must be replaced; refer to Section 307-02 .
    7. If the coolers are to be replaced, use only factory approved service parts; refer to Section 303-03 .

Torque Converter Flushing

Material

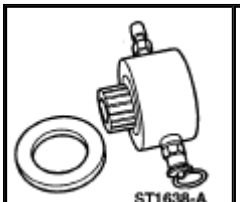
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

NOTE: When the transmission has been repaired for internal damage the torque converter must be cleaned using a mechanically agitated cleaner.

1. Using a suitable torque converter/fluid cooler cleaner, clean and flush the torque converter.
2. After flushing, drain the remainder of the solvent.
3. Add 1.9 liter (2 qt.) of clean transmission fluid to the converter and agitate by hand.
4. Thoroughly drain the solution.

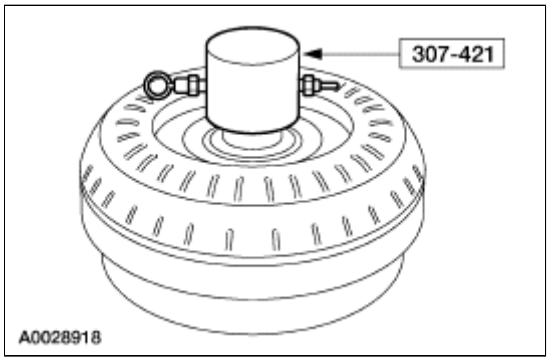
Torque Converter Leak Check

Special Tool(s)

	Leak Tester, Torque Converter 307-421

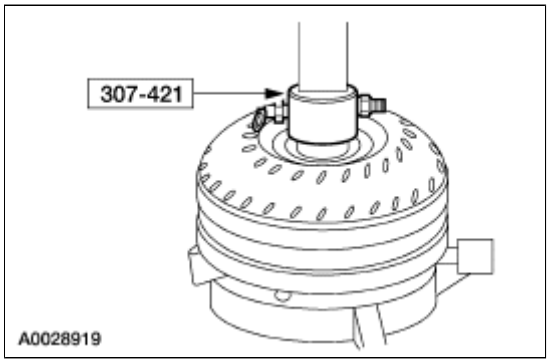
1. Clean the outside surface of the torque converter.

2. Install the special tool into the converter hub.



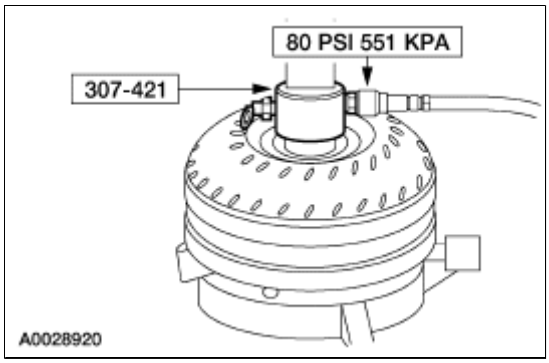
3. **WARNING: Always follow correct safety procedures while using press. Failure to follow these instructions may result in personal injury.**

   Install the torque converter with the installed special tool into the arbor press.
   Secure the press, apply enough force to seal the tool into the torque converter.

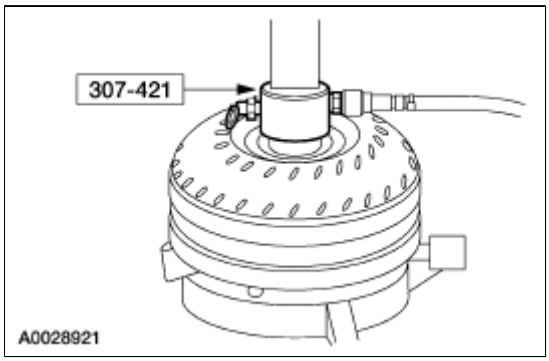


4. **NOTE:** Use clean dry shop air.

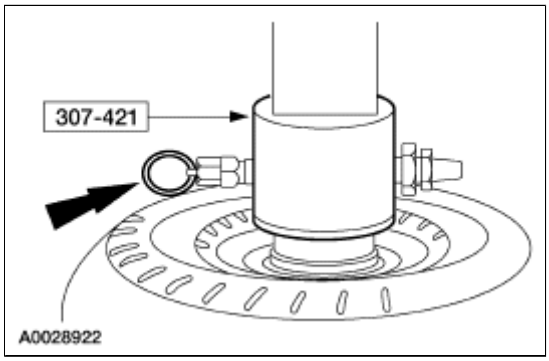
   Apply air pressure to the valve on the special tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, seams, drain plug and studs. A soap bubble solution may be applied around these areas to aid in diagnosis. If a leak is found around the drain plug, install a new drain plug and recheck the torque converter. If any other leaks are present, install a new or remanufactured torque converter.



6. Remove the air hose. Release pressure and then slowly release the press. Remove the torque converter. Remove the special tool.

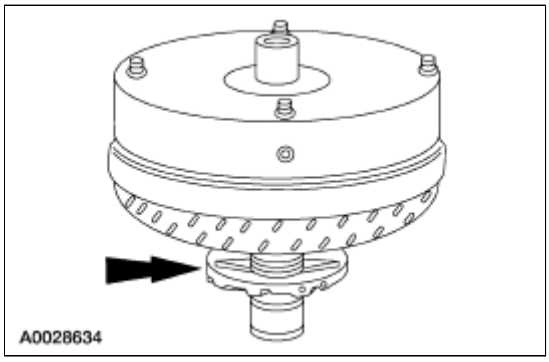


Torque Converter Impeller to Pump Stator Interference Check

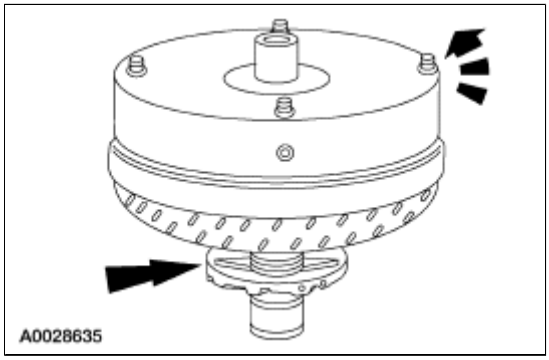
1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

   Position the front pump support with the splines up.

2. Mount the torque converter on the front pump support with the splines on the one-way clutch inner race, engaging the mating splines of the front pump support.

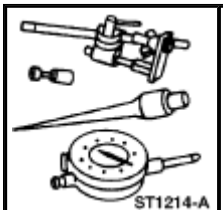


3. Hold the front pump support stationary and rotate the torque converter counterclockwise.
   - The torque converter should rotate freely with no signs of scraping.
   - If there are signs of scraping, install a new or remanufactured torque converter.

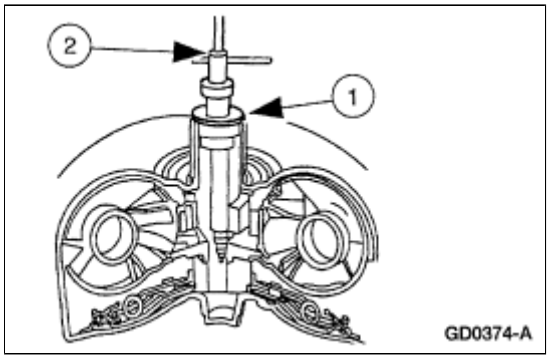


End Play Check

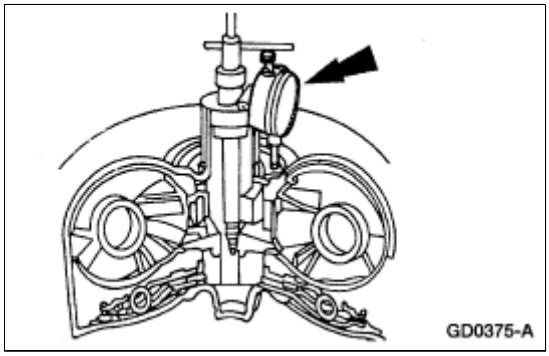
Special Tool(s)

 ST1214-A	Dial Indicator With Bracketry 100-002 (TOOL-4201-C) or equivalent
ST1196-A	End Play Checking Tool 307-071 (T80L-7902-A) or equivalent

1. Insert End Play Checking Tool into the torque converter pump drive.
    1. Position End Play Checking Tool.
    2. Tighten the inner post until the tool is securely locked.



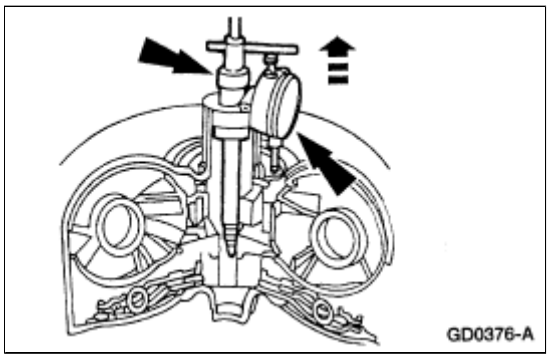
2. Attach Dial Indicator With Bracketry to End Play Checking Tool.
    - Position the dial indicator bottom on the converter pump drive hub and zero the dial.



3. Lift up on End Play Checking Tool and note the dial indicator reading.
   - If the reading exceeds end play limits, replace the torque converter (7902).

Torque Converter End Play

New or Rebuilt Torque Converter	Used Torque Converter
0.355-1.04 mm (0.014-0.041 inch) Max.	0.355-1.87 mm (0.014-0.074 inch) Max.



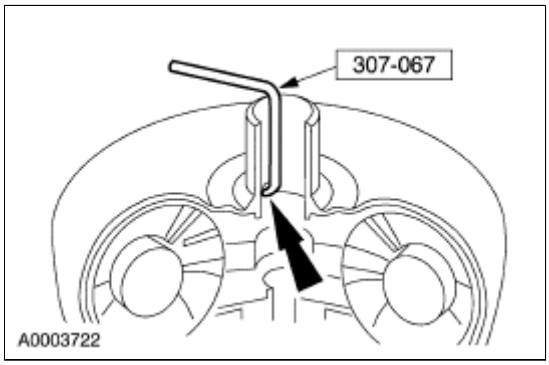
4. Remove the dial indicator and tool.

Torque Converter One-Way Clutch Check

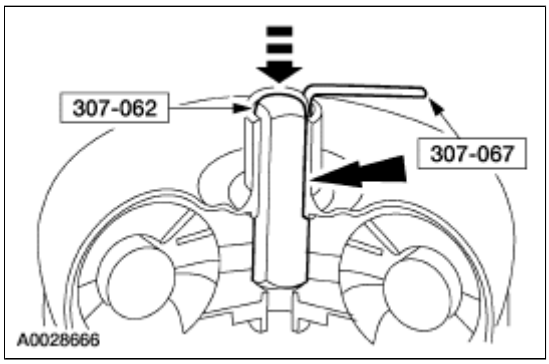
Special Tool(s)

ST1193-A	Holding Tool, One-Way Clutch 307-062 (T76L-7902-C) or equivalent
ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R) or equivalent

1. Install the special tool in one of the grooves in the stator thrust washer.

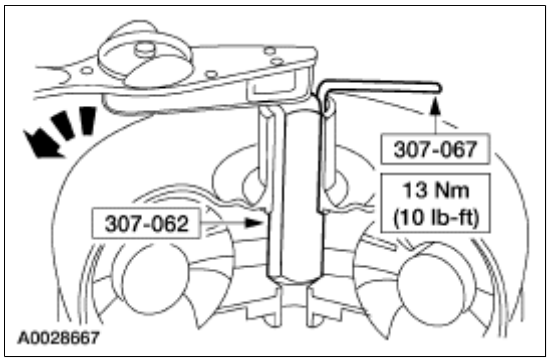


2. Install the special tool in the converter pump drive.



3. Use a torque wrench to turn the special tool counterclockwise while holding the special tool stationary.
    - The converter should lock up and hold torque.

- The torque converter one-way clutch should rotate freely in the clockwise direction.
- Try the clutch for lockup and hold in at least five positions.
- If the torque converter fails the lockup test torque, install a new or remanufactured torque converter.

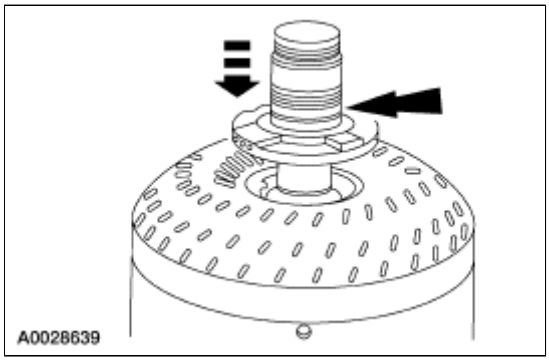


Torque Converter Turbine to Pump Stator Interference Check

1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

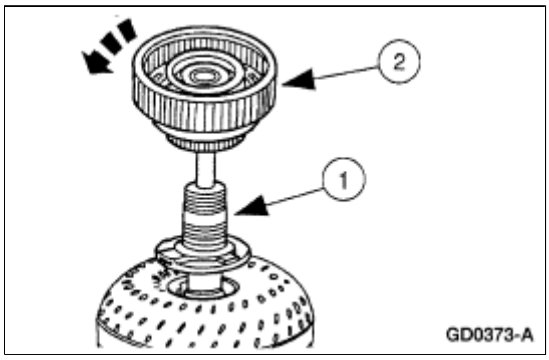
   Position the torque converter with the pump drive up.

2. Install the front pump support to engage the mating splines of the front pump support shaft on the torque converter.



3. Install the forward clutch cylinder and shaft, engaging the splines with the rear clutch hub.

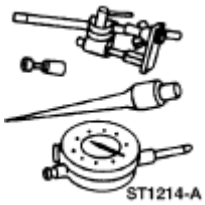
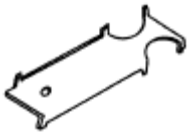
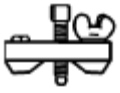
4. Check for stator to turbine interference.
   1. Hold the front pump support stationary.
   2. Attempt to rotate the forward clutch cylinder and shaft.
      - The turbine and torque converter clutch assemblies should rotate in both directions, not exceeding maximum torque of 9.5 Nm (7 lb-ft), without any signs of metallic interference or scraping noise.

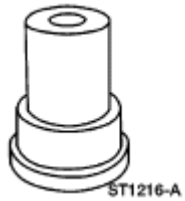
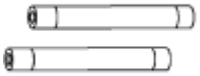


5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
   - The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the torque converter into the crankshaft. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
ST1197-A	Shim Selection Gauge 307-072 (T80L-77003-A)
 ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)

 ST1216-A	Remover/Installer, Transmission Extension Housing 307-077 (T80L-77110-A)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
ST1940-A	Test Plate Screw Set, Transmission 307-126 (T82P-7006-C)
ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
ST1188-A	Installer, Transmission Extension Housing Oil Seal 308-002 (T61L-7657-A)
ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Material

Item	Specification
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

CAUTION: Before beginning assembly, carry out and inspect the following:

When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

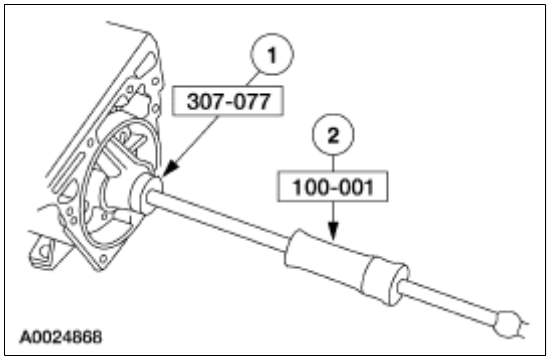
All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

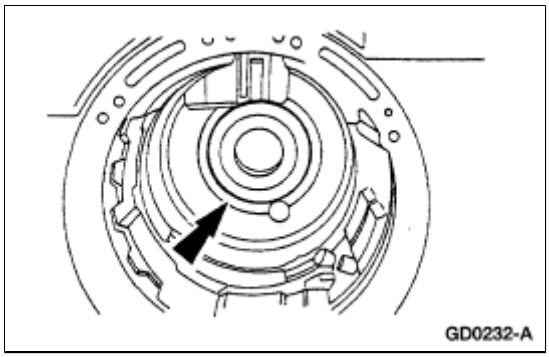
Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

1. Use the special tools to install the rear case bushing if removed.
    1. Position the rear case bushing and the special tool inside the case.
    2. Assemble the special tools through the back of the case.



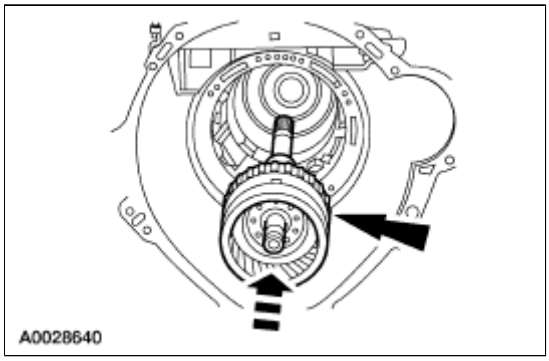
2. Place the transmission in the vertical position.

3. Coat the No. 9 case rear bearing with petroleum jelly and install on the case boss.

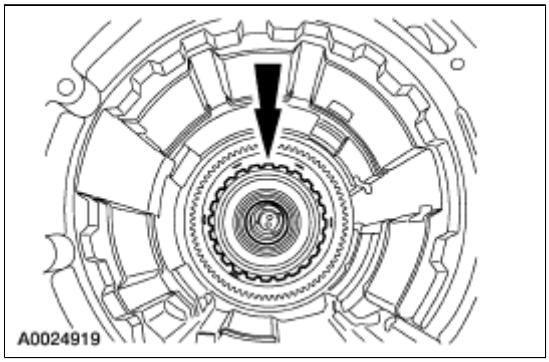


4. **CAUTION: Be sure the No. 7 needle bearing and direct clutch hub are installed as shown in the Subassembly section. Internal damage and shift problems may occur.**

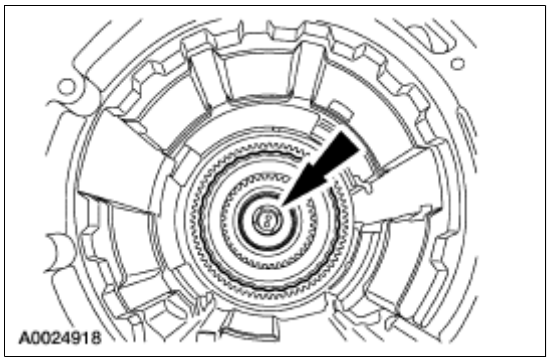
   Install the output shaft and output shaft ring gear.



5. Install the No. 8 bearing.

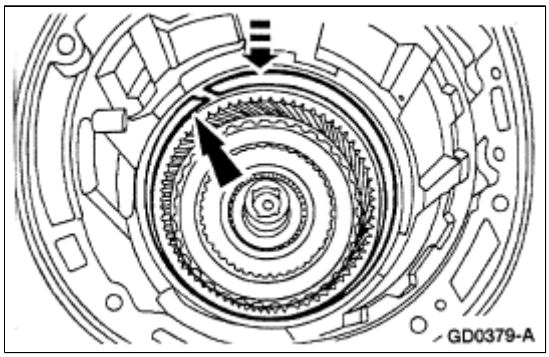


6. Install the direct clutch.



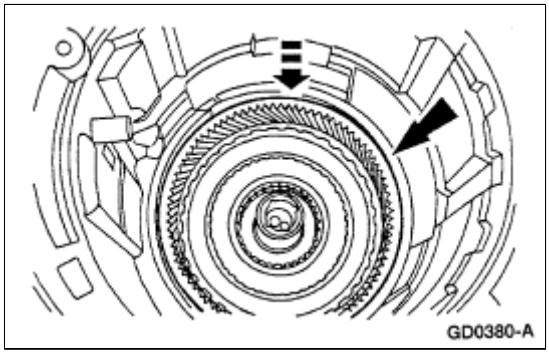
7. **NOTE:** The reverse band support retaining ring is used for assembly purposes during production. The reverse band support retaining ring is not required during assembly and it will not affect the operation of the transmission.

   Install the reverse band support retaining ring.



8. **NOTE:** Make sure the band is seated on the anchor pins.

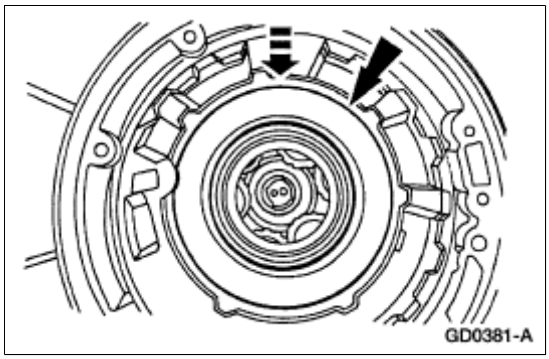
   Install the reverse band.



9. **NOTE:** The planetary assembly and planetary gear support cannot be installed unless the notch cut in the planetary gear support is aligned with the overdrive band anchor pin.

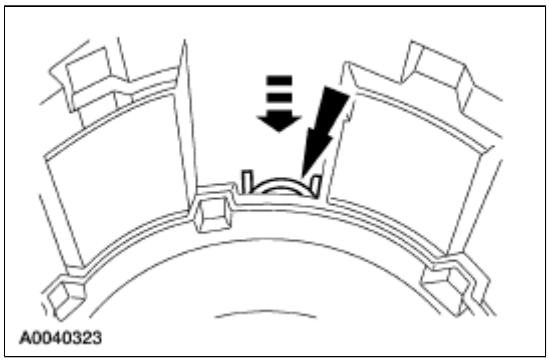
   NOTE: The top of the planetary gear support must be below the snap ring groove.

   Install the planetary assembly and planetary gear support as a unit.
   - Rotate the output shaft to fully seat the planetary assembly.

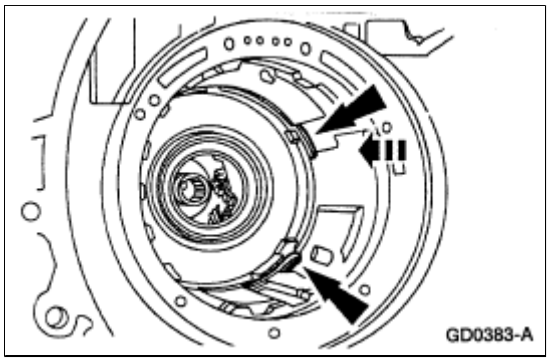


10. **NOTE:** The planet support spring must be compressed and installed below the snap ring groove. When the planet support spring is installed correctly both ends of the spring will be visible.

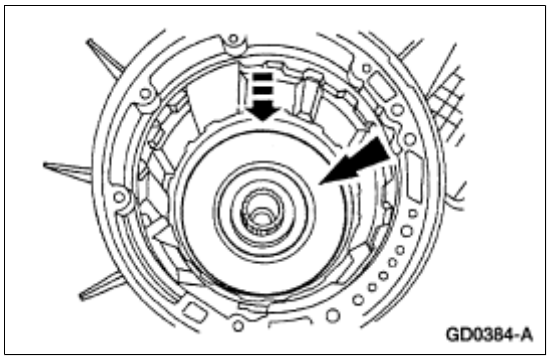
    Install the case to the planet support spring located at the 1 o'clock position.



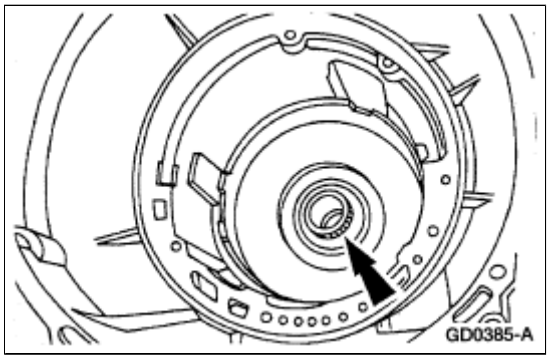
11. Install the center support retaining ring.
    - Reference the retaining ring tabs to the band anchor pin location.



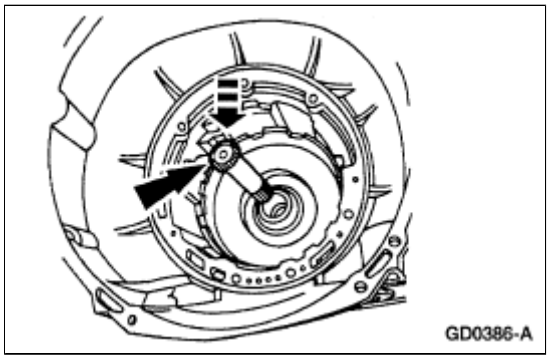
12. Install the forward clutch sun gear, the No. 5 forward clutch sun gear bearing and the reverse sun gear.



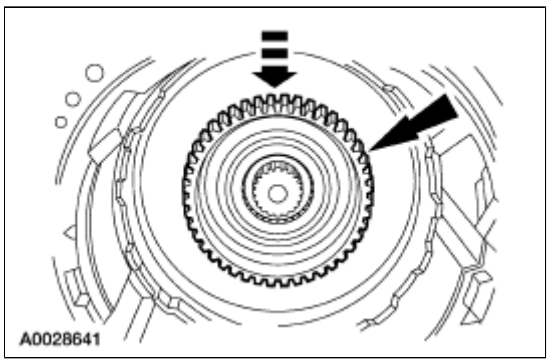
13. Install the No. 4 forward clutch hub bearing.



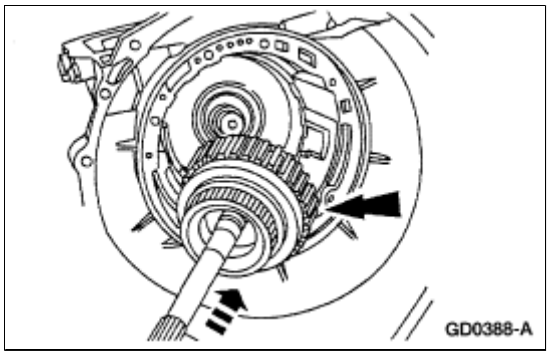
14. Install the intermediate stub shaft.



15. Install the forward clutch hub and the No. 3 forward clutch hub front bearing.

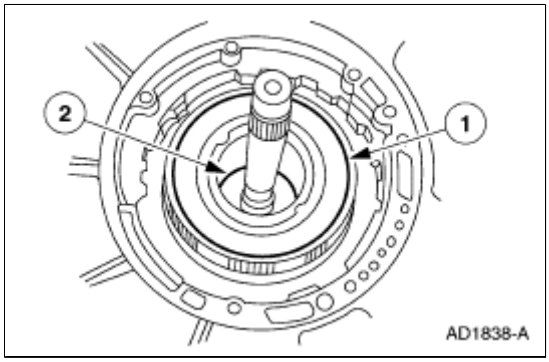


16. Install the forward clutch assembly.

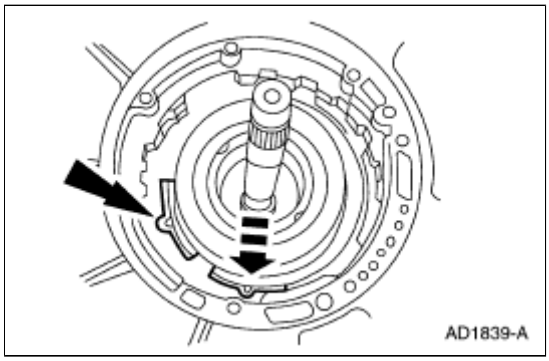


17. **NOTE:** Make sure the reverse clutch cylinder lugs are completely seated in the notches of the reverse sun gear.

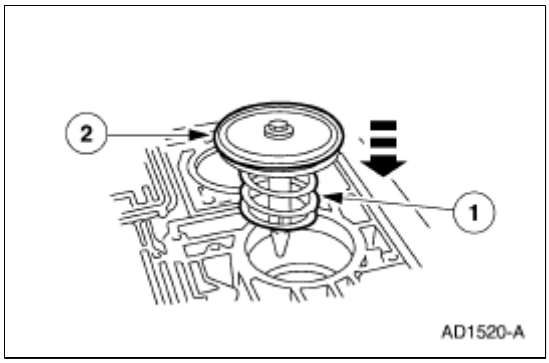
    Install the reverse clutch cylinder assembly.
    1. Install the reverse clutch cylinder.
    2. Install the No. 2 forward clutch bearing.



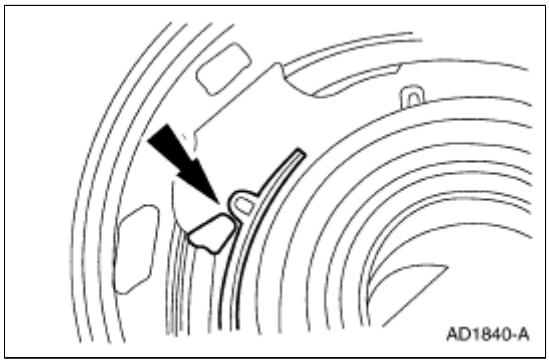
18. Install the overdrive band.
    - Position the overdrive band pocket onto the anchor pin.



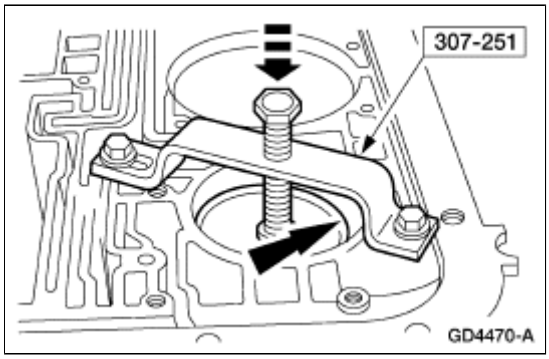
19. Install the overdrive servo spring.
    1. Install the overdrive servo piston return spring.
    2. Install the overdrive servo piston.



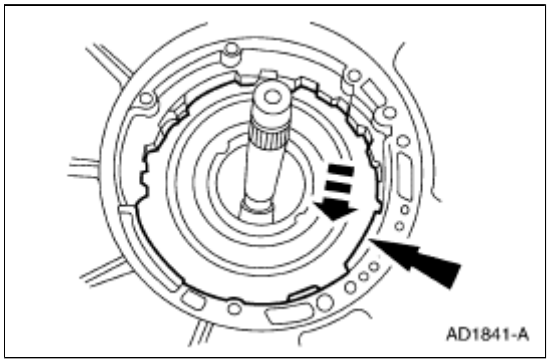
20. Verify the tip of the piston assembly engages the pocket of the overdrive band.



21. Using the special tool, compress the overdrive servo assembly and install the overdrive servo retaining ring.

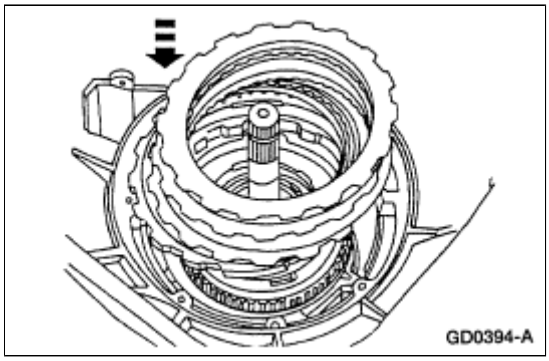


22. Install the intermediate clutch pressure plate.



23. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

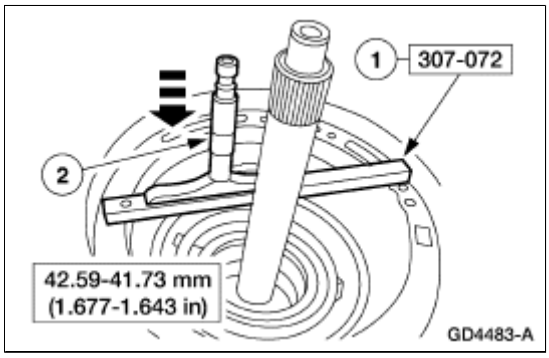
    Install the intermediate clutch pack and selective steel plate.



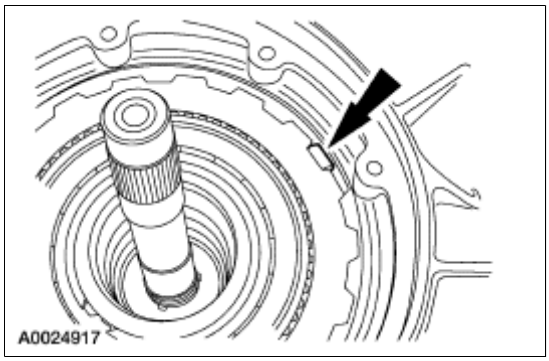
24. Using the special tool, check the intermediate clutch clearance.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure and verify intermediate clutch clearance is within specification.
       If the intermediate clutch is not within specification, install a correct selective plate.

Selective Steel Plates

Specification
1.80-1.70 mm (0.071-0.067 inch)
2.05-1.95 mm (0.081-0.077 inch)
2.31-2.20 mm (0.091-0.087 inch)
2.56-2.46 mm (0.101-0.097 inch)



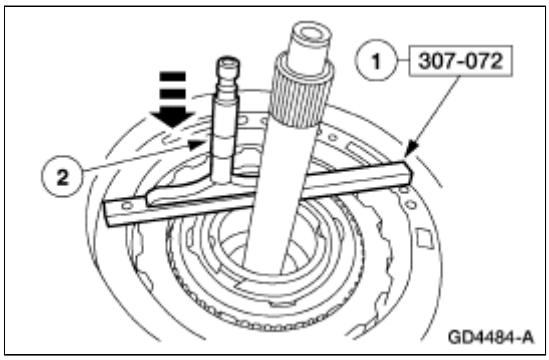
25. Install the intermediate anti-rattle clip, if equipped.



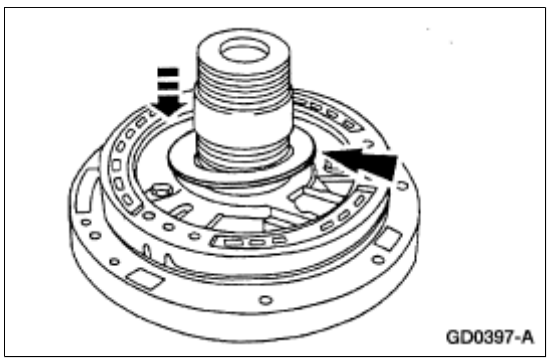
26. Using the special tool, measure end clearance for the No.1 front pump thrust washer.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure end play clearance. Use the No.1 thrust washer chart to select the correct washer.

No.1 Thrust Washer Chart

Depth	Thickness	Color Code
37.706-38.184 mm (1.485-1.503 inch)	1.270-1.372 mm (0.050-0.054 inch)	Green
38.185-38.641 mm (1.504-1.521 inch)	1.727-1.829 mm (0.068-0.072 inch)	Yellow
38.642-39.073 mm (1.522-1.538 inch)	2.159-2.261 mm (0.085-0.089 inch)	Natural
39.074-39.505 mm (1.539-1.555 inch)	2.591-2.692 mm (0.102-0.106 inch)	Red
39.506-40.165 mm (1.556-1.581 inch)	3.023-3.124 mm (0.119-0.123 inch)	Blue

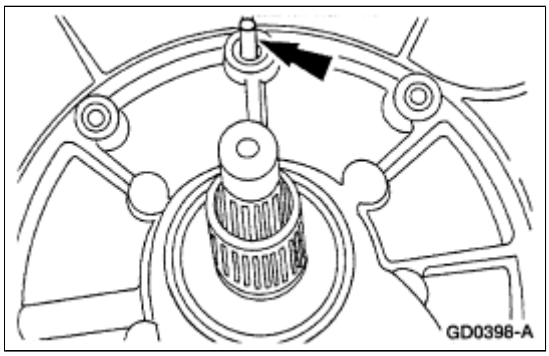


27. Install the No.1 front pump support thrust washer.
    - Use petroleum jelly to hold the washer in place.



28. **NOTE:** The alignment pin is a fabricated M8 x 1.25 mm (0.05 in) bolt with the head removed.

    Install an alignment pin at the top of the case.

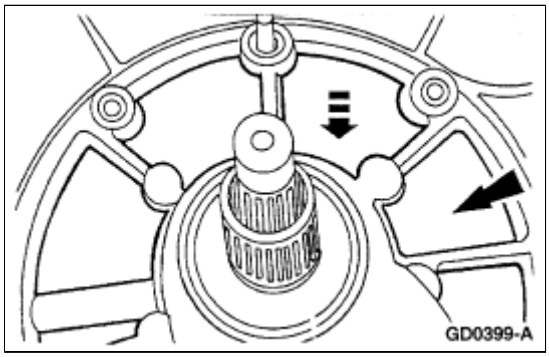


29. **NOTE:** Make sure the gasket is positioned correctly and the case passages are not covered.

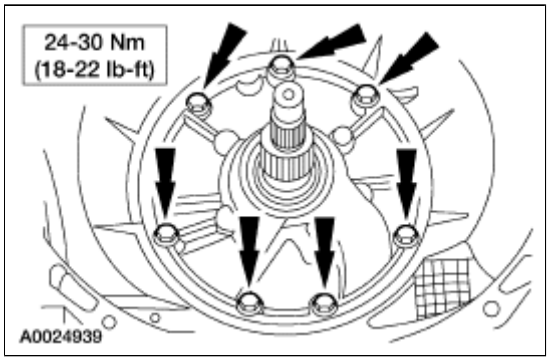
    Install the pump gasket.

30. **NOTE:** To aid assembly, shake the input shaft while pushing down on the pump.

    Install the pump assembly.



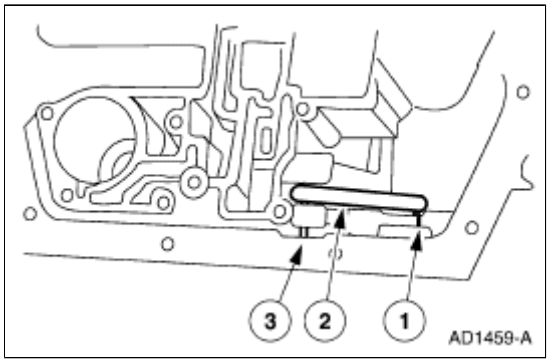
31. Remove the alignment pin and install the front pump bolts.
    - Alternate bolt tightening to set the pump.



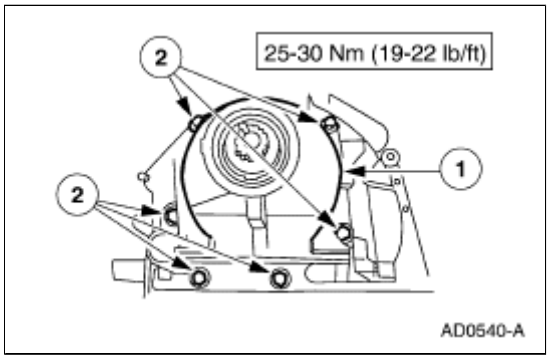
32. Rotate the transmission to the horizontal position.

33. Install the parking pawl.

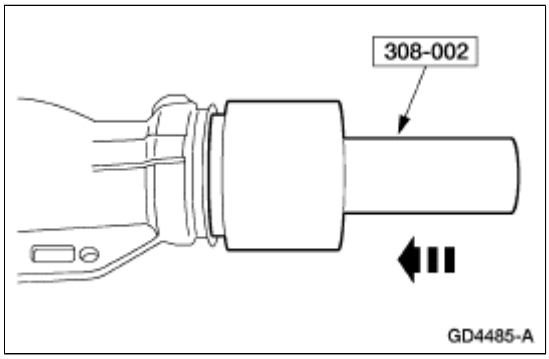
1. Position the parking pawl return spring.
2. Position the parking pawl.
3. Install the parking pawl shaft.



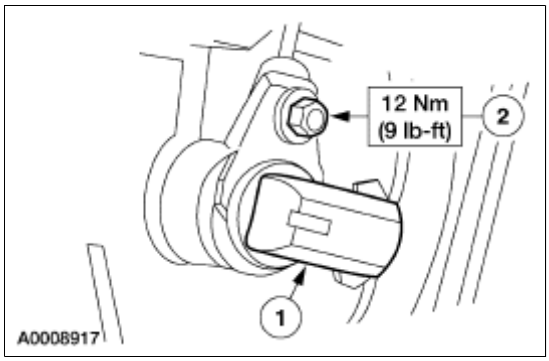
34. Install a new extension housing gasket and the extension housing.
    1. Position the extension housing.
    2. Install the four bolts and two nuts.



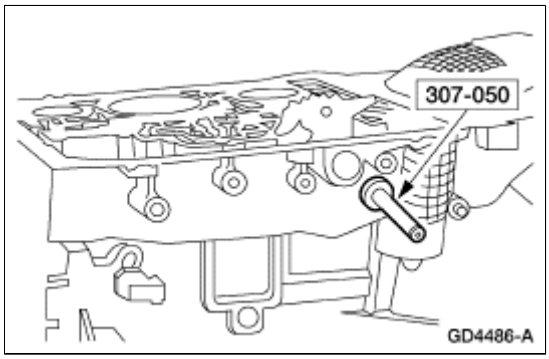
35. Using the special tool, install a new extension housing seal.



36. Install the output shaft speed (OSS) sensor.
    1. Position the OSS sensor.
    2. Install the bolt.

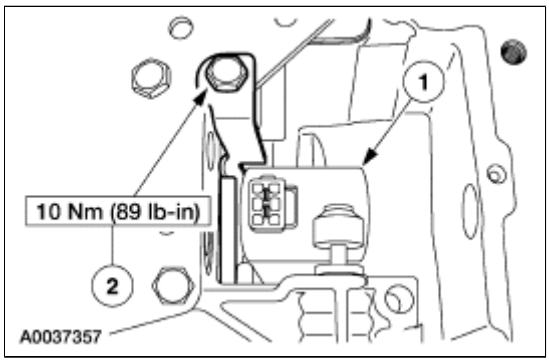


37. Using the special tool, install the manual control lever seal.

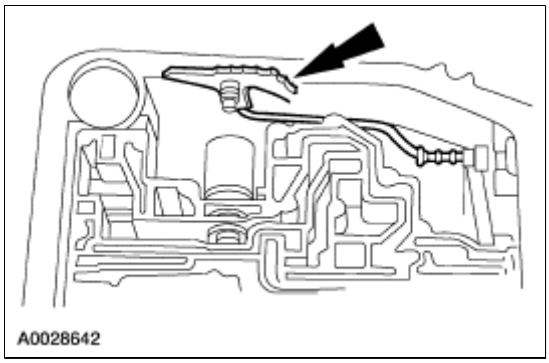


38. **NOTE:** Lubricate the electronic pressure control (EPC) solenoid O-rings with clean automatic transmission fluid.

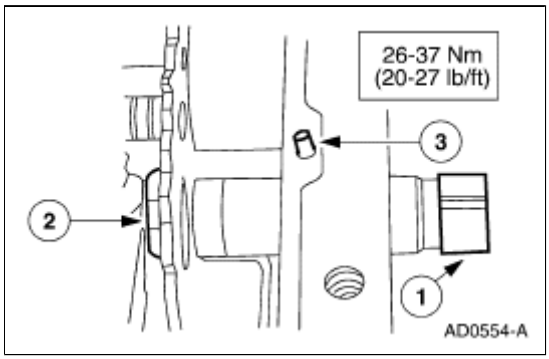
    Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



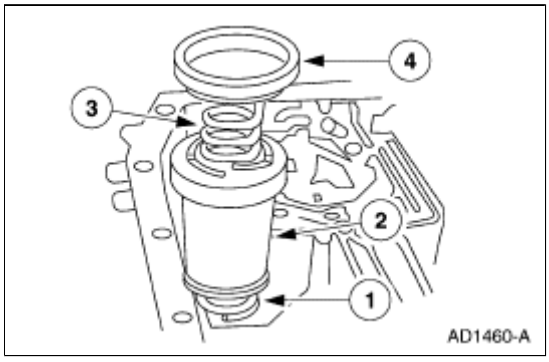
39. Install the manual valve detent lever and parking lever actuating rod.



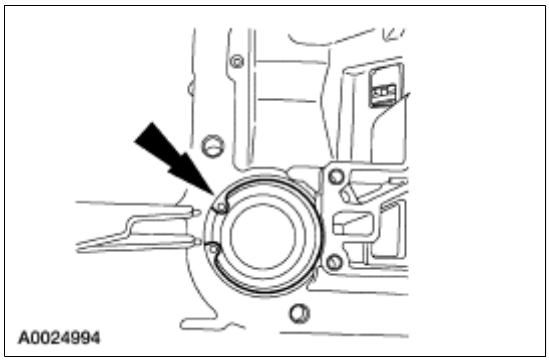
40. Install the manual control lever shaft.
    1. Slide the manual control shaft into the case.
    2. Install the manual lever shaft inner nut.
    3. Install the manual lever shaft retaining pin.



41. Install the 1-2 accumulator piston assembly.
    1. Install the 1-2 accumulator upper spring.
    2. Install the 1-2 accumulator.
    3. Install the 1-2 accumulator lower spring.
    4. Install the 1-2 accumulator cover and seal.



42. Install the 1-2 accumulator retaining ring.

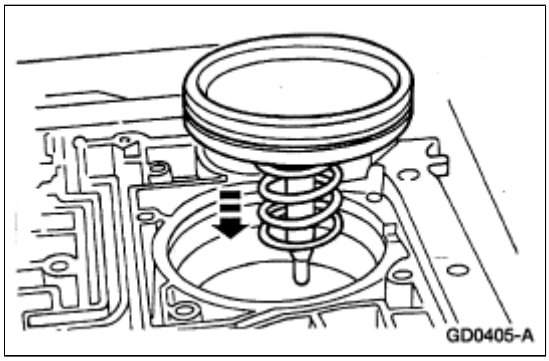


43. **NOTE:** This is not an ordinary installation procedure and does not compensate for band wear. When new piston and rod assembly installation becomes necessary, or when a new reverse band has been installed, the reverse piston and rod length must be adjusted.

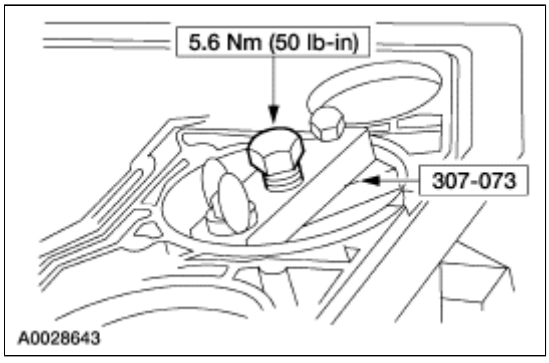
    NOTE: Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

    NOTE: Do not install the reverse servo piston cover and seal at this time.

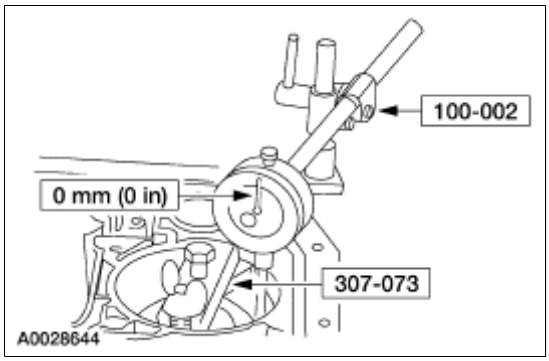
    Install the reverse servo piston and rod assembly.



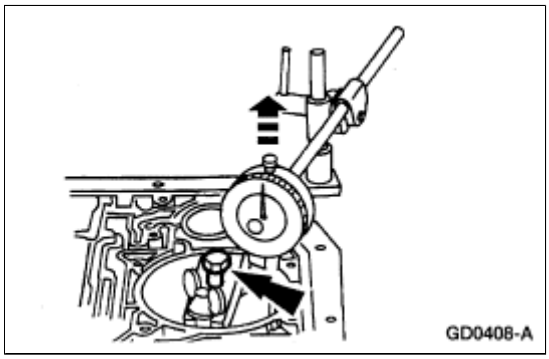
44. Install the special tool.
    - Tighten the bolt.



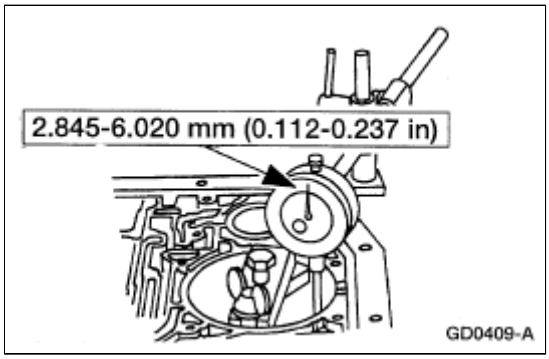
45. Install the special tool.
    - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



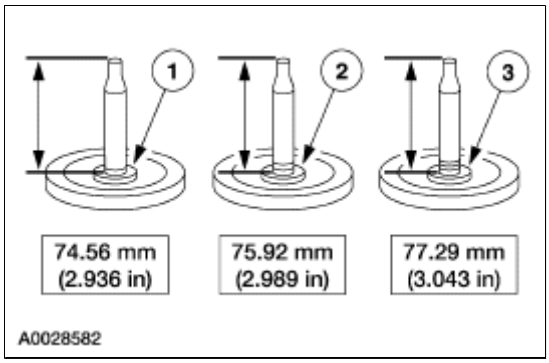
46. Loosen the bolt until the piston stops against the tool.



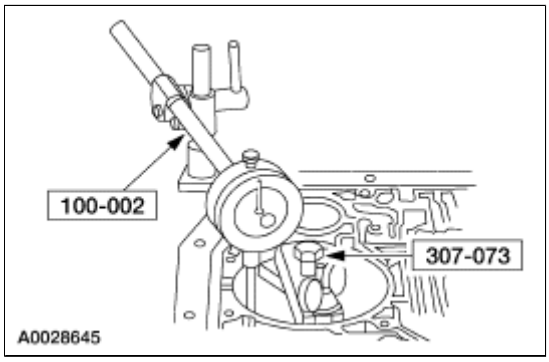
47. Verify that the amount of piston travel on the dial indicator is within specification.



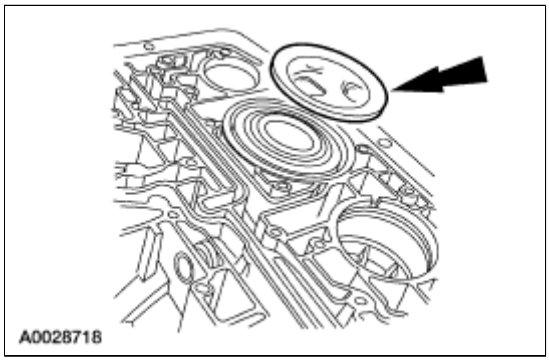
48. If piston travel is not within specification, select and install the correct servo assembly to bring the servo piston travel within specification.
    1. One groove
    2. Two grooves
    3. Three grooves



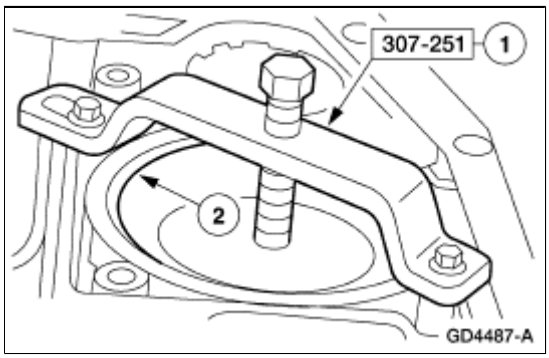
49. Remove the special tools.



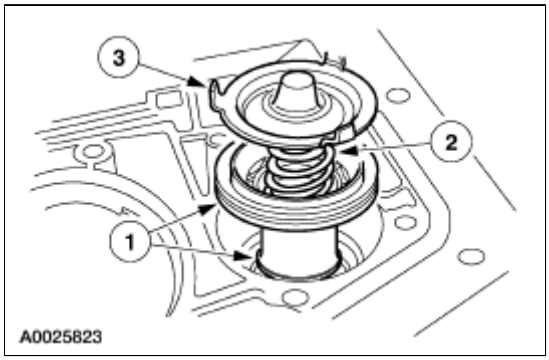
50. Install the reverse servo piston cover and seal assembly.



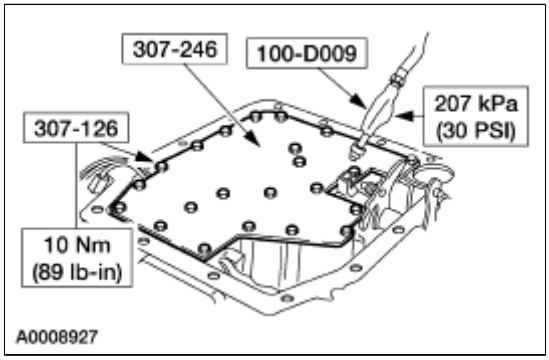
51. Using the special tool, install the reverse servo retaining ring.
    1. Compress the reverse band servo.
    2. Install the reverse band servo retaining ring.



52. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.

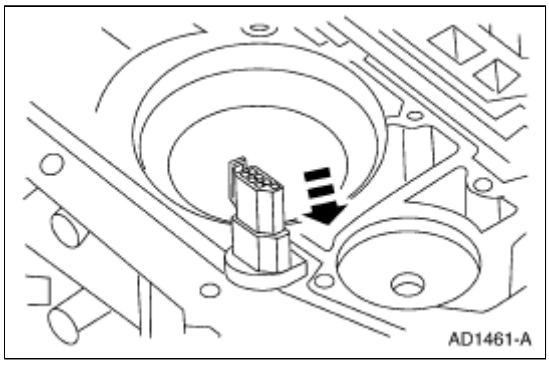


53. Using the special tools apply regulated air pressure to the test ports. Verify that the components are applied and released.



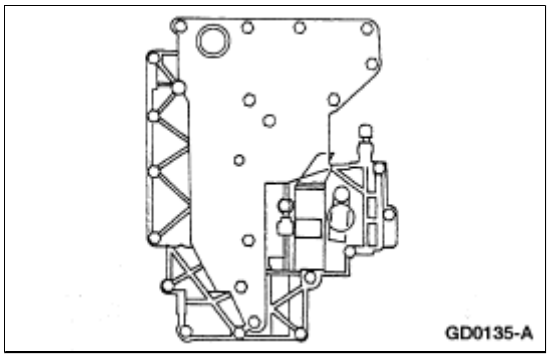
54. **NOTE:** The tab on the electrical connector is secured by main control valve body.

    Install the electrical connector into the case.



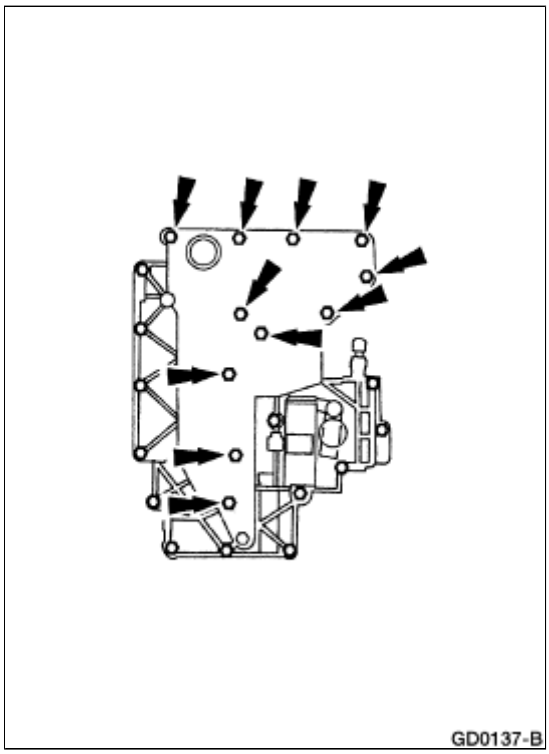
55. **NOTE:** The alignment bolts are valve body assembly bolts and are in the valve body.

    Align the main control valve body alignment bolts and position the main control valve body.



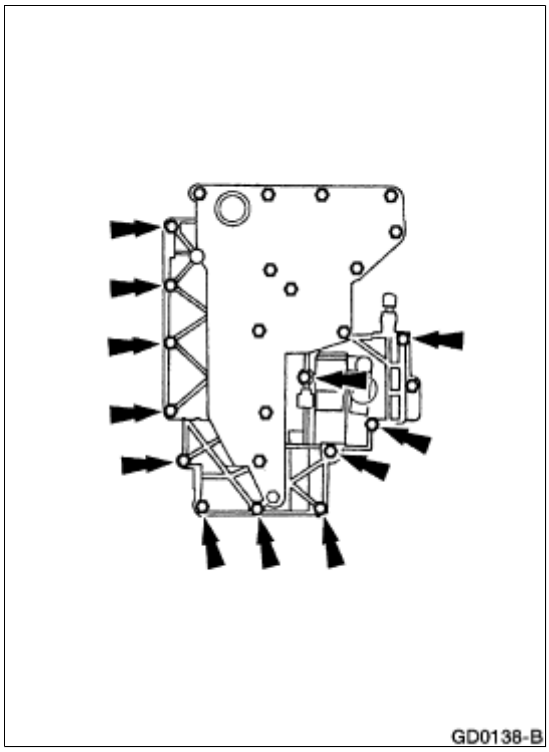
56. **NOTE:** The main control valve body bolts will be tightened in later steps.

    Loosely install the 11 long main control valve body bolts.

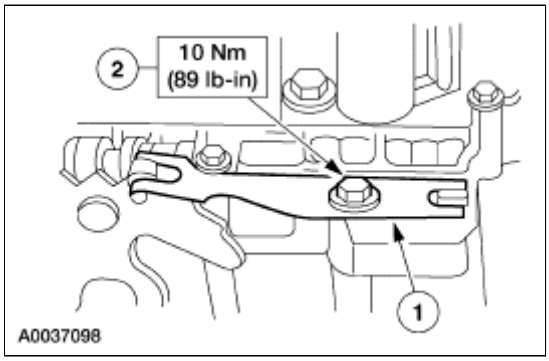


57. **NOTE:** The main control valve body bolts will be tightened in later steps.

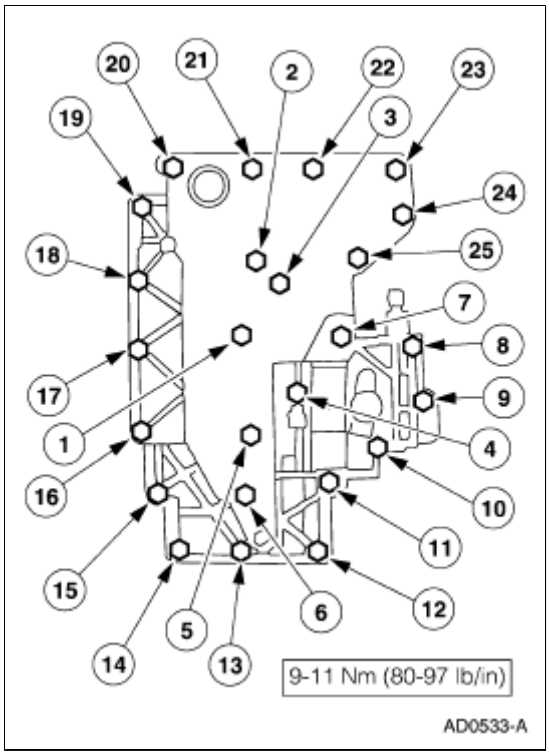
    Loosely install the 12 short main control valve body bolts.



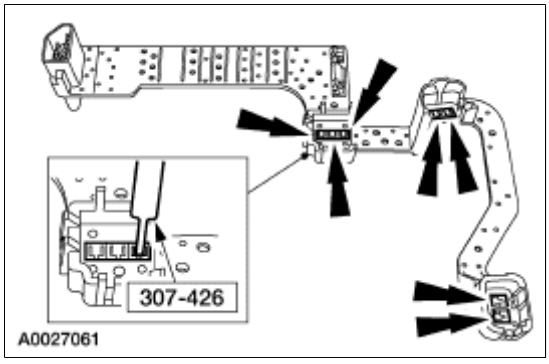
58. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring.
    2. Install the bolt.



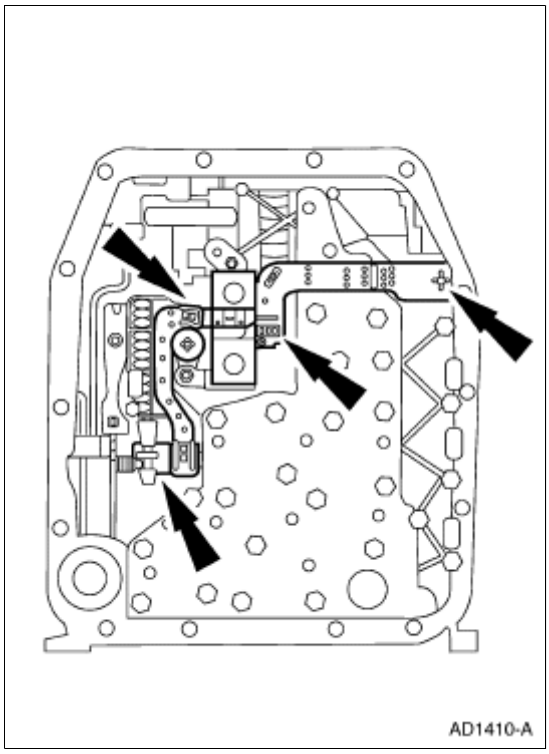
59. Tighten the bolts in the sequence shown.



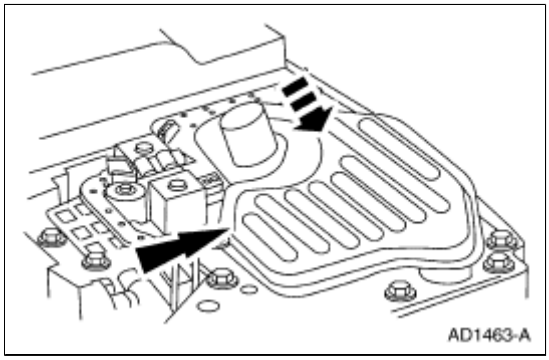
60. Inspect the lead frame for damage.
    - Using the special tool, check all the lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



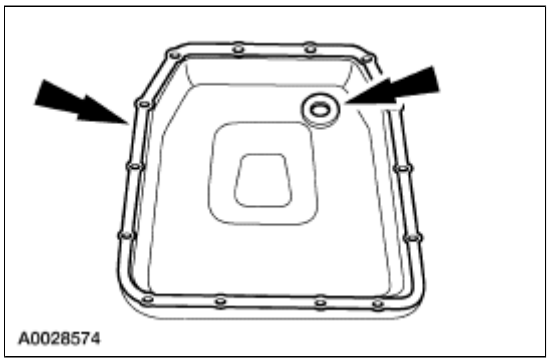
61. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



62. Install the fluid filter and seal assembly.



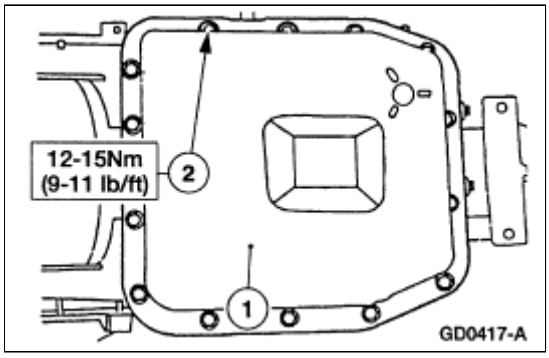
63. Position the pan magnet onto the fluid pan.



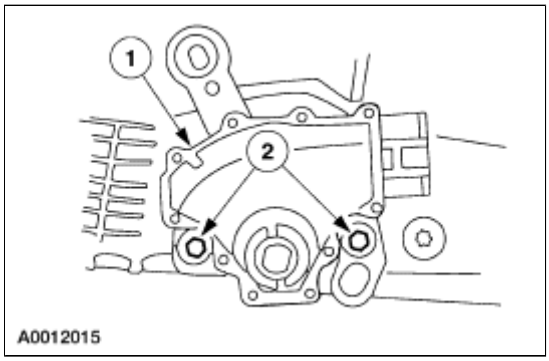
64. **NOTE:** The pan gasket is reusable; clean and inspect for damage. If not damaged, the gasket should be reused.

Install the fluid pan.

1. Position the transmission fluid pan.
2. Install the 14 transmission fluid pan bolts.



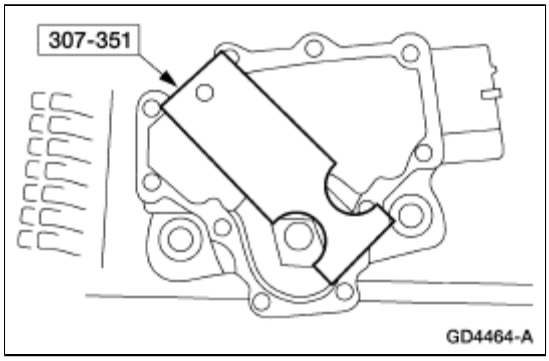
65. Install the digital transmission range (TR) sensor.
    1. Install the digital TR sensor.
    2. Loosely install the digital TR bolts.



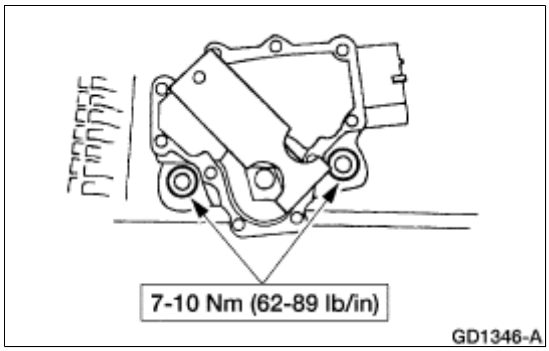
66. **NOTE:** The tool is designed to fit snugly.

    NOTE: Manual shift lever must be in the neutral position.

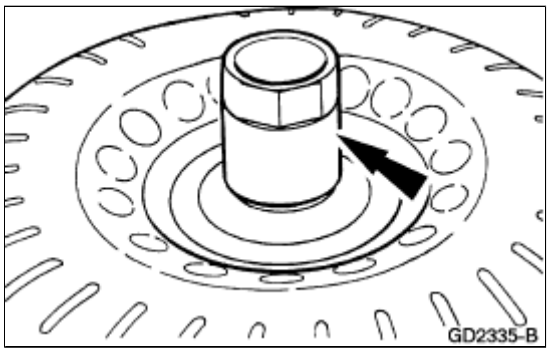
    Using the special tool, align the digital TR sensor slots.



67. Tighten the bolts.



68. Lightly lubricate the converter hub with clean automatic transmission fluid.

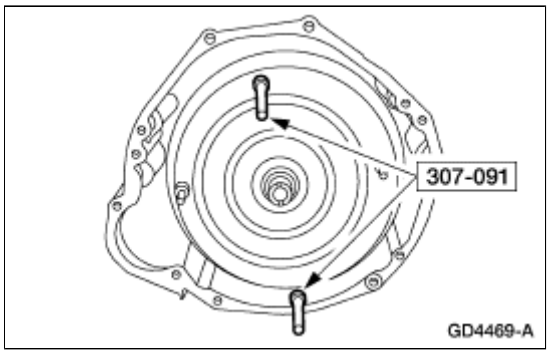


69. **WARNING: The torque converter can fall out if the transmission is tipped.**

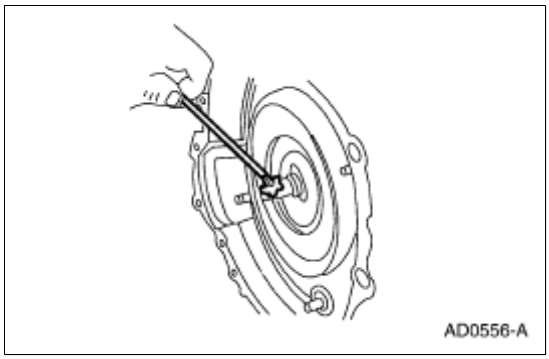
CAUTION: Make sure the converter hub is fully engaged in the front pump support and gear and rotates freely. Do not damage the hub seal.

CAUTION: If the torque converter slides out, the hub seal may be damaged.

Using the special tools, install the torque converter.



70. Lubricate the torque converter pilot hub with multi-purpose grease.


AD0556-A

Transmission

Special Tool(s)

ST1636-A	Torque Converter Holding Tool 307-346 (T97T-7902-A)

Installation

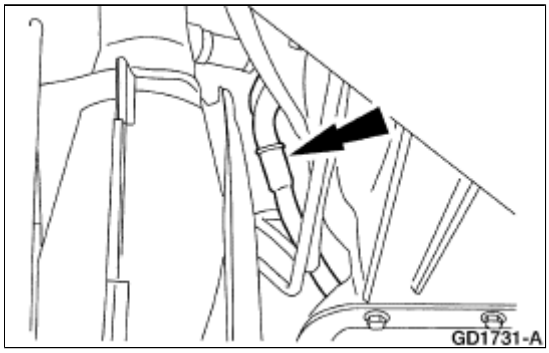
1. **CAUTION: During this move, to avoid damage, do not allow the transmission to get into a nose-down position as this will cause the torque converter to move forward and disengage from the pump gear. The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine.**

   Position and secure the transmission on High-Lift Transmission Jack.
   - Raise and position the transmission into the vehicle.

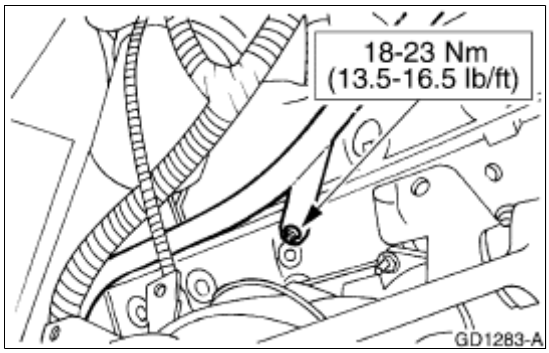
2. **NOTE:** Make sure the torque converter is fully seated in the transmission before aligning the transmission to the engine.

   Align the orange balancing marks between the torque converter studs and the flexplate bolt holes.

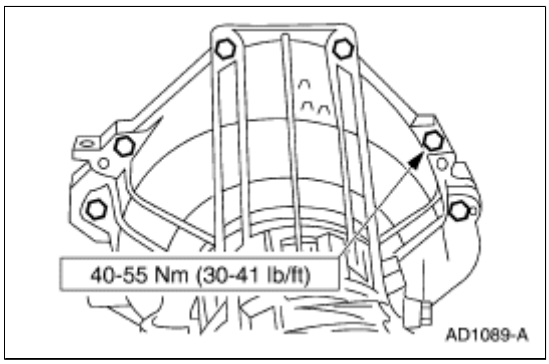
3. Install the transmission fluid fill tube.



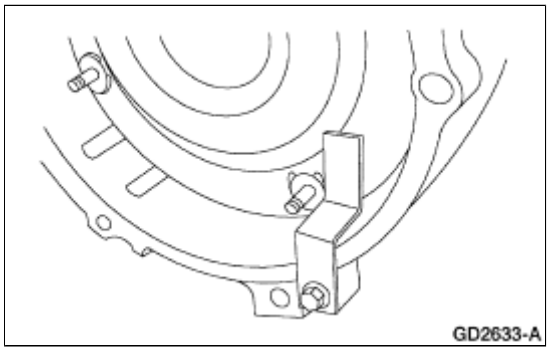
4. Install the bolt on the (RH) side of the cylinder head.



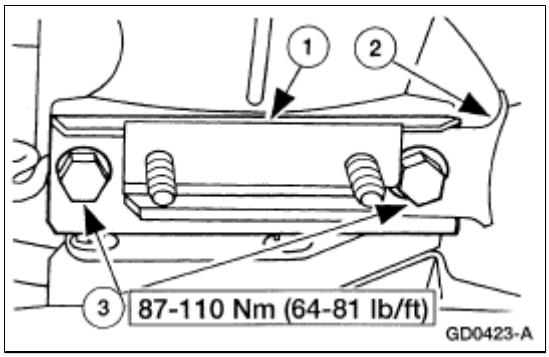
5. Install the six transmission to engine bolts.



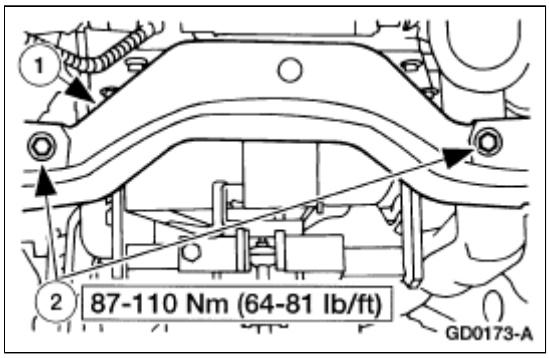
6. Remove the Torque Converter Holding Tool.



7. Install the transmission mount.
    1. Position the transmission mount.
    2. Position the exhaust pipe bracket.
    3. Install the bolts.

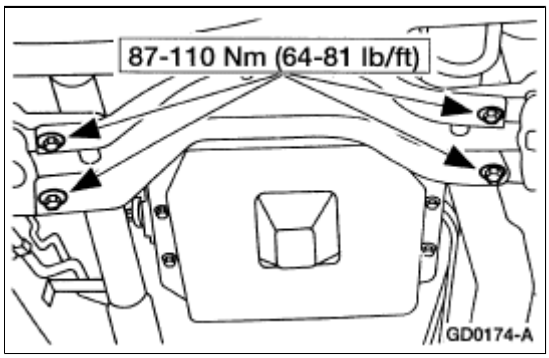


8. Install the rear crossmember.
    1. Position the crossmember.
    2. Install the bolts.

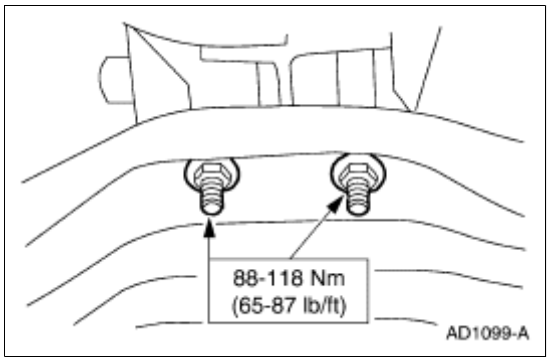


9. Install the exhaust. For additional information, refer to Section 309-00 .

10. Install the bolts.

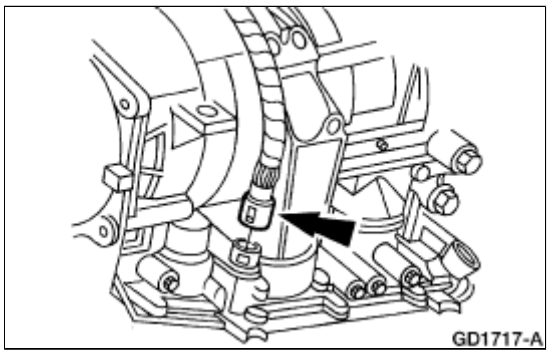


11. Install the two transmission mount nuts.

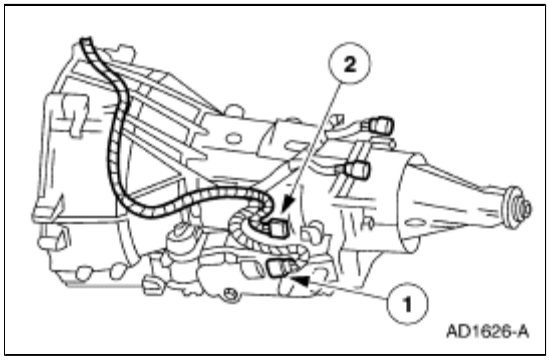


12. Remove the High Lift Transmission Jack.

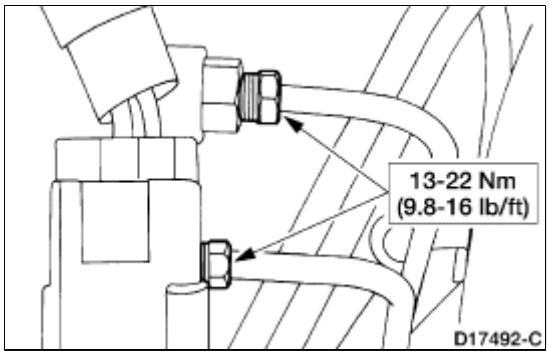
13. Connect the solenoid body assembly electrical connector.



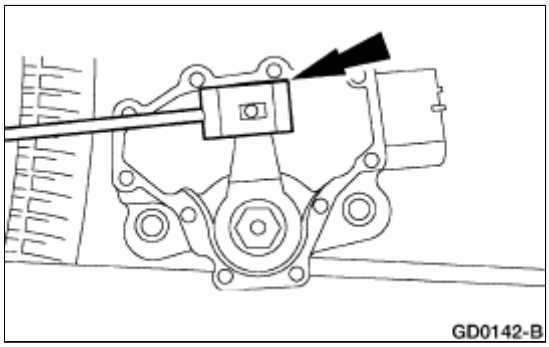
14. Connect the electrical connectors.
    1. Connect the digital transmission range (TR) sensor.
    2. Connect the output shaft speed (OSS) sensor.



15. Connect the transmission coolant lines.

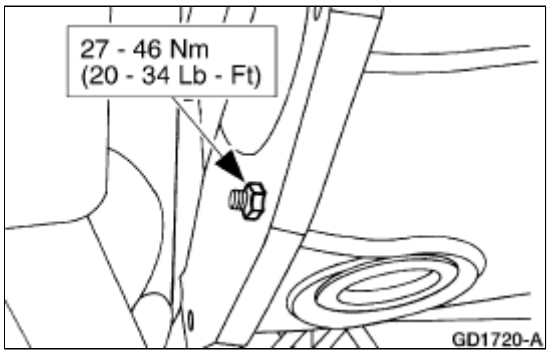


16. Connect the transmission shift linkage.

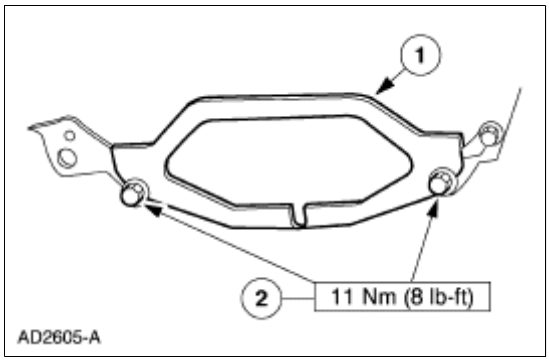


17. Install the starter motor. For additional information, refer to Section 303-06 .

18. Install the four nuts.



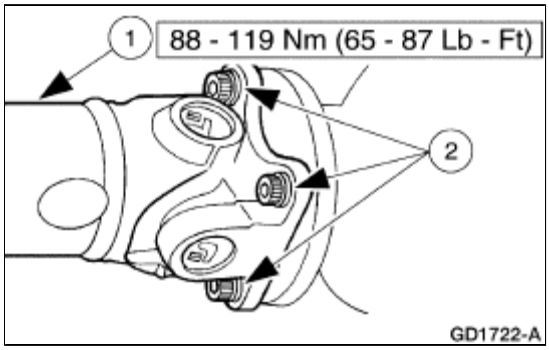
19. Install the transmission inspection cover.
    1. Position the transmission inspection cover.
    2. Install the bolts.



20. On 4WD vehicles install the transfer case. For additional information, refer to Section 308-07B .

21. **NOTE:** To maintain initial driveshaft balance, align the index marks made during removal.

    Install the rear driveshaft.
    1. Position the driveshaft.
    2. Install the four bolts.



22. Lower the vehicle.

23. Connect the battery ground cable.

24. Fill the transmission with fluid and inspect for proper operation.
    - Use MERCON® V (ATF) Transmission Fluid XT-5-QM or equivalent meeting MERCON® V specification.

Fluid Maintenance

CAUTION:Use only MERCON ® V Automatic Transmission Fluid XT-5-QM meeting Ford MERCON ® V specification. Use of any other fluids may result in a transmission malfunction or failure.

Intervals	
Normal Maintenance	Not required. Filled for life.
Special Operating Conditions	Change the fluid at 48,000 km (30,000 miles) intervals. Use MERCON ® V; Automatic Transmission Fluid XT-5-QM meeting Ford MERCON ® V specification. • Sustained high speed driving during hot weather 32°C (90°F) • Towing a trailer for long distances over 1600 km (1000 miles) • Accumulating 8000 km (5000 miles) or more in one month. • Continuous running service.

General Specifications

Vehicle	Engine	Approximate Liters	Refill Capacity [a] U.S. Quarts	Fluid Type
Explorer, Mountaineer— 5R55E (4x2)	4.0L SOHC	9.5	10.0	MERCON ® V XT-5-QM
Explorer — 5R55E (4x2)	4.0L OHV	9.3	9.8	
Explorer — 5R55E (4x4)	4.0L OHV	9.5	10.0	
Explorer, Mountaineer — 5R55E (4x4)	4.0L SOHC	9.8	10.3	MERCON ® V XT-5-QM
Mountaineer — 5R55E (4x2)	4.0L OHV	9.3	9.8	
Mountaineer — 5R55E (4x4)	4.0L OHV	9.5	10.0	

[a] Approximate dry capacity, includes cooler and lines. Fluid level indicator should be used to determine actual fluid requirements and fluid specification. Check the level at normal operating temperature. DO NOT OVERFILL. If it is necessary to add or replace fluid, use only fluid which has been certified by the supplier as meeting the Ford Motor Company specification shown.

General Specifications

Item	Specification
MERCON ® V Automatic Transmission Fluid XT-5-QM	MERCON ® V
Lubricant	
Ford Multi-Purpose Grease D0AZ-19584AA	ESA-M1C45-A

Band/Clutch Application Chart No. 601

Gear	Front Band	Intermediate Band	Low/ Rev-erse Band	Forward Clutch	Direct Clutch	Coast Clutch	Front One-Way Clutch		Rear One-Way Clutch		Engine Braking	TCIL
							Drive	Coast	Drive	Coast		
P											NE	NE
R			A		A		H	OR			NE	NE
N											NE	NE
1st				A			H	OR	H	OR	NO	OFF
1st [a]				A			H	OR	H	OR	NO	ON
2nd [b]	A			A			OR	OR	H	OR	NO	OFF
2nd [a] [b]	A			A			OR	OR	H	OR	NO	ON
3rd		A		A			H	OR	OR	OR	NO	OFF
3rd [a]		A		A			H	OR	OR	OR	NO	ON
4th				A	A		H	OR	OR	OR	NO	OFF
4th [a]				A	A	A	H	OR	OR	OR	YES	ON
5th	A			A	A		OR	OR	OR	OR	NO	OFF
Man 1st			A	A		A	H	OR	H	OR	YES	NE
Man 2nd (3rd gear)		A		A		A	H	OR	OR	OR	YES	NE

[a] Overdrive Cancelled CANCELLED
[b] PCM Controlled

A = Applied

H = Hold

OR = Overrunning

NE = No Effect

Selective Snap Rings

Coast and Reverse Clutch Drum					Forward Clutch Cylinder				
	Thickness		Diameter			Thickness		Diameter	
Part Number	mm	inch	mm	inch	Part Number	mm	inch	mm	inch
E860126-S	1.37	0.0539	130.1	5.122	E860115-S	1.37	0.0539	125.1	4.925

E860127-S	1.73	0.0681	130.1	5.122	E860116-S	1.73	0.0681	125.1	4.495
E860128-S	2.08	0.0819	130.1	5.122	E860117-S	2.08	0.0819	125.1	4.925
E860129-S	2.44	0.0961	130.1	5.122	E860118-S	2.44	0.0961	125.1	4.925

Service Identification Model Chart

Vehicle Application			
7000 Prefix and Suffix	**C=Column F=Floor**	**Engine Displacement**	**Vehicle Application**
XL2P-EA	C	4.0L EI	Explorer (4x2)
XL2P-FA	C	4.0L EI	Explorer (4x4)
XL2P-CA	C	4.0L (SOHC)	Explorer, Mountaineer (4x2)
XL2P-DA	C	4.0L (SOHC)	Explorer, Mountaineer (4x4)

Reference: Line Pressure Chart

			Idle 1000 RPM		WOT Stall	
Trans.	**Transmission Model/Application**	**Range**	**EPC**	**Line**	**EPC**	**Line**
5R55E	4.0L EI	R	55-65	175-215	112-134	282-350
	Explorer/Mountaineer	N	20-40	75-120		
	4x2, 4x4	(D) 2, 1	25-35	80-110	112-134	228-263
5R55E	4.0L SOHC	R	55-65	175-215	112-134	282-350
	Explorer/Mountaineer 4x2/4x4	N	20-40	75-120		
		(D), 2, 1	40-50	100-135	112-134	228-263

Clutch Plate Usage And Clearance Specifications

				Selective Snap Rings	
Clutch	**Steel**	**Friction**	**Clearance**	**Part Number**	**Thickness**
Forward Clutch (4.0L)	6	6	1.397-2.108 mm (0.055-0.083 in)	E860115-S	1.37 mm (0.0539 in)
				E860116-S	1.73 mm (0.0681 in)
Forward Clutch (2.5L, 3.0L)	5	5		E860117-S	2.08 mm (0.0819 in)
				E860118-S	2.44 mm (0.0961 in)
Direct Clutch			1.295-2.006 mm (0.051-0.079 in)	E860126-S	1.37 mm (0.0539 in)
4.0L SOHC use 1.71 mm (0.06 in)	5	5		E860127-S	1.73 mm (0.0681 in)
EI and all others use 2.14	4	4		E860128-S	2.08 mm (0.0819

mm (0.08 in)					in)
				E860129-S	2.44 mm (0.0961 in)
Coast Clutch	2	2	1.295-2.006 mm (0.051-0.079 in)	E860126-S	1.37 mm (0.0539 in)
				E860127-S	1.73 mm (0.0681 in)
				E860128-S	2.08 mm (0.0819 in)
				E860129-S	2.44 mm (0.0961 in)

Stall Speed

Vehicle	Engine	Rpm
Explorer	4.0 EI	2610-2983
Explorer, Mountaineer	4.0 SOHC	2632-3114

Shift Speeds — KM/H (MPH)

NOTE: Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application) refer to the Automatic Transmission Specification booklet.

Throttle Position	Range	Shift	MPH	KM/H
Closed Throttle	(D)	3-2	11-19	18-31
	(D)	2-1	6-16	10-26
Minimum Throttle (TP Voltage 1.25 Volts)	(D)	1-3	36-79 [a]	58-127
	(D)	1-2	11-13	18-21
	(D)	2-3	15-38	24-61
	(D)	3-4	16-47	26-76
	(D)	4-5	39-71	63-114
	(D)	5-4	39-49	63-79
	(D)	4-3	17-30	27-48
	(D)	3-2	10-22	16-35
	(D)	2-1	6-12	10-19
Wide Open Throttle	(D)	1-2	18-80	29-129
	(D)	2-3	55-94	88-151
	(D)	3-4	72-108	116-174
	(D)	4-5	100-134	161-216
	(D)	5-4	88-119	142-192
	(D)	4-3	66-96	106-154

	(D)	3-2	33-67	53-108
	(D)	2-1	25-40	25-64

[a] The 5R55E 4.0L EI will shift 1-3 at minimum throttle. At medium throttle the transmission will resume a normal shift pattern 1-2, 2-3, 3-4, 4-5.

Band Adjustment And Torque Chart

Description	Number of Turns To Back Off	Locknut		Adjusting Screw	
		Nm	Lb-Ft	Nm	Lb-Ft
Intermediate Band	2.0	47-61	35-45	14	10
Front Band	2.0	47-61	35-45	14	10

End Play Specifications

Transmission Front End Play Dimension "C"	Select Thrust Washer (No. 1 Nylon)		Identification: Color
	Part Number	Thickness	
Front No. 0.4 in (10 mm) (0.007-0.028 in) Without Gasket	F7TZ-7D014-VA F7TZ-7D014-TA F7TZ-7D014-MA F7TZ-7D014-NA F7TZ-7D014-PA F7TZ-7D014-RA F7TZ-7D014-SA	1.35-1.40 mm (0.053-0.055 in) 1.55-1.60 mm (0.061-0.063 in) 1.75-1.80 mm (0.069-0.071 in) 1.85-1.90 mm (0.073-0.075 in) 1.95-2.00 mm (0.077-0.079 in) 2.05-2.10 mm (0.081-0.083 in) 2.15-2.20 mm (0.085-0.087 in)	Blue White Green Red Beige Black Yellow

End Play Specifications

Rear (No. 4) Dimension "H"	Selective Needle Bearings (No. 4)		Identification: Notches
	Part Number	Thickness	
3.01-3.15 mm (0.119-0.124 in)	XW4Z-7D014-CA	2.65-2.80 mm (0.104-0.110 in)	0
3.17-3.34 mm (0.125-0.132 in)	XW4Z-7D014-DA	2.80-2.95 mm (0.110-0.116 in)	1
3.36-3.54 mm (0.133-0.140 in)	XW4Z-7D014-EA	3.00-3.15 mm (0.118-0.124 in)	2
3.57-3.71 mm (0.141-0.147 in)	XW4Z-7D014-FA	3.20-3.35 mm (0.126-0.132 in)	3
Rear No. 4 Reference End Play 0.20-0.54 mm (0.008-0.021 in)			

Torque Converter End Play

Transmission Model	Converter End Play			
	New or Rebuilt Converter		Used Converter	
	mm	inch	mm	inch
5R55E	0.58 max.	0.023 max.	1.27 max.	0.050 max.

Solenoid Application Chart

Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55E Solenoid States				
		SSA	SSB	SSC	SSD	Engine Braking
P/N	P/N	On	Off	Off	Off	No
R	R	On	Off	Off	Off	No
(D) (Overdrive)	1	On	Off	Off	Off	No
(D)	2 [2]	On	Off	On	Off	No
(D)	3	On	On	Off	Off	No
(D)	4	Off	Off	Off	Off	No
(D)	5	Off	Off	On	Off	No
Drive	1	On	Off	Off	Off	No
	2 [2]	On	Off	On	Off	No
	3	On	On	Off	On [2]	No
	4	Off	Off	Off	On	Yes
2	3	On	On	Off	On	Yes
1	1	On	Off	Off	On	Yes

[2] PCM Controlled
[2] On time calibration dependent

Torque Specifications

Description	Nm	lb-ft	lb-in
Catalytic converter-to-exhaust pipe nuts and bolts	34-46	25-34	—
Catalytic converter-to-crossover pipe nuts	34-46	25-34	—
Center support capscrew	9-13	—	80-115
Converter housing screws	36-52	27-39	—
Converter housing-to-engine screws	40-55	30-41	—
Crossmember screws	85-118	63-87	—
Crossmember nuts	88-115	65-85	—
Digital transmission range (TR) sensor screws	8-11	—	71-97
Extension housing screws and studs	36-52	27-39	—
Fluid pump screws	22-28	16-21	—

Front band locknut	47-61	35-45	—
Intermediate band locknut	47-61	35-45	—
Low/reverse servo cover screws	12-14	—	106-124
Main control valve body screws	8-11	—	71-97
Manual control outer lever nut	41-54	30-40	—
Manual valve detent spring screw	8-11	—	71-97
Manual valve inner lever nut	41-54	30-40	—
Output shaft speed sensor (OSS) sensor screw	8-11	—	71-97
Pressure plug to case (line and EPC)	8-12	—	71-106
Rear driveshaft screws	95-129	70-95	—
Separator plate screws	6-8	—	53-71
Solenoid clamp screws	6-8	—	53-71
Torque converter-to-flexplate nuts	30-40	22-30	—
Transmission cooler lines to case connectors	35-43	26-32	—
Transmission cooler line nut	24-31	18-23	—
Transmission fluid filter screws	8-11	—	71-97
Transmission fluid pan screws	13-15	—	115-132
Transmission servo heat shield nut	8-11	—	71-97
Transmission servo heat shield stud	12-16	—	106-142
Transmission mount nuts to crossmember	87-110	64-81	—
Transmission mount-to-extension housing screws	87-110	64-81	—
Turbine shaft speed (TSS) sensor screw	8-11	—	71-97
Transmission servo heat shield stud	12-16	—	106-142

Transmission Description

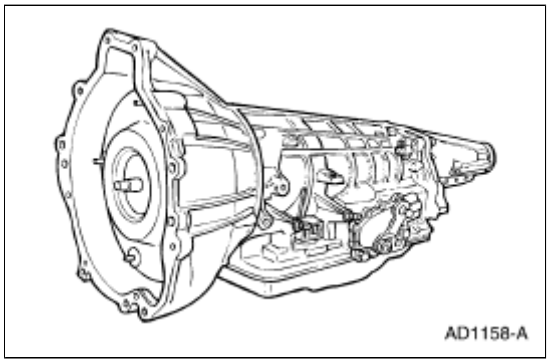
The 5R55E has the following features:

- Five forward speeds.
- Electronic shift, pressure, and torque converter clutch controls.
- Three compound planetary gearsets.
- Three bands.
- Three multi-plate clutches.
- Two one-way clutches.

All hydraulic functions are directed by electronic solenoids to control:

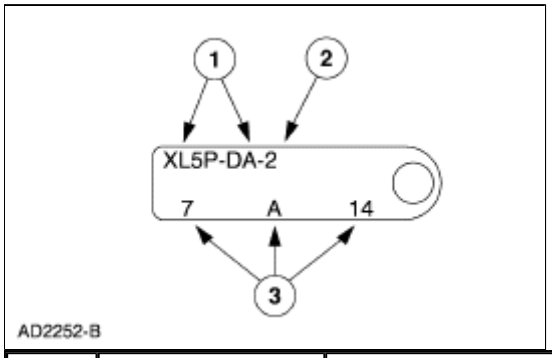
- Engagement feel.
- Shift feel.
- Shift scheduling.
- Modulated torque converter clutch (TCC) applications.
- Timing of the 3-2 torque demand and kickdown shifts.
- Engine braking (with O/D canceled) utilizing the coast clutch.
- Manual 1st timing.

Transmission View



Identification Tags

I. D. Tag Located on Transmission Case

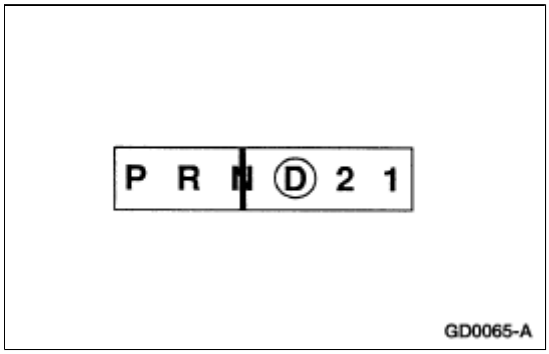


Item	Part Number	Description
1	—	Assembly Part No. Prefix and Suffix
2	—	Line Shift Code
3	—	Build Date Code (Year, Month, Day)

All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. Refer to the code in the space marked TR. For service ID level or build date information, refer to the transmission service ID tag located on the transmission case.

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- There is no power flow through the transmission.
- The parking pawl locks the output shaft to the case.
- The engine may be started.
- The ignition key may be removed.

Reverse

In the REVERSE position:

- The vehicle may be operated in a rearward direction, at a reduced gear ratio.

Neutral

In the NEUTRAL position:

- There is no Power flow through the transmission.
- The output shaft is not held and is free to turn.
- The engine may be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- Automatic shifts.
- Apply and release of the torque converter clutch.
- Maximum fuel economy during normal operation.

- Automatic shift 1-4 with O/D canceled.
- Engine braking with coast clutch applied in 1, 3 and 4.

2nd Position—3rd Gear

The 2nd position provides:

- Third gear start and hold.
- The torque converter clutch may apply and release.
- Improved traction on slippery roads.
- Engine braking.

Manual Low Position

If this position is selected at normal road speeds, the transmission will shift into third gear, then into first when the vehicle reaches a speed below approximately 48 km/h (30 mph).

This position provides:

- First gear operation only.
- Engine braking for descending steep grades.

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module (PCM) (12A650). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever (7210)). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

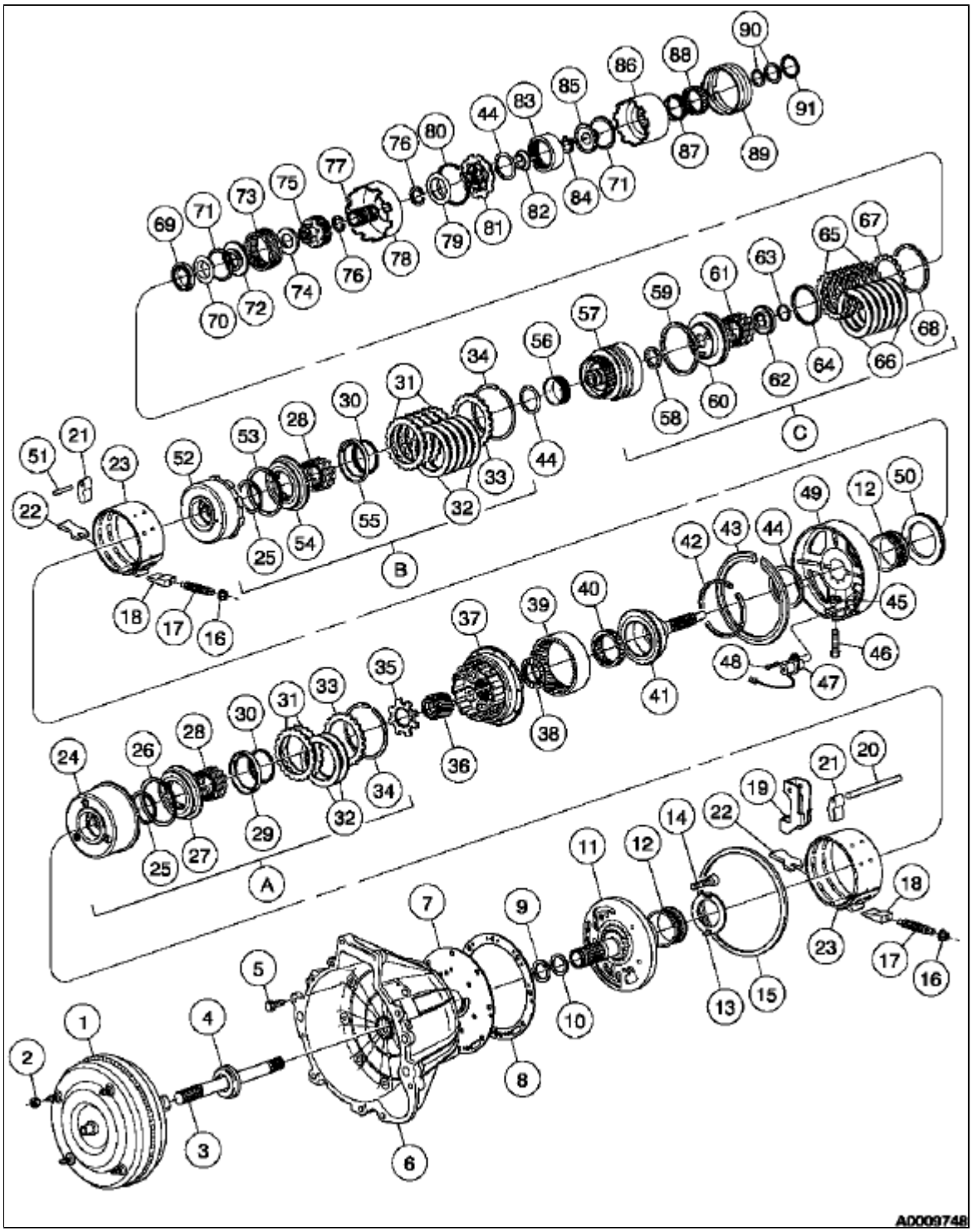
Torque Demand

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

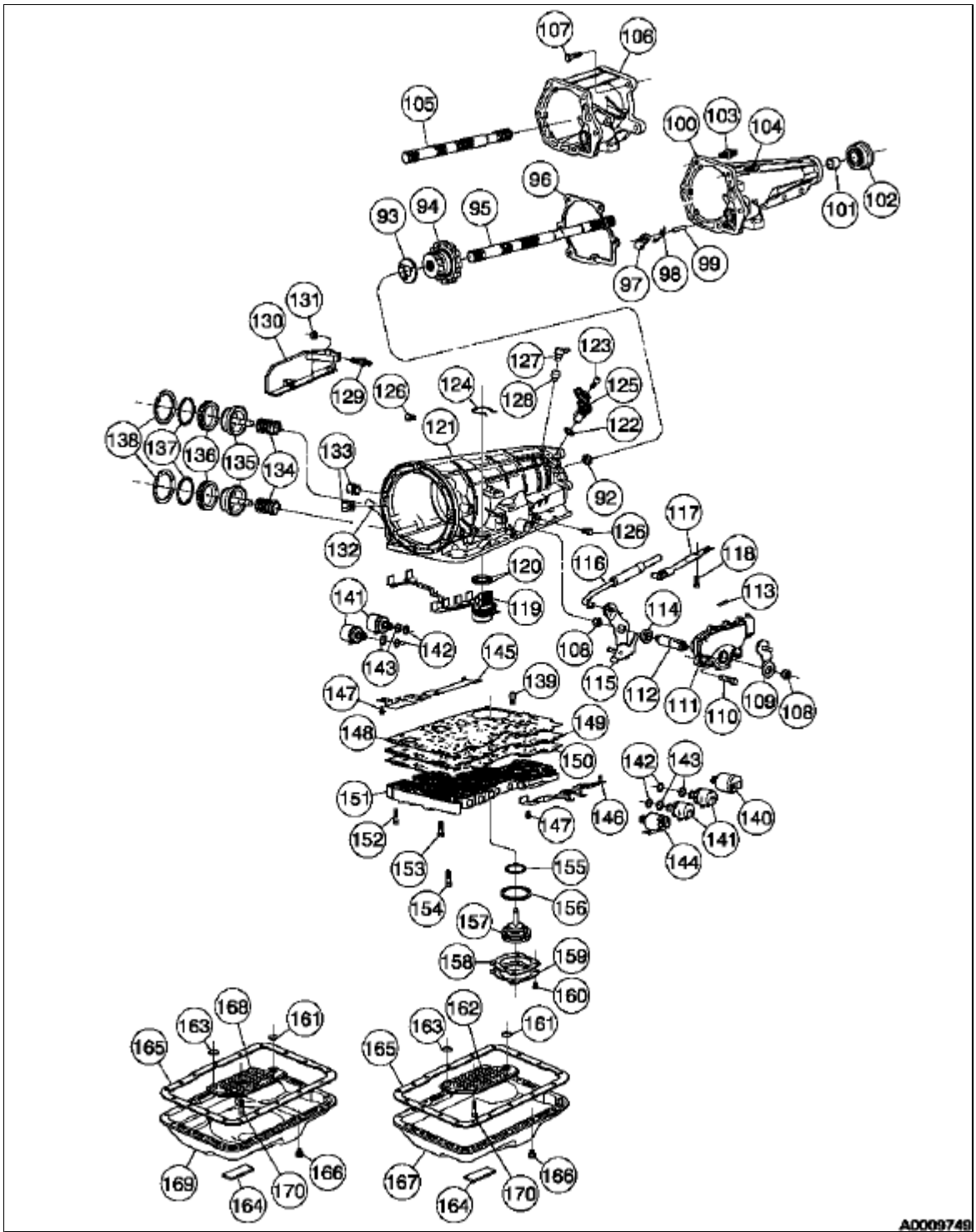
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Disassembled Views



Disassembled Views



Item	Part Number	Description
1	7902	Converter assembly — (contains piston type clutch)
2	379299-S2	Nut — (attaches converter assembly to flexplate) (4 req'd)
3	7017	Shaft — input
4	7A248	Seal assembly — converter hub to converter

		housing (also in converter housing assembly)
5	E804595	Screw and seal assembly — M10 x 33 (attaches converter housing to case) (8 req'd)
6	7976	Converter housing
7	7B472	Plate — fluid pump adapter
8	7A136	Converter housing-to-case gasket
9	7L323	Seal ring — fluid pump support
10	W701431-S300	O-ring — fluid pump shaft to inner gear (also in pump assembly)
11	7M205	Fluid pump assembly
12	7M155	Bearing assembly
13	7D014	Washer — fluid pump input thrust (select fit) No. 1
14	W701429-S309M	Screw, fluid pump-to-converter housing (6 req'd)
15	7A248	Seal ring — fluid pump
16	E825100-S100	Nut and seal assembly — hex intermediate and front band adjustment/lock (2 req'd)
17	7C492	Screw — intermediate and front band adjuster/lock (2 req'd)
18	7D430	Strut — intermediate and front band anchor (2 req'd)
19	7A653	Bracket — front band lever to case
20	7D433	Shaft — front band actuating lever
21	7330	Lever — intermediate and front band servo (2 req'd)
22	7D029	Strut — intermediate and front band apply (2 req'd)
23	7D034	Band assembly — intermediate and front (2 req'd)
24	7L669	Drum assembly — front brake and coast clutch
25	7D404	Seal ring — coast clutch and direct clutch piston — inner (2 req'd)
26	7A548	Seal ring — coast clutch piston — outer
27	7A262	Piston — coast clutch
28	7A480	Spring — coast and direct clutch piston (40 req'd)
29	7A527	Retainer — coast and direct clutch piston springs
30	E860125-S	Retaining ring, 63 mm — coast and direct clutch piston
31	7B442	Plate — coast (2 req'd) and direct (4 or 5 req'd) clutch external steel
32	7B164	Plate — coast (2 req'd) and direct (4 or 5 req'd) clutch internal friction

33	7B066	Plate — coast and direct clutch pressure (2 req'd)
34	E860126S/129S	Retaining ring — coast and direct clutch plates (select fit) (2 req'd)
35	7660	Adapter — coast clutch to front carrier
36	7D063	Gear — sun overdrive
37	7B446	Carrier — planetary gear front (with trigger wheel)
38	7L495	Bearing — front planet thrust No. 2
39	7A153	Gear — overdrive ring
40	7C109	Shaft — overdrive center
41	7A658	Shaft — center overdrive ring (includes front overrunning clutch 7C109)
42	W702037-S300	Retaining ring — center shaft in front ring gear
43	W702465-S300	Retaining ring — center support in case
44	7M153	Bearing — center shaft thrust No. 3, 5, and 9 (3 req'd)
45	E826160-S76	Nut and cage assembly — (attaches center support to case)
46	E804373-S	Screw cap (attaches center support to case)
47	7M101	Sensor — turbine shaft speed (TSS)
48	W702297-S300	Screw — turbine shaft speed sensor
49	7A130	Support — center
50	7D014	Bearing — intermediate brake drum thrust (select fit) No. 4
51	7D433	Shaft — intermediate band actuating lever
52	7D044	Drum — intermediate brake and direct clutch (not available separately)
53	7A548	Seal ring — direct clutch piston outer
54	7A262	Piston — direct clutch
55	7A527	Retainer — direct clutch piston spring
56	7M154	Bearing assembly
57	7A360	Cylinder — forward clutch
58	7A548	Seal ring — forward clutch piston inner
59	7A548	Seal ring — forward clutch piston outer
60	7A262	Piston — forward clutch
61	7A480	Spring — forward clutch piston (15 req'd)
62	7A527	Retainer — forward clutch piston spring
63	E860109-S	Retaining ring — forward clutch piston and spring in forward clutch cylinder
64	7B070	Spring — forward clutch cushion
65	7B442	Plate — forward clutch external steel (6 req'd)
66	7B164	Plate — forward clutch internal friction (6 req'd)

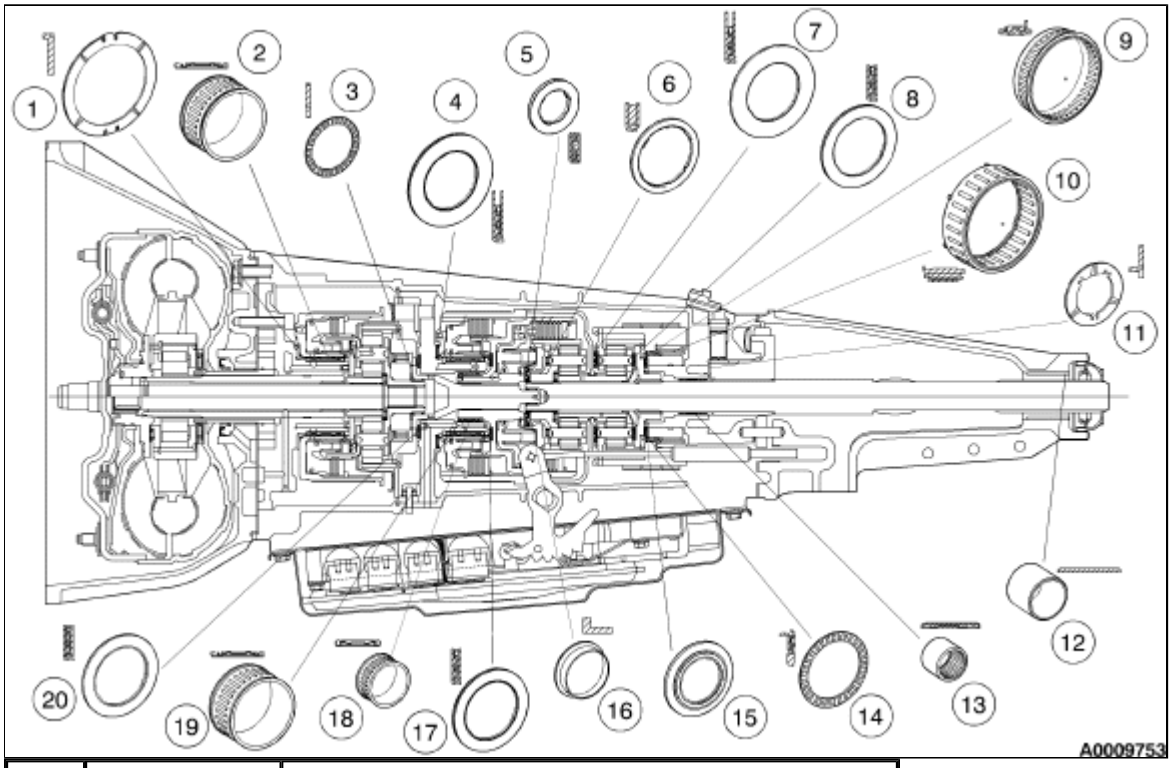
67	7B066	Plate — forward clutch pressure
68	E860115S/118S	Retaining ring — forward clutch plates in forward clutch cylinder (select fit)
69	7D234	Bearing — forward ring gear hub thrust No. 6A
70	7D090	Washer — forward clutch thrust No. 6B
71	E860122-S	Retaining ring — forward and output shaft ring gears to hubs (2 req'd)
72	7B067	Hub — forward ring gear
73	7D392	Gear — forward ring (72 external teeth and 57 internal teeth)
74	7F374	Bearing — forward planet thrust No. 7
75	7A398	Planetary — forward (6 pinion)
76	E860121-S	Retaining ring 39 mm (1.56 in) — input shell to sun gear assembly (2 req'd)
77	7D063	Gear — sun (forward)
78	7D064	Shell — input
79	7M151	Bearing — low/reverse planet carrier thrust No. 8
80	W702037-S300	Retaining ring — low/rev planet to low/rev brake drum
81	7D006	Planet — low/reverse (6 pinion)
82	7B176	Sleeve — output
83	7A153	Gear — output shaft ring
84	E860527-S	Retaining ring 25 x 2 mm — output shaft in case
85	7D164	Hub — output shaft
86	7C498	Drum — low/reverse brake (includes overrunning clutch)
87	7D001	Bearing — part of reverse drum
88	7C109	Clutch assembly — part of reverse drum
89	7D095	Band — low/reverse
90	7M150	Bearing race (2 pieces) — output shaft hub thrust No. 10A
91	7M150	Bearing — output shaft hub thrust No. 10B
92	7R205	Bearing — output shaft to case (part of case assembly)
93	7B368	Washer — output shaft thrust No. 11
94	7M167	Gear — transmission parking
95	7060	Shaft — output (4x2)
96	7086	Gasket — extension housing
97	7A441	Pawl — parking
98	7D070	Spring — parking pawl return
99	7D071	Shaft — parking pawl

100	7A039	Extension housing (4x2)
101	7A034	Bushing — extension housing (4x2)
102	7052	Seal — extension housing to slip yoke (4x2)
103	E804137-S72	Stud — extension housing (1 or 2 req'd)
104	E800152-S72	Screw — extension housing (5 or 6 req'd)
105	7060	Shaft — output (4x4)
106	7A039	Extension housing (4x4)
107	N605804-S100	Screw — extension housing to transfer case (5 req'd)
108	W701271-S309	Nut — attaches outer and inner manual valves to shaft (2 req'd)
109	7A256	Lever — manual control outer
110	N806933-S100	Screw — digital transmission range (TR) sensor (2 req'd)
111	7F293	Sensor — digital transmission range (TR)
112	7A308	Shaft — manual valve outer to inner lever
113	E840125-S	Pin — spring (retains outer manual lever to case)
114	7B498	Seal — main control lever
115	7A115	Lever — manual valve inner
116	7A232	Rod — parking pawl actuating
117	7E332	Spring assembly — manual valve detent
118	E800185-S	Screw detent spring
119	7Z409	Connector — transmission case (16-pin with wire harness to 6 solenoids)
120	W703015-S300	O-ring — transmission case (16-pin) connector
121	7005	Case assembly (model dependent)
122	W702981-S300	O-ring — speed sensor
123	W702297-S300	Screw — OSS sensor
124	W703165-S300	Spring — transmission case (16-pin) connector
125	7H103	Sensor — output shaft speed (OSS)
126	390318-S2	Plug — pipe line and EPC pressure (part of case assembly) (2 req'd)
127	7034	Vent — (4x4)
128	7034	Vent — (4x2)
129	E804533-S201	Stud — attaches heat shield to case
130	7F013	Shield — transmission heat
131	N620040-S36	Nut — transmission heat shield
132	7A160	Tube — lube fluid inlet — short
133	7D273	Connector — fluid tube (2 req'd)
134	7D028	Spring — intermediate servo and front piston

135	7D021	Piston and rod — intermediate and front servo
136	7D027	Cover and seal — intermediate and front servo
137	7D040	O-ring — intermediate and front servo
138	E860343-S	Retaining ring — 67 x 1.5 mm intermediate and front servo
139	E804357-S76	Screw — attaches separating plate to main control (3 req'd)
140	7G383	Solenoid — electronic pressure control (EPC)
141	7G484	Solenoid — transmission shift (SS) (4 req'd)
142	W702949-S300	O-ring — shift solenoid small (13x1.5) (4 req'd)
143	W702951-S300	O-ring — shift solenoid large (15x1.5) (4 req'd)
144	7G136	Solenoid — torque converter clutch (TCC)
145	7L491	Clamp — (SSA and SSC) solenoids
146	7L491	Clamp — TCC/SSD/SSB and EPC solenoids
147	E800155-S	Screw — clamp (2 req'd)
148	7C155	Gasket — control valve body-to-case
149	7A008	Plate — valve body separating (not available separately)
150	7D100	Gasket — control valve body separating
151	7A100	Control valve body — main (model dependent)
152	E800154-S	Screw — M6x45 main control valve body (4 req'd)
153	E800153-S	Screw — main control valve body (16 req'd)
154	E800163-S	Screw — main control valve body (3 req'd)
155	7423	Seal ring — low/reverse servo piston small
156	7423	Seal ring — low/reverse servo piston large
157	7D189	Piston — low/reverse band servo (select fit)
158	7L173	Gasket — low/reverse servo cover
159	7D036	Cover — low/reverse servo
160	E800156-S	Screw — low/reverse servo cover (4 req'd)
161	E853163-S	O-ring — fluid filter small
162	7A098	Filter — fluid pan (4x2)
163	E853164-S	O-ring — fluid filter large
164	7E290	Magnet
165	7A191	Gasket — fluid pan
166	W701203-S309M	Screw — transmission fluid pan (18 req'd)
167	7A194	Pan — transmission fluid (4x2)
168	7A098	Filter — transmission fluid pan (4x4)
169	7A194	Pan — transmission fluid (4x4)

170	E800154-S	Screw — fluid filter
A	—	Coast clutch assembly
B	—	Direct clutch assembly
C	—	Forward clutch assembly

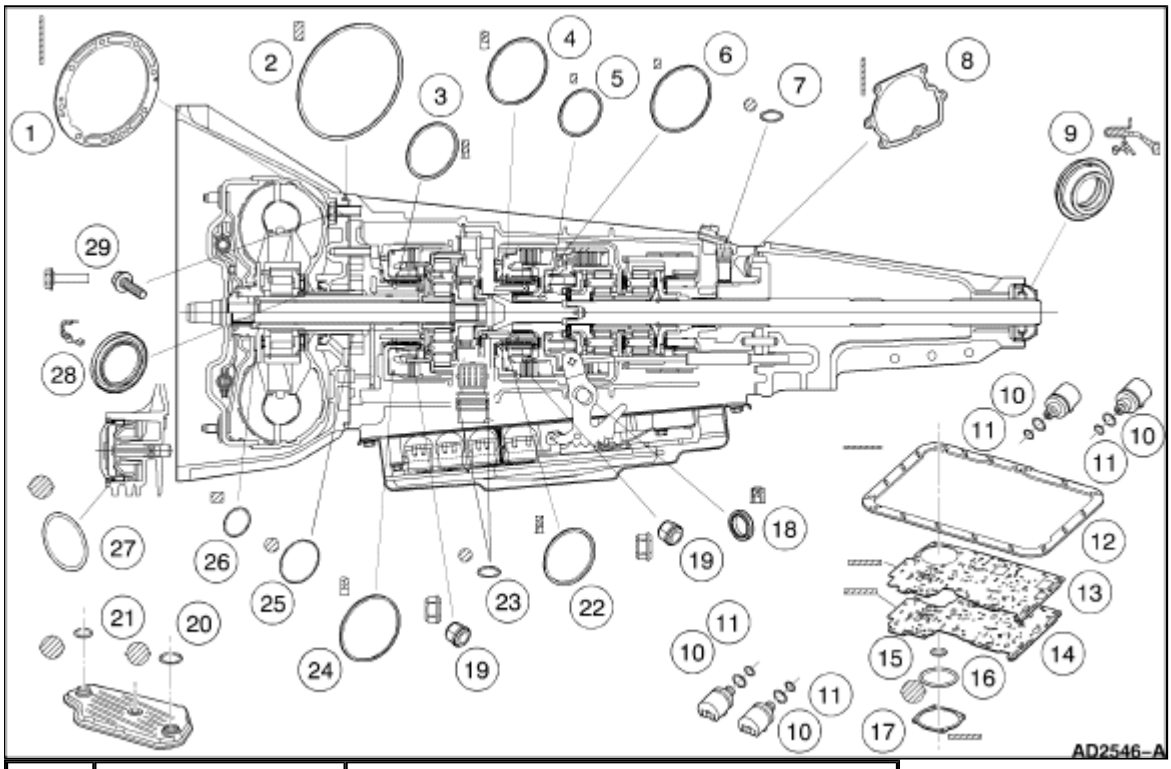
Bushings, Bearing and Thrust Washer Locator



Item	Part Number	Description
1	7D014	No. 1 selective washer
2	7M155	Bearing and seal assembly
3	7L495	No. 2 needle bearing
4	7F014	No. 4 selective needle bearing
5	7D234	No. 6A needle bearing
6	7F374	No. 7 needle bearing
7	7M151	No. 8 needle bearing
8	7M153	No. 9 needle bearing
9	7D001	Bearing — part of reverse drum
10	7C109	Clutch assembly — part of reverse drum
11	7B368	No. 11 washer
12	7A034	Bushing (part of 7A039) (serviced separately)
13	7R205	Needle bearing
14	7M150	No. 10B needle bearing assembly
15	7M150	No. 10B needle bearing assembly (2 pieces)
16	7D090	No. 6B bushing
17	7M153	No. 5 needle bearing

18	7M154	Bearing and seal assembly
19	7M155	Bearing and seal assembly
20	7M153	No. 3 needle bearing

Seals, Rings and Gaskets Locator



Item	Part Number	Description
1	7A136	Gasket (fluid pump)
2	7A248	Seal ring (fluid pump)
3	7D404	Seal ring
4	7A548	Seal ring
5	7A548	Seal ring
6	7A548	Seal ring
7	W702981-S300	O-ring
8	7086	Gasket (transmission extension)
9	7052	Seal (extension housing)
10	W702949-S300	O-ring (large) (4 req'd)
11	W702951-S300	O-ring (small) (4 req'd)
12	7A191	Gasket (fluid pan)
13	7C155	Gasket (main control, upper)
14	7D100	Gasket (main control, lower)
15	7423	O-ring (reverse servo piston) (small)
16	7423	O-ring (reverse servo piston) (large)
17	7L173	Gasket (reverse servo plate cover)

18	7B498	Seal assembly (manual cover lever)
19	E825100-S100	Nut and seal
20	7A469	O-ring (large) (fluid filter)
21	7A469	O-ring (small) (fluid filter)
22	7D404	Seal ring
23	W703015-S300	O-ring
24	7A548	Seal ring
25	W703015-S300	O-ring
26	7L323	Seal ring
27	7D040	O-ring (intermediate/front servos)
28	7A248	Seal assembly (converter hub)
29	E804595-S200	Screw and seal assembly

Main Components and Functions

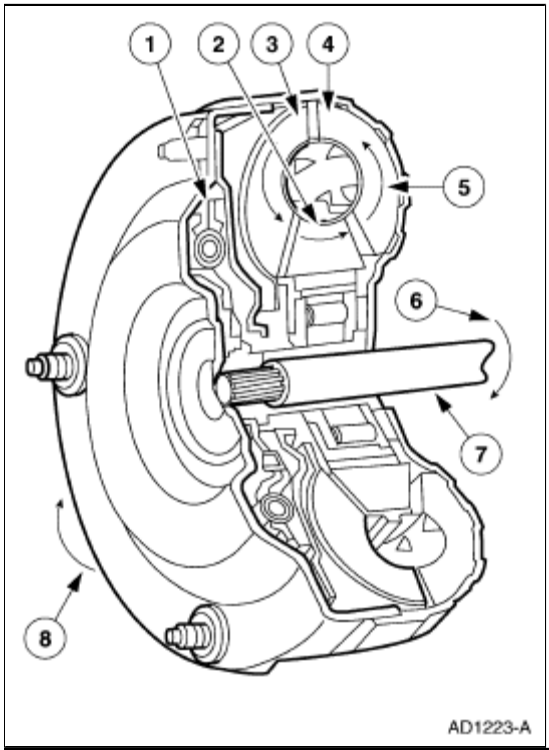
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- Impeller assembly
- Turbine assembly
- Reactor assembly
- Clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)

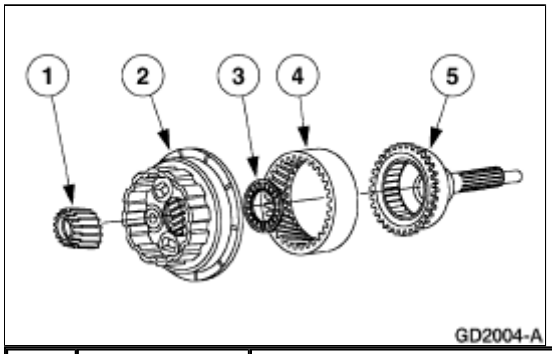
3	—	Turbine (part of 7902)
4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the planetary gearsets through the input shaft. Bands and clutches are used to hold and drive certain combinations of gearsets. This results in five forward ratios and one reverse ratio, which are transmitted to the output shaft and differential.

Gear Ratio	
1st	2.47 to 1
2nd	1.87 to 1
3rd	1.47 to 1
4th	1.00 to 1
5th	0.75 to 1
Reverse	2.10 to 1

Planetary Gearset — Front

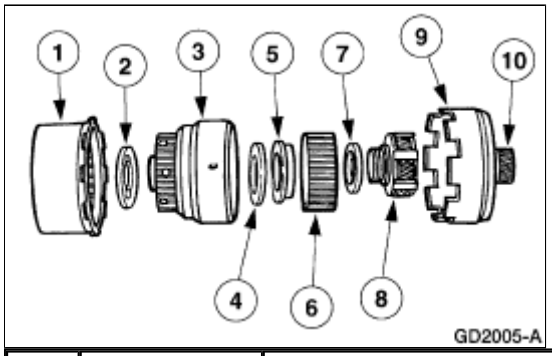


Item	Part Number	Description
1	7D063	Front sun gear
2	7B446	Front planetary gear carrier
3	7L495	Front planetary thrust bearing (No. 2)
4	7653	Front ring gear
5	—	Center ring and shaft (includes front overrunning clutch)

The planetary gear front carrier is driven by the input shaft.

- The front planetary gearset carrier drives the center shaft via the overdrive one-way clutch in 1st, 3rd and 4th gears.
- In 2nd, the front sun gear is held causing the pinion gears to rotate around the front sun gear.
- The pinion gears in turn drive the front ring gear and, with the intermediate band applied results in a 2nd gear ratio of 1.87 to 1.
- In 5th, the front sun gear is held causing the pinion gears to rotate around the front sun gear.
- The pinion gears in turn drive the front ring gear and, with the intermediate band applied results in a 5th (overdrive) gear ratio of 0.75 to 1.
- The front planetary gearset is internally splined to the coast clutch for engine braking.

Planetary Gearset — Forward

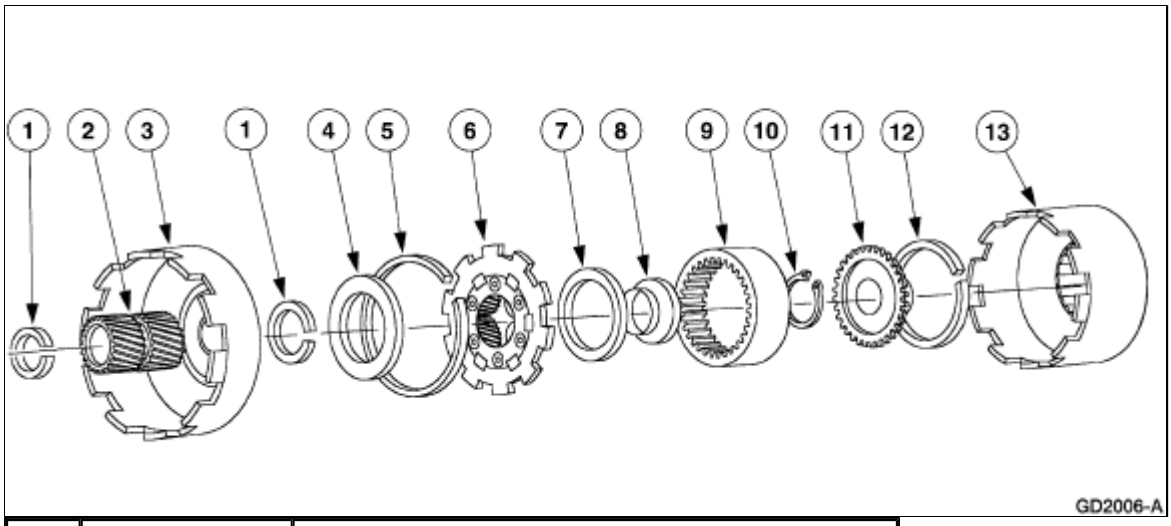


Item	Part Number	Description
1	7D044	Intermediate brake and direct clutch drum
2	7M153	Forward clutch thrust bearing (No. 5)
3	7A360	Forward clutch cylinder
4	7D234	Forward ring gear thrust bearing (No. 6a)
5	7D090	Forward clutch thrust washer (No. 6b)
6	7D392	Forward ring gear
7	7F374	Forward planetary thrust bearing assembly (No. 7)
8	7A398	Forward planetary
9	7D064	Input shell
10	7D063	Forward sun gear

The forward planetary gearset is splined to the output shaft.

- The forward planetary gearset is driven by the forward ring gear when the forward clutch is applied.
- The forward planetary gearset pinions drive the forward sun gear.
- The forward sun gear is splined to the input shell.

Planetary Gearset — Low/Reverse



Item	Part Number	Description
1	E860121-S	Retaining ring (2 req'd)
2	7D063	Forward sun gear
3	7D064	Input shell
4	7M151	Reverse planetary carrier thrust bearing (No. 8)
5	W702037-S300	Retaining ring
6	7D006	Low/reverse planetary gearset
7	7M153	Reverse planetary carrier thrust bearing (No. 9)
8	7B176	Output shaft sleeve
9	7A153	Output shaft ring gear
10	E860527-S	Retaining ring
11	7D164	Output shaft hub
12	E860122-S	Retaining ring
13	7C498	Low/reverse brake drum

The low/reverse planetary gearset is connected to the reverse brake drum by lugs from the low/reverse brake drum to the lugs of the low/reverse planetary gearset.

- The low/reverse planetary gearset is driven by the forward sun gear which is splined to the input shell.
- The splines of the forward sun gear drive the pinions in the low/reverse planetary gearset.
- The pinions of the low/reverse planetary gearset drive the output shaft ring gear and output shaft hub which is splined to the output shaft.
- The low/reverse planetary gearset is held via the low one-way clutch in the low/reverse brake drum, when the low/reverse band is applied.

Input Shaft

The input shaft is supported by two bushings in the stator support.

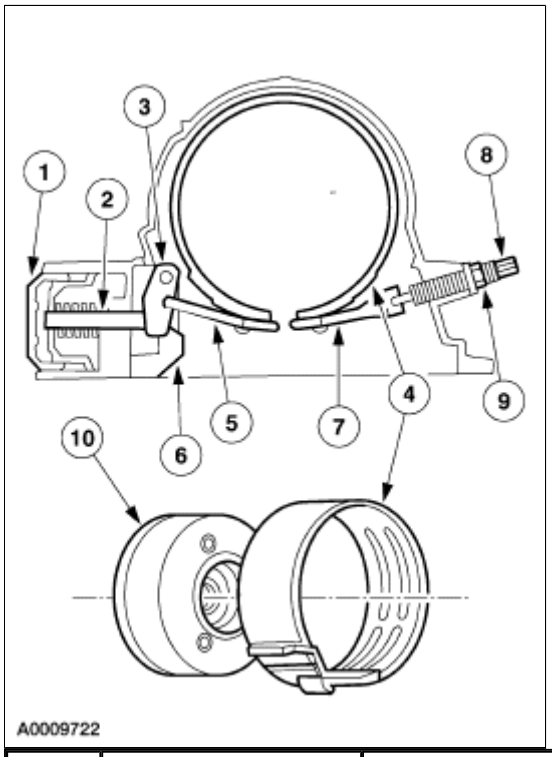
- End positioning of the input shaft is controlled by the splines in the converter turbine and the front planetary carrier.

Output Shaft

The output shaft is supported by a bearing in the case and by the slip yoke bushing in the extension housing. End positioning is controlled by the parking pawl gear and snap ring shoulder and by the reverse ring gear hub and snap ring.

Apply Components

Band — Front



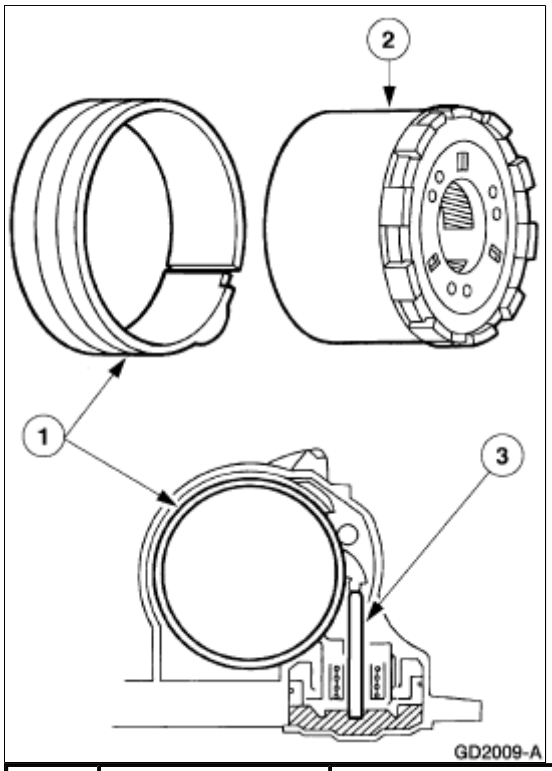
Item	Part Number	Description
1	7L493	Front servo cover assembly
2	7D021	Front servo piston and rod
3	7330	Front band servo lever
4	7D034	Front band
5	7D029	Front band apply strut
6	7A653	Front band lever to case bracket
7	7D430	Front band anchor strut
8	7C492	Front band adjuster/lock screw
9	E825100-S100	Front band lock nut
10	7L669	Front brake and coast clutch

Hydraulic pressure is applied to the front side of the front servo.

- This pressure causes the servo to stroke and apply force to the band.
- This action causes the front brake and coast clutch drum to be held.

- The front band holds the front brake and coast clutch drum to the case in 2nd and 5th gears.
- This causes the front sun gear to be held stationary through the coast clutch adapter and the front brake and coast clutch drum.

Band — Low/Reverse

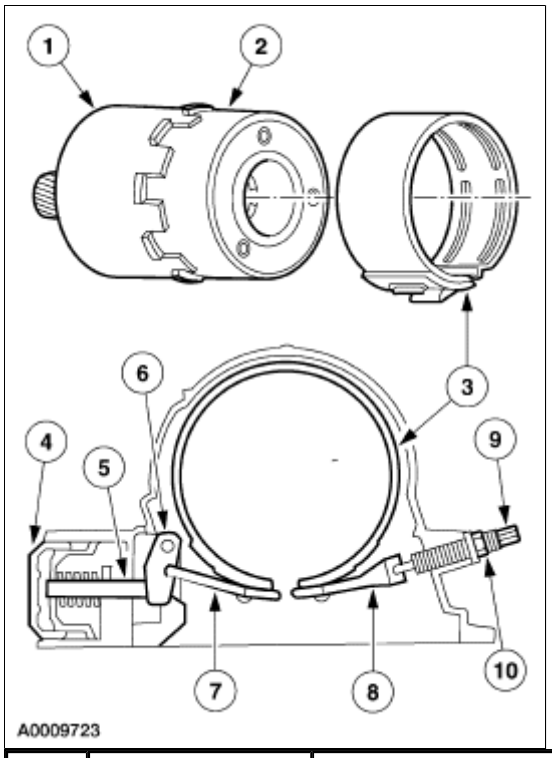


Item	Part Number	Description
1	7D095	Low/reverse band
2	7C498	Low/reverse brake drum
3	7D189	Low/reverse servo piston assembly

Hydraulic pressure is applied to the front side of the low/reverse servo.

- This pressure causes the servo to stroke and apply force to the low/reverse band.
- This action causes the low/reverse brake drum to be held.
- The low/reverse band holds the low/reverse brake to the case in 1st position and reverse gears.
- This causes the low/reverse planetary assembly to be held stationary.

Band — Intermediate

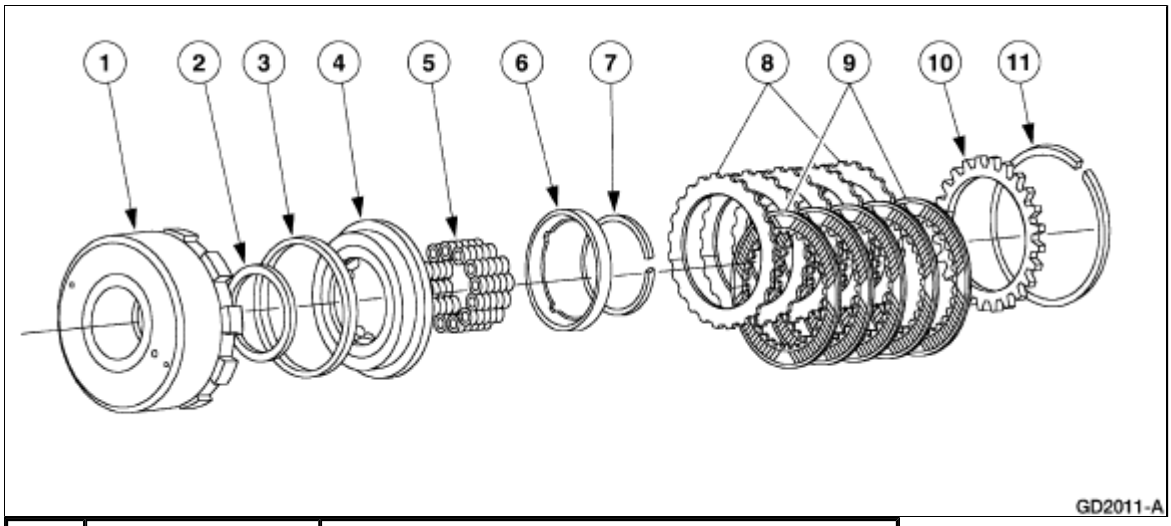


Item	Part Number	Description
1	7D064	Input shell
2	7D044	Intermediate brake and coast clutch drum
3	7D034	Intermediate band
4	7L493	Intermediate servo cover
5	7D021	Intermediate servo piston and rod
6	7330	Intermediate band servo lever
7	7D029	Intermediate band apply strut
8	7D430	Intermediate band anchor strut
9	7C492	Intermediate band adjuster/lock screw
10	E825100-S100	Front band lock nut

Hydraulic pressure is applied to the front side of the intermediate servo.

- This pressure causes the servo to stroke and apply force to the intermediate band.
- This action causes the intermediate brake and direct clutch drum to be held.
- The intermediate band holds the intermediate brake and direct clutch drum to the case in 3rd gear.
- This causes the input shell and forward sun gear to be held stationary.

Clutch — Direct

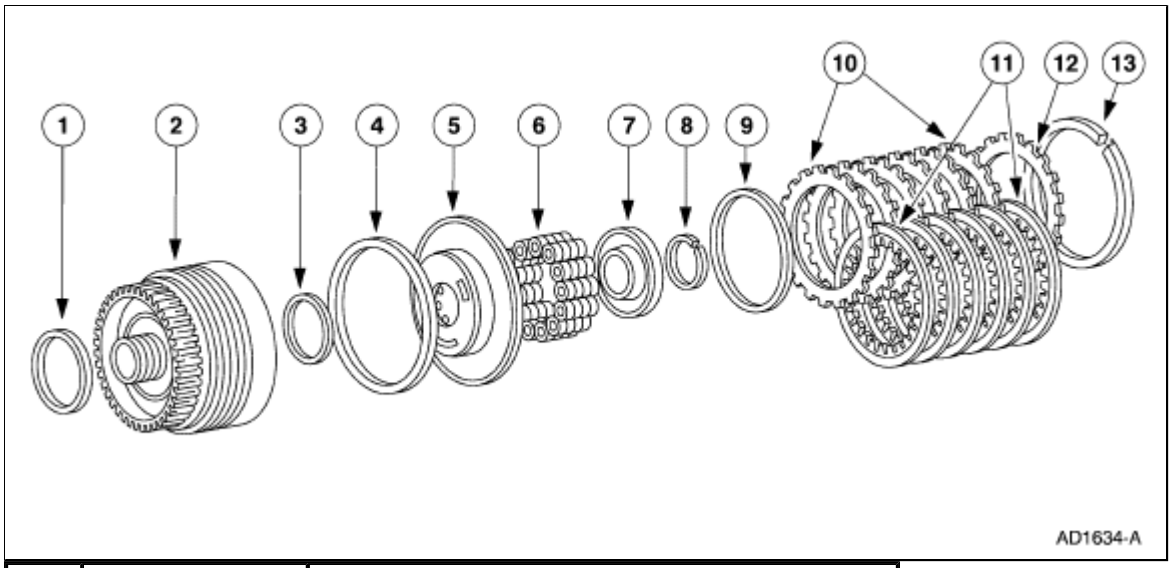


Item	Part Number	Description
1	7D044	Intermediate brake and direct clutch drum
2	7D404	Direct clutch piston inner seal ring
3	7A548	Direct clutch piston outer seal ring
4	7A258	Direct clutch piston
5	7A480	Direct clutch piston spring (20 req'd)
6	7A527	Direct clutch piston spring retainer (8 tabs)
7	E860125-S	Retaining ring
8	7B442	Direct clutch external plate — steel
9	7B164	Direct clutch internal plate — friction
10	7B066	Direct clutch pressure plate
11	E860126S/129S	Retaining ring (select fit)

The direct clutch is a multi-disc clutch made up of steel and friction plates.

- The direct clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- It is housed in the intermediate brake and direct clutch drum.
- In drive, the direct clutch is applied and coupled to the forward clutch. This drives the input shell and forward sun gear in 4th and 5th gears.
- In reverse, the direct clutch is applied and coupled to the input shell and forward sun gear.
- This action causes the forward sun gear to drive the pinions of the low/reverse planetary carrier.
- Since the low/reverse planetary carrier is held stationary by the low/reverse band, the pinions drive the output shaft ring gear in reverse.

Clutch — Forward

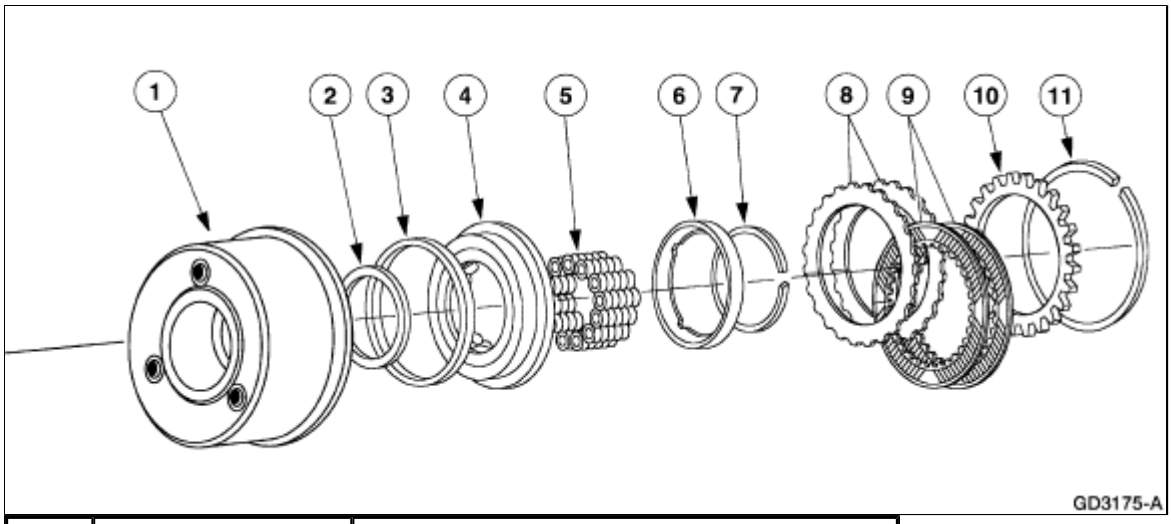


Item	Part Number	Description
1	7M153	Forward clutch cylinder thrust bearing (No. 5)
2	7A360	Forward clutch cylinder
3	7D548	Forward clutch piston inner seal
4	7A548	Forward clutch piston outer seal
5	7A262	Forward clutch piston
6	7A480	Forward clutch piston spring (15 req'd)
7	7A527	Forward clutch piston spring retainer
8	E860109-S	Retaining ring
9	7B070	Forward clutch cushion spring
10	7B442	Forward clutch external plate — steel
11	7B164	Forward clutch internal plate — friction
12	7B066	Forward clutch pressure plate
13	E860115S/118S	Retaining ring (select fit)

The forward clutch is a multi-disc clutch made up of steel and friction plates.

- The forward clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- The forward clutch is applied in all forward gears.
- When applied, the forward clutch provides a direct mechanical coupling between the input shaft and the forward ring gear and hub.

Clutch — Coast

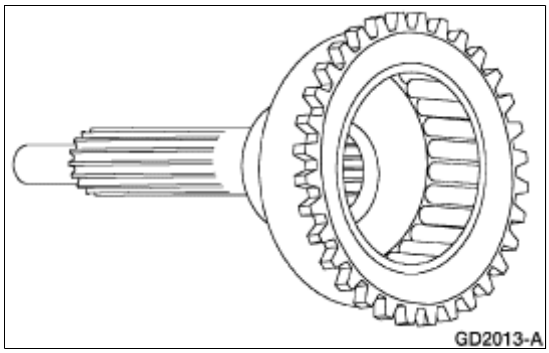


Item	Part Number	Description
1	7L669	Front brake and coast clutch drum
2	7D404	Coast clutch piston inner seal ring
3	7A548	Coast clutch piston outer seal ring
4	7A258	Coast clutch piston
5	7A480	Coast clutch piston spring (20 req'd)
6	7A527	Coast clutch piston spring retainer
7	E860125-S	Retaining ring
8	7B442	Coast clutch external plate — steel
9	7B164	Coast clutch internal plate — friction
10	7B066	Coast clutch pressure plate
11	E860126S/129S	Retaining ring (select fit)

The coast clutch is a multi-disc clutch made up of steel and friction plates.

- The coast clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- The coast clutch is housed in the front brake and coast clutch drum.
- The coast clutch is applied when the TCS switch is on, energizing SSD, and 5th gear operation is inhibited (4th gear only).
- The coast clutch is hydraulically applied when the transmission is in 2nd and 1st position.
- When applied, the coast clutch locks the input shaft to the front planetary carrier, thus preventing the one-way clutch from overrunning when the vehicle is coasting.
- This allows the use of engine compression to help slow the vehicle and provide engine braking.

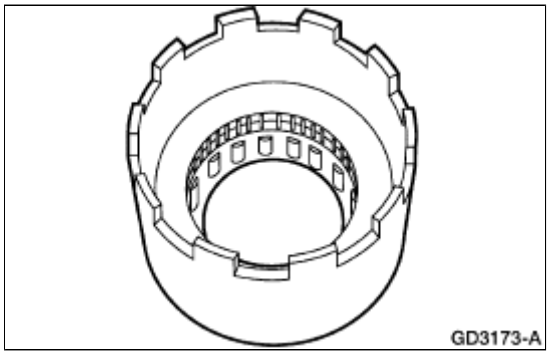
One-Way Clutch — Front



The front one-way clutch is a sprag-type one-way clutch that is pressed into the center shaft.

- The front one-way clutch is driven by the ring gear of the front planetary carrier.
- The front one-way clutch holds and drives the outer splines of the center shaft in 1st, 3rd, and 4th gears.
- The front one-way clutch overruns during all coast operations and at all times in 2nd and 5th gear.

One-Way Clutch — Low/Reverse

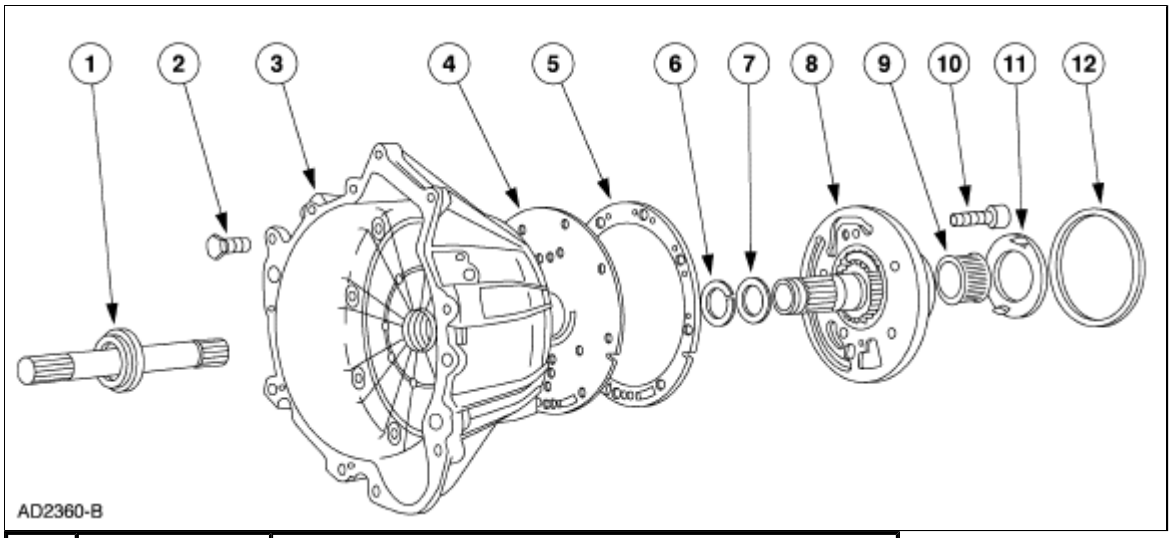


The low/reverse one-way clutch is a sprag-type one-way clutch.

- The low/reverse one-way clutch holds the low/reverse brake drum and low/reverse planetary assembly to the case in 1st gear only.
- In all other gears the low/reverse one-way clutch overruns.

Hydraulic System

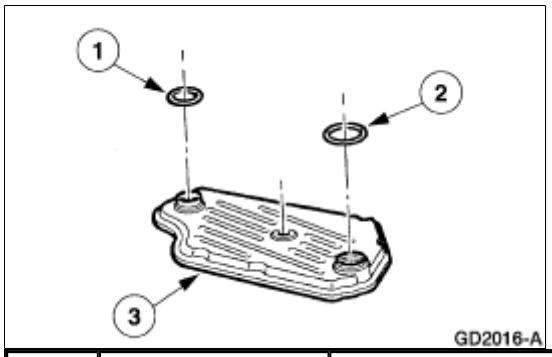
Fluid Pump



Item	Part Number	Description
1	7A248	Converter hub-to-converter housing seal
2	E804595-S2000	Converter housing-to-transmission case bolt and seal assembly (8 req'd)
3	7976	Converter housing
4	7B472	Fluid pump adapter plate
5	7A136	Fluid pump gasket
6	7L323	Fluid pump support seal ring
7	W701431-S300	Fluid pump shaft-to-inner gear O-ring
8	7A103	Fluid pump
9	7M155	Bearing assembly
10	W701429-S309M	Fluid pump-to-converter housing bolts (6 req'd)
11	7D014	Nylon fluid pump input thrust washer (No. 1) (selective)
12	7A248	Seal and ring fluid pump

- The fluid pump provides the fluid pressure required to charge the torque converter, main control assembly, transmission cooling system, lubrication system and apply devices.
- The fluid pump is a positive displacement, gear and crescent-type pump.
  - The fluid pump is driven by the torque converter cover hub.

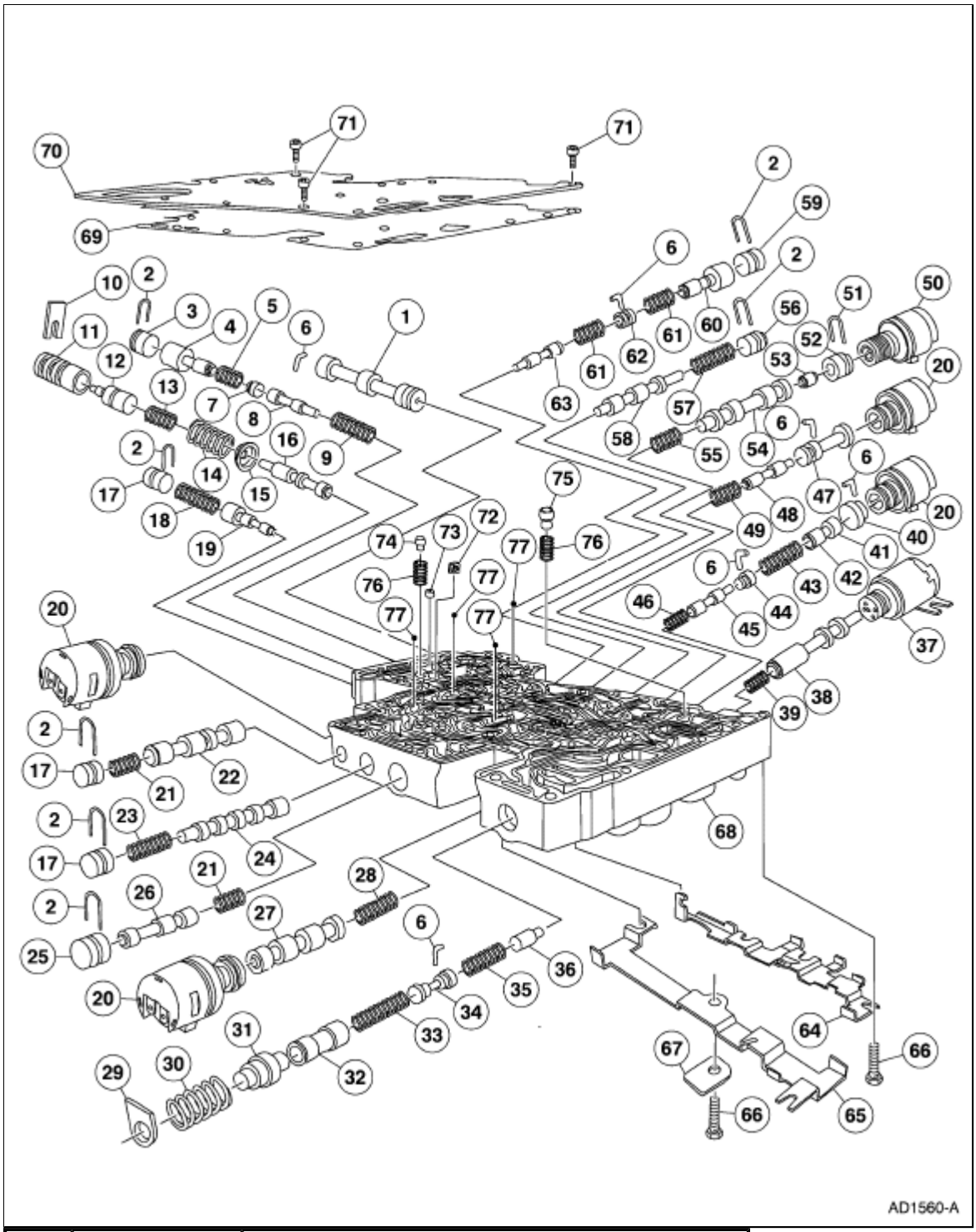
Filter



Item	Part Number	Description
1	7A469	Transmission fluid filter small o-ring
2	7A469	Transmission fluid filter large o-ring
3	7A098	Transmission fluid filter

- All fluid drawn from the transmission fluid pan by the fluid pump passes through the fluid filter.
- The transmission fluid filter and its accompanying seals are part of the fluid path from the sump (pan) to the fluid pump.
  - The transmission fluid filter has a bypass section which allows fluid vented at the main regulator valve to be recirculated to the fluid pump, without passing through the transmission fluid filter.

Main Control



Item	Part Number	Description
1	—	Valve — manual
2	7E335	Retainer — valve plug (7 req'd)
3	—	Plug — valve retainer
4	—	Valve — forward modulator
5	—	Spring — forward modulator

6	7E335	Retainer — valve plug (6 req'd)
7	—	Plug — valve retainer
8	—	Valve — EPC boost
9	—	Spring — EPC boost
10	7E336	Retainer — valve plug
11	—	Sleeve — pressure boost
12	—	Valve — pressure boost
13	—	Spring — pressure boost
14	—	Spring — oil pressure regulator
15	—	Retainer — main regulator spring
16	—	Valve — pressure regulator
17	—	Plug — valve retainer (3 req'd)
18	—	Spring — forward engagement
19	—	Valve — forward engagement control
20	7G484	Solenoid — shift (4 req'd)
21	—	Spring — 4-3 (K.D./T.D.) (2 req'd)
22	—	Valve — 4-3 (K.D.)
23	—	Spring — manual low (1)
24	—	Valve — manual low (1)
25	—	Plug — valve retainer
26	—	Valve — 4-3 (T.D.)
27	—	Valve — 1-2 and 4-5 shift
28	—	Spring — 1-2 and 4-5 shift
29	7E366	Retainer — valve plug
30	—	Spring — thermostat bypass
31	—	Valve — thermostat bypass
32	—	Valve — thermostat bypass
33	—	Spring — thermostat bypass
34	—	Plug — valve retainer
35	—	Spring — cooler limit
36	—	Valve — cooler limit
37	7G136	Solenoid — torque converter clutch (TCC)
38	—	Valve — converter clutch
39	—	Spring — converter clutch
40	—	Plug — valve retainer
41	—	Valve — converter clutch
42	—	Spring — converter clutch
43	—	Spring — converter clutch (3.0 L/4.0 L only)
44	—	Plug — valve retainer

45	—	Valve — coast clutch
46	—	Spring — coast clutch
47	—	Plug — valve retainer
48	—	Valve — 4-3 downshifts
49	—	Spring — 4-3 downshifts
50	7G383	Solenoid — EPC
51	7E335	Retainer — valve plug
52	—	Plug — valve retainer
53	—	Valve — 2-3 shift
54	—	Valve — 2-3 shift
55	—	Spring — 2-3 shift
56	—	Plug — valve retainer
57	—	Spring — 3-4 shift
58	—	Valve — 3-4 shift
59	—	Plug — valve retainer
60	—	Valve — reverse modulation
61	—	Spring — reverse modulation (2 req'd)
62	—	Plug — valve retainer
63	—	Valve — reverse modulation
64	7L491	Clamp — SSA/SSB
65	7L491	Clamp — SSC/SSD/EPC/TCC
66	E800155-S72	Screw — retain solenoid clamps (2 req'd)
67	7D132	I.D. Plate
68	—	Body — valve
69	7D100	Gasket — separator plate
70	7A008	Plate — separator
71	E804357-S76	Screw — retain separator plate (3 req'd)
72	7N113	Screen — EPC limit circuit
73	7D376	Extension housing lube orifice
74	7E368	Valve — EPC limit (metal)
75	7E368	Valve — converter relief (plastic)
76	7E340	Spring — EPC limit/converter relief (2 req'd)
77	7E195	Ball (4 req'd)

- The main control valve body and related components are part of the pressure side of the hydraulic system.
- The main control valve body consists of the solenoids, the valve body assembly and the separator plate.
- These components combine to convert electrical signals into hydraulic actions.
    - All valves in the main control assembly are anodized aluminum and cannot be sanded, filed, or dressed in any other way. Any damage to the valves that prevents or restricts their movement,

requires replacement of the entire main control valve body.

Transmission Electronic Control System

Electronic System Description

The powertrain control module (PCM) (12A650) and its input/output network control the following transmission operations:

- Shift timing.
- Line pressure (shift feel).
- Torque converter clutch.

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these inputs signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the PCM uses six output solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining electronic pressure control (EPC) pressures.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module. The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects temperature of engine coolant and supplies the information to the powertrain control module (PCM). The ECT sensor is used to control torque converter clutch (TCC) operation.

Anti-Lock Brake Speed Sensor

The programmable speedometer/odometer module (PSOM) receives input from the rear brake anti-lock sensor. After processing the signal, the PSOM relays it to the powertrain control module and the speed control module. Information from the PSOM is used to help determine shift scheduling, torque converter

clutch operation and electronic pressure control (EPC).

Mass Air Flow (MAF) Sensor

The mass air flow sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module (PCM) to calculate injector pulse width. For transmission strategies the MAF sensor is used to regulate electronic pressure control, shift and torque converter clutch scheduling.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C is engaged, electronic pressure control (EPC) pressure is adjusted to compensate for additional load on the engine.

Electronic Ignition (EI) System

The electronic ignition consists of a crankshaft position sensor, two four tower ignition coils and the powertrain control module. The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the PCM. The PCM uses PIP signal in the transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and EPC pressure.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the powertrain control module when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Transmission Control Switch (TCS)

The transmission control switch (TCS) is a momentary contact switch that allows the driver to cancel operation of 5th (overdrive) gear.

The TCS is located on the end of the selector lever.

When the driver initially presses the TCS a signal is sent to the powertrain control module.

The PCM uses the shift solenoids to disengage/disable 5th gear operation and activate the coast clutch.

At the same time the PCM illuminates the transmission control indicator lamp (TCIL), to notify the driver that 5th gear is canceled.

When the TCS is pressed again, 5th gear operation is enabled, the coast clutch is released and the TCIL is turned off.

Whenever the ignition is cycled (vehicle shut off then started again) the TCS is turned off and 5th gear will be enabled, even if the TCS had been on when the ignition was shut off.

Transmission Control Indicator Lamp (TCIL)

The transmission control indicator lamp (TCIL) is located in the instrument panel and is labled O/D OFF. It is illuminated in conjunction with the transmission switch (TCS).

Turbine Shaft Speed (TSS) Sensor

The turbine shaft speed (TSS) sensor is a magnetic pickup that sends the powertrain control module torque converter turbine speed information.

The TSS sensor is mounted internally on the center support.

The PCM uses TSS information to help determine electronic pressure control (EPC) and torque converter clutch (TCC) operation.

4x4 Low (4x4L) Switch

The 4x4 low (4x4L) range switch is located on the transfer case cover. It provides an indication of when the 4x4 transfer case gear system is in the low range. The PCM then modifies the shift schedule for 4x4L transfer case gear ratio.

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the output shaft ring gear, that sends a signal to the powertrain control module to indicate transmission output shaft speed. The OSS is used for torque converter clutch control, speed scheduling and to determine electronic pressure control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital TR sensor completes the start circuit in Park and Neutral, the back-up lamp circuit in Reverse and the neutral sense circuit (4x4 only) in Neutral. The digital TR sensor also opens and closes a set of four switches that are monitored by the powertrain control module to determine the position of the manual lever (P, R, N, D, 2, 1).

Transmission Fluid Temperature (TFT) Sensor

- The transmission fluid temperature (TFT) sensor is a thermistor-type sensor that varies a reference voltage signal. The resistance in the TFT varies with temperature. The powertrain control module (PCM) monitors the voltage signal across the TFT, and uses this information to determine the transmission fluid temperature.
- The TFT is located on the main control body wiring harness assembly.
- The PCM uses the TFT signal to help determine shift scheduling, torque converter clutch operation and electronic pressure control (EPC).

Electronic Pressure Control (EPC) Solenoid

The electronic pressure control (EPC) solenoid is a variable force style (VFS) solenoid. The VFS type solenoid is an electro-hydraulic actuator combining a solenoid and a regulating valve.

The powertrain control module varies the current to the EPC solenoid.

This action causes the solenoid to regulate transmission line pressure and line modulator pressure. This is done by producing resisting forces to the main regulator and line modulator circuits. These two solenoids control clutch application pressures.

Shift Solenoids — A, B, C, and D

Four On/Off shift solenoids allow the powertrain control module to control shift scheduling.

- The solenoids are two-way, normally open style.
- The shift solenoids (SSA, SSB, SSC, and SSD) provide gear selection by controlling the pressures of the shift valves.
- SSD is also used to apply and release the coast clutch.

Torque Converter Clutch (TCC) Solenoid

The torque converter clutch (TCC) solenoid is used to control the apply and release of the TCC.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module. Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To correctly diagnose a concern have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- TSBs and OASIS Messages.
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for correct adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Perform on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to Diagnosis By Symptom for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns • Check the fluid level and condition • Verify the concern by operating the vehicle • Check for non-factory-installed items and verify correct installation • Check the shift linkage adjustments • Check TSBs and OASIS messages for vehicle concerns • Carry out quick test both KOER and KOEO • Record all codes 1) Did you record any Diagnostic Trouble Codes?	Yes	· Repair all hard Diagnostic Trouble Codes. Follow the pinpoint tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this Workshop Manual.
	No	· Refer to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· Clear codes and carry out drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· Repair all continuous test memory codes. Follow the pinpoint tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· Carry out the final quick test to verify that no Diagnostic Trouble Codes are present. Clear memory codes.
	No	· Refer to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· Install the scan tool and carry out output state control test, then GO to Step 6.
	No	· Refer to the hydraulic and mechanical routine to diagnose and repair the concern, then GO to Step 7.
6) Was the transmission	Yes	· Refer to the Powertrain Control/Emissions Diagnosis (PC/ED)

concern corrected when the scan tool was installed?		manual, intermittent fault diagnosis section and use the scan tool or WDS to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).
	No	· Refer to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	· Carry out the final quick test to verify that no diagnostic trouble codes are present. Clear memory codes.
	No	· Get assistance from Technical Hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions as to when the concern occurs, for example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperature
- Vehicle driving conditions
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to verify the concern.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the engine.

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshift
- Downshift
- Coasting
- Engagement
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

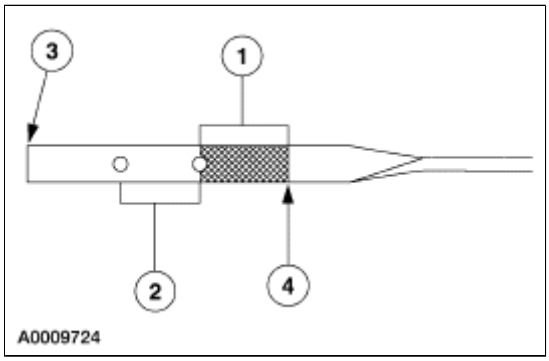
Check Fluid Level and Condition

CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid below the Do Not Drive mark or internal failure could result.

NOTE: Automatic transmission fluid expands when warmed. To obtain an accurate fluid level check, drive the vehicle until warmed, approximately 30 km (18.75 miles). If the vehicle has been operated for an extended period at high speeds, in city traffic, during hot weather or while pulling a trailer, the vehicle should be turned off for about 30 minutes to allow the fluid to cool before checking.

NOTE: The transmission fluid level should be checked at normal operating temperatures, 66°C-77°C (150° F-170°F), on a level surface. The normal operating temperature can be reached after approximately 32 km (20 miles) of driving. However, you can check the fluid level without driving if the outside temperature is above 10°C (50°F). When the vehicle has not been driven, and the outside is above 10°C (50°F), the fluid level should be between the holes on the indicator. If the transmission fluid is to be checked when the fluid is at room temperature, the fluid level indicator could indicate that fluid should be added if the indicator is misread. If fluid is added at this time, an overfill condition could result when the vehicle reaches operating temperature of 66°C-77°C (150°F-170°F).

1. Drive the vehicle 30 km (18.75 miles) or until the vehicle reaches normal operating temperatures.
2. Park the vehicle on a level surface and apply the parking brake.
3. With the parking brake applied and your foot on the brake pedal, start the engine and move the range selector lever through all the gear ranges. Allow sufficient time for each gear to engage.
4. Place the range selector lever in (P) park and leave the engine running.
5. Remove the fluid level indicator and wipe it clean with a lint free cloth.
6. Install the fluid level indicator until it is fully seated into the filler tube.
7. Remove the fluid level indicator and inspect the fluid level. The fluid level should be in the designated area for normal and room temperature.



Item	Description
1	Fluid level at operating temperature 66°C-77°C (150°F-170°F)
2	Fluid level at room temperature 10°C-35°C (50°-95°F)
3	Do not drive if below this area and outside temperatures are above 10°C (50°)
4	Do not add if above the crosshatched area

High Fluid Level

Fluid levels above the safe range may result in transmission failure. An overfill condition of transmission fluid may cause shift or engagement concerns and possible damage. High fluid levels can be caused by an overheating condition. A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission malfunction and/or damage. If an overfill reading is indicated drain and refill the transmission.

Low Fluid Level

DO NOT DRIVE the vehicle if the fluid level is below the hole at the bottom of the fluid level indicator or not on the fluid level indicator, and the outside temperatures are above 10°C (50°F). A low fluid level could result in poor transmission engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

CAUTION: The use of any other type of transmission fluid than specified could result in transmission malfunction and/or damage. An overfill condition of transmission fluid may cause shift or engagement concerns and possible damage.

Before adding fluid be sure that the correct type is being used. The type of fluid used is found on the fluid level indicator, on the handle, in the owner manual, and in the specification section in this section.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the transmission fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter and cooler lines.
7. Carry out diagnostic checks and adjustments. Refer to Diagnosis By Symptom in this section.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

The Shift Point Road Test and Torque Converter Clutch Operation Test provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.
2. Operate vehicle with selector lever in (D) range.
3. Apply minimum throttle and observe speeds at which upshift occurs and torque converter engages. Refer to the following Shift Speeds Chart. Also refer to the Automatic Transmission Specifications.
4. Stop the vehicle. Depress transmission control switch (TCS) to activate D range. Repeat Step 3. Transmission will make all upshifts except 4-5 and torque converter clutch apply should occur above 46 km/h (29 mph).
5. Press accelerator pedal to floor, wide open throttle (WOT). Transmission should shift from fourth to third, third to second, or third to first, depending on vehicle speed, and torque converter clutch should release.
6. With vehicle speed above 48 km/h (30 mph), move transmission range selector lever from (D) range to 1 range (LOW) and release accelerator pedal. Transmission should immediately downshift to third gear. When vehicle speed drops below 32 km/h (20 mph), transmission should downshift into first gear.
7. If transmission fails to upshift/downshift or torque converter clutch does not apply/release, refer to Diagnosis By Symptom for possible causes.

Shift Speeds — KM/H (MPH)

NOTE: Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application), refer to the Automatic Transmission Specification booklet.

Throttle Position	Range	Shift	MPH	KM/H
Closed Throttle	(D)	3-2	11-19	18-31
	(D)	2-1	6-16	10-26
Minimum Throttle (TP Voltage 1.25 Volts)	(D)	1-3	36-79 [a]	58-127
	(D)	1-2	11-13	18-21
	(D)	2-3	15-38	24-61
	(D)	3-4	16-47	26-76
	(D)	4-5	39-71	63-114
	(D)	5-4	39-49	63-79
	(D)	4-3	17-30	27-48
	(D)	3-2	10-22	16-35
	(D)	2-1	6-12	10-19
Wide Open Throttle	(D)	1-2	18-80	29-129
	(D)	2-3	55-94	88-151

	(D)	3-4	72-108	116-174
	(D)	4-5	100-134	161-216
	(D)	5-4	88-119	142-192
	(D)	4-3	66-96	106-154
	(D)	3-2	33-67	53-108
	(D)	2-1	25-40	25-64

[a] The 5R55E 4.0L EI will shift 1-3 at minimum throttle. At medium throttle the transmission will resume a normal shift pattern 1-2, 2-3, 3-4, 4-5.

Torque Converter Diagnosis

Prior to torque converter replacement, all diagnostic procedures must be followed. This is to prevent the unnecessary replacement of good torque converters. Only after a complete diagnostic evaluation can the decision be made to replace the torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary Inspection.

2. Know and Understand the Customer's Concern.

3. Verify the Concern — Carry out the Torque Converter Clutch Operation Test. Refer to the Torque Converter Operation Test in this section.

4. Carry out Diagnostic Procedures.

- Run on-board diagnostics. Refer to the On-Board Diagnostics With Diagnostic Tool in this section.
  - Repair all non-transmission related DTCs first.
  - Repair all transmission DTCs.
  - Rerun on-board diagnostic to verify repair.
- Carry out Line Pressure Test. Refer to the Line Pressure Test in this section.
- Carry out Stall Speed Test. Refer to the Stall Speed Test in this section.
- Carry out Diagnosis by Symptom Index. Refer to Diagnosis By Symptom in this section.
  - Use the index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and service as required before servicing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

1. Carry out Quick Test. Refer to the On-Board Diagnostics With Diagnostic Tool in this section. Check for DTCs. Refer to the Diagnostic Trouble Code Chart.

2. Connect a tachometer to the engine.

3. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.

4. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h

(50 mph) and tap brake pedal with the left foot.

5. Engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, refer to the Torque Converter Operation Concerns in Diagnosis By Symptom .

6. If the vehicle stalls in(D) or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, refer to the Torque Converter Operation Concerns in Diagnosis By Symptom in this section. Repair as required. If the vehicle does not stall in (D), refer to Diagnosis By Symptom in this section.

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- Electronic add-on items:
  - Air conditioning
  - Generator (alternator)
  - Engine turbo
  - Cellular telephone
  - Cruise control
  - CB radio
  - Linear booster
  - Backup alarm signal
  - Computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module (PCM), or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- Leaks, refer to the Leakage Inspection in this section.
- Correct linkage adjustments, refer to Section 307-05 .

Shift Linkage Check

Check for a incorrectly adjusted shift linkage by matching the detents in the transmission range selector lever with those in the transmission. If they match, the incorrect adjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

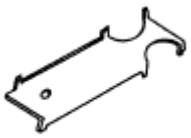
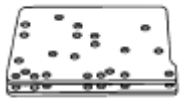
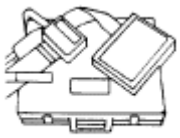
Refer to the technical service bulletins and OASIS messages which pertain to the transmission concern and follow the procedure as outlined.

Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the powertrain control system.

Diagnostics

Special Tool(s)

 ST1633-A	TRS Alignment Tool 307-351 (T97L-70010-A)
 ST1637-B	Transmission Test Plate 307-342 (T95L-77000-AH)
ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
	Digital TR Sensor Overlay 007-00131 or equivalent
 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent
	MLP-TR Cable 418-F107 (007-00111) or equivalent

ST1632-A	
ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent
ST1565-A	Pressure Gauge 307-004 (T57L-77820-A)

Diagnosing electronically controlled automatic transmissions is simplified using the following procedures. It is important to remember that there is a definite procedure to follow. Do not take short cuts or assume that critical checks or adjustments have already been made. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics With Scan Tool

NOTE: For detailed instructions and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

These quick tests should be used to diagnose the Powertrain Control Module (PCM) and should be carried out in order.

- Quick Test 1.0 — Visual Inspection
- Quick Test 2.0 — Set Up
- Quick Test 3.0 — Key On, Engine Off
- Quick Test 4.0 — Continuous Memory
- Quick Test 5.0 — Key On, Engine Running
- Special Test Mode
    - Wiggle Test Mode
    - Output Test Mode
- PCM Reset Mode
- Clearing DTCs

- OBD II Drive Cycle
- Other NGS Features

For further information on other diagnostic testing features using the scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode
- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

Output state control (OSC) mode allows the technician to take control of certain parameters to function the transmission. For example, OSC allows the technician to shift the transmission only when commanding a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. For another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

NOTE: To operate OSC the Digital Transmission Range (TR) Sensor and the Vehicle Speed Sensor (VSS) must be operational. No Diagnostic Trouble Codes (DTCs) related to the digital TR sensor or the VSS sensor can be present.

- The vehicle requirements MUST BE MET when SENDING the OSC value. Refer to Vehicle Requirements for each individual test.
- If the vehicle requirements are NOT MET when SENDING the OSC value, an ERROR MESSAGE will appear. When the ERROR MESSAGE is received, OSC is aborted and must be restarted.
- If AFTER SENDING an OSC value, and the vehicle requirements are no longer met, the PCM will cancel the OSC value and NO ERROR message will appear.
- The OSC value [XXX] may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures:

- Carry out visual inspection and vehicle preparation as required.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Diagnostic Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.
- Repair all VSS and digital TR sensor DTCs.
- Make sure that VSS/digital TR sensors are functional.
- Select "Active Command Modes."
- Select "Trans - Bench Mode or Trans - Drive Mode."

OSC — Transmission Bench Modes

The following Transmission Bench Modes may be used or required during diagnostics.

SSA, SSB, SSC, SSD and TCC in BENCH MODE:

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA - Activates SS#1 OFF or ON.
- SSB - Activates SS#2 OFF or ON.
- SSC - Activates SS#3 OFF or ON.
- SSD - Activates SS#4 OFF or ON.
- TCC - Activates TCC OFF or ON.

OSC "SSA, SSB, SSC, SSD, TCC" BENCH MODE Operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in P.
- Key ON.
- Engine OFF.

OSC Command Values

- [OFF] - turns solenoid OFF.
- [ON] - turns solenoid ON.
- [XXX] - cancels OSC value sent.
- [SEND] - sends the values to PCM.

BENCH MODE Procedure for SSA, SSB, SSC, SSD, and TCC

Follow operating instructions from the NGS menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB, SSC, SSD, or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in BENCH MODE:

The BENCH MODE is also used to test the functionality of the transmission's electronic pressure control. During BENCH MODE, the EPC solenoid can ramp in increments of 15 psi from zero to 90 psi and 90 to zero psi.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected values.
- [00] - sets EPC pressure to 00 psi.
- [15] - sets EPC pressure to 15 psi.
- [30] - sets EPC pressure to 30 psi.
- [45] - sets EPC pressure to 45 psi.
- [60] - sets EPC pressure to 60 psi.
- [75] - sets EPC pressure to 75 psi.
- [90] - sets EPC pressure to 90 psi.

OSC "EPC" — BENCH MODE should ONLY be operated to check PRESSURE FUNCTIONALITY using an installed pressure gauge (300 psi) when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in P.
- Pressure gauge installed.
- Key ON.
- Engine ON.
- Engine rpm at 1500.

OSC "EPC" BENCH MODE should ONLY be operated to complete EPC SOLENOID CIRCUIT PINPOINT TESTS when:

- VSS and Digital TR Sensor are operational.
- No VSS and Digital TR Sensor DTCs are present.
- Transmission range selector lever is in "P" or "N".
- Key "ON".
- Engine "OFF".

OSC Command Values

- [00] - sets EPC pressure to 00 psi.
- [15] - sets EPC pressure to 15 psi.
- [30] - sets EPC pressure to 30 psi.
- [45] - sets EPC pressure to 45 psi.
- [60] - sets EPC pressure to 60 psi.
- [75] - sets EPC pressure to 75 psi.
- [90] - sets EPC pressure to 90 psi.
- [OFF] - turns solenoid OFF.
- [ON] - turns solenoid ON.
- [XXX] - cancels OSC value sent.
- [SEND] - sends the values to PCM.

BENCH MODE Procedure for EPC

Following operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.

- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0 - 90 psi."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC — Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GR_CM - allows upshifts or downshifts.
- TCC - engages or disengages the torque converter clutch.
- EPC - increases/decreases EPC pressure.

GR_CM in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GR_CM parameter allows the technician to choose the following options:

- [1] - PCM selects 1st gear.
- [2] - PCM selects 2nd gear.
- [3] - PCM selects 3rd gear.
- [4] - PCM selects 4th gear.
- [5] - PCM selects 5th gear.

OSC "GR_CM" Mode Operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Engine ON.
- TCC "OFF.
- Transmission range selector lever on O/D.
- Vehicle speed is greater than 2 mph.

OSC Command Values

- [1] - PCM selects 1st gear.
- [2] - PCM selects 2nd gear.
- [3] - PCM selects 3rd gear.
- [4] - PCM selects 4th gear.
- [5] - PCM selects 5th gear.
- [OFF] - turns solenoid OFF.
- [ON] - turns solenoid ON.
- [XXX] - cancels OSC value sent.
- [SEND] - sends the values to PCM.

DRIVE MODE Procedure for GR_CM

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans - DRIVE MODE."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - GR_CM."
- Select Value "1-5."
- Press "SEND" to send command.
- Re-Select Value "1-5."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

TCC in DRIVE MODE:

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC - activates TCC OFF and ON.
- [ON] - turns TCC solenoid ON.
- [OFF] - turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE Operates ONLY when:

- VSS and digital TR sensors are operational.
- No VSS and digital TR sensor DTCs present.
- Engine ON.
- Transmission range selector lever in O/D.
- Vehicle speed is greater than 2 mph.

OSC "TCC ON" DRIVE MODE Operates ONLY when:

- VSS and digital TR sensors are operational.
- No VSS and digital TR sensor DTCs present.
- Engine on.
- Transmission range selector lever in O/D.
- Vehicle speed is greater than 2 mph.
- Transmission in 2nd gear or higher.
- TFT is between 60 and 275 degrees F.
- Brake not applied "OFF" below 20 mph.
- (Not an excessive load on engine (engine lugging).

OSC Command Values

- [OFF] - turns TCC OFF.
- [ON] - turns TCC ON.

- [XXX] - cancels OSC value sent.
- [SEND] - sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in DRIVE MODE

This OSC functions is used to increase the EPC pressure while testing the transmission shift functions. This OSC functions can only increase the EPC pressure greater than what the PCM normally commands. If an OSC value, such as [75] or [90] psi is sent, the upshifts and downshifts should exhibit a harsher shift. Harsher shifts would indicate that the EPC pressure control works at higher pressures. The best test for the EPC is to use the BENCH MODE and a hydraulic pressure gauge. Using EPC in the BENCH MODE will confirm that the EPC works at both the higher and lower pressures.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected
  - [00] - sets EPC pressure to 00 psi.
  - [15] - sets EPC pressure to 15 psi.
  - [30] - sets EPC pressure to 30 psi.
  - [45] - sets EPC pressure to 45 psi.
  - [60] - sets EPC pressure to 60 psi.
  - [75] - sets EPC pressure to 75 psi.
  - [90] - sets EPC pressure to 90 psi.

OSC "EPC" DRIVE MODE Operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in O/D.
- Pressure gauge installed.
- Key ON.
- Engine ON.
- Vehicle speed greater than 2 mph.
- OSC value for EPC must be greater than what the PCM commands (see EPC PID).

OSC Command Values

- [00] - sets EPC pressure to 00 psi.
- [15] - sets EPC pressure to 15 psi.
- [30] - sets EPC pressure to 30 psi.
- [45] - sets EPC pressure to 45 psi.
- [60] - sets EPC pressure to 60 psi.
- [75] - sets EPC pressure to 75 psi.
- [90] - sets EPC pressure to 90 psi.
- [OFF] -" turns solenoid OFF.
- [ON] - turns solenoid ON.
- [XXX] - cancels OSC value sent.
- [SEND] - sends the values to PCM.

DRIVE MODE Procedure for EPC.

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-90 psi."
- Press "SEND" to send command.
- Re-Select Value "0-90 psi."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control (OSC) and Accessing PIDs

To confirm that the OSC value was sent by the NGS and the EEC has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PID:

OSC Parameter	Corresponding PID	Additional PIDs
SSA	SSA	SSA (1)F
SSB	SSB	SSB (2)F
SSC	SSC	SSC (3)F
SSD	SSD/CCSF	—
TCC	TCC	TCCF, TCCMACT (do not use PID TCCMCMD during OSC)
EPC	EPC	—
GR_CM	GEAR	TRANRAT

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID

value. If no ERROR MESSAGE was received and the value of the corresponding PID remains the same as the value sent from OSC, then the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous torque converter clutch code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, refer to the Solenoid Application Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in Overdrive, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fifth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fifth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.
    - If the DTCs are still present, refer to the Diagnostic Trouble Chart. Repair all non-transmission DTCs first as they can directly affect the operation of the transmission. Repeat the Quick Test and the Road Test to verify the correction. Erase the DTCs, carry out the Drive Cycle Test and repeat the Quick Test after completing repair on the DTC.
    - If the continuous test passes and a concern is still present, refer to Diagnosis By Symptom in this section, OASIS messages, and TSBs for concerns.

After On-Board Diagnostic

NOTE: The vehicle wiring harness, and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Refer to the On-Board Diagnostic Trouble Code Chart for information on condition and symptoms. This chart will be helpful

in referring to the proper manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the powertrain control module (PCM) wiring harness for proper connections, bent or broken pins, corrosion, loose wires, proper routing, proper seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis by Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Chart for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Chart

Diagnostic Trouble Code Chart

****May also be generated by some other non-electric transmission hardware system.**					
***Output circuit check, generated only by electrical symptoms.**					
Five Digit DTC	**Component**	**Description**	**Condition**	**Symptom**	**Action**
P0112	IAT	IAT indicates 125°C (254°F) (grounded).	Voltage drop across IAT exceeds scale set for temperature 125°C (254°F).	Incorrect EPC pressure. Either high or low which will result in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit).	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure. Either high or low which will result in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range.	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1116	ECT	ECT out of on-board diagnostic range.	ECT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (254°F).	Voltage drop across ECT exceeds scale set for temperature	Torque converter clutch will always be off, resulting in reduced fuel	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED)

			125°C (254°F) (grounded).	economy.	manual.
P0118	ECT	ECT indicates -40°C (-40°F).	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1124	TP	TP voltage high/low for on-board diagnostic.	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0121, P0122, P0123, P1120, P1121, P1125, P1124	TP	TP concern.	PCM has detected an error. This error may cause a transmission concern.	Harsh engagements, firm shift feel, abnormal shift schedule, torque converter clutch does not engage. Torque converter clutch cycling.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0102, P0103, P1100, P1101	MAF	MAF concerns.	MAF system has a malfunction which may cause a transmission concern.	High/low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a TP failure.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0300-P0308, P0320, P0340, P1351-P1364	EI	EI concerns.	EI system has a malfunction which may cause a transmission concern.	Harsh engagements and shifts, late WOT shifts, no torque converter clutch engagement.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503, P0500, P1501	VSS	Insufficient VSS input.	PCM detected a loss of vehicle speed signal during operation.	Torque converter clutch engages, shift engagement/ disengagement (hunting) on grades.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1704	Digital TR.	Digital TR circuits reading in-between gear positions during KOEO/KOER.	Digital TR sensor or shift cable improperly adjusted or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position. (i.e., in overdrive position, transmission stuck in manual 2).	Refer to Pinpoint Test C .
P1705	Digital TR.	Digital TR not in PARK or NEUTRAL during KOEO/KOER.	KOEO/KOER not run in PARK or NEUTRAL; or Digital TR circuit failure.	Rerun KOEO/KOER in PARK or NEUTRAL.	Refer to Pinpoint Test C .

P1703	BPP	Brake not actuated during on-board diagnostic KOER.	Brake not cycled during KOER.	Failed ON or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed.	Brake ON circuit failure during KOEO.	Failed ON or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1460	A/C	A/C clutch cycling pressure switch error.	A/C or defrost ON condition may result from A/C clutch being ON during on-board diagnostic.	DTC set during on-board diagnostic — rerun with A/C OFF. Failed ON — EPC pressure slightly low with A/C OFF.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0731**	SSA, SSB, SSC or internal parts.	1st gear error	No 1st gear.	Improper gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to the Solenoid On/Off Charts. Refer to Pinpoint Test A .
P0732**	SSA, SSB, SSC or internal parts.	2nd gear error.	No 2nd gear.	Improper gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to the Solenoid On/Off Charts. Refer to Pinpoint Test A .
P0733**	SSA, SSB, SSC or internal parts.	3rd gear error.	No 3rd gear.	Improper gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission	Refer to the Solenoid On/Off Charts. Refer to Pinpoint Test A .

				concerns (stuck valves, damaged friction material).	
P0734**	SSA, SSB, SSC or internal parts.	4th gear error.	No 4th gear.	Improper gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to the Solenoid On/Off Charts. Refer to Pinpoint Test A .
P0750*	SSA	SSA solenoid circuit failure.	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Improper gear selection depending on condition mode and manual lever position. See Solenoid On/Off Charts. Will flash MIL.	Refer to Pinpoint Test A .
P0753*	SSA	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. Refer to Solenoid On/Off Charts. Will flash TCIL.	Refer to Pinpoint Test A .
P0755*	SSB	SSB solenoid circuit failure.	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Improper gear selection depending on condition mode and manual lever position. See Solenoid On/Off Charts. Will flash MIL.	Refer to Pinpoint Test A .
P0758*	SSB	SSB solenoid circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Charts. Will flash TCIL.	Refer to Pinpoint Test A .
—	TCIL	TCIL circuit failure.	TCIL circuit open or shorted.	Failed ON — overdrive cancel mode always ON. NO flashing TCIL for EPC failure or sensor. Failed OFF — overdrive cancel mode never indicated. NO flashing TCIL for	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

				EPC sensor failure.	
P1747**	EPC	EPC solenoid circuit failure, shorted circuit.	Voltage through EPC solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit — causes minimum EPC pressure (minimum capacity) and limits engine torque (alt. firing). With zero EPC — no engagements. If engagements occur and then EPC goes to zero, then no, 2nd, 3rd, and 5th gears. Slips in 1st and 4th with high input torque.	Refer to Pinpoint Test D .
P0741**	TCC	TCC slippage detected.	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation. Flash TCIL.	Refer to Diagnosis By Symptom in this section.
P1780	TCS	TCS not changing states.	TCS not cycled during self test. TCS circuit open or shorted.	No (D) cancel when switch is cycled during KOER.	Rerun on-board diagnostic and cycle switch. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1711	TFT	TFT out of on-board diagnostic range.	Transmission not at operating temperature during on-board diagnostic.	DTC set — vehicle cold or overheated.	Warm or cool vehicle to normal operating temperature. Refer to Pinpoint Test B .
P0713	TFT	-40°C (-40°F) indicated TFT sensor circuit open.	Voltage drop across TFT sensor exceeds scale set for temperature -40° C (-40°F).	Firm shift feel.	Refer to Pinpoint Test B .
P0712	TFT	157°C (315°F) indicated TFT sensor circuit grounded.	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	Firm shift feel.	Refer to Pinpoint Test B .
P0715	TSS	Insufficient input from turbine shaft speed sensor.	PCM detected a loss of TSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque converter clutch activation.	Refer to Pinpoint Test E .
P0743*	TCC	TCC solenoid circuit failure during on-board	TCC solenoid circuit fails to provide voltage drop across	Short circuit — engine stalls in second (OD, 2 range) at low idle	Refer to Pinpoint Test A .

		diagnostic.	solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostics.	speeds with brake applied. Open circuit — torque converter clutch never engages.	
P1783	TFT	Transmission overtemp condition indicated.	Transmission fluid temperature exceeded 127°C (270°F).	Increase in EPC pressure.	Refer to Pinpoint Test B .
P0705	Digital TR sensor.	Digital TR circuit failure.	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an improperly adjusted digital TR sensor.	Increase in EPC pressure (harsh shifts). Defaults to (D) or D for all gear positions. In (D) position transmission is stuck in D or manual 2.	Refer to Pinpoint Test C .
P0708	Digital TR sensor.	Digital TR sensor circuit TR3A open.	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an improperly adjusted digital TR sensor.	Increase in EPC pressure. Defaults to (D)or D for all gear ranges.	Refer to Pinpoint Test C .
P1781	4x4L	4x4 low switch failure.	Switch closed or shorted during KOEO.	Early or delayed shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1729	4x4L	4x4 low switch failure.	Circuit open/shorted.	Early or delayed shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0760*	SSC	SSC solenoid circuit failure.	SSC circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Improper gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart. Will flash MIL.	Refer to Pinpoint Test A .
P0763*	SSC	SSC solenoid circuit failure	SSC circuit failed to provide voltage drop across solenoid. Circuit open or shorted or	Incorrect gear selection depending on condition mode and manual lever position. See	Go To Pinpoint Test A .

			PCM driver failure during on-board diagnostic.	Solenoid On/Off chart. Will flash TCIL.	
P1701	Transmission.	Reverse engagement error.	Voltage through EPC solenoid is checked. Error noted if tolerance is exceeded.	EPC pressure low, SSA is off, engine lacks power.	Refer to Diagnosis By Symptom in this section.
P1746**	EPC	EPC solenoid circuit open.	Voltage through EPC solenoid is checked. Error is noted if tolerance is exceeded.	Open circuit — causes maximum EPC pressure, harsh engagements and shifts.	Refer to Pinpoint Test D .
P1714	SSA	SSA malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Refer to Pinpoint Test F .
P1715	SSB	SSB malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Refer to Pinpoint Test F .
P1716	SSC	SSC malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Refer to Pinpoint Test F .
P1717	SSD	SSD malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Refer to Pinpoint Test F .
P0735	SSA, SSB, SSC, SSD or internal parts.	5th gear error.	No 5th gear.	Improper gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material etc.).	Refer to the Solenoid On/Off Charts. Refer to Pinpoint Test A .
P0720	Output Shaft Speed sensor.	Insufficient input from OSS sensor.	PCM detected a loss of OSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque	Refer to Pinpoint Test E .

				converter clutch engagement.	
P0765	SSD	SSD solenoid circuit failure.	SSD circuit failed to provide voltage drop across solenoid. Circuit open, shorted or PCM driver circuit failure during on-board diagnostics.	Improper gear selection depending on condition, mode and manual lever position. See the Solenoid On/Off Charts. Will flash MIL.	Refer to Pinpoint Test A .
P0768	SSD	SSD solenoid circuit failure	SSD circuit failed to provide voltage drop across solenoid. Circuit open, shorted or PCM driver circuit failure during on-board diagnostics.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Charts. Will flash TCIL.	Refer to Pinpoint Test A .
P1740	TCC	TCC malfunction.	Mechanical failure of the solenoid detected.	Failed ON — engine stalls in 2nd (O/D, Manual 2 ranges) at low idle speeds with brake applied. Failed OFF — torque converter never applies.	Refer to Pinpoint Test F .
P0721	OSS	Output shaft speed sensor signal noisy.	PCM has detected an erratic OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Refer to Pinpoint Test E .
P1900	OSS	OSS signal intermittent.	PCM has detected an intermittent OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Refer to Pinpoint Test E .
P1713	TFT	No change in TFT - low range.	PCM has detected no TFT change at low range during operation.	Increase EPC, improper TCC engagement schedule, harsh engagement, harsh shifts.	Refer to Pinpoint Test B .
P1718	TFT	No change in TFT - high range.	PCM has detected no TFT change at high range during operation.	Increase EPC, improper TCC engagement schedule, harsh engagement, harsh shifts.	Refer to Pinpoint Test B .
P1702	Digital TR.	Digital TR signal intermittent, code P0705, P0708 are set.	See P0705, P0708 conditions.	See P0705, P0708 Symptoms.	Refer to Pinpoint Test C .

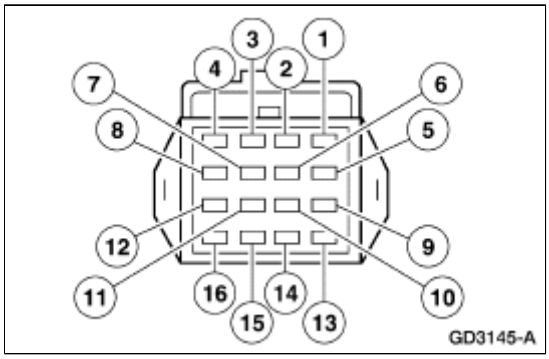
Rotunda Transmission Tester

The Rotunda Transmission Tester is used to diagnosis electronically controlled transmissions and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Rotunda Transmission Tester allows separation of the vehicle electronics from transmission electronics; refer to the Rotunda Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test
- Switch Test - Park/Neutral, Backup Lamp, and Optional Circuits

Transmission Connector Layout

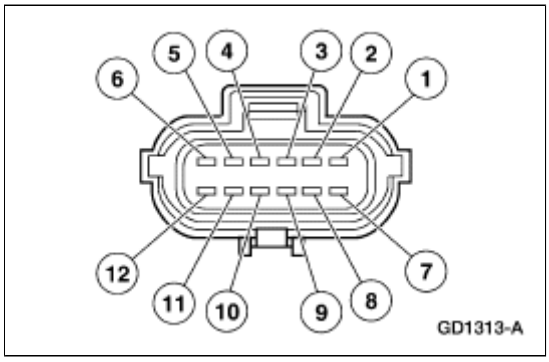
Transmission Vehicle Harness Connector



Pin Number	Circuit	Circuit Function
1	361 (RD)	TCC Power
2	970 (GN/WH)	Turbine Shaft Speed Sensor Signal
3	359 (GY/RD)	Sensor Signal Return (TSS)
4	923 (OG/BK)	Transmission Fluid Temperature Sensor
5	480 (PK/YE)	Torque Clutch Solenoid
6	—	NOT USED
7	971 (PK/BK)	Shift Solenoid SSC
8	359 (GR/RD)	Sensor Signal Return (TFT)
9	924 (BR/OG)	Shift Solenoid SSD
10	361 (RD)	Shift Solenoid Power
11	361 (RD)	EPC Power
12	925 (WH/YE)	Electronic Pressure Control Solenoid
13	—	NOT USED
14	315 (PK/OG)	Shift Solenoid SSB
15	—	NOT USED

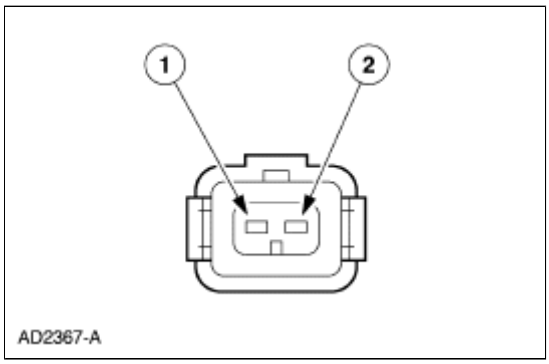
16	237 (OG/YE)	Shift Solenoid SSA

Digital Transmission Range (TR) Sensor Harness Connector



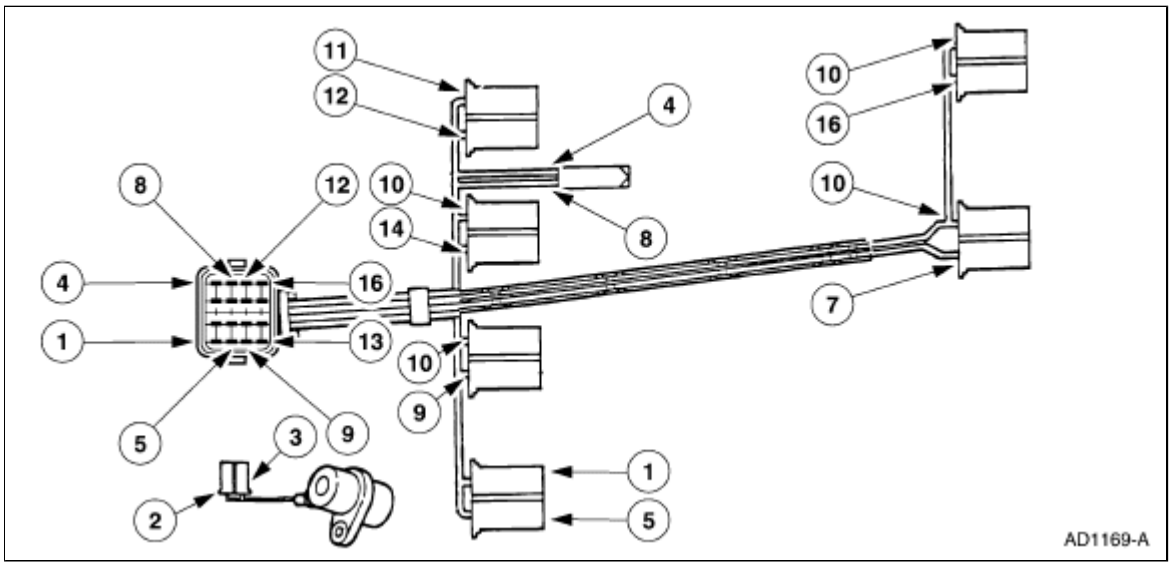
Pin Number	Circuit	EEC-V Pin Number	Circuit Function
1	—	—	NOT USED
2	359 (GY/RD)	91	Signal Return
3	199 (LB/YE)	64	TR3A
4	1144 (YE/BK)	3	TR1
5	1145 (LB/BK)	49	TR2
6	1143 (WH/BK)	50	TR4
7	57 (BK)	—	Ground
8	463 (RD/WH)	—	Neutral Sense
9	298 (PK/OG)	—	Fused Power Feed
10	32 (RD/LB)	—	Starter Control
11	140 (BK/PK)	—	Back Up
12	329 (PK)	—	Starter to Starter Interrupt Relay

Output Shaft Speed (OSS) Sensor Connector



Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed Sensor (OSS)
2	—	Signal Return

Internal Harness Diagram



Pin Number	Circuit	Circuit Function
1	Black	TCC Power
2	Red	Turbine Shaft Speed Sensor Signal
3	White	Sensor Signal Return (TSS)
4	Red	Transmission Fluid Temperature Sensor
5	Purple	Torque Converter Clutch Solenoid
6	—	NOT USED
7	Yellow	Shift Solenoid SSC
8	Red	Sensor Signal Return (TFT-)
9	Orange	Shift Solenoid SSD
10	White	Shift Solenoid Power
11	Green	EPC Power
12	Blue	Electronic Pressure Control Solenoid
13	—	NOT USED
14	Brown	Shift Solenoid SSB
15	—	NOT USED
16	Gray	Shift Solenoid SSA

Digital Transmission Range (TR) Sensor Diagnosis Chart

		PID: TR_D				PID: TR_V (volts)
Selector Position	PID: TR	TR4	TR3A	TR2	TR1	TR3A (PCM pin 64 to sigrtn)
PARK	P/N	0	0	0	0	0.0 Volts

In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D [a]	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	O/D [a]	1	1	1	1	1.3 - 1.8 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 2	Man 2	1	0	0	1	0.0 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 1	Man 1	0	0	1	1	0.0 Volts

[a] Will read "Drive" if O/D is canceled

A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open digital TR switch, 0= Closed digital TR switch.
D. Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
   - **Voltages for TR1, TR2, TR4:**
   - 0 = 0.0 volts (circuit shorted to ground)
   - 1 = 9.0 - 14.0 volts (open circuit).
   - **Voltage for TR3A:**
   - 0 = 0.0 volts (circuit shorted to ground).
   - 1 = 1.3 - 1.8 volts (open circuit).
   - 1.8 - 5.0 volts = Invalid Reading (open in wires or bad resistor in digital TR sensor).

Wiggle Test Information for Open/Shorts

A. TR4, TR3A, TR2, and TR1 are all closed in Park (shorted to signal return), so Park is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
B. TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present unplug the transaxle harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire terminal from the PCM connector. If the short is still present, then the PCM has an internal failure, otherwise the failure is in the vehicle harness.

Pinpoint Tests

Any time an electrical connector or solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or replace as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Application Chart — 5R55E

Selector Lever Position	Powertrain Control Module (PCM) Commanded Gear	5R55E Solenoid States				
		SSA	SSB	SSC	SSD	Engine Braking
P/N	P/N	On	Off	Off	Off	No
R	R	On	Off	Off	Off	No
(D) (Overdrive)	1	On	Off	Off	Off	No
(D)	2 [1]	On	Off	On	Off	No
(D)	3	On	On	Off	Off	No
(D)	4	Off	Off	Off	Off	No
(D)	5	Off	Off	On	Off	No
(D) Off	1	On	Off	Off	Off	No
	2 [1]	On	Off	On	Off	No
	3	On	On	Off	On [2]	No
	4	Off	Off	Off	On	Yes
2	3	On	On	Off	On	Yes
1	1	On	Off	Off	On	Yes

[1] PCM controlled.
[2] On time calibration dependent

Shift Solenoid Failure Mode Chart "Always On"

Failed OFF due to powertrain control module and/or vehicle wiring concerns, solenoid electrically, mechanically or hydraulically stuck ON.

SSA ALWAYS "ON":	Transmission Range Selector Lever Position		
	OD	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	3	1
2	2	Ratio 1.1	2
3	3	3	3
4	1	3	1
5	2	Ratio 1.1	2

SSB ALWAYS "ON":	Transmission Range Selector Lever Position		
	OD	2	1
PCM Gear Commanded	Actual Gear Obtained		

1	3	3	3
2	Ratio 1.1	Ratio 1.1	Ratio 1.1
3	3	3	3
4	3	3	3
5	Ratio 1.1	Ratio 1.1	Ratio 1.1

	Transmission Range Selector Lever Position		
SSC ALWAYS "ON":	**OD**	**2**	**1**
PCM Gear Commanded	**Actual Gear Obtained**		
1	2	3	1
2	2	Ratio 1.1	2
3	Ratio 1.1	3	3
4	5	3	3
5	5	Ratio 1.1	Ratio 1.1

	Transmission Range Selector Lever Position		
SSD ALWAYS "ON":	**OD**	**2**	**1**
PCM Gear Commanded	**Actual Gear Obtained**		
1	1	3	1
2	1	3	1
3	3	3	3
4	4	3	3
5	4	3	3

Shift Solenoid Failure Mode Chart "Always Off"

Failed ON due to powertrain control module and/or vehicle wiring concerns, solenoid electrically or hydraulically stuck OFF.

	Transmission Range Selector Lever Position		
SSA ALWAYS "OFF":	**OD**	**2**	**1**
PCM Gear Commanded	**Actual Gear Obtained**		
1	4	3	3
2	5	Ratio 1.1	Radio 1.1
3	3	3	3
4	4	3	3

5	5	Ratio 1.1	Ratio 1.1

SSB ALWAYS "OFF":	Transmission Range Selector Lever Position		
	OD	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	3	3
2	2	Ratio 1.1	2
3	1 [a b])	3	1
4	4	3	3
5	5	Ratio 1.1	Ratio 1.1

[a] During Downshift Only
[b] During Upshift Only

SSC ALWAYS "OFF":	Transmission Range Selector Lever Position		
	OD	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	3	1
2	1	3	1
3	3	3	3
4	4	3	3
5	4	3	3

SSD ALWAYS "OFF":	Transmission Range Selector Lever Position		
	OD	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	3	1
2	2	Ratio 1.1	2
3	3	3	3
4	4	3	3
5	5	Ratio 1.1	Ratio 1.1

PINPOINT TEST A: SHIFT SOLENOIDS (SSA, SSB, SSC, SSD) AND TORQUE CONVERTER CLUTCH (TCC) SOLENOID

CONDITIONS	DETAILS/RESULTS/ACTIONS

NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests.

NOTE: Refer to the Internal Harness Diagram illustration preceding these pinpoint tests.

NOTE: Read and record all DTCs. All Digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).

A1 ELECTRONIC DIAGNOSTICS

1

2

3 Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding.

4

Scan Tool

5

6

Diagnostic Data Link

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does vehicle enter Trans-Bench Mode?**

→ **Yes**
REMAIN in Trans-Bench Mode. GO to A2 .

→ **No**
REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

A2 WIGGLE TEST

1 Remain on Trans-Bench Mode.

2 Select PIDs to be monitored;

PID Command	PID Actual
SSA	SS1F
SSB	SS2F
SSC	SS3F
SSD	CCSF
TCC	TCCF

3 Select "ON" to turn suspect solenoid on.

4 Press "SEND".

5 Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes.

6 Select "OFF" to turn solenoid off.

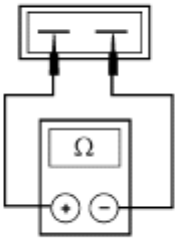
7 Press "SEND".

- **Does the suspect solenoid(s) fault state change?**

→ **Yes**
REPAIR open or short in the vehicle harness or connector.

	→ **No** GO to A3 .
A3 SOLENOID FUNCTIONAL CHECK	
	1 Monitor each solenoid state. 2 Turn each solenoid ON and OFF. • **Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard?** → **Yes** GO to A4 . → **No** GO to A5 .
A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)	
	1 Carry out OSC Trans-Drive Mode. 2 Select GR_CM for Shift Solenoids or follow procedures for GR_CM; refer to Output State Control (OSC) Procedures in this section. 3 Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode Output State Control (OSC) Procedures in this section. • **Does the transmission upshift and downshift or torque converter engage/disengage when commanded?** → **Yes** CLEAR all DTCs. Road test to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose shift or torque converter concerns. → **No** GO to A5 .
A5 CHECK FOR BATTERY VOLTAGE	
3	1 Remove transmission fluid pan. 2 Visually inspect all wires and connectors for damage.

	4 Connect DVOM positive lead to VPWR solenoid terminal and negative lead to a good ground. • **Is the battery voltage present?** → **Yes** GO to A6 . → **No** CHECK for open or short circuit in harness, or solenoid.
A6 ELECTRICAL SIGNAL CHECK	
2 Trans-Bench Mode	1 Leave positive lead connected to VPWR solenoid terminal and connect negative lead to the signal terminal of the appropriate solenoid. 3 Select Parameter SSA, SSB, SSC, SSD or TCC. 4 Select "ON". 5 Press "SEND". 6 Turn the solenoids ON and OFF, while monitoring the voltage reading on the DVOM, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click). 7 Select "OFF", press "SEND". • **Does the voltage and solenoid state change?** → **Yes** GO to A7 . → **No** CHECK for open or short circuit in harness, solenoid or a PCM concern.
A7 CHECK SOLENOID RESISTANCE AT SOLENOID	
2	1 Disconnect the appropriate solenoid connector at the solenoid. 2 Check solenoid resistance by connecting an ohmmeter at the terminals of the solenoid.



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3 Measure and record the resistance for each solenoid (SSA, SSB, SSC, SSD or TCC).

Solenoid	Resistance (ohms)
SSA	22-48
SSB	22-48
SSC	22-48
SSD	22-48
TCC	8.9-16

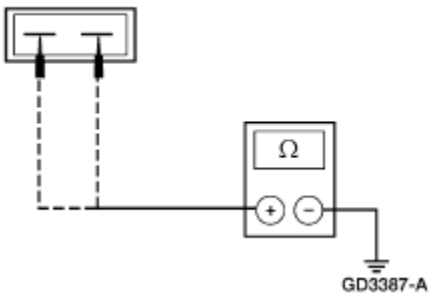
- **Is the resistance within specification?**

→ **Yes**
GO to A8 .

→ **No**
INSTALL a new solenoid.

A8 CHECK SOLENOID FOR SHORT TO GROUND

1



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1 Check for continuity between engine ground and appropriate shift solenoid terminal with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).

Solenoid	Terminal
SSA	+/-
SSB	+/-
SSC	+/-
SSD	+/-
TCC	+/-

- **Is there continuity?**

→ **Yes**
INSTALL a new solenoid.

	→ **No** REFER to Diagnosis By Symptom in this section for diagnosis of shift or torque converter concerns.

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests. **NOTE:** Refer to the Internal Harness Diagram illustration preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS	
	1 Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding.
2 Scan Tool	
3 	
	4 Select Diagnostic Data Link. 5 Select PCM. 6 Select PID/Data Monitor and Record.
7 PIDs; TFT, TFTV	
	• **Does the vehicle enter PID/Data Monitor and Record?** → **Yes** REMAIN in PID/Data Control. GO to B2. → **No** REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

B2 WARM-UP/COOL-DOWN CYCLE

1 While monitoring the TFT PIDs, perform the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down.

- **Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?**

→ **Yes**
If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. Road test to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating.

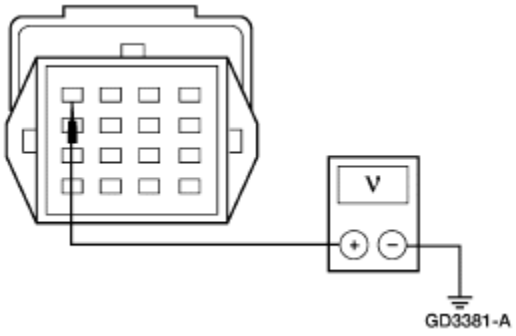
If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector.

→ **No**
GO to B3.

B3 ELECTRICAL SIGNAL CHECK

1 Visually inspect all wires and connectors for damage.

2



2 Connect DVOM positive lead to +TFT at sensor terminal and negative lead to a good ground.

- **Is the voltage present?**

→ **Yes**
GO to B4.

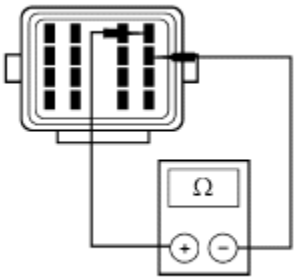
→ **No**
CHECK for open or short circuit in vehicle harness, internal harness or a PCM concern.

B4 CHECK RESISTANCE OF TFT SENSOR

1

Transmission Harness

2



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2 Connect DVOM across +TFT and -TFT terminals at transmission connector.

3 Record the resistance.

4 Resistance should be approximately in the following ranges:

Transmission Fluid Temperature

°C	°F	Resistance (Ohms)
-40 to -20	-40 to -4	967K - 284K
-19 to -1	-3 - 31	284K - 100K
0 - 20	32 - 68	100K - 37K
21 - 40	69 - 104	37K - 16K
41 - 70	105 - 158	16K - 5K
71 - 90	159 - 194	5K - 2.7K
91 - 110	195 - 230	2.7K - 1.5K
111 - 130	231 - 266	1.5K - 0.8K
131 - 150	267 - 302	0.8K - 0.54K

- **Is the resistance in the range?**

→ **Yes**
REFER to Diagnosis By Symptom in this section to diagnose an overheating concern.

→ **No**
INSTALL a new internal harness (sensor is part of harness).

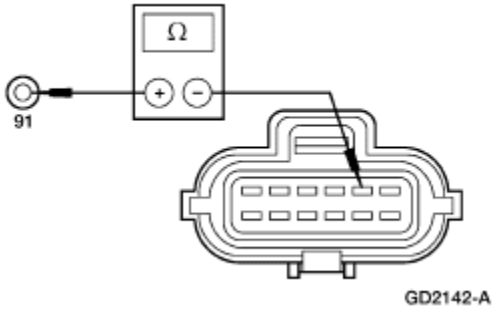
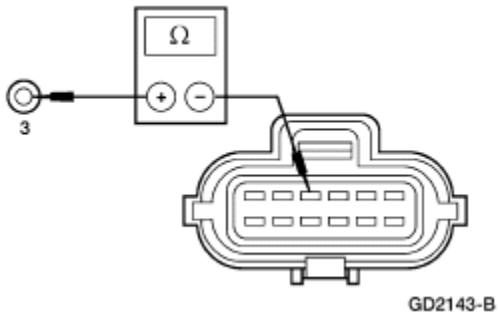
PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

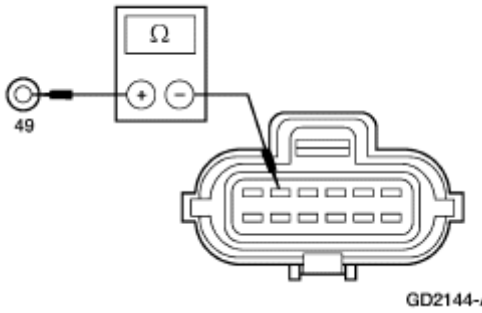
CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding these pinpoint tests. **NOTE:** Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	
C1 VERIFY DIAGNOSTIC TROUBLE CODES	
1 2 	3 Carry out the on-board diagnostic test. DTC codes P0705 and P0708 cannot be set by an improperly adjusted digital TR sensor. • **Are only DTC codes P0705, P0708 present?** → **Yes** GO to C4 . → **No** GO to C2 .
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
1 2 5 	3 Check to make sure the digital TR sensor harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding. 4 Apply the parking brake. 6 Disconnect the shift cable/linkage from the manual lever.

	7 Verify that the Digital TR Sensor Alignment Tool fits in the appropriate slots. • **Is the digital TR sensor properly adjusted?** → **Yes** GO to C3 . → **No** ADJUST the digital TR sensor. PLACE the transmission range selector lever into PARK and CLEAR the DTCs. RERUN OBD Tests.GO to C3 .
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
2 	1 Place the manual lever in the overdrive position. 3 Re-connect the shift cable/linkage. 4 Verify that the shift cable/linkage is properly adjusted. Refer to Section 307-05 . • **Is the shift cable/linkage properly adjusted?** → **Yes** GO to C4 . → **No** ADJUST the shift cable/linkage. REFER to the Section 307-05 . GO to C4 .
C4 CHECK ELECTRICAL SIGNAL OPERATION	
1 2 Digital TR Sensor	2 **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** Press the button and pull out on the digital TR harness connector. 3 Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose

	wires and missing or damaged seals. • **Is there damage to the connector, pins or harness?** → **Yes** REPAIR as required. CLEAR DTCs and RERUN OBD Tests. → **No** If diagnosing a DTC, GO to C5 . If diagnosing a starting concern, 4x4 low engagement concern, or a backup lamp concern,GO to C10 .
C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)	
1 2 Scan Tool 3 Digital TR Sensor 4 5 TR PIDS TR, TR_D, TR_V	6 Move transmission range selector lever into each gear and stop. 7 Observe any of the following PIDs, (vehicle dependent) TR and TR_D, TR_V while wiggling harness, tapping on sensor, and/or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708. 8 Compare the PIDs to the Digital Transmission

	Range (TR) Sensor Diagnosis Chart. • **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis Chart, and does the TR_D PID remain steady when the harness is wiggled, the sensor is tapped, or the vehicle is driven?** → **Yes** The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. → **No** If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent. GO to C6.
C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION	
1 Digital TR Sensor 2 TR-E Cable to Transmission Tester 3 TR-E Cable to Digital TR Sensor	4 Place the DIGITAL TR Overlay onto Transmission Tester. 5 Carry out SENSOR Test as instructed on the Digital TR Overlay. • **Does the status lamp on the tester TR-E cable match the selected gear positions?** → **Yes** Concern is not in the digital TR sensor, GO to C7. → **No**

	INSTALL a new digital TR sensor and ADJUST. CLEAR DTCs and RERUN OBD Tests.
C7 CHECK PCM HARNESS CIRCUITS FOR OPENS	
1 	
2 Powertrain Control Module (PCM)	2 Inspect for damaged or pushed out pins, corrosion or loose wires.
3 Digital TR Sensor	3 **CAUTION: Do not pry on the connector. This will damage the connector and result in a transmission concern.** Disconnect digital TR sensor connector.
	4 Install the 104-Pin Breakout Box
5  GD2142-A	5 Measure the resistance between the PCM test pin 91 at the 104-Pin Breakout Box and signal return circuit pin at vehicle harness connector pin 2.
6  GD2143-B	6 Measure the resistance between the PCM test pin 3 at the 104-Pin Breakout Box and TR1 circuit pin at vehicle harness connector pin 4.
7	7 Measure the resistance between the PCM test pin 49 at the 104-Pin Breakout Box and TR2 circuit pin at vehicle harness connector pin 5.



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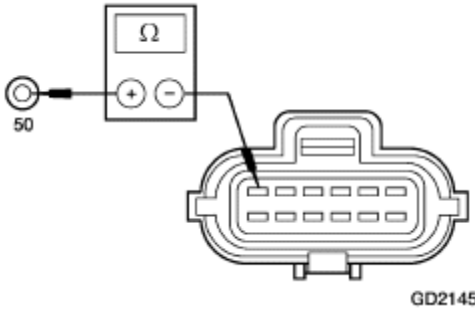

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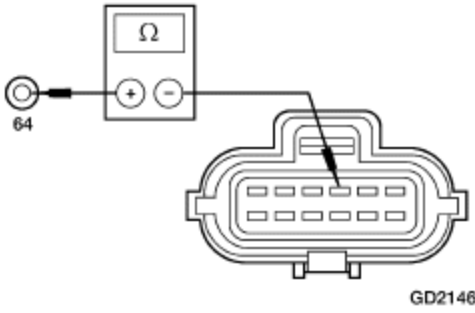


GD2146-A

8 Measure the resistance between the PCM test pin 50 at the 104-Pin Breakout Box and TR4 circuit pin at vehicle harness connector pin 6.

9 Measure the resistance between the PCM test pin 64 at the 104-Pin Breakout Box and TR3A circuit pin at vehicle harness connector pin 3.

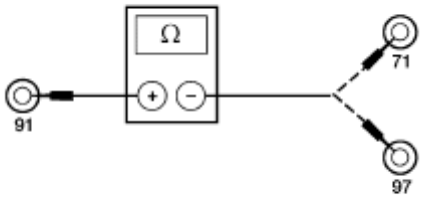
- **Are all resistances less than 5 ohms?**

→ **Yes**
GO to C8 .

→ **No**
REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. RERUN OBD Tests.

C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER

1 Measure the resistance between PCM test pin 91 and test pins 71 and 97 at the 104-Pin Breakout Box.



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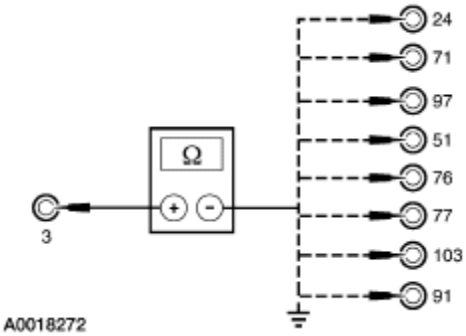
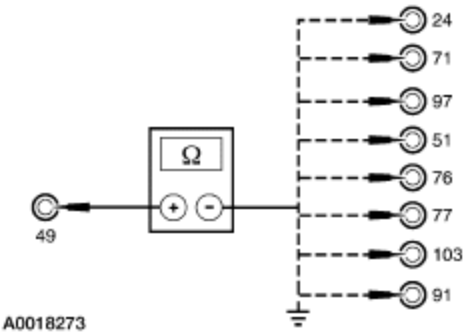
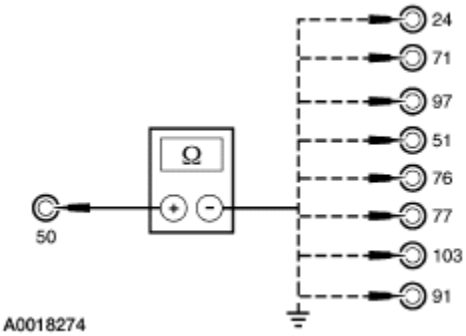
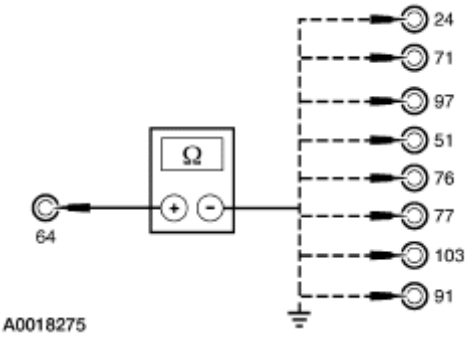
2  A0018272	2 Measure the resistance between PCM test pin 3 and test pins 24, 71, 97, 51, 76, 77, 103, and 91 at the 104-Pin Breakout Box and ground.
3  A0018273	3 Measure the resistance between PCM test pin 49 and test pins 24, 71, 97, 51, 76, 77, 103, and 91 at the 104-Pin Breakout Box and ground.
4  A0018274	4 Measure the resistance between PCM test pin 50 and test pins 24, 71, 97, 51, 76, 77, 103, and 91 at the 104-Pin Breakout Box and ground.
5	5 Measure the resistance between PCM test pin 64 and test pins 24, 71, 97, 51, 76, 77, 103, and 91 at the 104-Pin Breakout Box and ground.



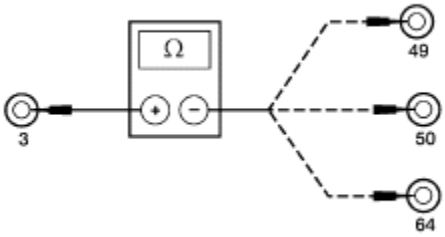
- **Are all resistances greater than 10,000 ohms?**

→ **Yes**
GO to C9 .

→ **No**
REPAIR short circuit(s). RECONNECT all components. CLEAR DTCs. RERUN OBD Tests.

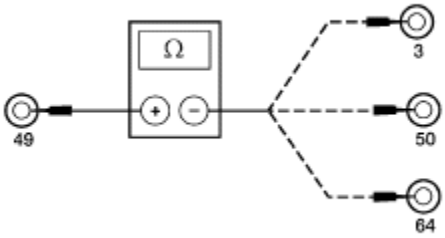
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS

1



1 Measure the resistance between test pin 3 and pins 49, 50, and 64 at the 104-Pin Breakout Box.

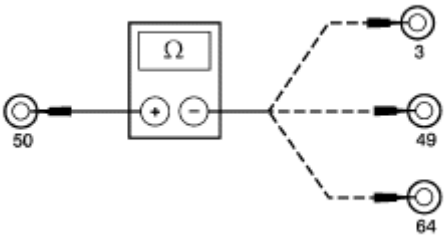
2



2 Measure the resistance between test pin 49 and pins 3, 50, and 64 at the 104-Pin Breakout Box.

3

3 Measure the resistance between test pin 50 and pins 3, 49, and 64 at the 104-Pin Breakout Box.



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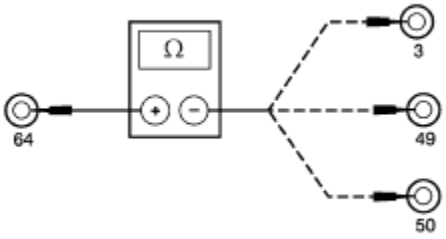
4



GD2262-A

4 Measure the resistance between test pin 64 and pins 3, 49, and 50 at the 104-Pin Breakout Box.

- **Are all the resistances greater than 10,000 ohms?**

→ **Yes**
INSTALL a new PCM. RECONNECT all components. CLEAR DTCs and RERUN OBD Tests.

→ **No**
REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs and RERUN OBD Tests.

C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR

1

TR-E Cable to Transmission

2

TR-E Cable to Digital TR Sensor

3 Place the DIGITAL TR Overlay onto Transmission Tester.

4 Carry out SWITCH Test as instructed on the

	Digital TR Overlay. • **Does the status lamp on the tester indicate RED for the correct gear position?** → **Yes** Concern is not in the digital TR sensor. For Start System concerns, refer to Section 303-06 . For Backup Lamp concerns, GO to Section 417-01 . For Optional Circuits: 4x4 Low Neutral Sense; REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and workshop manual Section 308-07A for diagnosis. → **No** INSTALL a new digital TR sensor. Clear DTCs and RERUN OBD Tests.

PINPOINT TEST D: ELECTRONIC PRESSURE CONTROL (EPC) SOLENOID

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests. **NOTE:** Refer to the Transmission Internal Harness Connector illustration preceding these pinpoint tests. **NOTE:** Read and record all DTCs. All Digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
1 2 4 Scan Tool 5	3 Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in the connector and in good condition before proceeding.

6

Diagnostic Data Link

7

PCM

8

Active Command Modes

9

Output State Control (OSC)

10

Trans-Bench Mode

- **Does the vehicle enter the Trans-Bench Mode?**

→ **Yes**
REMAIN in Trans-Bench Mode. GO to D2 .

→ **No**
REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

D2 SOLENOID FUNCTIONAL TEST

3

1 Install 300 psi pressure gauge into EPC tap.

2 Monitor pressure gauge.

Parameter; EPC

4 Select value - 15, 30, 45, 60, 70 or 90 psi.

5 Press "SEND".

6 Select another value "0-90 psi".

7 Press "SEND".

8

XXX

9 Press "SEND".

- **Does the pressure reading match the commanded pressure?**

→ **Yes**
CLEAR DTCs.

→ **No**
GO to D3 .

D3 CHECK FOR BATTERY VOLTAGE

1 Remove the transmission fluid pan, refer to Fluid Pan, Gasket and Filter in this section.

2 Visually inspect all wires and connectors for damage.

3

4 Connect DVOM positive lead to VPWR solenoid terminal and negative lead to a good ground.

- **Is the battery voltage present?**

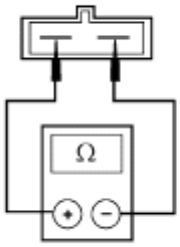
→ **Yes**
GO to D4 .

→ **No**
CHECK for open or short circuit in harness.

D4 ELECTRICAL SIGNAL CHECK

1 Leave positive lead connected to VPWR

	solenoid terminal and connect negative lead to the signal terminal of the EPC solenoid. 2 Turn the solenoids ON and OFF, while monitoring the voltage reading on the DVOM, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click).
3 Trans-Bench Mode 4 Parameter; EPC	5 Select a value "0-90 psi". 6 Press "SEND". 7 Select another value "0-90 psi". 8 Press "SEND".
9 XXX	10 Press "SEND". • **Does the voltage and solenoid state change?** → **Yes** GO to D5 . → **No** CHECK for open or short circuit in harness or PCM.
D5 CHECK SOLENOID RESISTANCE AT SOLENOID	
1 Transmission Harness 2	2 Check solenoid resistance by connecting an ohmmeter at the terminals of the solenoid.



3 Measure and record the resistance of the EPC solenoid. Resistance should be between 3.10-5.7 ohms.

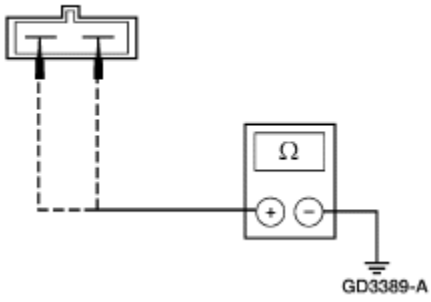
- **Is the resistance within specifications?**

→ **Yes**
GO to D6 .

→ **No**
INSTALL a new solenoid.

D6 CHECK SOLENOID FOR SHORT TO GROUND

1



1 Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).

Solenoid	Terminal
EPC	+/-

- **Is there continuity?**

→ **Yes**
INSTALL a new solenoid.

→ **No**
REFER to Diagnosis By Symptom in this section for pressure concerns.

PINPOINT TEST E: TURBINE SHAFT SPEED (TSS), OUTPUT SHAFT SPEED (OSS) SENSORS

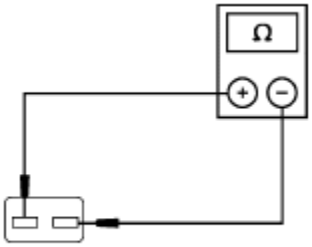
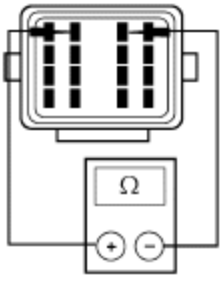
CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Refer to the Output Shaft Speed (OSS) Sensor Connector illustration preceding these pinpoint tests.	

E1 ELECTRONIC DIAGNOSTICS

	1 Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding.
2 Scan Tool	
3	
4 Diagnostic Data Link	
5 PCM	
	6 Select PID/Data Monitor and Record. 7 Select the following PIDs: TSS, OSS. • **Does vehicle enter PID/Data Monitor and Record?** → **Yes** REMAIN in PID/Data. GO to E2 . → **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

E2 DRIVE CYCLE TEST

	1 While monitoring the appropriate sensor PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. • **Does the TSS or OSS Speed PID increase and decrease with engine and vehicle speed or is the sensor signal erratic (drop to zero or near zero and**

	return to normal operation)? → **Yes** If the TSS or OSS Speed PID increase and decrease with engine and vehicle speed, CLEAR all DTCs. Road test to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section for diagnosis. If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector. → **No** If the TSS or OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is steady, GO to E3.
E3 CHECK RESISTANCE OF TSS OR OSS SENSOR	
2  AD1084-B	1 Disconnect the appropriate vehicle harness connector from the OSS sensor. For the TSS sensor, disconnect the vehicle harness connector from the transmission. 2 For OSS: Connect ohmmeter negative lead to one pin of the sensor and the positive lead to the other pin on the sensor.
3  GD3385-A	3 For TSS: Connect ohmmeter negative lead to the signal return pin and the positive lead to the TSS signal at the transmission connector. 4 Record the resistance. Resistance should be as follows:

Sensor	Resistance (ohms)
TSS	64-126
OSS	305-735

- **Is the resistance within specification for the appropriate sensor?**

→ **Yes**
REFER to Diagnosis By Symptom in this section for concern diagnosis.

→ **No**
REPLACE OSS and TSS sensor.

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1716, P1717, P1740.	
F1 ELECTRONIC DIAGNOSIS	
1 Scan Tool 2 3	4 Carry out KOEO Test until continuous DTCs have been displayed. 5 If any of the following DTCs are present, continue with this test: P1714, P1715, P1716, P1717, P1740. • **Are other DTCs present for TFT or shift solenoids?** → **Yes** REPAIR the DTCs for TFT or shift solenoids first. CLEAR DTCs and CARRY OUT transmission Drive Cycle test. RERUN Quick Test. → **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code

	Chart for code description. GO to F2 .
F2 TRANSMISSION DRIVE CYCLE TEST	
	1 Carry out transmission drive cycle test; refer to the Transmission Drive Cycle Test in this section. • **Does the vehicle upshift and downshift OK?** → **Yes** GO to F3 . → **No** REFER to Diagnosis By Symptom in this section for concern diagnosis.
F3 RETRIEVE DTCS	
1 Scan Tool 2 3 	4 Carry out KOEO Test until continuous DTCs have been displayed. • **Are DTCs P1714, P1715, P1716, P1717, P1740 still present?** → **Yes** REPLACE PCM. Road test and RERUN Quick Test. → **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.

Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

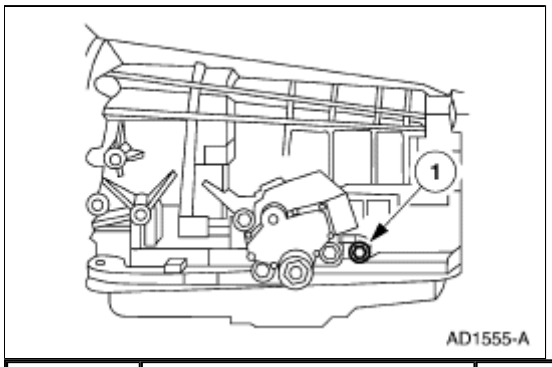
Line Pressure Test

CAUTION: Carry out Line Pressure Test prior to carrying out Stall Speed Test. If line pressure is low at stall, do not carry out Stall Speed Test or further transmission damage will occur. Do not maintain wide open throttle in any gear range for more than five seconds.

NOTE: Certain sensor failures may cause high EPC, FMEM (Failure Mode Effect Management) actions. Be sure that self test and electrical repairs have been carried out, or test results may be incorrect.

This test verifies that the line pressure is within specifications.

1. Connect pressure gauge to the line pressure tap.



Item	Part Number	Description
1	—	Line pressure tap

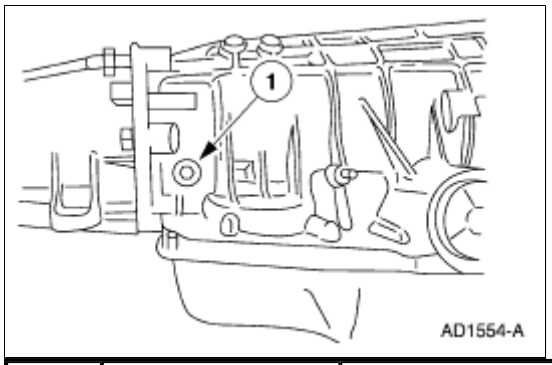
2. Start engine and check line pressures. Refer to the following Line Pressure chart to determine if line pressure is within specifications.

Reference: Line Pressure Chart

Trans.	Transmission Model/Application	Range	Idle 1000 RPM		WOT Stall	
			EPC	Line	EPC	Line
5R55E	4.0L EI	R	55-65	175-215	112-134	282-350
		N	20-40	75-120		
		(D) 2, 1	25-35	80-110	112-134	228-263
5R55E	4.0L SOHC	R	55-65	175-215	112-134	282-350
		N	20-40	75-120		
		(D), 2, 1	40-50	100-135	112-134	228-263

3. If line pressure is not within specifications, check EPC pressure.

4. Connect Pressure Gauge to EPC pressure tap.



Item	Part Number	Description
1	—	Electronic pressure control (EPC)

5. Restart engine and check EPC pressure. Refer to reference Line Pressure Chart for specification.

6. If EPC pressure is not within specification, carry out Pinpoint Test E to diagnose EPC operation. If EPC operation is OK refer to Line Pressure Diagnosis Chart for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High at Idle — All Ranges	• Wiring Harnesses • EPC Boost Valve • EPC Solenoid • Main Regulator Valve
Low at Idle — All Ranges	• Low Fluid Level • Fluid Inlet Filter/Seal • Main Control Body • Cross Leaks • Gaskets • Pump • Separator Plate
Low — All Forward Ranges	• Forward Clutch • Main Control • Front Servo
Low in Park Only	• Valve Body
Low in Reverse Only	• Separator Plate • Rear Servo Piston, Cover Seal • Reverse Clutch • Front Servo • Valve Body • Forward Clutch
Low in Neutral Only	• Valve Body • Front Servo
Low in Overdrive Only	• Forward Clutch • Front Servo • Valve Body
Low in Drive Only (O/D Cancelled)	• Forward Clutch • Front Servo • Valve Body
Low in 1st Position	• Forward Clutch

	• Valve Body
Low in 2nd Position	• Intermediate Servo • Front Servo • Forward Clutch

Stall Speed Test

This test checks operation of the following items:

- Torque converter clutch
- Forward clutch
- Low one-way clutch (OWC) assembly
- Engine driveability concerns

WARNING: Apply the parking brake firmly while carrying out each Stall Speed Test.

CAUTION: Always carry out Line Pressure Test procedures prior to carrying out the Stall Speed Test. If line pressure is low at stall, do not carry out Stall Speed Test or further transmission damage will occur.

NOTE: The Stall Speed Test should be carried out with the engine and transmission at normal operating temperatures.

1. Connect tachometer to the engine.

2. **CAUTION: After testing each of the following ranges (D), 2, 1, and R, move the transmission range selector lever to N (NEUTRAL) and run engine at 1000 rpm for about 15 seconds to allow the torque converter to cool before testing the next range.**

   CAUTION: Do not maintain wide open throttle in any range for more than five (5) seconds.

   CAUTION: If the engine rpm recorded by the tachometer exceeds maximum specified rpm, release the accelerator pedal immediately. Clutch or band slippage is indicated.

   NOTE: Prolonged use of this procedure may set Diagnostic Trouble Code P0712, P1783. After carrying out Stall Speed Test run OBD Test and clear DTCs from memory.

   Press accelerator pedal to floor (WOT) in each range. Record rpm reached in each range. Stall speeds should be a follows:

Vehicle	Engine	Rpm
Explorer	4.0 EI	2610-2983
Explorer/ Mountaineer	4.0 SOHC	2632-3114

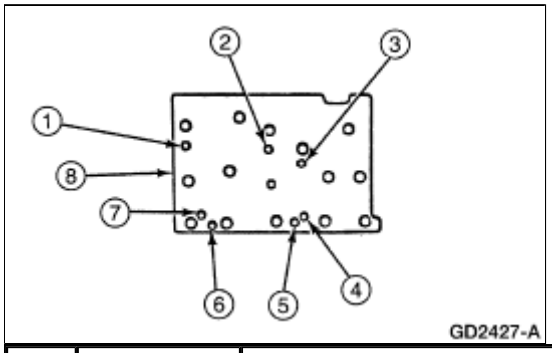
   If stall speeds were too high, refer to the following Stall Speed Diagnosis Chart. If stall speeds were too low, first check the engine idle speed. If engine idle is OK, remove torque converter and check the

torque converter clutch for slippage.

Stall Speed Diagnosis Chart

Transmission Range Selector Lever Position	Stall Speeds High	Stall Speeds Low
(D)Overdrive, D, and 1	Front One-Way Clutch, Rear One-Way Clutch	—
D, 2 and 1	Forward Clutch, Front One-Way Clutch	—
(D)Overdrive	Forward Clutch, Front One-Way Clutch	—
(D)Overdrive, D, 2, 1 and R	General Pressure Concerns, Forward Clutch, Front One-Way Clutch	Converter One-Way Clutch or Engine Driveability Concerns
R Only	Reverse Band, Direct Clutch, Low/Reverse Servo	—
2 Only	Intermediate Band/Servo	—
1 Only	Low/Reverse Band/Servo	—

Air Pressure Tests



Item	Part Number	Description
1	—	Coast clutch apply
2	—	Direct clutch apply
3	—	Forward clutch apply
4	—	Intermediate servo release
5	—	Intermediate servo apply
6	—	Front servo release
7	—	Front servo apply
8	307-342	4R44E/5R55E transmission test plate (T95L-77000-AH)
—	—	4R44E/5R55E transmission test plate gasket (T95L-77000-AH1)

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid

pressure to determine the location of the malfunction.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated (276 kPa [40 psi] maximum) air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the component applies. There should be no hissing sound when the component is fully applied.

NOTE: Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

3. Drain transmission fluid and remove the transmission fluid pan.

4. Remove the main control valve body.

5. Install transmission test plate and gasket. Tighten bolts to 11 Nm (8 lb-ft).

6. Apply air to the appropriate clutch port (refer to diagram). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or check balls are leaking a hissing sound may be heard.

If test results find that the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates another clutch simultaneously, disassemble and use air pressure to check the fluid passages in the center support and clutches to detect obstructions.

Leakage Inspection

CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Leakage at the transmission fluid pan to case gasket often can be stopped by tightening the attaching bolts to 14 Nm (10 lb-ft). If necessary, replace the oil pan case gasket.

Check the fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, replace the damaged parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring, then tighten the fitting to maximum specification.

If the leak continues, replace cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and the cooler line fittings in this section. Refer to Section 307-02 .

Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines for the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the oil cooler tank. If the cooler is leaking and or will not hold pressure, replace the cooler.

If leakage is found at the transmission range selector lever, replace the seal.

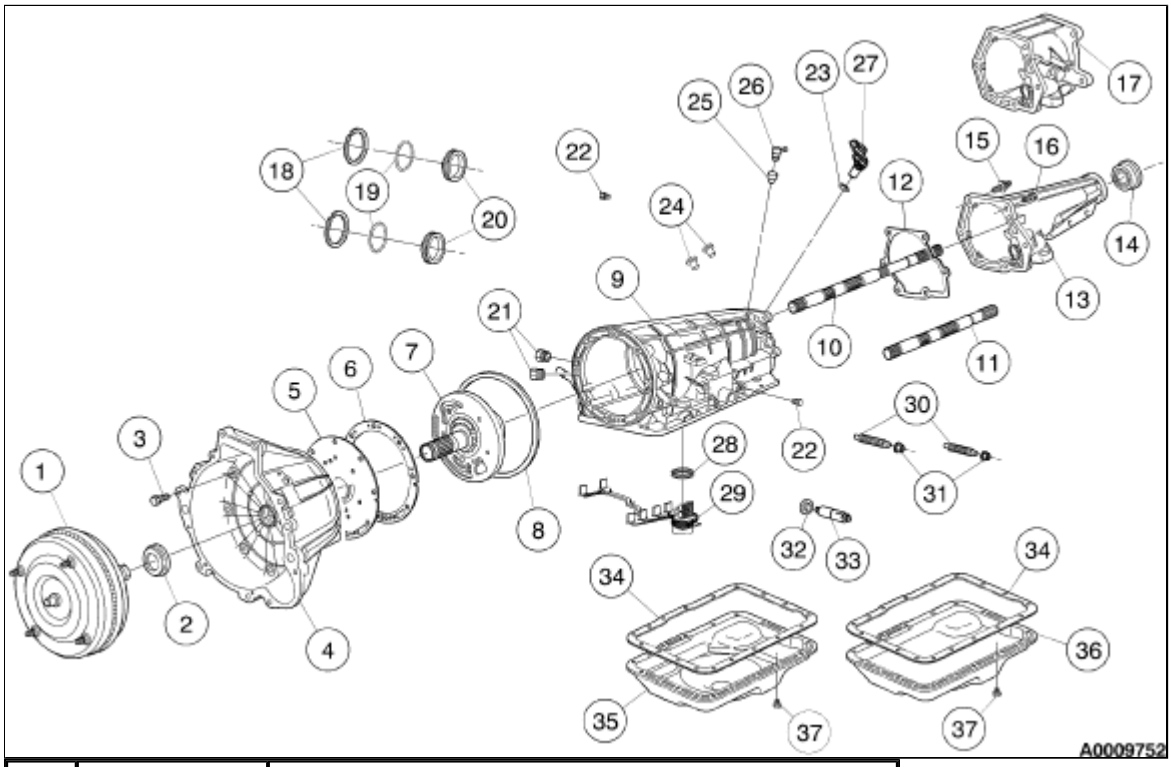
If leakage is found at the transmission internal harness connector, replace O-ring.

External Sealing

The transmission has the following parts to prevent external fluid leakage:

- Gaskets.
- Lip-type seals.
- O-ring seals.
- Seal rings.
- Seal grommets.
- Thread sealant.

External Sealing



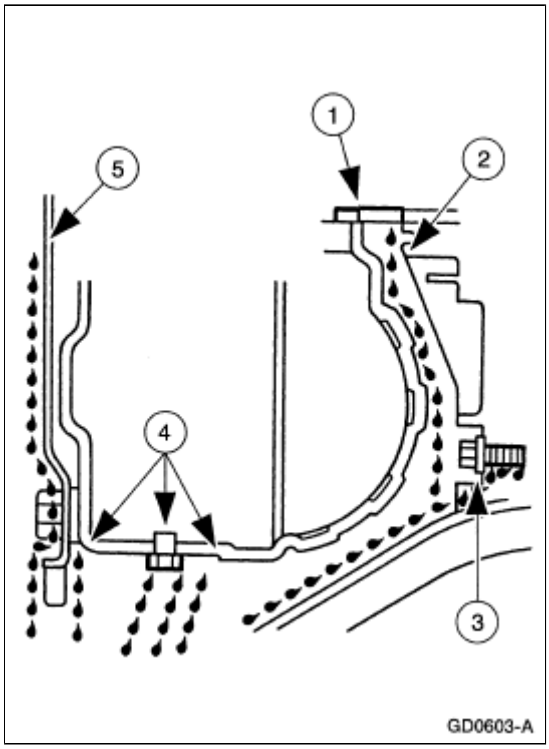
Item	Part Number	Description
1	7902	Torque converter assembly
2	7A248	Seal assembly — converter hub
3	E804595	Screw and seal assy
4	7976	Housing assembly — converter
5	7B472	Plate — fluid pump adaptor

6	7A136	Gasket — converter housing to case
7	7A103	Support and gear assembly — fluid pump
8	7L323	Seal ring — fluid pump
9	7005	Case assembly
10	7060	Shaft assembly — output (4x2)
11	7060	Shaft assembly — output (4x4)
12	7086	Gasket — extension housing
13	7A039	Housing assembly — extension (4x2)
14	7052	Seal assembly — extension housing
15	E804137-S72	Stud — extension housing to case
16	E800152-S72	Screw — extension housing to case (5 required)
17	7A039	Housing assembly — extension (4x4)
18	E860343-S	Retaining ring (servos)
19	7D040	O-ring — servo cover to case
20	7D027	Cover and seal assembly (servo)
21	7D273	Connector assembly — fluid tube
22	E450102-S80	Plug — pipe line and EPC pressure
23	W702981-S300	O-ring — speed sensor
24	E840171-S2	Pin (reverse band anchor)
25	7034	Vent assembly (4x2)
26	7034	Vent assembly (4x4)
27	7H103	Sensor assembly — trans output shaft speed (OSS) model dependent
28	84400120	O-ring — 16 pin connector assembly to case
29	7Z409	Connector assembly
30	7C492	Screw — intermediate and front band adjuster/lock
31	E825100-S100	Nut and seal assembly — hex intermediate and front band adjustment/lock
32	7B498	Seal assembly — main control lever
33	7A308	Shaft — manual valve outer to inner lever
34	7A191	Gasket — fluid pan
35	7A194	Pan — fluid (4x4)
36	7A194	Pan — fluid (4x2)
37	W701203-S309M	Screw — fluid pan-to-case

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear (7A103) and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By

careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.

3. Fluid that leaks by a front pump to case screw or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

4. Fluid leakage from the converter drain plug (vehicle-dependent), converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter, on the back face of the flexplate, and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.

5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes improperly diagnosed as transmission pump gasket leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

a. Leakage at the valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the

torque converter housing.
c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
d. Leakage at oil pressure sensor.

Leak Check Test

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak.

2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist, refer to Section 100-02 . Run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light

Fluid soluble aniline or fluorescent dyes premixed at the rate of 2.5 ml (1/2 teaspoon) of dye powder to 0.24L (1/2 pint) of automatic transmission fluid have proven helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine fluid or transmission fluid leak is present, or if the fluid in the transmission fluid cooler hose leaks into the engine coolant system. An ultraviolet light must be used to detect the fluorescent dye solution.

Transmission Fluid Cooler

CAUTION: Whenever a transmission has been disassembled to replace worn or damaged parts, all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use the torque converter/oil cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures as outlined in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler (7A095). These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back in use.

Transmission Fluid Cooler Flow Test

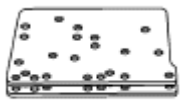
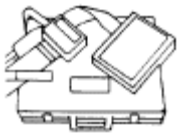
NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test, refer to Section 307-05 for adjustments.

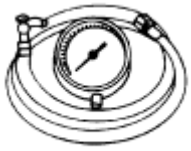
1. Remove fluid level indicator from fluid filler tube.
2. Place funnel in fluid filler tube.
3. Raise the vehicle on a hoist, refer to Section 100-02 and place suitable safety stands under the vehicle.
4. Remove the cooler return line (rear fitting) from the fitting on the transmission case.
5. Connect one end of a hose to the cooler return line and route other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the safety stands and lower the vehicle. Insert end of hose into the funnel.
7. Start the engine and run it at idle with the transmission in NEUTRAL position.
8. Once a steady flow of fluid (without air bubbles) is observed, remove the hose from the funnel and place the hose in a measuring container for 15 seconds. After 15 seconds place the hose back into the funnel and turn the engine off. Measure the amount of fluid in the container. If adequate flow was observed, approximately 237 ml (8 oz) will be in the measuring container; the test is now complete.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter outline fitting (front fitting) on the transmission case.
10. Repeat Steps 7 and 8. If flow is now approximately 1 liter (1 quart) in 30 seconds, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section. Refer to Section 307-02 for fluid cooler diagnosis. If the flow is still not approximately 1 liter (1 quart) in 30 seconds, service the pump, main control and or converter.

For installation of new cooler tubes, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

 ST1637-B	Air Test Plate, Transmission 307-342 (T95L-77000-AH)
ST1137-A	73 III Digital Multimeter 105-R0057 or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (014-00950) or equivalent (T94L-50-EEC-V)
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
	Transmission Tester 307-F016 (007-00130) or equivalent

ST1389-A	
 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

The Diagnosis by Symptom Index gives the technician diagnostic information, direction, and suggests possible components, using a symptom as a starting point.

The Diagnosis by Symptom Index is divided into two categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Symptom Index, select the Concern/Symptom that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:

a. Preliminary inspections.
b. Verifications of condition.
c. Checking the fluid levels.
d. Carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   NOTE: The powertrain control module (PCM) has an adaptive learn strategy to electronically control the transmission which will automatically adjust the shift feel. When the battery has been disconnected, or a new battery installed, certain transmission operating parameters may be lost. The PCM must relearn these parameters. During this learning process you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

   Begin with the Electrical Routine, if indicated. Follow the reference or action required statements.

Always carry out the on-board diagnostic tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Concerns	Routines	
	Electrical [a]	Hydraulic/ Mechanical
· **Engagement Concerns:**		
· No Forward Only	201	301
· No Reverse Only	202	302
· Harsh Reverse Only	203	303
· Harsh Forward Only	204	304
· Delayed/Soft Reverse Only	205	305
· Delayed/Soft Forward Only	206	306
· No Forward and No Reverse	207A	307A
· No Forward in (D) Position and No Reverse	207B	307B
· Harsh Forward and Harsh Reverse	208	308
· Delayed Forward and Delayed Reverse	209	309
· **Shift Concerns:**		
· Some/All Shifts Missing	210	310
· Timing Concern		
· Early/Late (Some/All)	211	311
· Erratic/Hunting (Some/All)	212	312
· Feel Concerns		
· Soft/Slipping (Some/All)	213	313
· Harsh (Some/All)	214	314
· No First Gear in Drive, Engages in a Higher Gear	215	315
· No First Gear in Manual 1st Position	216	316
· No Manual Third Gear in 2nd Position	217	317
· **Torque Converter Clutch Operation Concerns:**		
· Does Not Apply	240	340
· Always Applied/Stalls Vehicle	241	341
· Cycling/Shudder/Chatter	242	342
· **Other Concerns:**		
· Shift Lever Efforts High	251	351
· External Leaks	252	352
· Driveability Concerns	253A	353A
· Engine Runs Poor — Wrong Gear Ratio in (D), 2 or 1 Positions	253B	353B

· Noise/Vibration — Forward or Reverse	254	354
· Engine Will Not Crank	255	355
· No Park Range	256	356
· Overheating	257	357
· No Engine Braking in 2nd Position	258	358
· No Engine Braking in 1st Position	259	359
· No Engine Braking with (D) Cancelled (3rd and 4th Gears)	260	360
· Fluid Venting or Foaming	261	361
· Slips/Chatters in 1st Position	263	363
· Slips/Chatters in 2nd Position	264	364
· FMEM — Harsh Engagements and Shifts	265	365

[a] Carry out electrical routines first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band/clutch application pressure, low line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are low, check the following components: oil filter and seal assembly, main controls, pump assembly.
Fluid Filter and Seal Assembly	
· Filter, plugged, damaged	· Install new filter and seal assembly.
· Filter seal damaged, missing	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Forward modulator valve/EPC boost valve (207), forward engagement control valve (209), spring, damaged, missing, misassembled,	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may

stuck bore damaged	result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Screws out of torque specifications	· Tighten screws to specifications.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Center Support Assembly	
· Forward clutch support seal rings leaking	· Carry out air pressure check. If OK, go to forward clutch assembly. Repair as required.
Forward Clutch Assembly	
· Burnt, damaged, leaking check ball and cylinder; leaking piston seal rings	· Carry out air pressure check. Repair as required.
Rear One-Way Clutch Assembly	
· Rear one-way clutch damaged, worn	· Install a new case.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band/clutch application pressure, low line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are low, check the following component: reverse clutch.
Fluid Filter and Seal Assembly	
· Filter, plugged, damaged	· Install new filter and seal assembly.
· Filter seal damaged, missing	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.

· 2-3 shift valve (203), 3-4 shift valve (204), reverse modulator valve (205), spring, damaged, missing, misassembled, stuck bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Pump damaged, leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Reverse Band	
· Burnt, damaged	· Inspect for damage. Repair as required.
· Servo piston, seals, gasket or cover damaged	· Inspect and install new piston, seals or gasket as required.
Reverse Drum	
· One way clutch damaged	· Inspect for damage. Repair as required.
· Bearing damaged	· Inspect for damage. Repair as required.
· Drum damaged	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, TP, VSS, RPM, SSA (off), electronic pressure control (EPC) solenoid	· Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
303 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressure, high line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are high, check the following component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
	· Inspect for damage. Carry out pinpoint test. Repair as

· EPC, SSA solenoid stuck, damaged, O-ring damaged or out bore	required.
· Reverse modulator valve (205), pressure boost valve/main regulator valve (208), check ball B, spring, damaged, missing, misassembled, stuck bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Reverse Band	
· Burnt, damaged	· Inspect for damage. Repair as required.
· Servo piston, seals, gasket or cover damaged	· Inspect and install new piston, seals or gasket as required.
Reverse Drum	
· One way clutch damaged	· Inspect for damage. Repair as required.
· Bearing damaged	· Inspect for damage. Repair as required.
· Drum damaged	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, VSS, TP, RPM, EPC solenoid	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
304 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressure, high line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are high, check the following component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC solenoid stuck, damaged, O-ring damaged or out bore	· Inspect for damage. Carry out pinpoint test. Repair as required.
· Reverse modulator valve (205), forward modulator valve/EPC boost valve (207),	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main

forward engagement control valve (209), spring, damaged, missing, misassembled, stuck bore damaged	control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Forward Clutch Assembly	
· Assembly	· Air check assembly.
· Check balls missing or damaged	· Inspect for mislocation, poor seating, damage. Install a new forward clutch cylinder.
· Friction element damaged or worn	· Inspect for damage. Repair as required.
· Hub damaged	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, VSS, TP, RPM, EPC solenoid	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
305 — HYDRAULIC/MECHANICAL ROUTINE	
Engine Driveline	
· Inspect the driveshaft, U-joints, engine mounts	· Inspect for damage. Repair as required.
· Restriction in cooling system	· Carry out transmission fluid cooler flow test.
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect fluid condition. Repair as required.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band/clutch application pressure, low line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are low, check the following component: main control.
Fluid Filter and Seal Assembly	
· Filter, plugged, damaged	· Install new filter and seal assembly.
· Filter seal damaged, missing	
Main Control Assembly	

· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC solenoid stuck, damaged, O-ring damaged or out bore	· Inspect for damage. Carry out pinpoint test. Repair as required.
· Reverse modulator valve (205), forward modulator valve/EPC boost valve (207), forward engagement control valve (209), spring, damaged, missing, misassembled, stuck bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front One-way Clutch Assembly	
· One-way clutch damaged	· Inspect for damage. Repair as required.
Center Support Assembly	· Inspect for damage. Repair as required.
· Direct/reverse clutch center support seal rings, ring grooves, worn or damaged	
Reverse Band	
· Burnt, damaged	· Inspect for damage. Repair as required.
· Servo piston, seals, gasket or cover damaged	· Inspect and install new piston, seals or gasket as required.
Reverse Drum	
· One way clutch damaged	· Inspect for damage. Repair as required.
· Bearing damaged	· Inspect for damage. Repair as required.
· Drum damaged	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action
206 — ELECTRICAL ROUTINE	
Powertrain Control System	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, VSS, TP, RPM, EPC solenoid	
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	· Adjust fluid to correct level.
· Incorrect level	
Shift Linkage	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Cable and bracket damaged, misadjusted, TR misadjusted	

Incorrect Pressures	
· Incorrect band/clutch application pressure, low line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are low, check the following component: main control.
Fluid Filter and Seal Assembly	
· Filter, plugged, damaged	· Install new filter and seal assembly.
· Filter seal damaged, missing	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC solenoid stuck, damaged, O-ring damaged or out bore	· Inspect for damage. Carry out pinpoint test. Repair as required.
· Forward modulator valve/EPC boost valve (207), forward engagement control valve (209), spring, damaged, missing, misassembled, stuck bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Extension housing lube orifice plug, missing	· Inspect for damage. Repair as required.
· Wrong component used in rebuild	· Verify that correct components were used.
Front One-way Clutch Assembly	
· One-way clutch damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Leaking check ball, not seating	· Install a new piston.
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Forward hub seal rings damaged	· Inspect for damage. Repair as required.
Rear One-Way Clutch Assembly	
· Rear one-way clutch damaged, worn	· Install a new case.

Engagement Concerns: No Forward and No Reverse

Possible Component	Reference/Action
207A — ELECTRICAL ROUTINE	
No Electrical Concerns	
307A — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specifications. If pressure is

pressure low, EPC pressure low	high/low, check the following possible component: main control.
Filter and Seal Assembly	
· Filter damaged, plugged; seal damaged, cut or missing	· Inspect for damage and install new parts.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· EPC blow-off valve, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front Pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Front One-Way Clutch Assembly	
· Overdrive one-way clutch damaged	· Inspect for damage. Repair as required.

Engagement Concerns: No Forward in (D) Position and No Reverse

Possible Component	Reference/Action
207B — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, TP, RPM, VSS, EPC	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
307B — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	

· Incorrect level	· Adjust to correct level.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low, EPC pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specifications. If pressure is high/low, check the following possible components: main control, pump assembly.
Filter and Seal Assembly	
· Filter damaged, plugged; seal damaged, cut or missing	· Inspect for damage and install new parts.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Forward modulator valve/EPC boost valve (207), pressure boost valve (208), EPC blow off valve, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Front One-Way Clutch Assembly	
· Front one-way clutch damaged	· Determine cause of condition. Repair as required.
Mechanical	
· Mechanical damage	· Check splines on turbine input shaft and overdrive carrier, overdrive one-way clutch, center shaft, forward clutch, forward carrier and output shaft.

Engagement Concerns: Harsh Forward and Reverse

Possible Component	Reference/Action
208 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harness, internal transmission wiring harness, PCM, EPC, TSS, TFT, VSS, Digital TR, TCC, TP and MAF*	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear DTCs, road test and rerun Self-Test.
	· *Refer to the FMEM — Routine 265 for additional information.

308 — HYDRAULIC/MECHANICAL ROUTINE	
Engine/Driveline	
· Looseness in the driveshaft, U-joints or engine mounts	· Repair as required.
· Engine idle speed too high	· Check engine idle speed. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
Fluid	
· Incorrect level	· Adjust to correct level.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator or valve (208), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.

Engagement Concerns: Delayed/Soft Forward and Reverse

Possible Component	Reference/Action
209 — ELECTRICAL ROUTINE	
No Electrical Concerns	
309 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level.
· Fluid contaminated	· Inspect fluid for contamination. If contaminated, locate source of contamination. If burnt, inspect mechanical band, clutches. Repair as required.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specifications. If pressure is low, check the following possible components: main control, pump assembly.
Filter and Seal Assembly	
· Filter damaged, plugged; seal damaged, cut or missing	· Inspect for damage and install new parts.

Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), EPC blow-off valve, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harness, internal transmission wiring harness, PCM, EPC, TSS, OSS, Digital TR, TCS, TP, SSA, SSB, SSC, SSD, and RPM	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear DTCs, road test and rerun Self-Test.
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Contaminated	· Inspect fluid for contamination. If contaminated, locate the source of contamination. If burnt, inspect the mechanical band and clutches.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band and clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. See pressure chart for specifications. If pressure is low check main control, pump, and EPC solenoid.
Filter and Seal Assembly	

· Filter damaged, plugged; seal damage, cut, or missing	· Inspect for damage and install new.
Main Control Assembly	
· Screws out of torque specification	· Adjust screws to specification.
· Gasket damaged or off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in the electrical routine. Repair as required.
· Forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), extension housing lube orifice, check ball C damaged, spring damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged install a new main control. If parts are missing install new parts or main control. If misassembled, reassemble correctly. Do not stone, file, or sand valves. This will remove the anodized finish and may result in further main control or transmission failure.
· Wrong components used during assembly	· Verify that the correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 220/320 ■ Shift 2-3, Routine 221/321 ■ Shift 3-4, Routine 222/322 ■ Shift 4-5, Routine 270/370 ■ Shift 5-4, Routine 271/371

Shift Concerns: Timing Concerns — Early/Late

Possible Component	Reference/Action

211 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, TP, TFT, EPC, OSS, RPM, and shift solenoids	· Carry out shift point road test. Run Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
Other Electrical Concerns	
· No power to the PCM. Keep alive memory erased from the PCM	· Inspect EEC power relay. Repair as required.
	· Restore memory by carrying out drive cycle test.
311 — HYDRAULIC/MECHANICAL ROUTINE	
Engine Driveability Concerns	
· Vehicle runs poor	· See routines 253A, 253B, 353A, and 353B.
Other	
· Tire size change, axle ratio change, or speedometer gear change	· Verify vehicle has original equipment. See the Certification Label and Safety Standard Certification Label. Changes in tire size or axle ratio will affect shift timing.
Incorrect Pressures	
· Incorrect band, or clutch application pressure, line pressure low (late shift)	· Check line pressure at tap. Carry out line pressure and stall speed tests. See pressure chart for specifications. If the line pressure is low check the following possible component: main control.
Main Control Assembly	
· Screws out of torque specification.	· Adjust screws to specification.
· Gasket damaged or off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in the electrical routine. Repair as required.
· Wrong components used during assembly	· Verify that the correct components were used.
	· Refer to the following shift routine(s) for further diagnosis: ■ Soft/Slipping Shift 1-2, Routine 226/326 ■ Soft/Slipping Shift 2-3, Routine 227/327 ■ Soft/Slipping Shift 3-4, Routine 228/328 ■ Soft/Slipping Shift 4-5, Routine 272/372 ■ Soft/Slipping Shift 5-4, Routine 273/373 ■ Soft/Slipping Shift 4-3, Routine 229/329

Shift Concerns: Timing Concerns — Erratic/Hunting

Possible Component	Reference/Action
212 — ELECTRICAL ROUTINE	
Powertrain Control System	

· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, TP, RPM, EPC, TFT, shift solenoids, Digital TR sensor, TCC, output shaft speed (OSS)	· Carry out shift point road test. Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
312 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Carry out the fluid condition check.
Filter and Seal Assembly	
· Filter damaged, plugged; seal damaged, cut, or missing	· Inspect for damage and install new.
Main Control Assembly	
· Screws out of torque specification.	· Adjust screws to specification.
· Gasket damaged or off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in the electrical routine. Repair as required.
· Wrong components used during assembly	· Verify that the correct components were used.
Torque Converter Clutch	
· Torque converter	· See the Torque Converter Operation Concerns: Cycling/Shudder/Chatter Hydraulic/Mechanical Routine 342.
Specific Shifts	· Refer to the following shift routine(s) for further diagnosis: ● No 1-2 shift, Routine 220/330 ● No 2-3 shift, Routine 221/331 ● No 3-4 shift, Routine 222/332 ● No 4-5 shift, Routine 270/370 ● No 5-4 shift, Routine 271/371 ● Soft/Slip 1-2 shift, Routine 226/326 ● Soft/Slip 2-3 shift, Routine 227/327 ● Soft/Slip 3-4 shift, Routine 228/328 ● Soft/Slip 4-5 shift, Routine 272/372 ● Soft/Slip 5-4 shift, Routine 273/373 ● Soft/Slip 4-3 shift, Routine 229/329 ● Harsh 1-2 shift, Routine 232/332 ● Harsh 2-3 shift, Routine 233/333 ● Harsh 3-4 shift, Routine 224/334 ● Harsh 4-5 shift, Routine 274/374 ● Harsh 4-3 shift, Routine 235/335 ● Harsh 3-2 shift, Routine 236/336

Shift Concerns: Feel — Soft/Slipping

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, TP, EPC solenoid, TFT, RPM, and MAF	· Carry out shift point road test. Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Carry out the fluid condition check.
Incorrect Pressures	
· Low line pressure	· Check pressures at line tap. See the Line Pressure Chart for specifications. If pressures are low check the following components: main controls, filter/seal, pump.
Filter and Seal Assembly	
· Filter damaged, plugged; seal damaged, cut, or missing	· Inspect for damage and install new.
Main Control Assembly	
· Screws out of torque specification	· Adjust screws to specification.
· Gasket damaged or off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in the electrical routine. Repair as required.
· Pressure boost valve/main regulator valve (208), EPC blow off valve, extension housing lube orifice, check ball C damaged, spring damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged install a new main control. If parts are missing install new parts or main control. If misassembled, reassemble correctly. Do not stone, file, or sand valves. This will remove the anodized finish and may result in further main control or transmission failure.
· Wrong components used during assembly	· Verify that the correct components were used.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.

· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
	· Refer to the following shift routine(s) for further diagnosis: ■ Soft/Slipping Shift 1-2, Routine 226/326 ■ Soft/Slipping Shift 2-3, Routine 227/327 ■ Soft/Slipping Shift 3-4, Routine 228/328 ■ Soft/Slipping Shift 4-5, Routine 272/372 ■ Soft/Slipping Shift 5-4, Routine 273/373 ■ Soft/Slipping Shift 4-3, Routine 229/329

Shift Concerns: Feel — Harsh

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harness, internal transmission wiring harness, PCM, EPC, OSS, TFT, RPM, Digital TR, TP and MAF*	· Run Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear DTCs, road test and rerun Self-Test.
	· * Refer to the FMEM — Routine 265 for additional information.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.

· Forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator or valve (208), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
	· Refer to the following shift routine(s) for further diagnosis: ■ Harsh Shift 1-2, Routine 232/332 ■ Harsh Shift 2-3, Routine 233/333 ■ Harsh Shift 3-4, Routine 234/334 ■ Harsh Shift 4-5, Routine 274/374 ■ Harsh Shift 4-3, Routine 235/335 ■ Harsh Shift 3-2, Routine 236/336

Shift Concerns: No 1st Gear, Engages In Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out shift point road test. Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, EPC, shift solenoids, Digital TR sensor	
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	· Inspect and repair as required. Verify transmission shift cable
· Cable and bracket damaged,	

misadjusted, TR misadjusted	adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Control Assembly	
· Screws out of torque specification	· Adjust screws to specification.
· Gasket damaged or off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in the electrical routine. Repair as required.
· Wrong components used during assembly	· Verify that the correct components were used.
Mechanical	
· Clutches damaged	· See the disassembly and assembly procedures.
· For diagnosis related to a specific gear use diagnostic tool to determine gear	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 220/320 ■ Shift 2-3, Routine 221/321 ■ Shift 3-4, Routine 222/322 ■ Shift 4-5, Routine 270/370

Shift Concerns: No First Gear in Manual First Position

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harness, PCM, SSA, and SSB	· Carry out shift point road test. Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
316 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures (no engine braking), line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, and SSB solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Check ball A damaged	· Inspect for damage. Repair as required.

Reverse Band	
· Burnt, damaged	· Inspect for damage. Repair as required.
· Servo piston, seals, gasket or cover damaged	· Inspect and install new piston, seals or gasket as required.
Reverse Drum	
· One way clutch damaged	· Inspect for damage. Repair as required.
· Bearing damaged	· Inspect for damage. Repair as required.
· Drum damaged	· Inspect for damage. Repair as required.
Low/Reverse One-Way Clutch Assembly	
· Rear one-way clutch damaged	· Inspect for damage. Repair as required.

SHIFT CONCERNS: NO MANUAL 2ND GEAR

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
No Electrical Concerns	
317 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressure, high or low line pressure	· Check line pressure at tap. Carry out line pressure and stall speed tests. See the line pressure chart for specification. If pressures are high or low, check the following component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Check ball A damaged	· Inspect for damage. Repair as required.
· Wrong component used in rebuild	· Verify that correct components were used.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: No 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, OSS, EPC, SSA, SSB, SSC, SSD, Digital TR	· Carry out shift point test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is low check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 1-2 shift valve (215), forward modulator valve/EPC boost valve (207), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: No 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, OSS, SSA, SSB, EPC, SSC, SSD, Digital TR	· Carry out shift point test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 1-2 shift valve (203), forward modulator valve/EPC boost valve (207), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file, or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: No 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle	· Carry out shift point test. Run on-board diagnostics. Refer to the

wiring harnesses, internal transmission wiring harnesses, PCM, TP, OSS, SSA, SSB, SSC, and SSD	Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 1-2 shift valve (203), 3-4 shift valve (204), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage, If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong components used in rebuild	· Verify that correct components were used.
Center Support Assembly	
· Screws not tightened to specification	· Inspect, install new and retighten to specification.
· Seal rings and bearings damaged	· Inspect for damage. Repair as required.
· Outside diameter of case bore or center support damaged or leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.

Shift Concerns: No 4-5 Shift (Automatic)

Possible Component	Reference/Action
270 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, OSS, EPC, SSC, SSD, and TCS	· Carry out shift point test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
370 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: main control.

Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSC, SSD, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), SSC solenoid, 4-5 shift valve (215), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong components used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Front Planetary Assembly	
· Damaged	· Inspect for damage. Repair as required.

Shift Concerns: No 5-4 Shift (Manual)

Possible Component	Reference/Action
271 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, OSS, and TCS	· Carry out shift point test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
371 — HYDRAULIC/MECHANICAL ROUTINE	
No hydraulic/mechanical components	

Shift Concerns: Soft/Slipping 1-2 Only (Automatic)

Possible Component	Reference/Action
226 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring	· Carry out shift point test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions

harnesses, PCM, TP, MAF, EPC	Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
326 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· EPC solenoid, 1-2 shift valve (215), 2-3 shift valve (203), forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), EPC blow-off valve, extension housing lube orifice, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping 2-3 Only (Automatic)

Possible Component	Reference/Action
227 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, MAF, EPC, SSD	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required, clear codes, road test and rerun on-board diagnostics.
327 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.

· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 1-2 shift valve (203), forward modulator valve/EPC boost valve (207), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping 3-4 Only (Automatic)

Possible Component	Reference/Action
228 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, EPC, TP	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
328 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 3-4 shift valve (204), forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), extension housing tube orifice, EPC blow-off valve, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.

Center Support Assembly	
· Screw not tightened to specification	· Inspect, retighten to specification.
· Seal rings and bearings, groove damaged	· Inspect for damage. Repair as required.
· Outside diameter or case bore, center support, damaged or leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping 4-5 Only (Automatic)

Possible Component	Reference/Action
272 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TP, EPC, MAF	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required, clear codes, road test and rerun on-board diagnostics.
372 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Forward modulator valve/EPC boost valve (207) pressure boost valve/main regulator valve (208), 4-5 shift valve (215), extension housing lube orifice, EPC blow-off valve, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.

· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping 4-3 Downshifts (Automatic)

Possible Component	Reference/Action
229 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, EPC, TP, SSB, SSC	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
329 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged, openings No. 100, 170 blocked	· Inspect for damage. Repair as required.
· SSB, SSC, EPC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 3-4 shift valve (204), forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), 4-3 kickdown valve (211), manual low valve (212), 4-3 torque demand valve (213), extension housing lube orifice, EPC blow-off valve, spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Center Support Assembly	
· Screw not tightened to specification	· Inspect, retighten to specification.
· Seal rings and bearings, groove damaged	· Inspect for damage. Repair as required.
· Outside diameter or case bore, center support, damaged or leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.

· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Shift Concerns: Harsh 1-2 Only (Automatic)

Possible Component	Reference/Action
232 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Repair as required. Clear codes, road test and rerun on-board diagnostics.
332 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· 1-2 shift valve (215), spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.

Shift Concerns: Harsh 2-3

Possible Component	Reference/Action
233 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, SSD	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required. Clear codes, road test and rerun on-board diagnostics.
333 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· 1-2 shift valve (203), spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.

Shift Concerns: Harsh 3-4 Shift Only (Automatic)

Possible Component	Reference/Action
234 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC, TP	· Carry out TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the

	diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
334 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 3-4 shift valve (204) torque converter clutch (200), forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), thermostat bypass valve/cooler limit valve (216), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Center Support Assembly	
· Seal rings and bearings damaged	· Inspect for damage. Repair as required.
· Outside diameter or case bore damaged or leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Torque Converter Clutch Assembly	
	· Refer to routines 241/341.

Shift Concerns: Harsh 4-5 Only (Automatic)

Possible Component	Reference/Action

274 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC, TP	· Carry out TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
374 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, O-ring, solenoid struck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Torque converter clutch (200), 4-5 shift valve (215) forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), thermostat bypass valve/cooler limit valve (216), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Front Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Torque Converter Clutch Assembly	
	· Refer to routines 241/341.

Shift Concerns: Harsh 4-3 Only (Automatic)

Possible Component	Reference/Action
235 — ELECTRICAL ROUTINE	
Powertrain Control System	
	· Carry out shift point and TCC tests. Run on-

· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC, EPC, SSC	board diagnostics. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
335 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, EPC, SSC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Torque converter clutch (200), forward modulator valve/EPC boost valve (207), pressure boost valve/main regulator valve (208), 4-3 kickdown valve (211), manual low valve (212), 4-3 torque demand valve (213), thermostat bypass valve/cooler limit valve (216), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Torque Converter Clutch Assembly	
	· Refer to routines 241/341.

Shift Concerns: Harsh 3-2

Possible Component	Reference/Action
236 — ELECTRICAL ROUTINE	
No Electrical Concerns	
336 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.

· 1-2 shift valve (203), sprint, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Clutch assembly burnt, worn, check ball leaking in clutch piston, piston seal rings damaged, friction or steel plates damaged	· Carry out air pressure test. Inspect for damage. Repair as required.

Torque Converter Clutch Operation Concerns: No Clutch Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, ECT, TSS, TCC*	· Carry out TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
	· * Also refer to Routine No. 265.
340 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Converter clutch control valve (201), thermostat bypass valve/cooler limit valve (216), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· TCC solenoid and valve (200), stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.

· Wrong component used in rebuild	· Verify that correct components were used.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Torque Converter Clutch Assembly	
· Torque converter internal malfunction preventing lockup, piston application	· Remove transmission. Inspect for damage. Install a new or remanufactured torque converter if required.

Torque Converter Operation Concerns: Clutch Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Low engine idle	· Verify engine idle speed is within specification.
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC	· Carry out TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Use scan tool to carry out Pinpoint Test. Repair as required, clear codes, road test and rerun on-board diagnostics.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· TCC solenoid and valve (200), TCC control valve (201), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control, If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and result in further main control or transmission damage.
· Wrong components used in rebuild	· Verify that correct components were used.
Torque Converter Clutch Assembly	
· Torque converter internal malfunction preventing lockup piston application	· Remove transmission. Inspect for damage. Install a new or remanufactured torque converter if required.

Torque Converter Clutch Concerns: Cycling/Shudder/Chatter

Possible Component	Reference/Action

242 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC, BBP, TP, RPM, TSS, OSS	· Carry out TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required. Clear codes, road test and rerun on-board diagnostics.
· Speed control equipped vehicles	· Evaluate with speed control off.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Fluid contaminated	· Inspect fluid for contamination. If contaminated, locate source of contamination. If burnt, inspect mechanical band, clutches. Repair as required.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· TCC solenoid and valve (200), converter clutch control valve (201), thermostat bypass valve/cooler limit valve (216), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front pump seal damage	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Torque Converter Clutch Assembly	
· End clearance (excessive), internal leakage, clutch material damage	· Carry out end play check. Inspect and repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
No Electrical Concerns	
351 — HYDRAULIC/MECHANICAL ROUTINE	
Brake Shift Interlock	
· System, solenoid damaged	· Refer to the Section 206-00 or Section 211-00 .
Shift Linkage	
· Cable and bracket damaged,	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift

misadjusted, TR misadjusted	cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Case	
· Manual control outer lever damaged. Manual valve inner lever pin bent, damaged. Manual valve inner lever, spring rod damaged	· Manual valve lever shaft retaining pin damaged.
	· Adjust linkage and install manual valve lever shaft retaining pin.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
No Electrical Concerns	
352 — HYDRAULIC/MECHANICAL ROUTINE	
Case	
· Case vent	· Check the vent for free breathing. Repair as required.
Seals/Gaskets	
· Leakage at gaskets, seals, etc. Refer to the leakage diagram for potential leak locations	· Remove all traces of lubricant on exposed surfaces of transmission. Check the vent for free breathing. Operate transmission at normal temperatures and carry out fluid leakage check. Repair as required.

Other Concerns: Driveability Concerns

Possible Component	Reference/Action
253A — ELECTRICAL ROUTINE	
Powertrain Control System	
· Engine runs poor	· Check engine tune-up. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing.
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TCC	· Carry out shift point tests in O/D with the TCS off. Refer to the shift point specification if out of specifications. Run on-board diagnostic and check for shift error codes. Carry out shift point and TCC tests. Re-run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
353A — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.

· TCC solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· 3-4 shift valve (215), spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Torque Converter Clutch Assembly	
· Torque converter one-way clutch slipping	· Inspect one-way clutch. Install a new or remanufactured torque converter.
· Incorrect TCC used in rebuild	· Inspect for correct TCC assembly. Install a new TCC as required.

Other Concerns: Driveability Concerns, Wrong Gear Ratio in D, 2nd and 1st Positions

Possible Component	Reference/Action
253B — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, SSA, SSB, SSC, SSD	· Carry out shift point and TCC tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required. Clear codes, road test and rerun on-board diagnostics.
353B — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· SSA, SSB, SSC, SSD, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· SSC solenoid and valve (215), spring, damaged, missing, misassembled, stuck, bore damaged (210, 202, 201)	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.

Other Concerns: Noise/Vibration — Forward or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	

No Electrical Concerns	
354 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: pump assembly.
Pump Assembly	
· Screws out of torque specification	· Tighten screws to specification.
· Cross leaks	· Inspect for damage. Repair as required.
· Front Pump seal worn or damaged	· Inspect for damage. Repair as required.
· Seal on inner pump gear damaged	· Inspect for damage. Repair as required.
Front One-Way Clutch Assembly	
· One-way clutch damaged, worn, misassembled	· Repair one-way clutch.
Rear One-Way Clutch Assembly	
· One-way clutch damaged, worn, misassembled	· Repair one-way clutch.
Other	
· Transmission oil cooler lines, fill tube grounding	· Relocate transmission oil cooler lines or fill tube correctly.
Gear	
· Gear noise	· Repair planetary gear assemblies.
Torque Converter Clutch Assembly	
	· Refer to routines 242/342.

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System	

· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, Digital TR sensor	· Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Use scan tool to carry out Pinpoint Test. Repair as required. Clear codes, road test and rerun on-board diagnostics.
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Pump Assembly	
· Seized	· See the disassembly procedure. Repair as required.
Flexplate	
· Damaged	· Inspect for damage. Repair as required.

Other Concerns: No Park Range

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
No Electrical Concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Park Mechanism	
· Park gear, parking pawl, parking pawl return spring, park or guide plate, parking pawl shaft, parking pawl actuating rod, manual lever, manual lever detent spring damaged, misassembled	· Inspect for damage. Repair as required.
· Transfer case and linkages damaged	· For transfer case and linkage diagnosis; refer to Section 308-07B .
4x4 Applications	
· Transfer case and linkage damaged	· For transfer case and linkage diagnosis; refer to Section 308-07B .

Other Concerns: Transmission Overheating

Possible Component	Reference/Action

257 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, TFT, TCC	· Carry out shift point and TCC test. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics.
357 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level.
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible components: main control, TCC.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· TCC, solenoid stuck, damaged, O-ring damaged or out of bore	· Inspect for damage. Carry out solenoid function test as listed in electrical routine. Repair as required.
· Thermostat bypass valve/cooler limit valve (216), spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Torque Converter Clutch Assembly	
· Seized torque converter one-way clutch	· Refer to routines 240/340.
	· Inspect torque converter one-way clutch.
· Excessive slip detected	· Install a new or remanufactured torque converter as required. Run on-board diagnostics.
Other	
· Restriction in transmission oil cooler or tubes	· Repair transmission oil cooler or tubes.

Other Concerns: No Engine Braking in 2nd Position

Possible Component	Reference/Action
258 — ELECTRICAL ROUTINE	
No Electrical Concerns	
358 — HYDRAULIC/MECHANICAL ROUTINE	

Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible components: main control, coast clutch assembly.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Extension housing lube orifice, check ball A and C not seating or damaged, spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong part used in rebuild	· Repair as required.
Coast Clutch Assembly	
· Coast clutch damaged	· Install a new coast clutch as required.
· Seal ring damaged	· Inspect for damage. Repair as required.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Other Concerns: No Engine Braking in 1st Position

Possible Component	Reference/Action
259 — ELECTRICAL ROUTINE	
No Electrical Concerns	
359 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level.
Shift Linkage	
· Cable and bracket damaged, misadjusted, TR misadjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	

· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Manual low valve (212), check ball E not seating correctly, spring, damaged, missing, misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong part used in rebuild	· Inspect for correct part. Repair as required.
Coast Clutch Assembly	
· Wrong part used in rebuild	· Inspect parts. Repair as required.
· Overdrive clutch damaged	· Install a new overdrive clutch as required.
· Seal rings damaged	
Reverse Band	
· Burnt, damaged	· Inspect for damage. Repair as required.
· Servo piston, seals, gasket or cover damaged	· Inspect and install new piston, seals or gasket as required.
Reverse Drum	
· One way clutch damaged	· Inspect for damage. Repair as required.
· Bearing damaged	· Inspect for damage. Repair as required.
· Drum damaged	· Inspect for damage. Repair as required.
Rear One-Way Clutch Assembly	
· Rear one-way clutch damaged	· Install new components as required.

Other Concerns: No Engine Braking With Overdrive Canceled (in 3rd and 4th)

Possible Component	Reference/Action
260 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, SSD	· Carry out shift point tests. Run on-board diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Carry out pinpoint tests using the diagnostic tool. Clear codes, road test and rerun on-board diagnostics. Also check for engine braking in 1 and 2* positions.
	· * No engine braking in O/D position with the TCS off, 1st gear is a normal function.
360 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.

· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Coast clutch solenoid and valve/converter clutch control valve (201), SSC solenoid, 3-4 shift solenoid (215), spring, damaged, missing misassembled, stuck, bore damaged	· Inspect for damage. If damaged, install a new main control. If parts are missing, install new parts or main control. If misassembled, reassemble correctly. Do not stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
· Wrong component used in rebuild	· Verify that correct components were used.
Coast Clutch Assembly	
· Wrong part used in rebuild	· Verify that correct components were used.
· Overdrive clutch damaged	· Install new components as required.
· Seal rings damaged	· Inspect for damage. Repair as required.

Other Concerns: Fluid Venting/Foaming

Possible Component	Reference/Action
261 — ELECTRICAL ROUTINE	
No Electrical Concerns	
361 — HYDRAULIC/MECHANICAL ROUTINE	
· Vent blocked or damaged	· Check vent for damage or blockage. Repair as required.
· Overfilled transmission	· Check level and adjust as required.
· Fluid contaminated (antifreeze, water)	· Check for contamination, locate source of contamination. Repair as required.
· Overheating	· Refer to routines 257/357.
· Filter and seal assembly damaged or misassembled	· Inspect filter and seal assembly for damage. Repair as required.

Other Concerns: Slips/Chatters in 1st Position

Possible Component	Reference/Action
263 — ELECTRICAL ROUTINE	
No Electrical Concerns	
363 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: main control.
· Incorrect band/clutch application pressures, line pressure high/low	
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.

· Separator plate damaged	· Inspect for damage. Repair as required.
· Wrong components used in rebuild	· Verify that correct components were used.
· Dirty or sticking main control valve body	· Clean, repair or install a new main control valve body.
Rear One-Way Clutch Assembly	
· Low/reverse one-way clutch damaged	· Install a new rear one-way clutch and case.

Other Concerns: Slips/Chatters in 2nd Position

Possible Component	Reference/Action
264 — ELECTRICAL ROUTINE	
No Electrical Concerns	
364 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Incorrect band/clutch application pressures, line pressure high/low	· Check line pressure at tap. Carry out line pressure and stall speed tests. Refer to the line pressure chart for specifications. If pressure is high/low, check the following possible component: main control.
Main Control Assembly	
· Screw out of torque specification	· Tighten to specification.
· Gasket damaged, off location	· Inspect and install a new gasket.
· Separator plate damaged	· Inspect for damage. Repair as required.
· Wrong components used in rebuild	· Verify that correct components were used.
· Dirty or sticking main control valve body	· Clean, repair or install a new main control valve body.
Intermediate Band and Servo Assemblies	
· Band adjustment incorrect	· Readjust to correct specification.
· Seal or piston, strut, lever, damaged	· Inspect for damage. Repair as required.
· Friction elements worn damaged misassembled	· Inspect for damage. Repair as required.
· Return spring wrong, damaged	· Inspect for damage. Repair as required.
· Piston rod lever incorrect	· Inspect for damage. Repair as required.
· Case bore damaged, leaking	· Inspect for damage. Repair as required.

Other Concerns: FMEM — Harsh Engagements and Shifts

Possible Component	Reference/Action
265 — ELECTRICAL ROUTINE	
Powertrain Control System	· Run on-board diagnostic. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out pinpoint tests using the diagnostic tool. Repair as required. Clear DTCs, road test and rerun Self-Test.
· Operating in FMEM strategy. Electrical inputs/outputs, vehicle wiring harnesses, internal transmission wiring harnesses, PCM, EPC, OSS, Digital TR, TCC, TFT, TP and MAF, shift error detected (shift solenoid, TSS, OSS and internal hardware)	
365 — HYDRAULIC/MECHANICAL ROUTINE	
No Hydraulic/Mechanical Concerns	

Transmission Fluid Cooler — Backflushing and Cleaning

CAUTION: Whenever a transmission has been disassembled to replace worn or damaged parts or because the valve body sticks from foreign material, the transmission fluid cooler must be cleaned using a suitable torque converter/fluid cooler cleaner. Under no circumstances should torque converters be cleaned by hand agitation with solvent.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the transmission cooler. These contaminants are a major cause of recurring transmission concerns and must be removed from the system before the transmission is put back into service.

1. Conduct backflushing with a suitable torque converter/transmission fluid cooler cleaner. Test the equipment to make sure that a vigorous fluid flow is present before proceeding. Replace the system filter if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler lines, connect two additional rubber hoses to the transmission end of the steel transmission cooler lines as described.
   - Connect the cleaner tank pressure line to the steel transmission cooler return line (longest line).
   - Connect a tank return hose to the steel transmission cooler pressure line (shorter line). Place the outlet end of this hose in the solvent tank reservoir.

3. Turn on solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling switch on and off will help dislodge contaminants in cooler system).

4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.

5. Use compressed air to blow out the cooler(s) and lines (blow air into the transmission cooler return line) until all solvent is removed.

6. Remove the rubber return hose from the remaining steel cooler line.

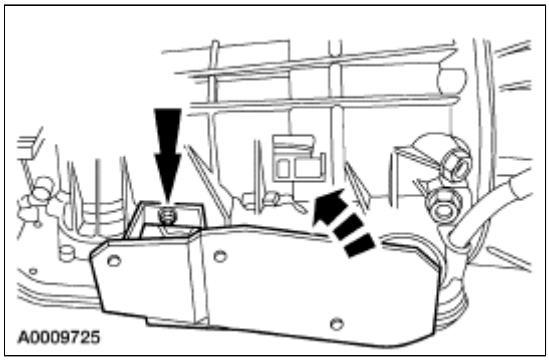
Fluid Pan, Gasket and Filter

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. **NOTE:** Transmission servo heat shield needs to be unclipped from the fluid pan rail and positioned out of the way for fluid pan removal.

   Loosen the nut and position the heat shield out of the way.

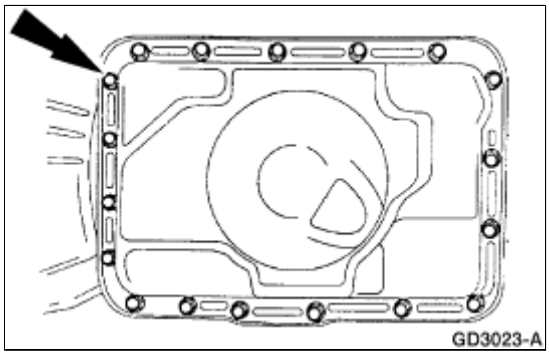


3. Place a drain pan under the transmission fluid pan.

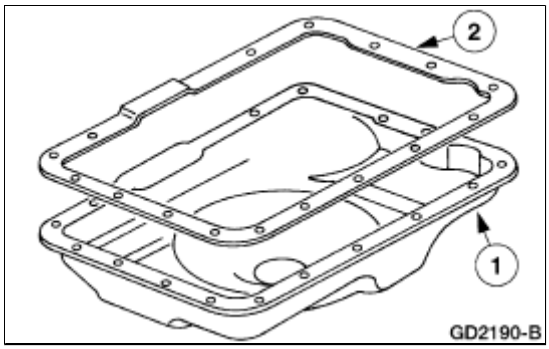
4. Disconnect the LH three-way catalytic converter heated oxygen sensor connectors.

5. Remove the three-way catalytic converter. For additional information, refer to Section 309-00 .

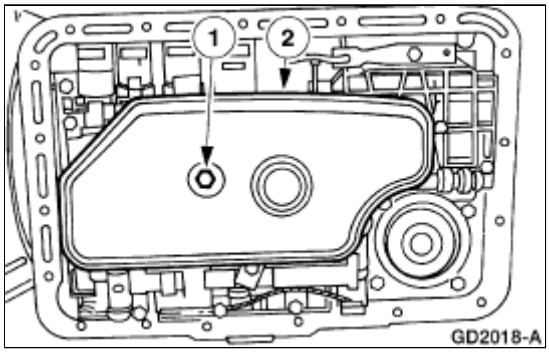
6. Drain transmission fluid.
   - Remove all the transmission fluid pan bolts except for two in the front. Loosen the two front transmission fluid pan bolts. Pry the rear of the transmission fluid pan down and allow fluid to drain. After fluid is drained remove the front two transmission fluid pan bolts.



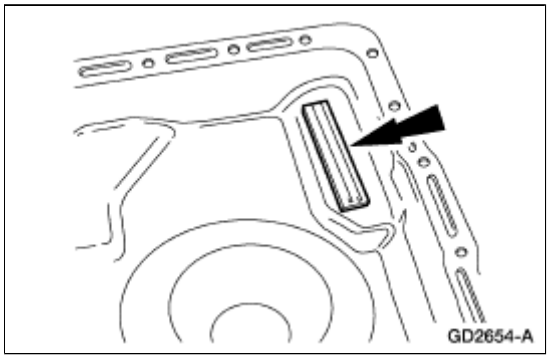
7. Remove the transmission fluid pan.
   1. Remove the transmission fluid pan.
   2. Remove and discard the transmission fluid pan gasket.



8. Remove and discard the transmission fluid filter.
    1. Remove the transmission fluid filter screw.
    2. Remove the transmission fluid filter.



9. Clean and inspect the transmission fluid pan and magnet. Clean all mating surfaces.

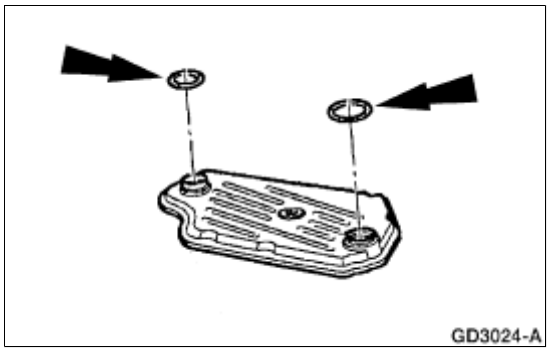


10. Flush the transmission fluid cooler and transmission fluid cooler lines. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Installation

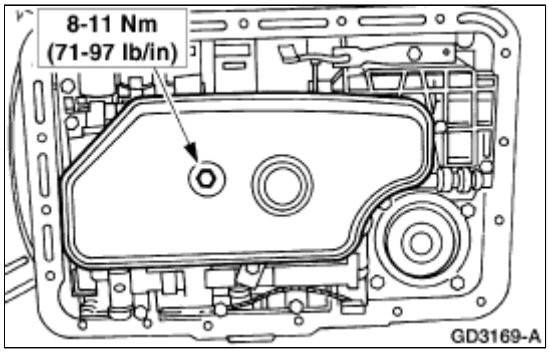
1. **CAUTION: Lubricate fluid filter O-rings with MERCON ® V; Automatic Transmission Fluid XT-5-QM meeting Ford specification MERCON ® V or they may be damaged.**

    Lube and install new O-rings onto the transmission fluid filter. Install a new transmission fluid filter.
    - Position transmission fluid filter on the main control valve body.

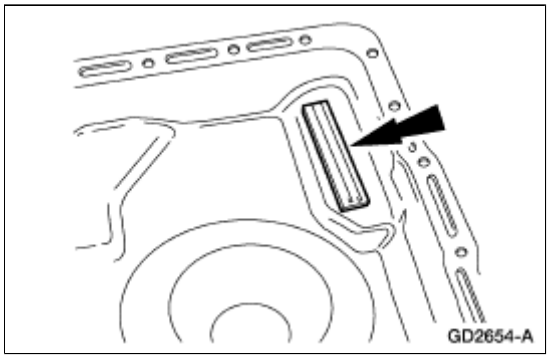


2. **CAUTION: Make sure wire harness is not pinched under filter.**

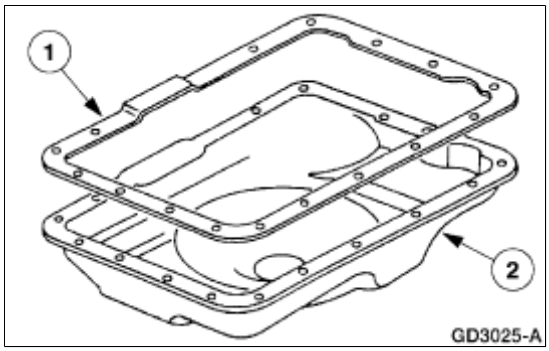
   Install transmission fluid filter screw.



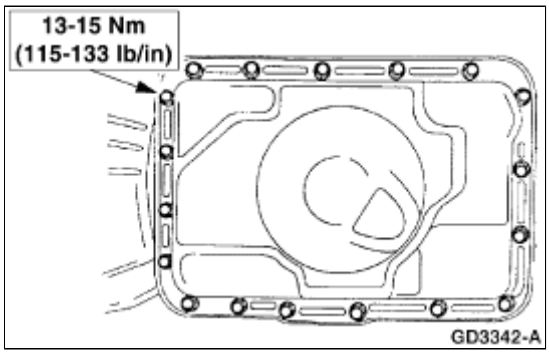
3. Position the oil pan magnet in the transmission fluid pan.



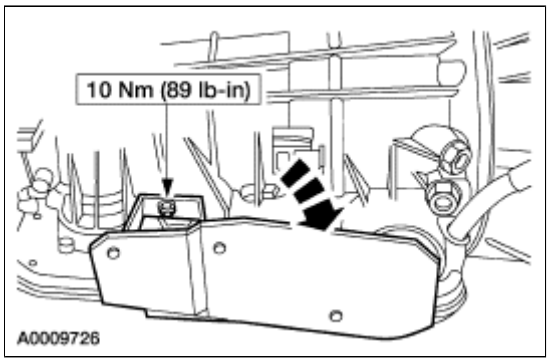
4. Install the transmission fluid pan.
   1. Position a new transmission fluid pan gasket on the transmission fluid pan.
   2. Install and align the transmission fluid pan.
      - Loosely install the transmission fluid pan screws.



5. Tighten the transmission fluid pan screws.
   - Use a crisscross sequence to tighten the transmission fluid pan screws.



6. Position the servo heat shield over the servos and clip it to the pan rail.



7. Install the three-way catalytic converter. For additional information, refer to Section 309-00 .
8. Connect the heated oxygen sensor connectors.
9. Lower the vehicle.
10. **NOTE:** When filling a dry transmission and converter start with a minimum of 3.7 liters (4 quarts).

    Fill transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM meeting Ford specification MERCON ® V.

Main Control Valve Body

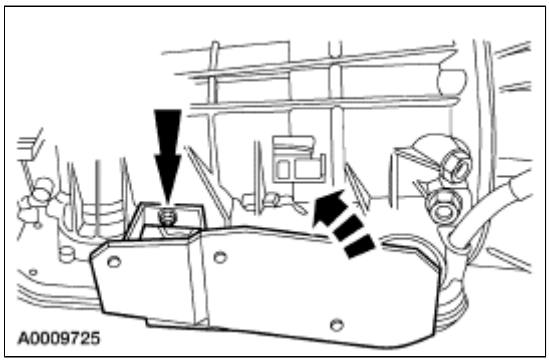
Special Tool(s)

ST1639-A	Valve Body Aligner (.235) 307-333 (T95L-70010-B)
ST1639-A	Valve Body Aligner (.248) 307-334 (T95L-70010-C)

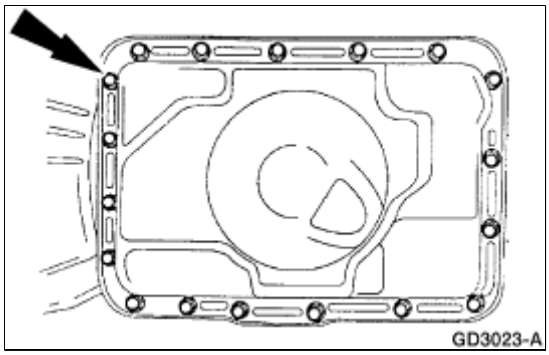
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Place a drain pan under the transmission fluid pan.
4. **NOTE:** Transmission servo heat shield needs to be unclipped from the fluid pan rail and positioned out of the way for fluid pan removal.

   Loosen the nut and position the heat shield out of the way.

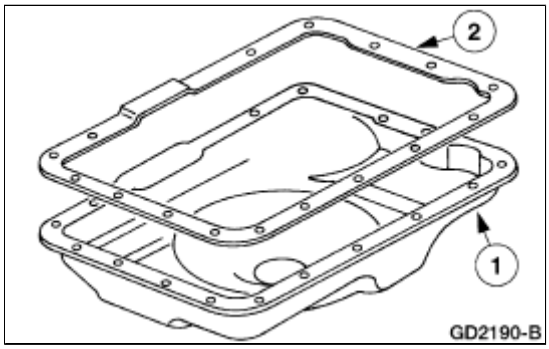


5. Drain transmission fluid.
   - Remove all the transmission fluid pan bolts except for two in the front. Loosen the two front transmission fluid pan bolts. Pry the rear of the transmission fluid pan down and allow fluid to drain. After fluid is drained remove the front two transmission fluid pan bolts.

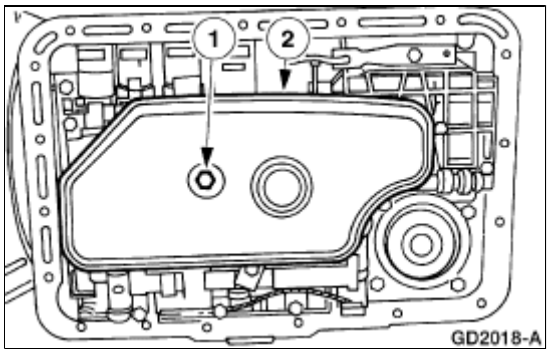


6. **NOTE:** If a transmission has been disassembled to replace worn or damaged parts and the valves in the main control valve body stick repeatedly from foreign material, the torque converter must be removed and cleaned by using a suitable torque converter/fluid cooler cleaner.

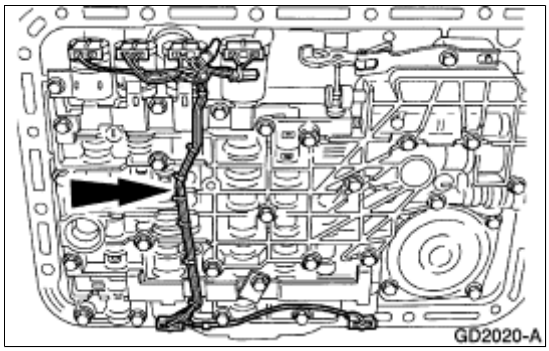
   Remove the transmission fluid pan.
   1. Remove the transmission fluid pan.
   2. Remove and discard the transmission fluid pan gasket.



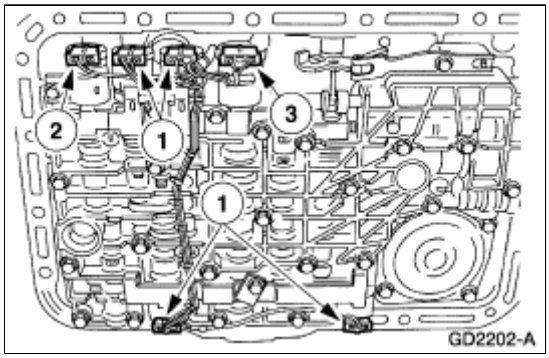
7. Remove and discard the transmission fluid filter.
   1. Remove the transmission fluid filter screw.
   2. Remove the transmission fluid filter.



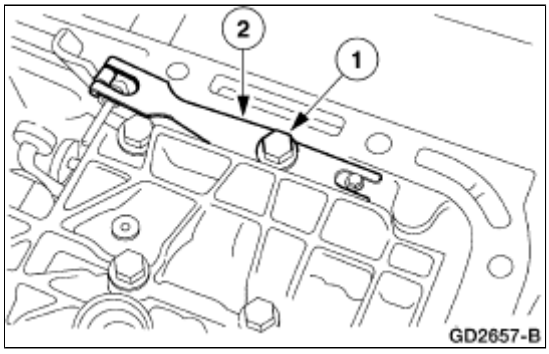
8. Unclip main control valve body wire harness.
   - Lift up on wire harness guide and protector and disengage the retaining pins from the solenoid clamps.



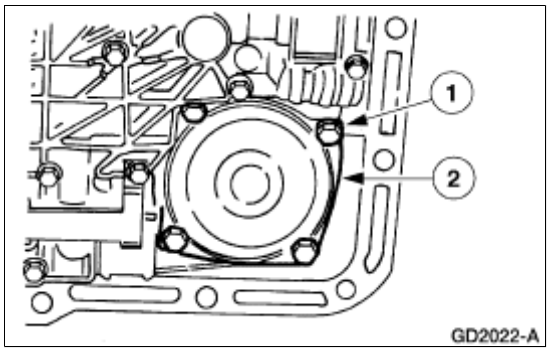
9. Disconnect the six solenoid electrical connectors.
    1. Disconnect the SSA, SSB, SSC and SSD electrical connectors.
    2. Disconnect the torque converter clutch (TCC) solenoid electrical connector.
    3. Disconnect the electronic pressure control (EPC) solenoid electrical connector.



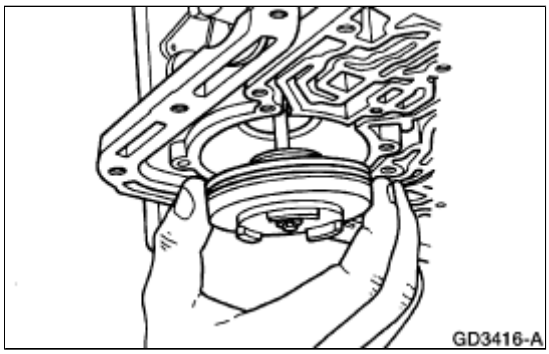
10. Remove the manual control valve detent lever spring.
    1. Remove the manual control valve detent lever spring screw.
    2. Remove the manual control valve detent lever spring.



11. Remove the low/reverse servo.
    1. Remove the low/reverse servo cover screws.
    2. Remove the low/reverse band servo cover and gasket. Discard the low/reverse servo separator plate cover gasket.

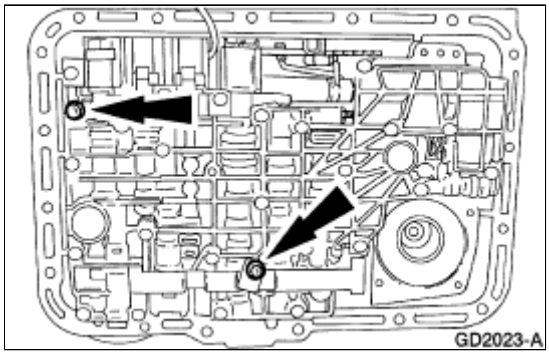


12. Remove the low/reverse band servo piston and rod.



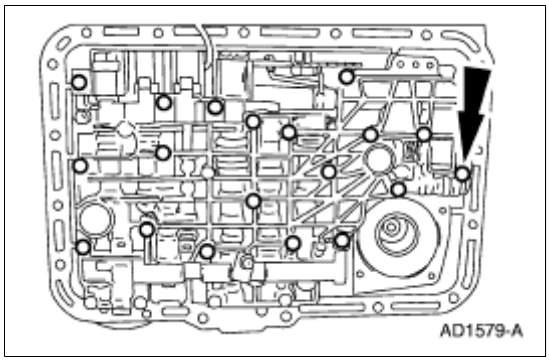
13. **CAUTION: Support the main control valve body.**

Do not remove the two (gold) screws specified.



14. **CAUTION: Support the main control valve body.**

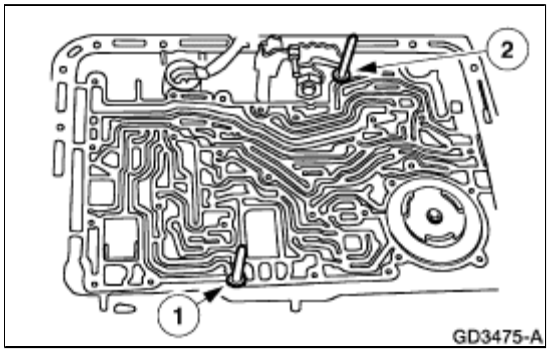
Remove the screws.



15. Remove the main control valve body.

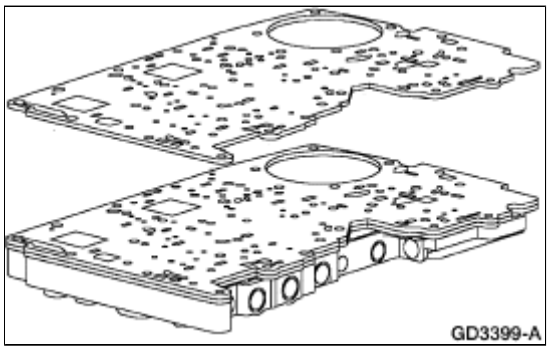
Installation

1. Install the Valve Body Aligner into the transmission case.
    1. Install the Valve Body Aligner (.248).
    2. Install the Valve Body Aligner (.235).

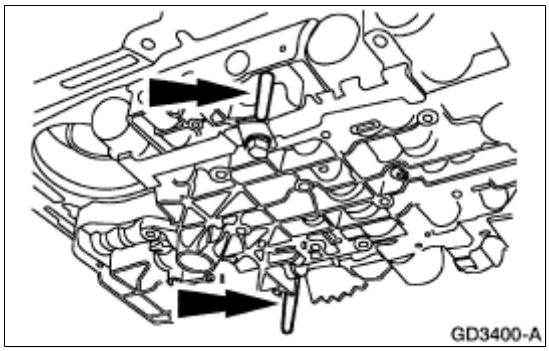


2. **NOTE:** Make sure main control to case gasket is properly aligned.

    Install new main control to case gasket.

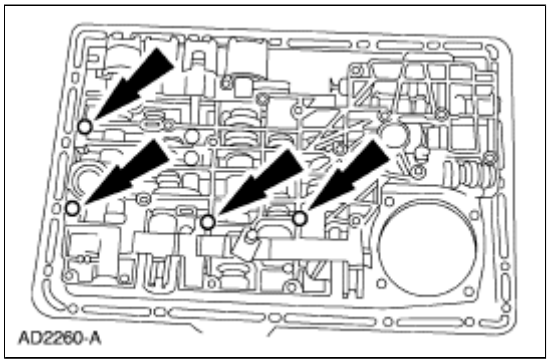


3. Position the main control valve body with the two Valve Body Aligners as a guide.



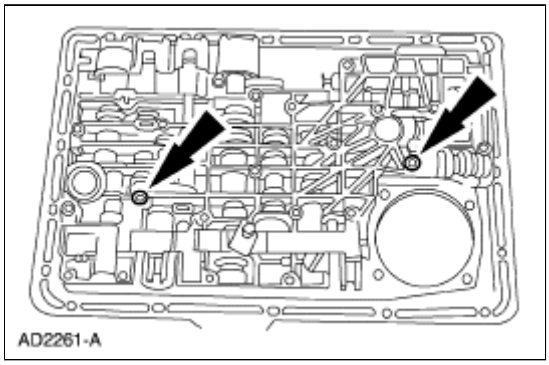
4. **NOTE:** The main control valve body screws will be tightened in later steps.

   Loosely install four M6 x 45 mm (1.8 in) screws.



5. **NOTE:** The main control valve body screws will be tightened in later steps.

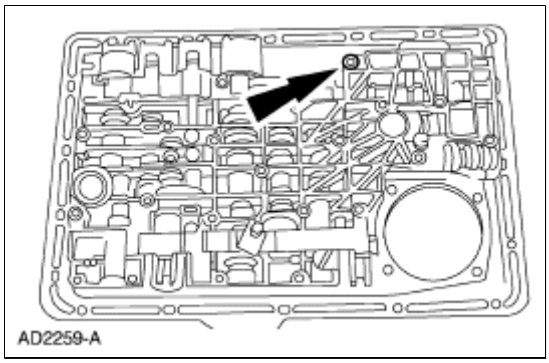
   Loosely install two M6 x 35 mm (1.4 in) screws.



6. Remove the Valve Body Aligners.

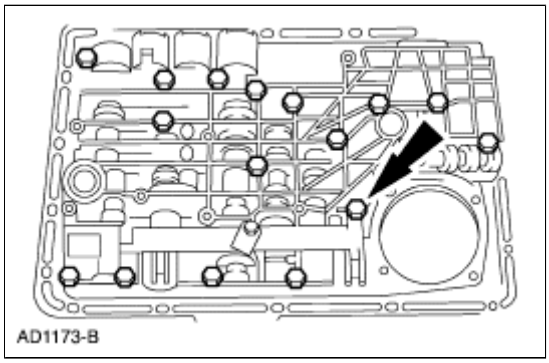
7. **NOTE:** The main control valve body screws will be tightened in later steps.

   Loosely install the M6 x 30 mm (1.2 in) screw.

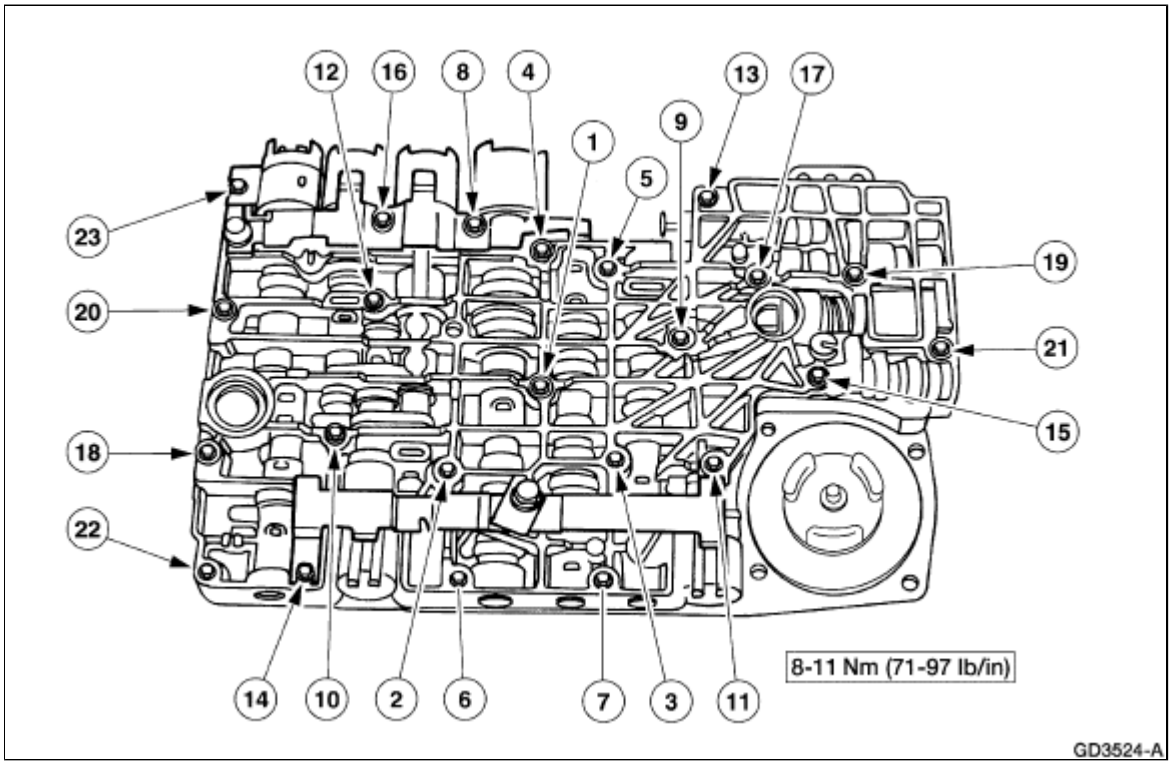


8. **NOTE:** The main control valve body screws will be tightened in later steps.

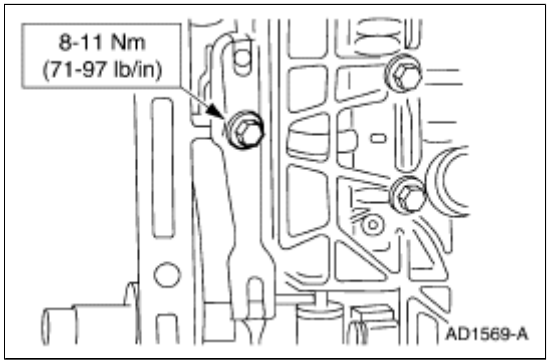
   Loosely install the sixteen M6 x 40 mm (1.6 in) main control valve body screws.



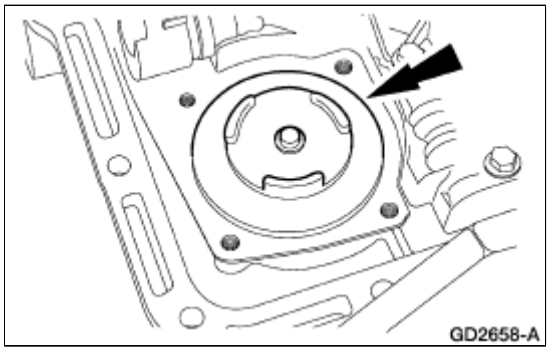
9. Tighten the main control valve body screws in the sequence shown.



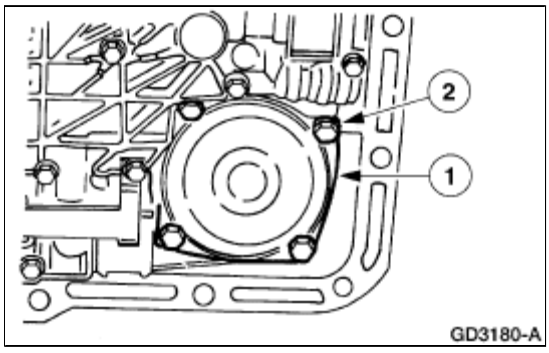
10. Install the manual control valve detent lever spring.



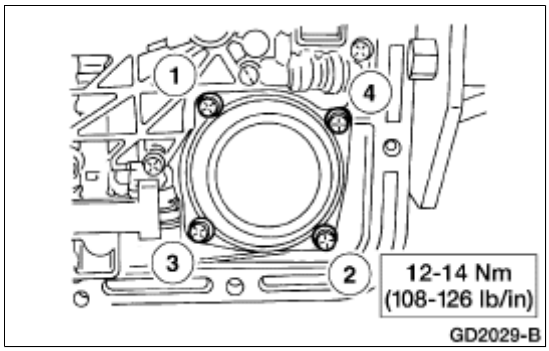
11. Install the low/reverse band servo piston and rod.



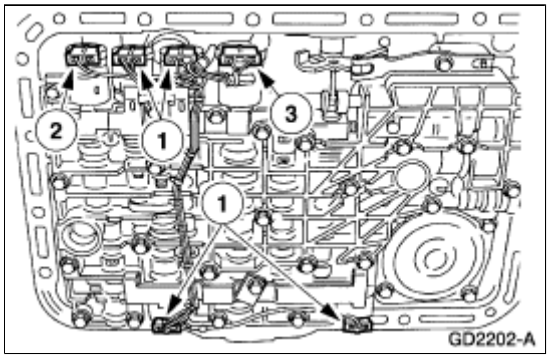
12. Install the low/reverse band servo cover.
    1. Install the low/reverse band servo cover and gasket.
    2. Loosely install the low/reverse servo piston cover screws.



13. Tighten the servo cover screws in the sequence shown.

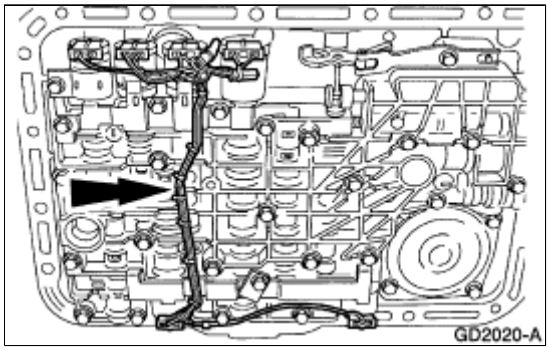


14. Connect the six solenoid electrical connectors.
    1. Connect SSA, SSB, SSC, and SSD electrical connectors.
    2. Connect the torque converter clutch (TCC) solenoid electrical connector.
    3. Connect the electronic pressure control (EPC) solenoid electrical connector.

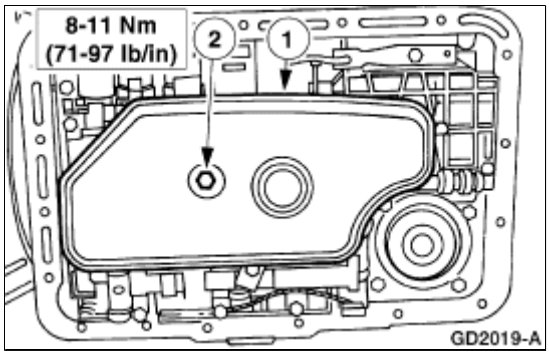


15. **CAUTION: Excessive pressure may break the locating pins.**

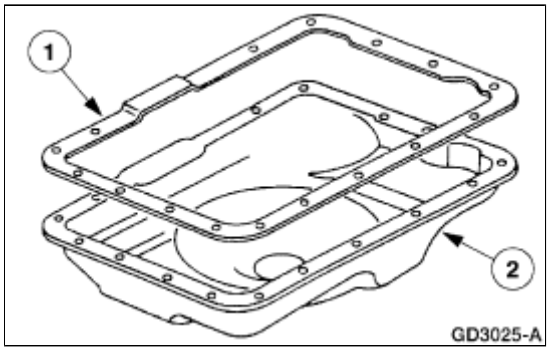
    Install the main control valve body wire harness.
    - Align the retaining pins to the holes in the solenoid clamps and press in the main control valve body wire harness guide and protector.



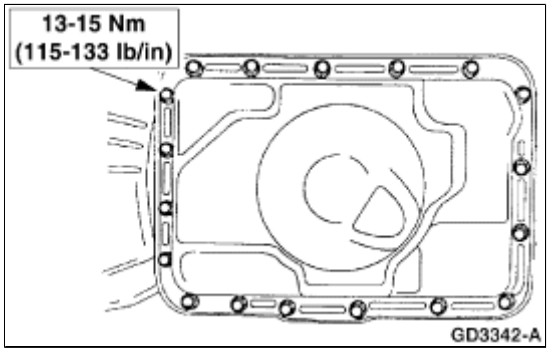
16. Install the transmission fluid filter.
    1. Install the transmission fluid filter.
    2. Install the transmission fluid filter screw.



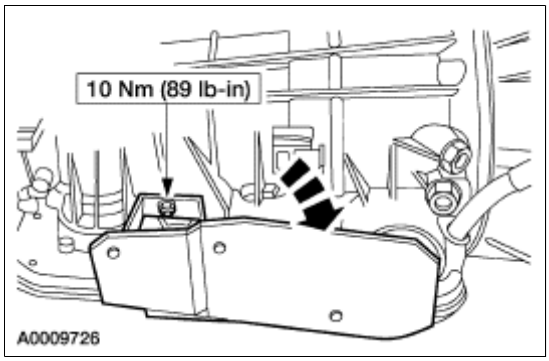
17. Install the transmission fluid pan.
    1. Position a new transmission fluid pan gasket on the transmission fluid pan.
    2. Install and align the transmission fluid pan.



18. Tighten the transmission fluid pan screws.
    - Use a crisscross sequence to tighten the transmission fluid pan screws.



19. Position the servo heat shield over the servos and clip it to the pan rail.



20. Lower the vehicle.

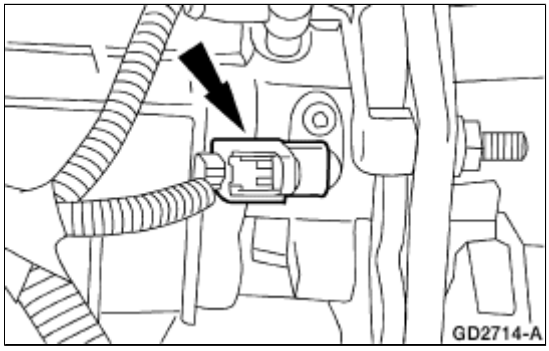
21. Connect the battery ground cable.

22. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

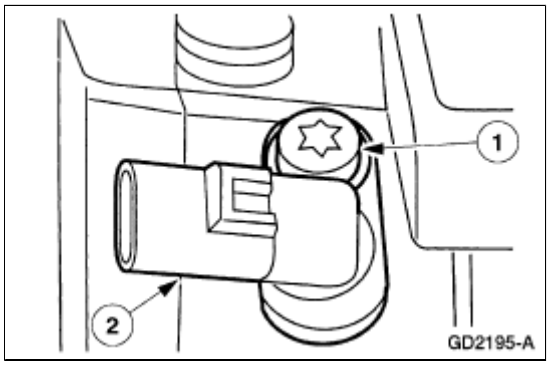
Output Shaft Speed (OSS) Sensor

Removal

1. Raise and support the vehicle. For additional information, refer to the Section 100-02 .
2. Disconnect output shaft speed (OSS) sensor electrical connector.

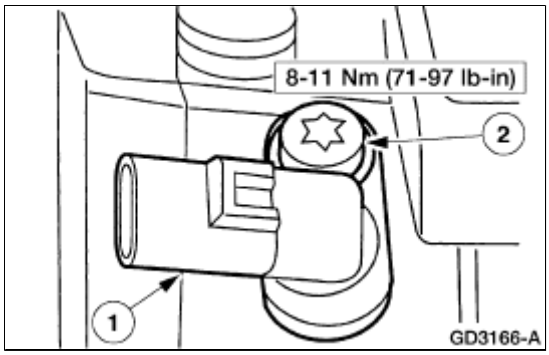


3. Remove OSS sensor.
    1. Remove the OSS sensor screw.
    2. Remove the OSS sensor from the transmission.
        - Inspect the OSS sensor O-ring for damage. If damaged, replace the O-ring.

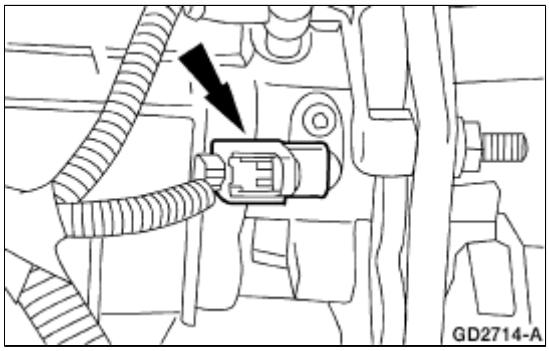


Installation

1. Inspect and lubricate O-ring with petroleum jelly.
    1. Install the OSS sensor into the transmission.
    2. Tighten OSS sensor screw.



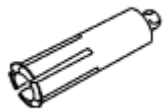
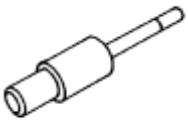
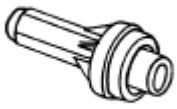
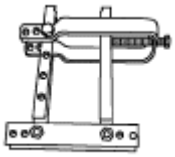
2. Connect OSS sensor electrical connector.



3. Lower the vehicle.

Extension Housing Seal and Bushing

Special Tool(s)

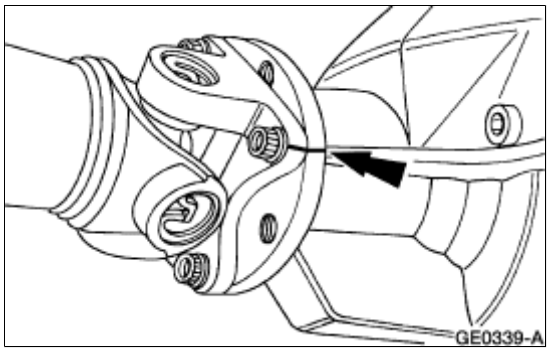
	Housing Bushing Remover 308-070 (T77L-7697-E)
 ST1790-A	Housing Bushing Replacer 307-065 (T77L-7697-F)
 ST1791-A	Extension Housing Seal Replacer 307-038 (T74P-77052-A)
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1758-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)

Removal

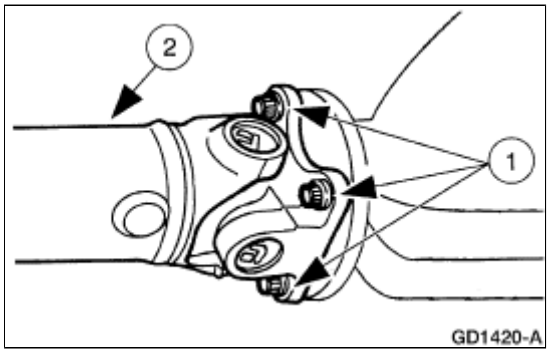
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they may be installed in their original alignment.

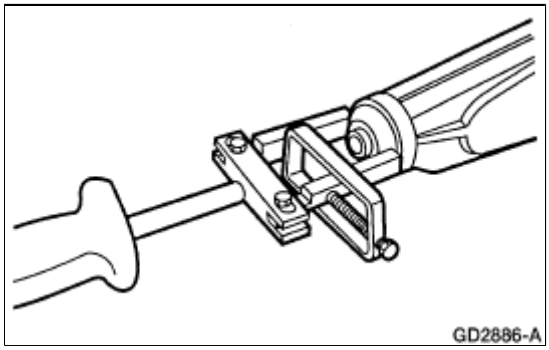
   Mark the rear driveshaft.



3. Remove the rear driveshaft.
    1. Remove the rear driveshaft bolts.
    2. Remove the rear driveshaft.

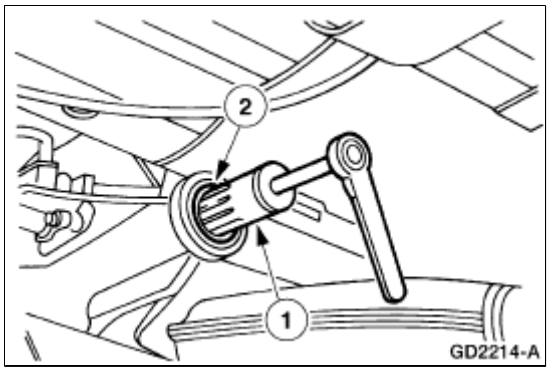


4. Using the Converter Oil Seal Remover and Impact Slide Hammer, remove the extension housing seal.



5. **CAUTION: Use the extension housing bushing remover carefully so that the seal area is not damaged.**

    Remove extension housing bushing.
    1. Install Housing Bushing Remover.
    2. Remove extension housing bushing.

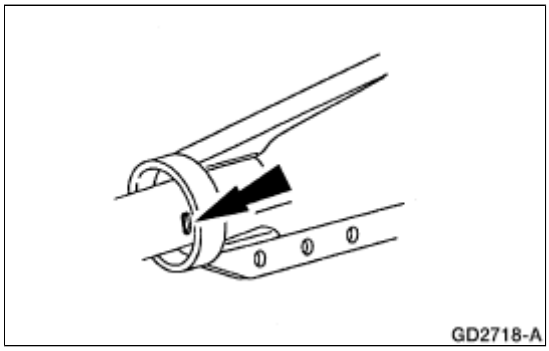


Installation

1. **CAUTION: The lube hole in the extension housing bushing must be aligned with the lube groove in the extension housing. This groove is located at the 3 o'clock position when viewed from the rear.**

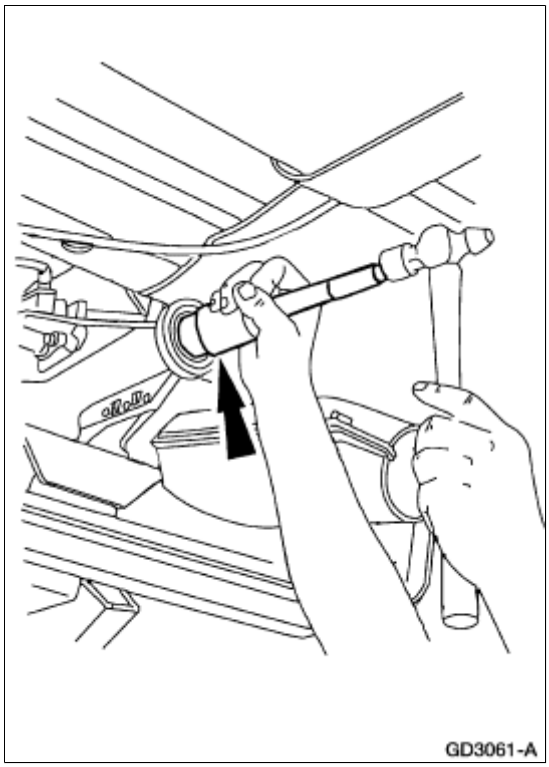
   NOTE: Inspect the counterbore of the extension housing for burrs. Remove any burrs from the extension housing counterbore with an oil stone.

   Position the extension housing bushing into the extension housing.

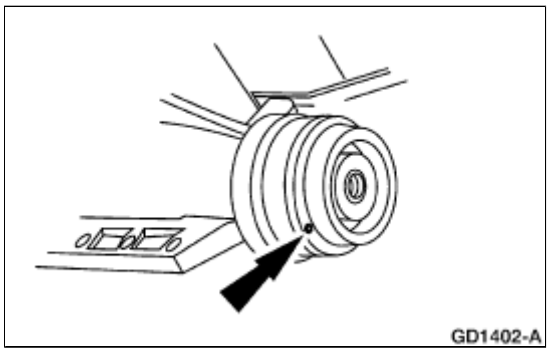


2. **CAUTION: The tool will bottom when bushing is in the proper position.**

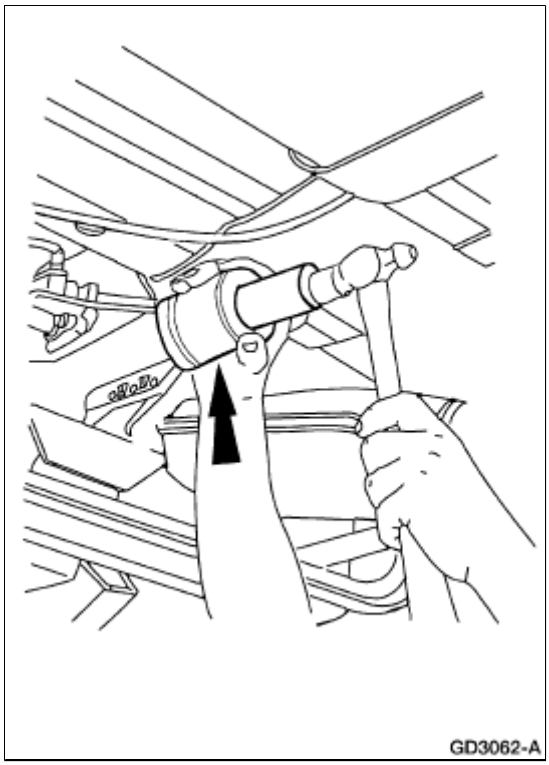
   Use the Housing Bushing Replacer to install the extension housing bushing.



3. Position new extension housing seal with drain hole in the 6 o'clock position.

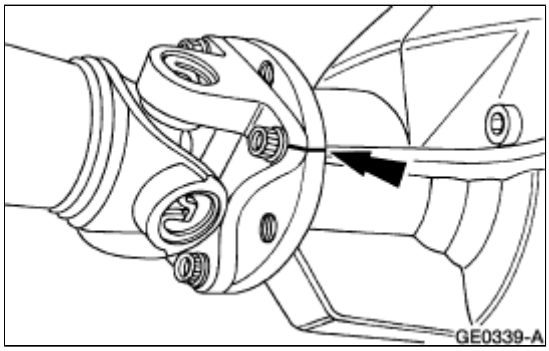


4. Use the Extension Housing Seal Replacer to install the extension housing seal.

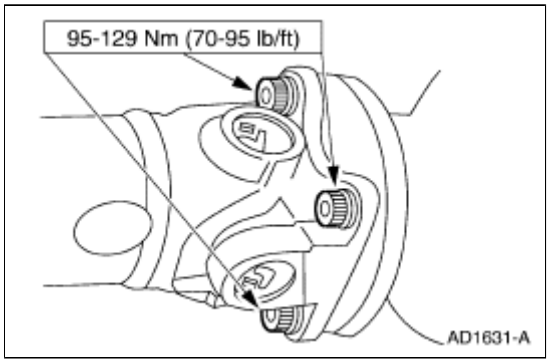


5. **NOTE:** Inspect the driveshaft slip-yoke for wear and damage. Replace if required.

   Align the drive shaft with the marks made during removal to ensure correct balance.



6. Install the rear driveshaft bolts.



7. Lower the vehicle.

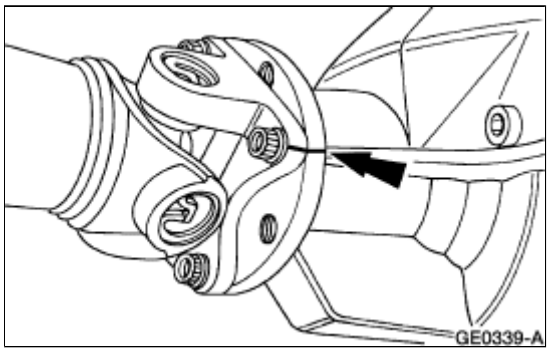
8. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

Extension Housing Gasket —4x2

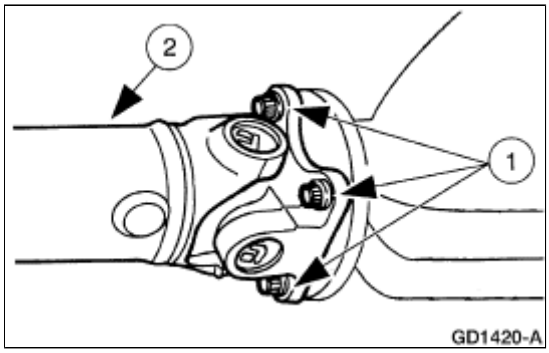
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to the Section 100-02 .
3. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they may be installed in their original alignment.

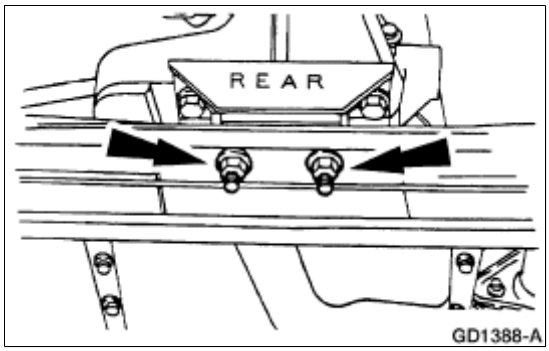
   Mark the rear driveshaft.



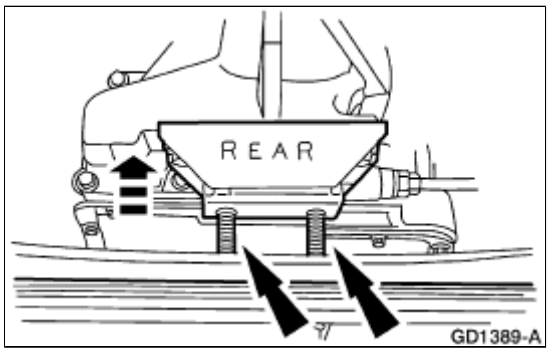
4. Remove the rear driveshaft.
   1. Remove the bolts.
   2. Remove the rear driveshaft.



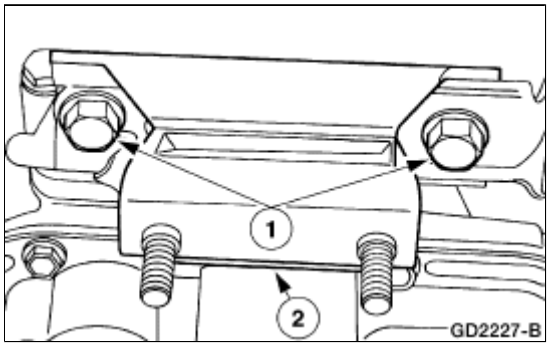
5. Remove the nuts.



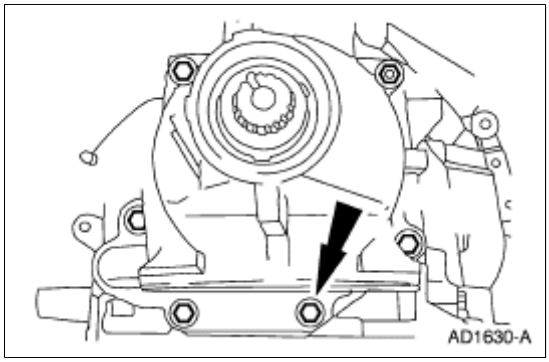
6. Raise and support the transmission.



7. Remove the transmission mount.
    1. Remove the screws.
    2. Remove the transmission mount.

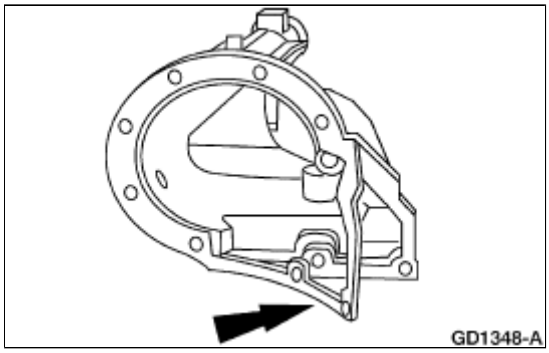


8. Remove the extension housing screws and studs.



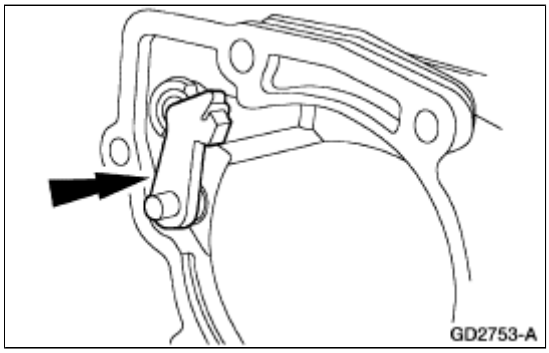
9. **CAUTION: The parking pawl, parking pawl return spring and parking pawl shaft could fall out during removal of the extension housing.**

   Remove the extension housing (7A039). Discard the extension housing gasket (7086).



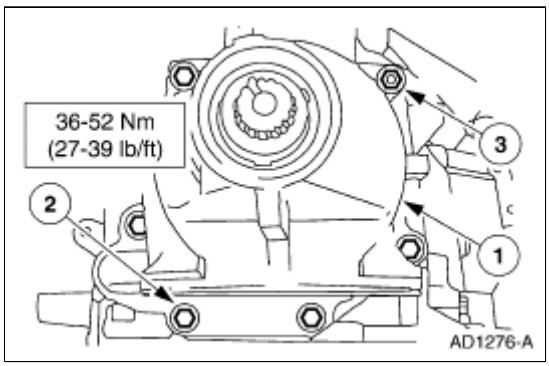
Installation

1. Clean the extension housing and install new extension housing gasket. Make sure that the parking pawl, spring, and shaft are correctly installed.

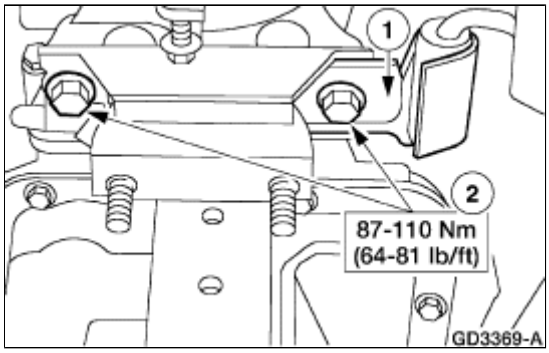


2. **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup.**

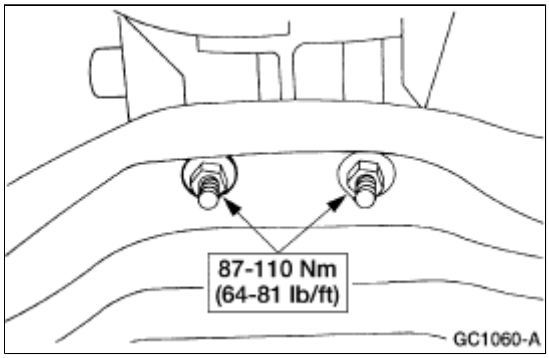
   Install the extension housing.
   1. Position the extension housing.
   2. Install the extension housing screws.
   3. Install the extension housing studs.



3. Install the transmission mount.
    1. Position the transmission mount on the extension housing.
    2. Install the transmission mount-to-extension housing screws.

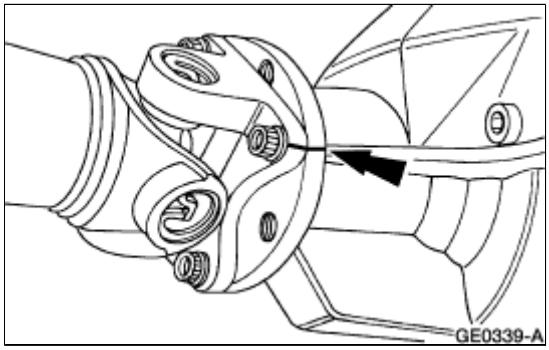


4. Install the transmission mount into the crossmember and tighten the transmission mount nuts.

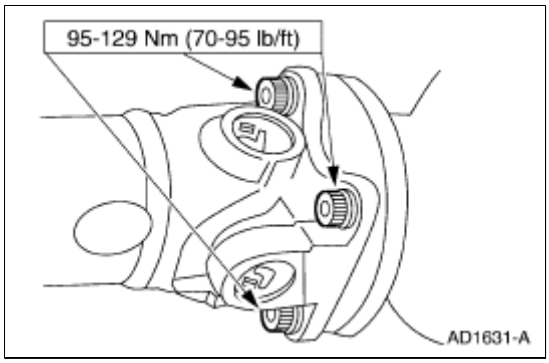


5. **NOTE:** Align the driveshaft with the marks made during removal to ensure correct balance.

    Align and install the rear driveshaft.



6. Install the bolts.



7. Lower the vehicle.

8. Connect the battery ground cable.

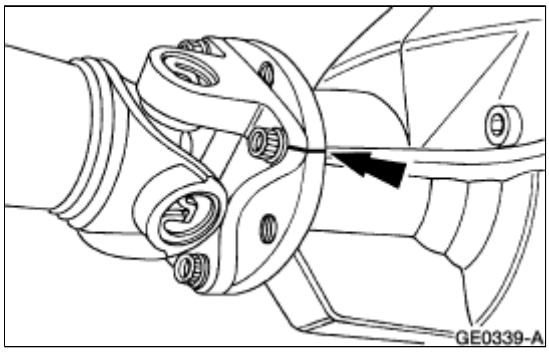
9. Fill the transmission to the correct fluid level and check for correct transmission operation.
   - Use MERCON® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON® V specification.

Extension Housing Gasket —4x4

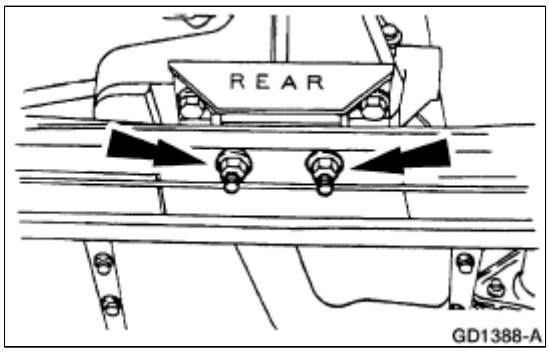
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they may be installed in their original alignment.

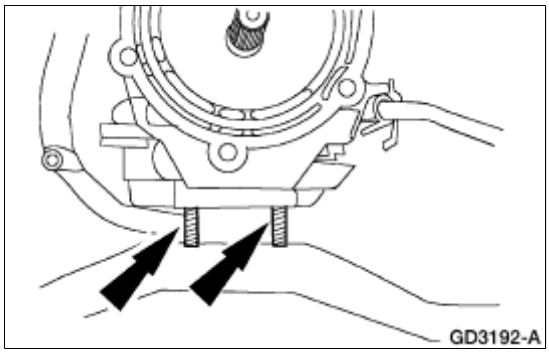
   Mark the rear driveshaft.



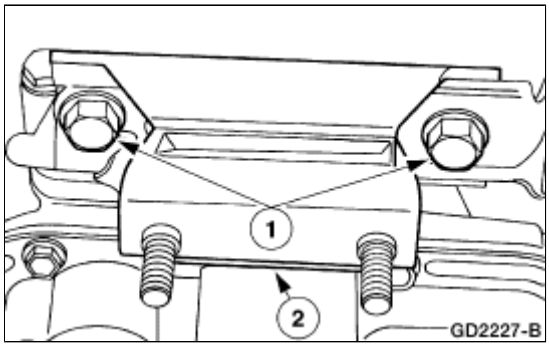
4. Remove the transfer case. For additional information, refer to Section 308-07B .
5. Remove the wire harness locators from the extension housing wire bracket.
6. Remove the transmission mount nuts.



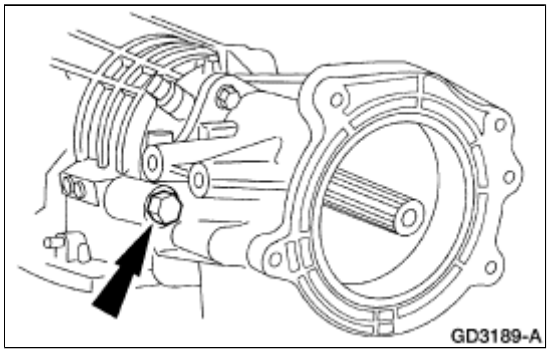
7. Raise and support the transmission.



8. Remove the transmission mount.
    1. Remove the transmission mount-to-extension housing screws.
    2. Remove the transmission mount.

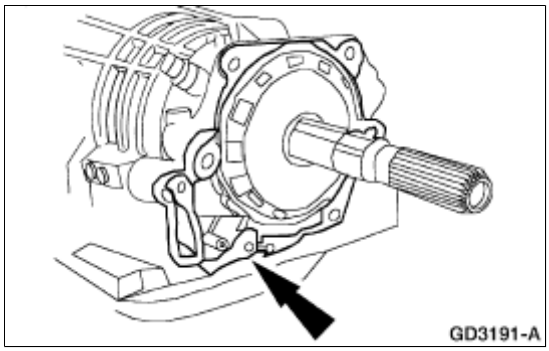


9. Remove the six extension housing screws and studs.



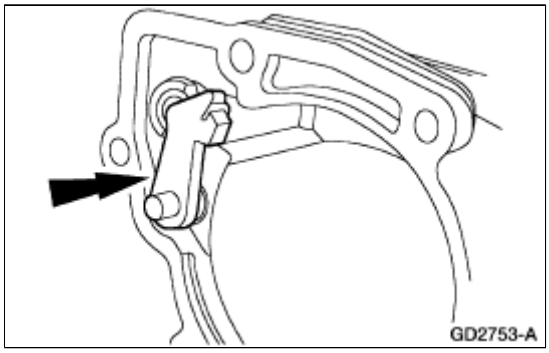
10. **NOTE:** The parking pawl (7A441), parking pawl return spring (7D070) and parking pawl shaft (7D071) may fall out during removal of the extension housing (7A039).

    Remove the extension housing. Discard the extension housing gasket (7086).



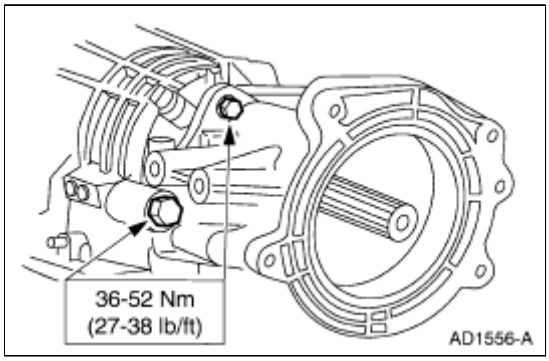
Installation

1. Clean the extension housing and install a new extension housing gasket. Make sure that the parking pawl, spring, and shaft are correctly installed.

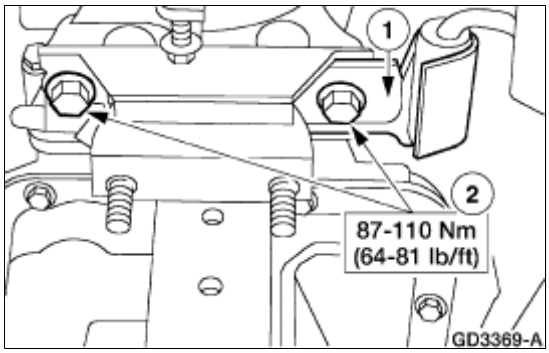


2. **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup.**

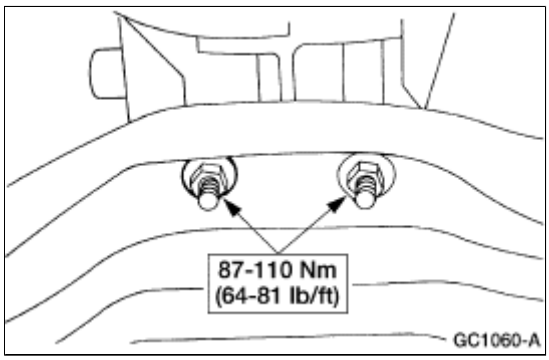
   Install the extension housing.
   - Position the extension housing and install the six extension housing screws and studs.



3. Install the transmission mount.
   1. Position the transmission mount on the extension housing.
   2. Install the screws.

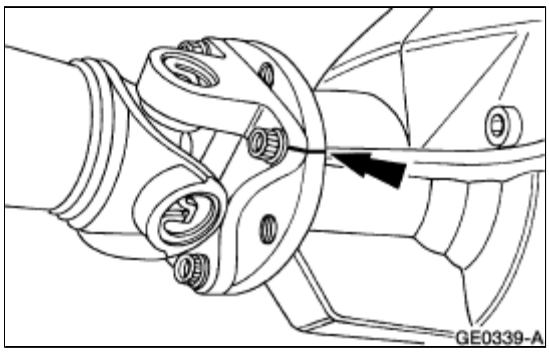


4. Install the transmission mount into the crossmember and tighten the nuts.

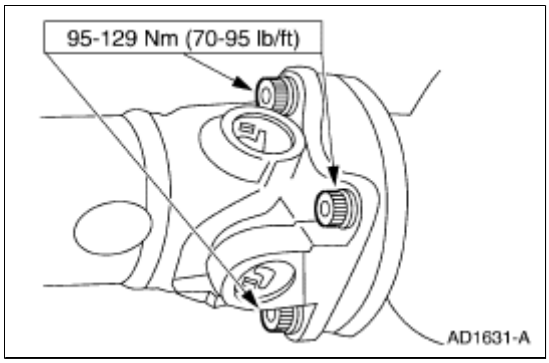


5. Install the wire harness locators from the extension housing wire bracket.
6. Install the transfer case.
7. **NOTE:** Align the driveshaft with the marks made during removal to ensure correct balance.

   Align and install the rear driveshaft.



8. Install the bolts.



9. Connect the battery ground cable.

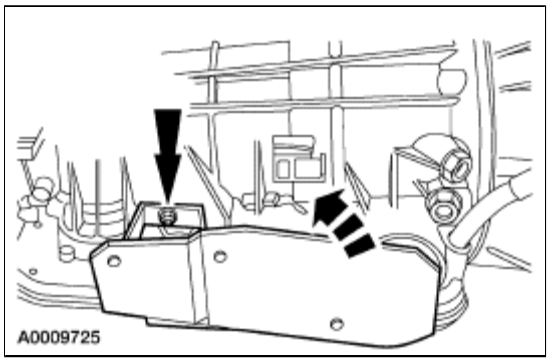
10. Fill the transmission to correct fluid level and check for correct transmission operation.
    - Use MERCON® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON® V specification.

Solenoids —Shift, Torque Converter Clutch, Electronic Pressure Control

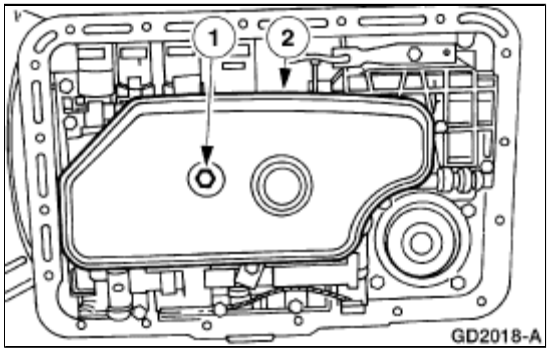
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** Transmission servo heat shield needs to be unclipped from the fluid pan rail and positioned out of the way for fluid pan removal.

   Loosen the nut and position the heat shield out of the way.



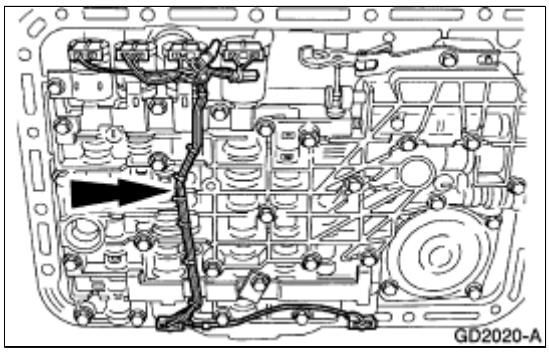
4. Place a drain pan under the transmission fluid pan.
5. Drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
6. Remove the transmission fluid filter.
   1. Remove the transmission fluid filter screw.
   2. Remove the transmission fluid filter.



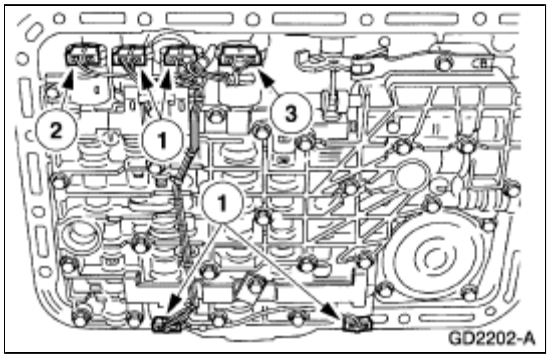
7. **NOTE:** Main control assembly does not need to be removed for solenoid service.

   Remove wire loom guide and protector.
   - Carefully lift up on wire loom guide and protector and disengage the retaining pins from the

solenoid clamps.



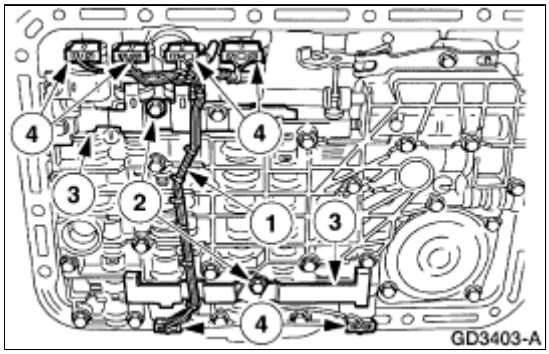
8. Disconnect the appropriate solenoid electrical connector.
    1. Disconnect shift solenoids electrical connectors.
    2. Disconnect the torque converter clutch (TCC) solenoid electrical connector.
    3. Disconnect the electronic pressure control (EPC) solenoid electrical connector.



9. **CAUTION: The TCC solenoid and converter modulator valve may pop out of its bore. This may damage the solenoid or converter modulator valve.**

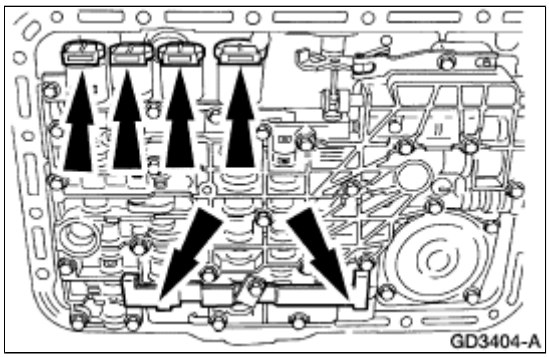
CAUTION: Shift solenoid (SSC) may pop out of its bore. This may damage the solenoid.

Remove the shift solenoids.
    1. Remove the wire harness.
    2. Remove the solenoid clamp screws.
    3. Remove the solenoid clamp.
    4. Remove the appropriate solenoid(s).



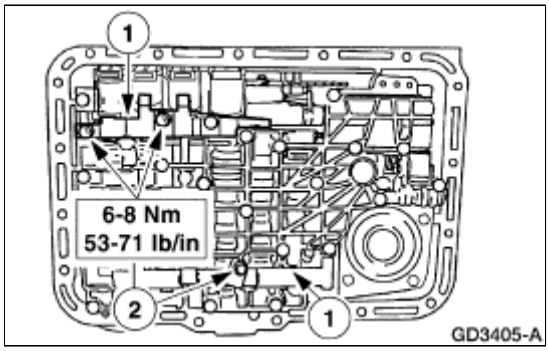
Installation

1. Install the new solenoid(s).

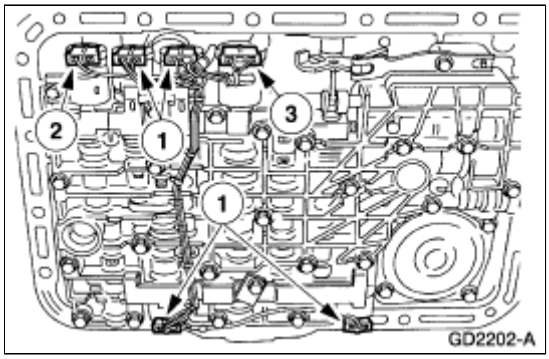


2. **CAUTION: The solenoid clamp must be installed in the TCC and EPC solenoid grooves, shift solenoid pockets and the No. 204 plug.**

   Install the solenoid clamp.
   1. Position the solenoid clamp on the main control valve body.
   2. Install the solenoid clamp screws.



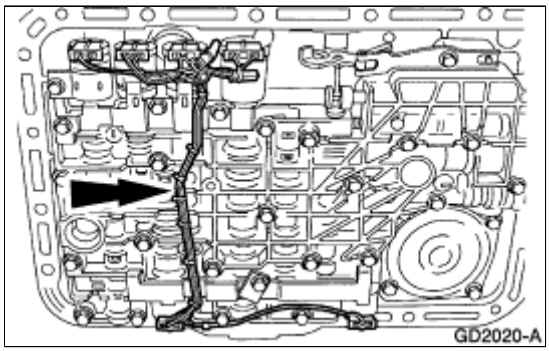
3. Connect the six solenoid electrical connectors.
   1. Connect shift solenoid SSA, SSB, SSC, SSD electrical connectors.
   2. Connect the torque converter clutch (TCC) solenoid electrical connector.
   3. Connect the electrical pressure control (EPC) solenoid electrical connector.



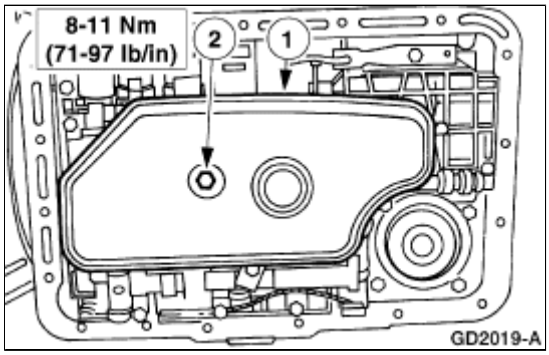
4. **CAUTION: Excessive pressure may break the retaining pins.**

Install the main control valve body wire loom.

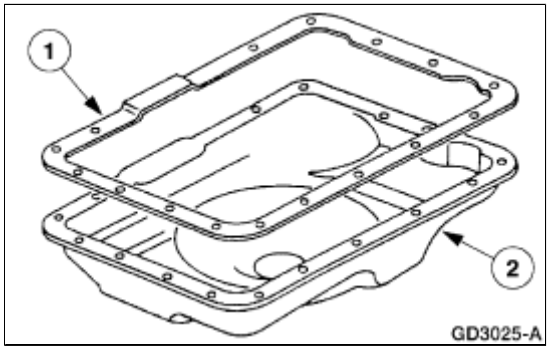
- Align the retaining pins to the holes in the solenoid clamps and gently press in the main control valve body wire loom guide and protector.



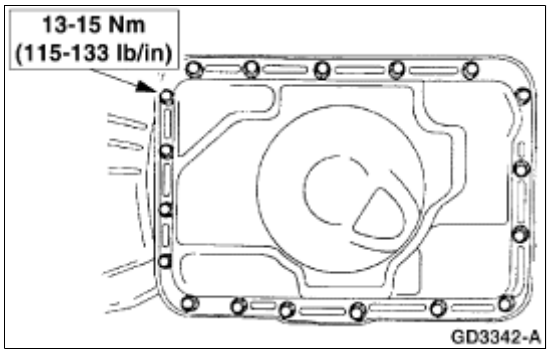
5. Install the transmission fluid filter.
    1. Install the transmission fluid filter.
    2. Install the transmission fluid filter screw.



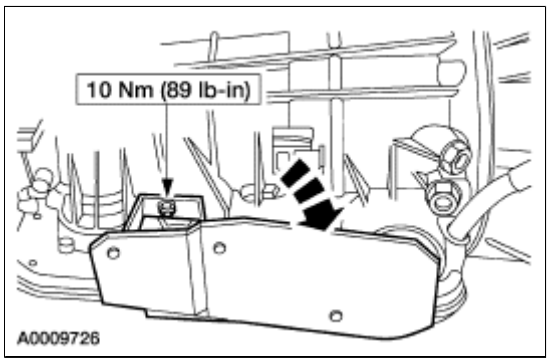
6. Install the transmission fluid pan.
    1. Position a new transmission fluid pan gasket on the transmission fluid pan.
    2. Align and install the transmission fluid pan.
        - Loosely install the transmission fluid pan screws.



7. Tighten the transmission fluid pan screws.



8. Position the servo heat shield over the servos and clip it to the pan rail.



9. Lower the vehicle.

10. Connect the battery ground cable.

11. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

Manual Control Lever Shaft and Seal

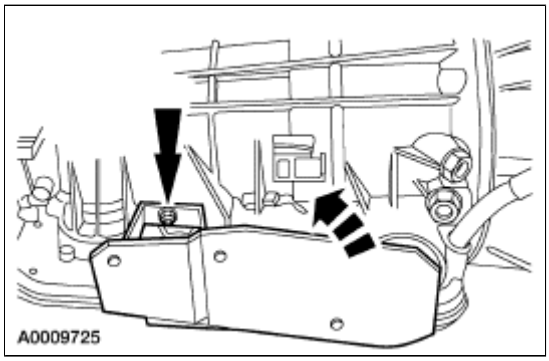
Special Tool(s)

ST1199-A	Oil Seal Replacer 307-050 (T74P-77498-A)

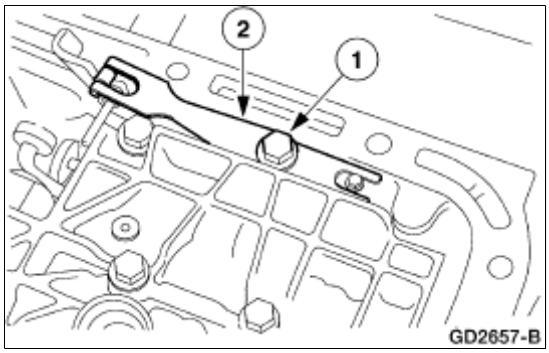
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** Transmission servo heat shield needs to be unclipped from the fluid pan rail and positioned out of the way for fluid pan removal.

   Loosen the nut and position the heat shield out of the way.

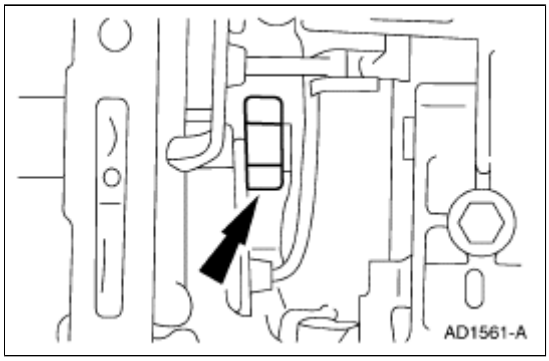
   
   A0009725
4. **NOTE:** It is not necessary to remove the transmission fluid filter to perform this procedure.

   Remove the transmission fluid pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
5. Remove the digital transmission range (TR) sensor. For additional Information, refer to Digital Transmission Range (TR) Sensor in this section.
6. Remove the manual control valve detent lever spring.
   1. Remove the manual control valve detent lever spring screw.
   2. Remove the manual control valve detent lever spring.

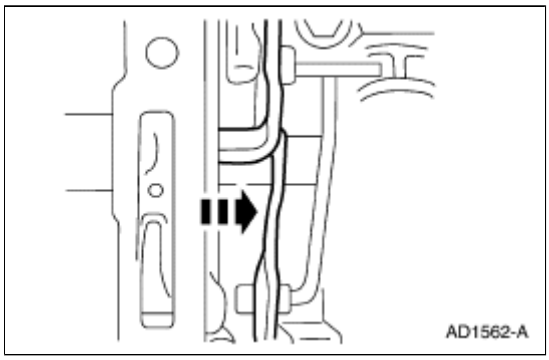


7. **CAUTION: Do not damage the valve inner lever pin.**

   Remove the manual valve inner lever nut.

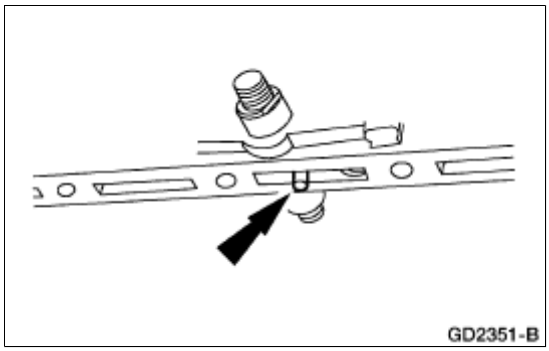


8. Separate the manual valve inner lever and the parking lever actuating rod.

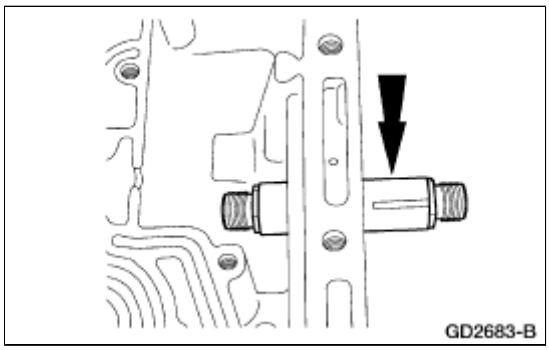


9. **CAUTION: Do not damage the case fluid pan rail.**

   Remove the manual control lever shaft spring pin.
   - Tap lightly on each side of the manual control lever shaft spring pin with a drift punch.
   - Pry the spring pin out of its bore.

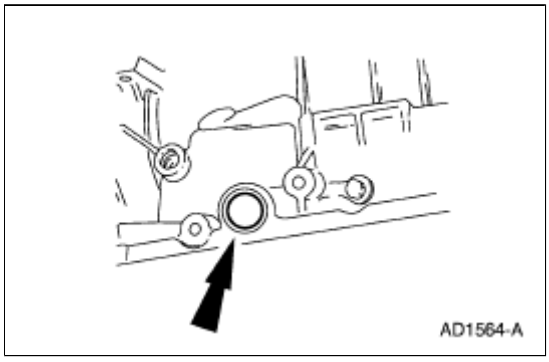


10. Remove the manual control lever shaft.



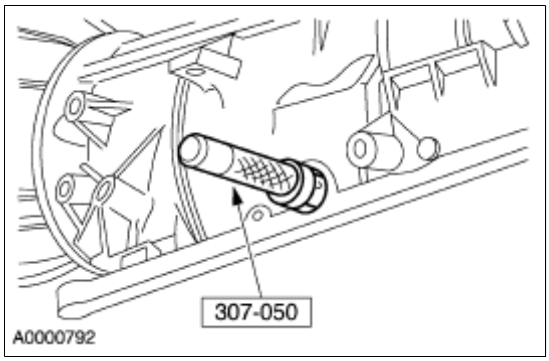
11. **CAUTION: Do not damage the bore.**

    Remove the manual control lever shaft seal.

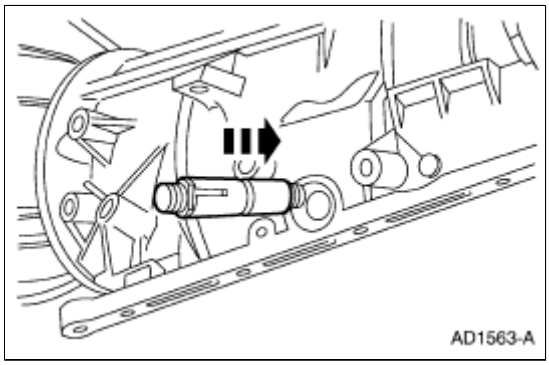


Installation

1. Using the special tool, install the manual control lever shaft seal.
    - Lubricate the manual control lever shaft seal with petroleum jelly.

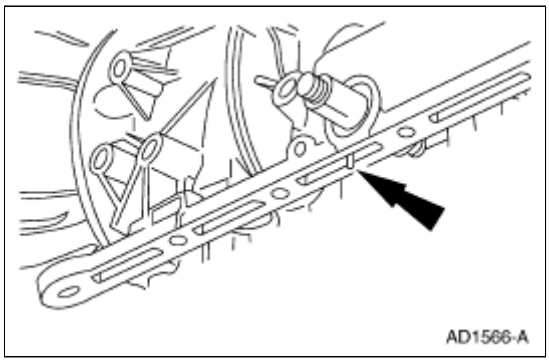


2. Install the manual control lever shaft.

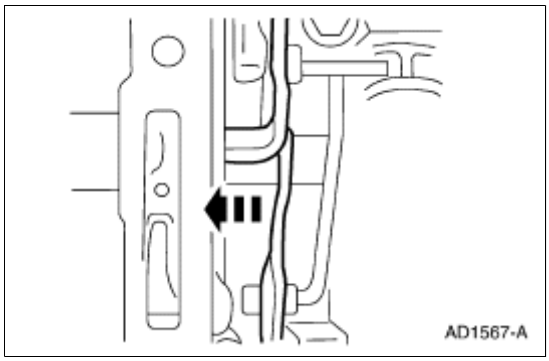


3. **CAUTION: Use care not to damage the fluid pan rail surface when installing the retaining pin.**

   Align the manual control lever shaft alignment groove with the manual control lever shaft spring pin bore in the transmission case.
   - Tap the manual control lever shaft spring pin into the transmission case.

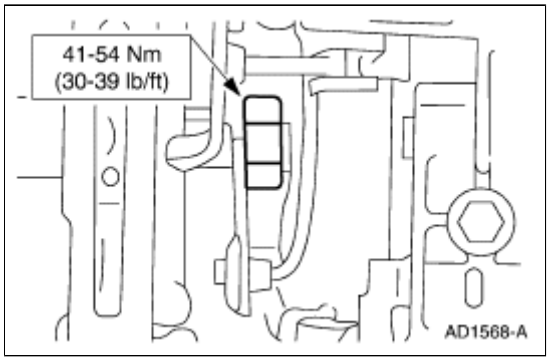


4. Align flats of the manual valve inner lever with flats on the manual control lever shaft. Install the manual valve inner lever and parking lever actuating rod onto the manual control lever shaft.



5. **CAUTION: Do not bend the manual valve inner lever pin.**

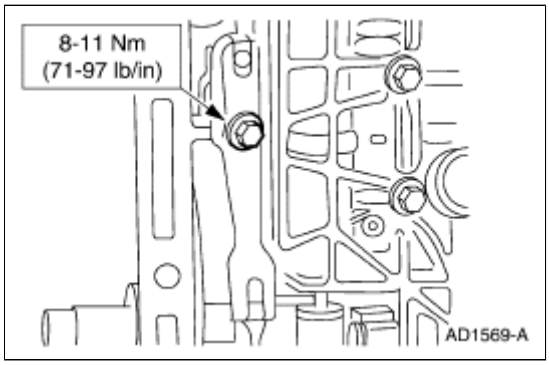
   Install the manual valve inner lever nut.



6. **CAUTION: Park pawl actuating rod must be properly installed into parking pawl and guide cup located in extension housing. Verify park linkage function.**

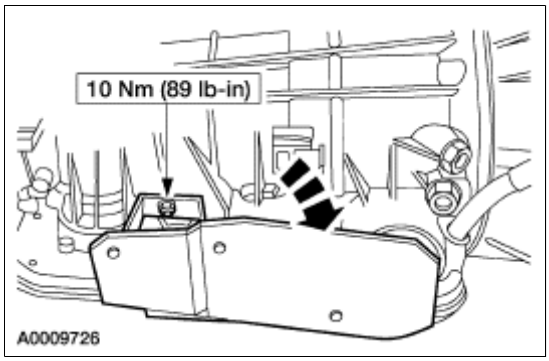
   Verify that the output shaft is locked in the PARK position.

7. Install the manual valve detent spring.



8. Install the transmission fluid pan with new pan gasket.

9. Position the servo heat shield over the servos and clip it to the pan rail.



10. Install the digital transmission range (TR) sensor.

11. Lower the vehicle.

12. Connect the battery ground cable.

13. Fill the transmission to proper level and check for proper transmission operation.
    - Use MERCON V® Automatic Transmission Fluid XT-5-QM meeting Ford specification MERCON V®.

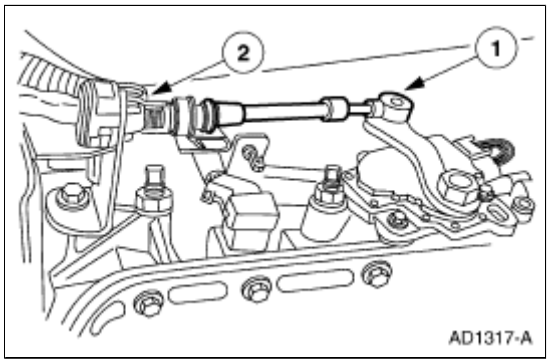
Digital Transmission Range (TR) Sensor

Special Tool(s)

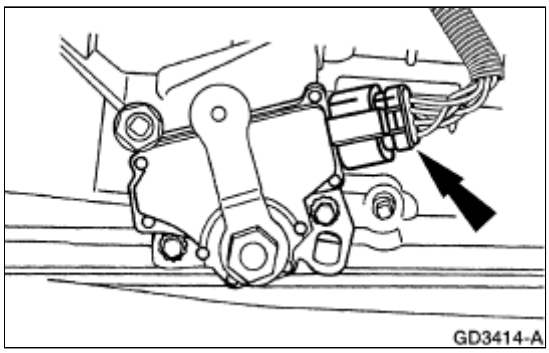
ST1633-A	TRS Alignment Gauge 307-351 (T97L-70010-A)

Removal

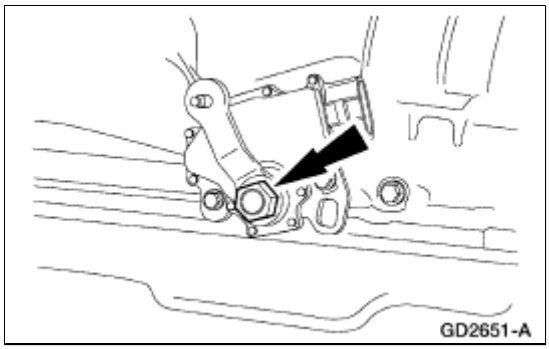
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the shift cable.
   1. Disconnect the shift cable from the manual control lever.
   2. Disconnect the shift cable from the bracket.



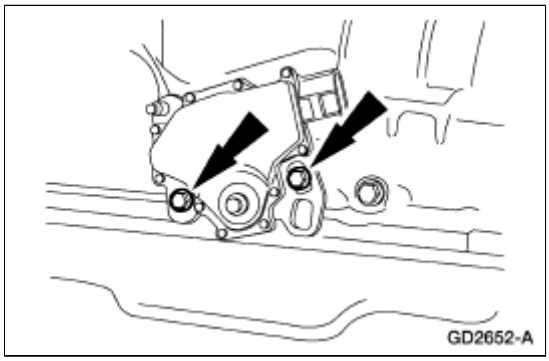
4. Disconnect the digital transmission range (TR) sensor electrical connector.



5. Remove the manual control outer lever nut and manual control outer lever.

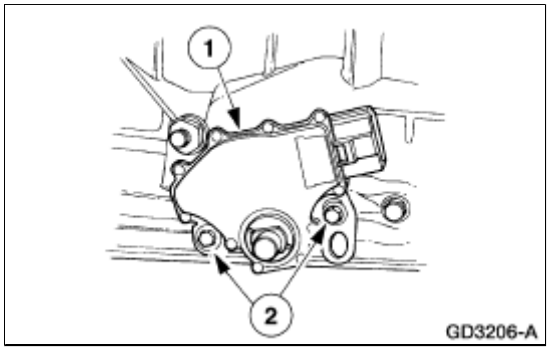


6. Remove the screws and the digital TR sensor.



Installation

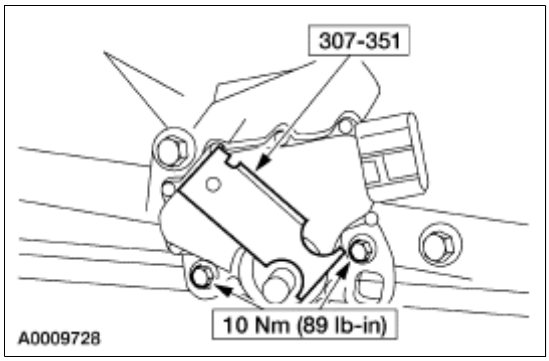
1. Install the digital TR sensor.
    1. Position the digital TR sensor.
    2. Loosely install the screws.



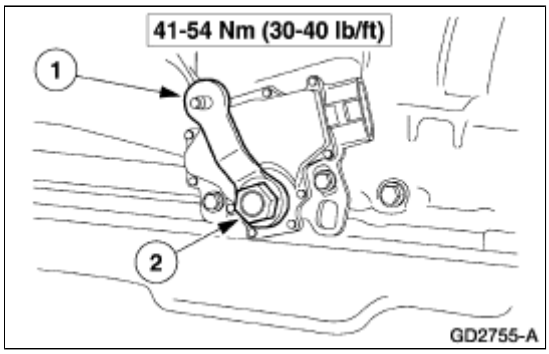
2. **CAUTION: Tightening one screw before tightening the other can cause the sensor to bind or become damaged.**

    NOTE: The manual lever must be in the neutral position.

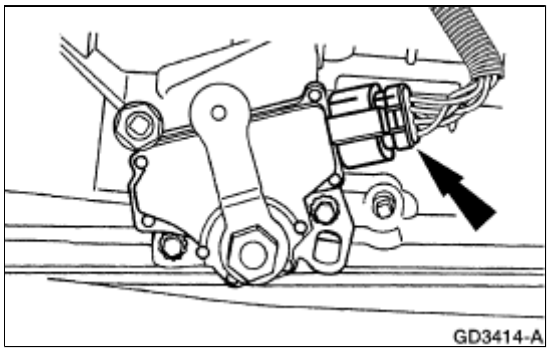
    Using the special tool, align the digital TR sensor and tighten screws in an alternating sequence.



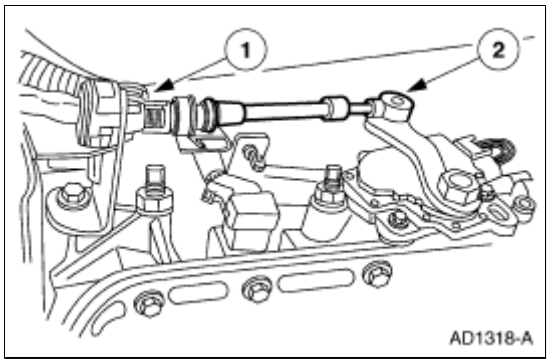
3. Install the manual control outer lever.
    1. Install the manual control outer lever.
    2. Install the manual control outer lever nut.



4. Connect the digital transmission range (TR) sensor electrical connector.



5. Connect the shift cable.
    1. Connect the shift cable to the bracket.
    2. Connect the shift cable to the manual control lever.



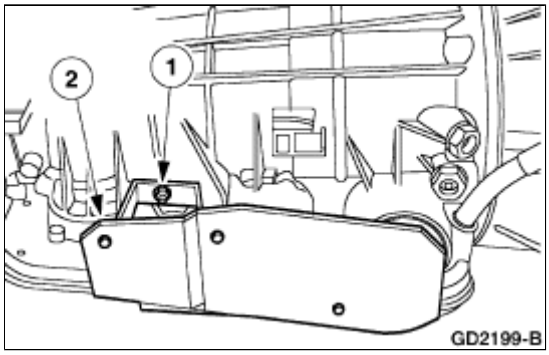
6. Verify that the shift cable is adjusted. For additional information, refer to Section 307-05 .
7. Lower the vehicle.
8. Connect the battery ground cable.

Heat Shield

Removal

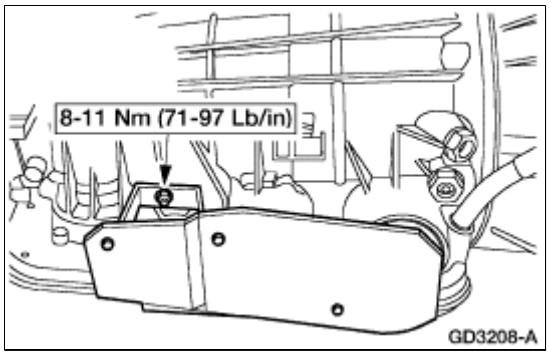
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the transmission servo heat shield.
    1. Remove the transmission servo heat shield nut.
    2. Remove the transmission servo heat shield.



Installation

1. Follow the removal procedure in reverse order.

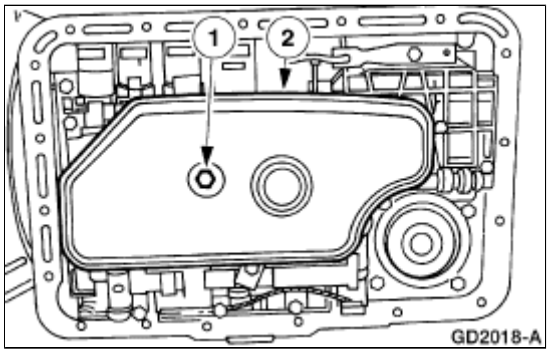


Internal Harness Service

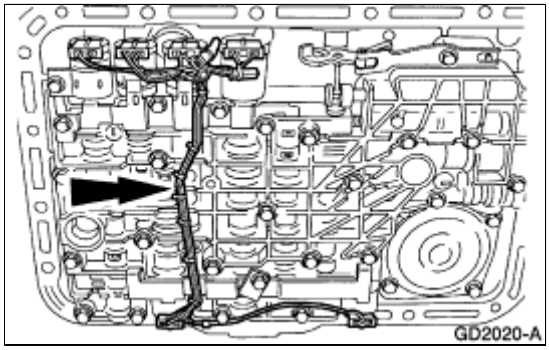
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle. for additional information, refer to Section 100-02 .
3. Disconnect vehicle harness from transmission case (16 pin) connector.
4. Drain the transmission fluid; Refer to Fluid Pan, Gasket and Filter in this section.
5. **NOTE:** The main control assembly does not need to be removed.

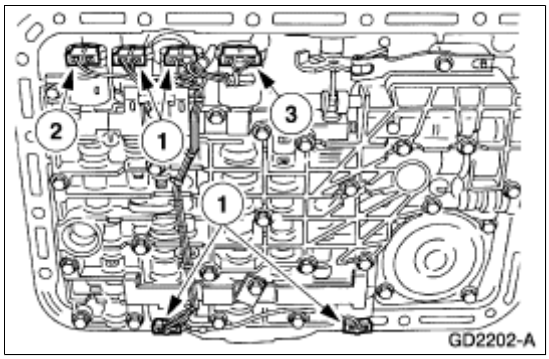
   Remove the transmission fluid filter.
   1. Remove the transmission fluid filter screw.
   2. Remove the transmission fluid filter.



6. Remove main control valve body wire loom.
   - Carefully lift up on wire loom guide and protector and disengage the retaining pins from the solenoid clamps.



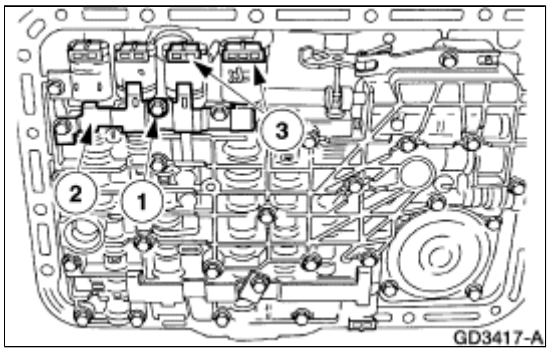
7. Disconnect the solenoid electrical connectors.
   1. Disconnect the SSA, SSB, SSC, and the SSD electrical connectors.
   2. Disconnect the torque converter clutch (TCC) solenoid electrical connector.
   3. Disconnect the electronic pressure control (EPC) solenoid electrical connector.



8. **CAUTION: The TCC solenoid and converter modulator valve may pop out of its bore. This may damage the solenoid or converter modulator valve.**

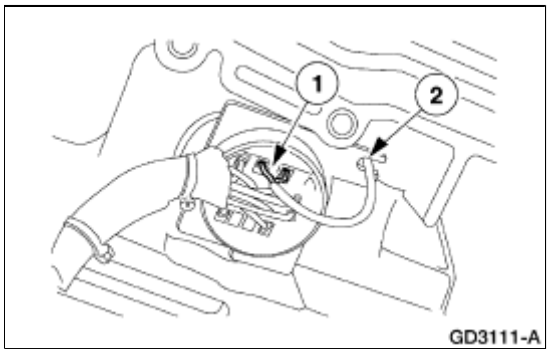
CAUTION: Shift solenoids may pop out of their bore. This may damage the solenoids.

Remove the EPC and SSB solenoids.
1. Remove the solenoid clamp bolts.
2. Remove the solenoid clamp.
3. Remove the EPC and SSB solenoids.



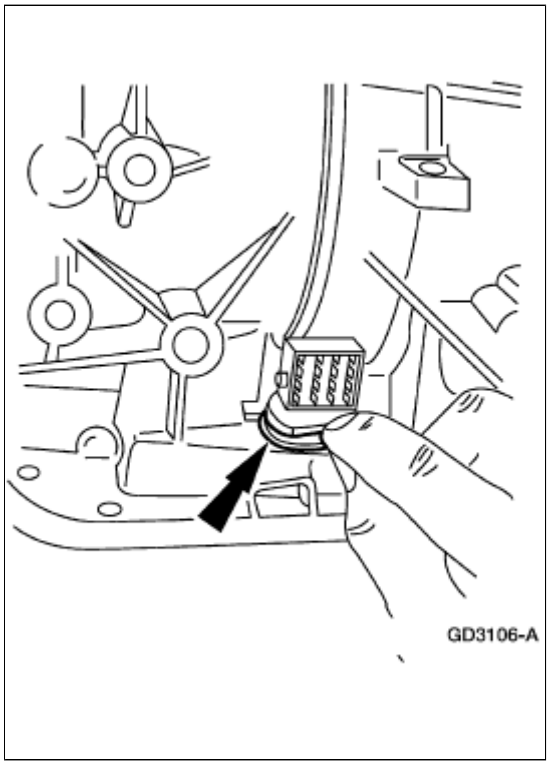
9. **CAUTION: Do not pry on the other wires or damage the connector case surface.**

Disconnect the turbine shaft speed (TSS) sensor electrical connector from the transmission case (16 pin) electrical connector.
1. Disconnect the TSS sensor electrical connector.
2. Remove from the TSS sensor wire locator.



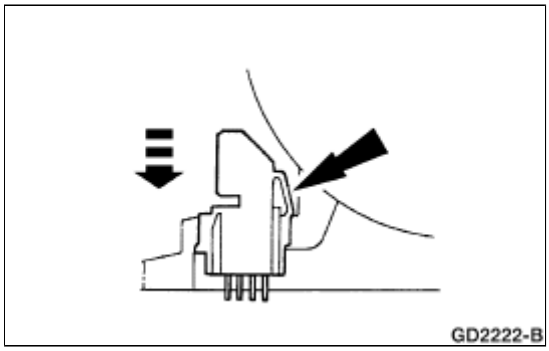
10. **CAUTION: Do not overstretch the retaining spring.**

    Remove the transmission case (16 pin) electrical connector retaining spring.



11. **CAUTION: Do not damage the connector or harness.**

    Remove the transmission case (16 pin) electrical connector.
    - Compress the tabs on the transmission case (16 pin) electrical connector.
    - Push the transmission case (16 pin) electrical connector out of transmission case.



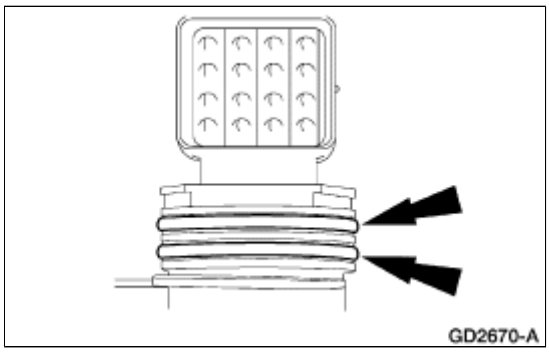
Installation

1. **NOTE:** Make sure the tab is in the lock position.

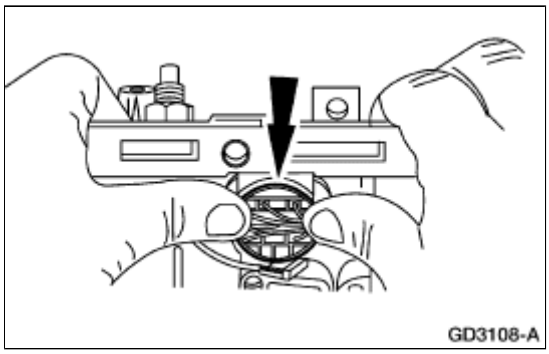
   NOTE: Install new O-rings on the transmission case (16 pin) electrical connector.

Install the transmission case (16 pin) electrical connector.

- Lubricate the transmission case (16 pin) electrical connector O-rings with petroleum jelly.



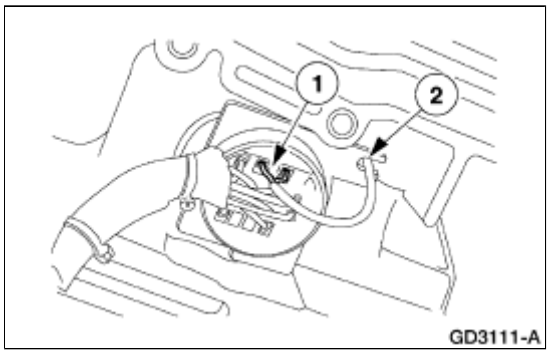
2. Press the transmission case (16 pin) electrical connector through the case until a click is heard.



3. **CAUTION: Align the slot on the TSS sensor electrical connector with the slot in the 16 pin case connector.**

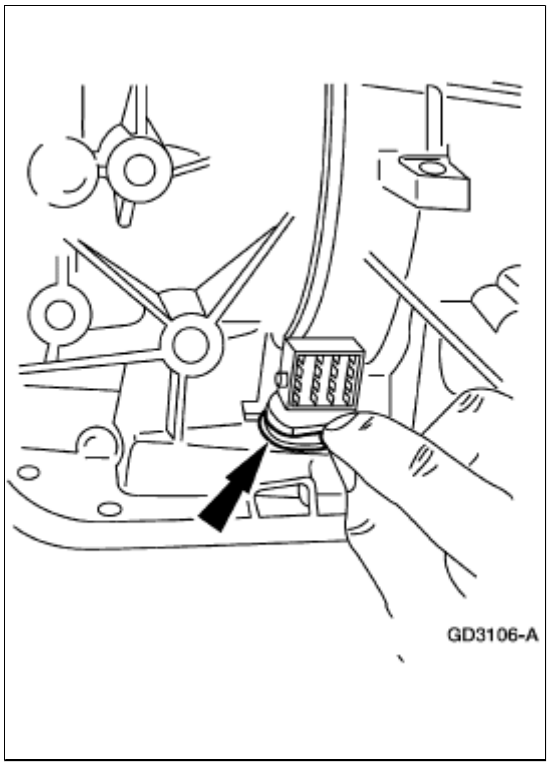
Install the TSS sensor wire.

1. Install TSS sensor wire into (16 pin) case connector.
2. Install TSS sensor wire into the locator.

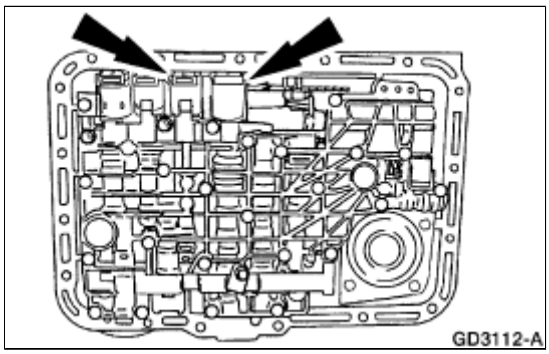


4. **CAUTION: Do not overstretch the retaining spring.**

Install the transmission case (16 pin) electrical connector retaining spring.

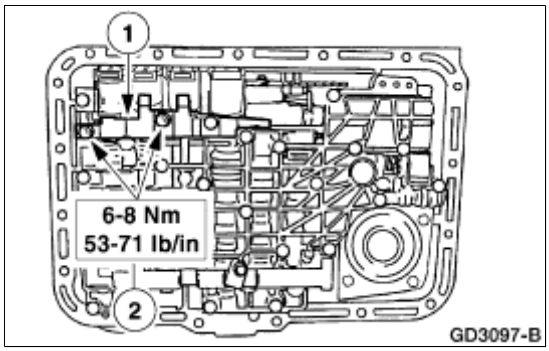


5. Install the EPC and SSB solenoids.

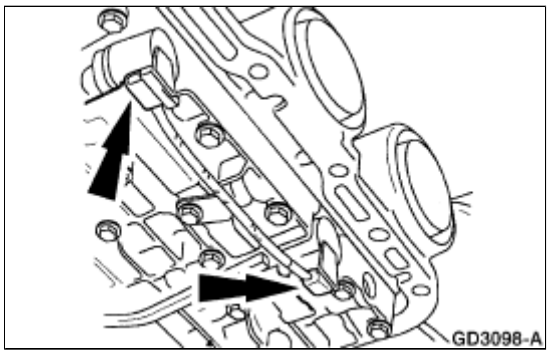


6. **CAUTION: The solenoid clamp must be installed in the TCC and EPC solenoid grooves, shift solenoid pockets and the No. 204 plug.**

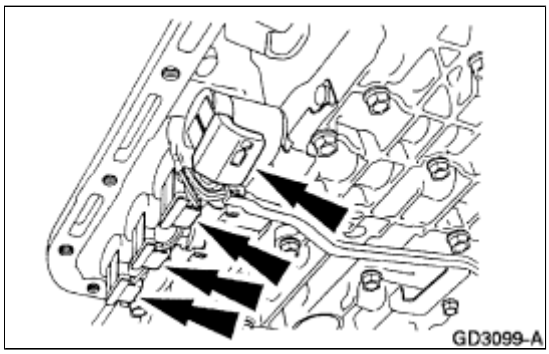
   Install the solenoid clamp.
   1. Position the solenoid clamp on the main control valve body (7A100).
   2. Install the solenoid clamp screws.



7. Connect the SSA and SSC shift (SS) solenoid electrical connectors.



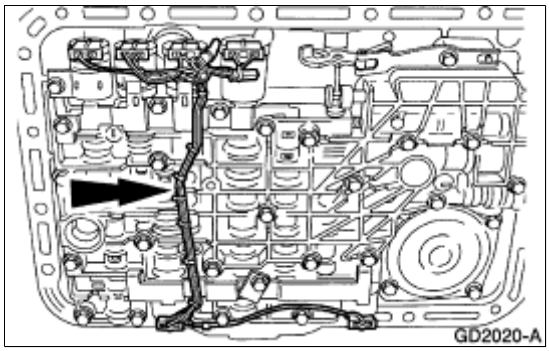
8. Connect the TCC, SSD, SSB, and EPC solenoid electrical connectors.



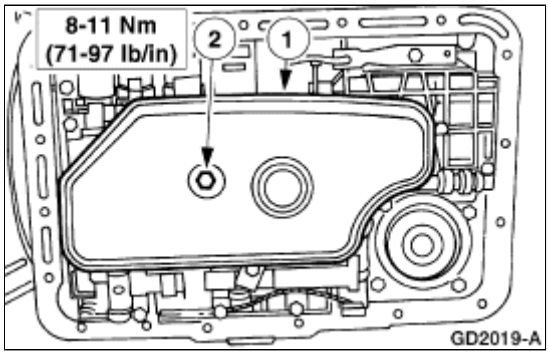
9. **CAUTION: Excessive pressure may break the retaining pins.**

Install the wire harness guide and protector.

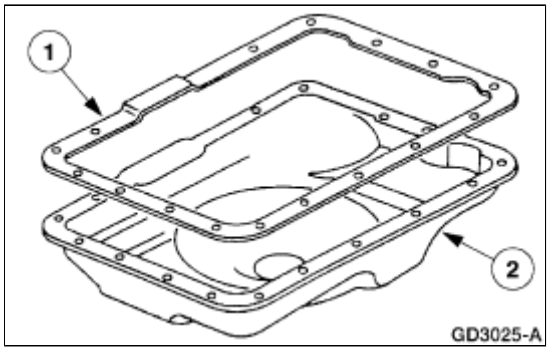
- Align the retaining pins to the holes in the solenoid clamps and gently press in the wire harness guide and protector.



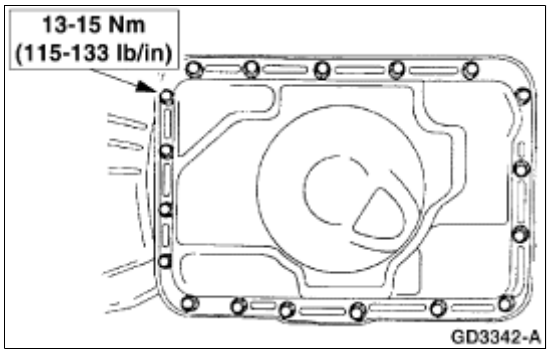
10. Install the transmission fluid filter.
    1. Install the transmission fluid filter.
    2. Install the transmission fluid filter screw.



11. Install the transmission fluid pan (7A194).
    1. Position a new transmission fluid pan gasket on the transmission fluid pan.
    2. Align and install the transmission fluid pan.
       - Loosely install the transmission fluid pan screws.



12. Tighten the transmission fluid pan screws.



13. Connect vehicle harness to transmission (16 pin) connector. Make sure lock is fully engaged.

14. Lower the vehicle.

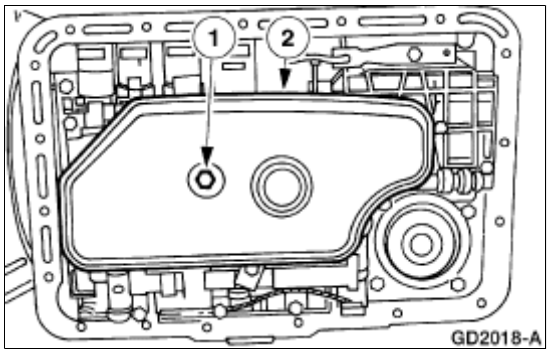
15. Connect the battery ground cable.

16. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

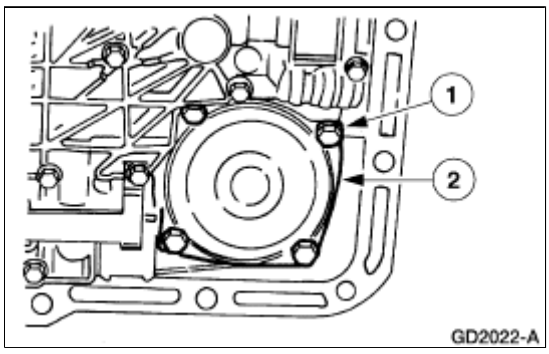
Low/Reverse Servo Assembly

Removal

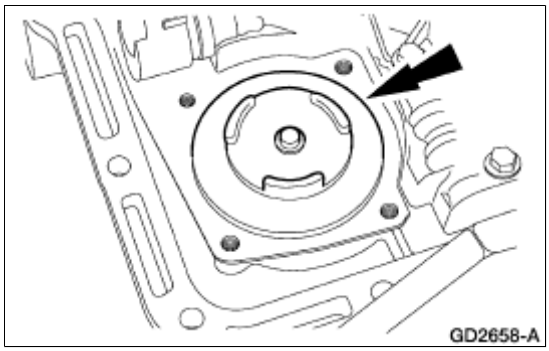
1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle; Refer to Section 100-02 .
3. Remove the transmission pan; Refer to Fluid Pan, Gasket and Filter in this section.
4. Remove the transmission fluid filter.
    1. Remove the transmission fluid filter screw.
    2. Remove the transmission fluid filter.



5. Remove the low/ reverse band servo cover (7D036).
    1. Remove the low/reverse band servo cover screws.
    2. Remove the low/ reverse band servo cover and gasket. Discard the low/ reverse servo separator plate cover gasket (7L173).



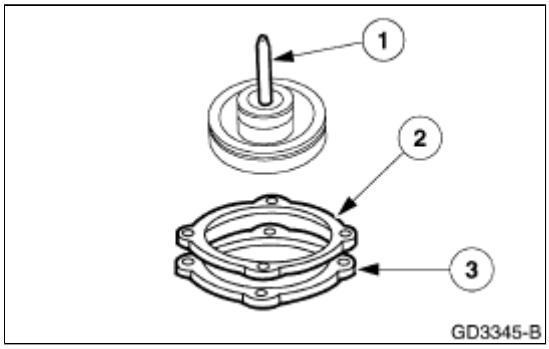
6. Remove the low/ reverse band servo piston and rod assembly.



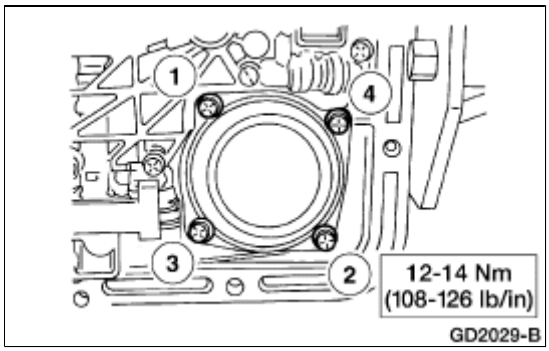
Installation

1. Clean and inspect the low/reverse band servo piston bore and the low/ reverse band servo piston and rod.

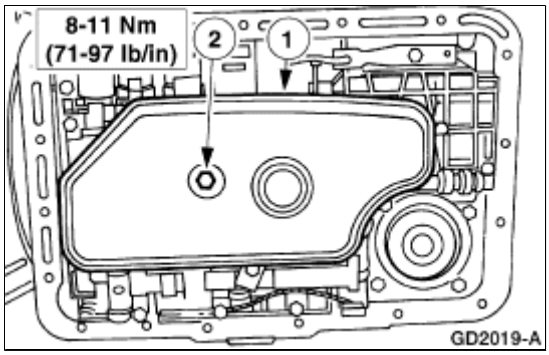
2. Install the low/ reverse band servo piston and rod.
    1. Install the low/ reverse band servo piston and rod assembly.
    2. Install a new low/ reverse band servo separator plate cover gasket.
    3. Install the low/ reverse band servo cover.
        - Loosely install the low/reverse band servo piston cover screws.



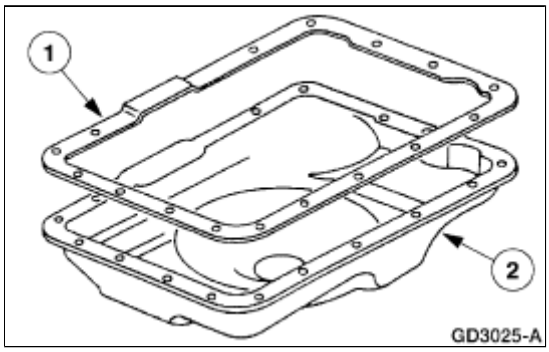
3. Tighten the servo cover screws in the sequence shown.



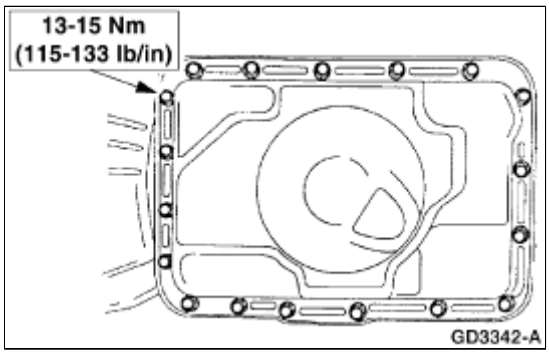
4. Install the transmission fluid filter.
    1. Install the transmission fluid filter.
    2. Install the transmission fluid filter screw.



5. Install the transmission fluid pan (7A194).
    1. Position a new transmission fluid pan gasket on the transmission fluid pan.
    2. Install and align the transmission fluid pan.
        - Loosely install the transmission fluid pan screws.



6. Tighten the transmission fluid pan bolts.
    - Use a crisscross sequence to tighten the transmission fluid pan screws.



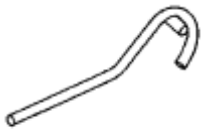
7. Lower the vehicle.

8. Connect the battery ground cable.

9. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V; Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

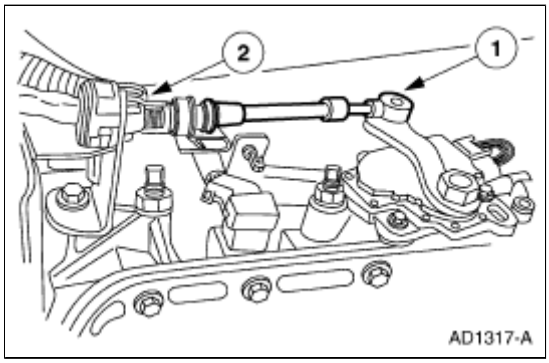
Front Servo

Special Tool(s)

ST1806-A	Servo Cover Compressor 307-340 (T95L-77028-A)
 ST1770-B	Servo Removal Tool 307-347 (T97T-7D021-A)

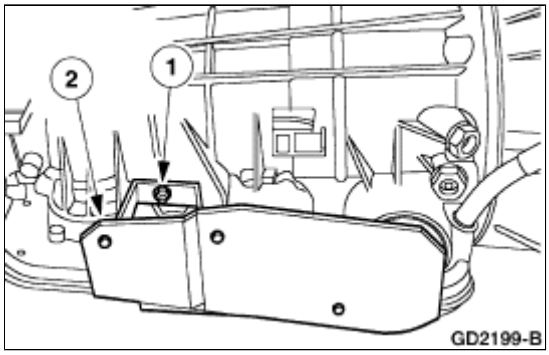
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support vehicle. For additional information, refer to Section 100-02 .
3. Remove the shift cable.
   1. Disconnect the shift cable from the manual control lever (7A256).
   2. Remove the shift cable from the bracket.

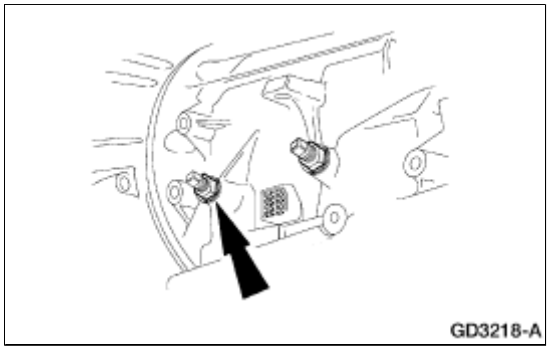


4. Remove the digital transmission range (TR) sensor. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
5. Remove the main control valve body (7A100). For additional information, refer to the Main Control Valve Body in this section.
6. Remove the three way catalytic converter (TWC) (5E212). For additional information, refer to Section 309-00 .

7. Remove the transmission servo heat shield (7F013).
    1. Remove the transmission servo heat shield nut.
    2. Remove the transmission servo heat shield.

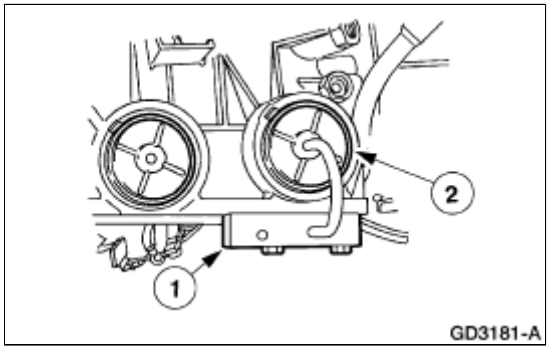


8. Remove the front band locknut and unscrew the front band adjusting screw.
    - Discard the front band locknut after removal.



9. **CAUTION: Servo cover is under spring pressure.**

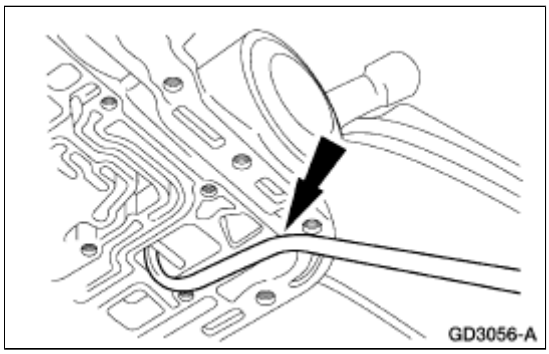
Using Servo Cover Compressor, remove the front band servo cover retaining ring.
1. Install the Servo Cover Compressor and compress the front band servo cover.
2. Remove the front servo cover retaining ring.
    - Slowly remove tension on the J-hook nut and remove the servo cover compressor.



10. **CAUTION: Servo removal tool should be used to prevent damage to servo and bore.**

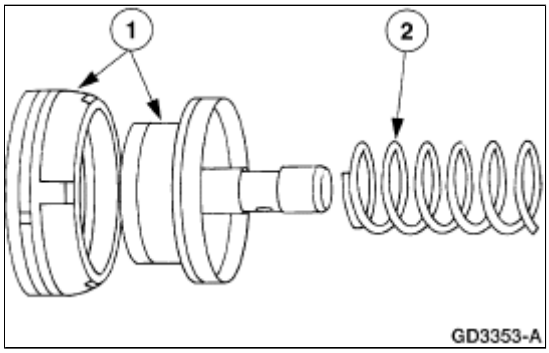
Use Servo Removal Tool to remove the front band servo cover, servo piston and servo piston spring (7D028).

- Insert Servo Removal Tool into the transmission case, locate on servo rod, and remove front band servo cover, servo piston and servo piston spring.



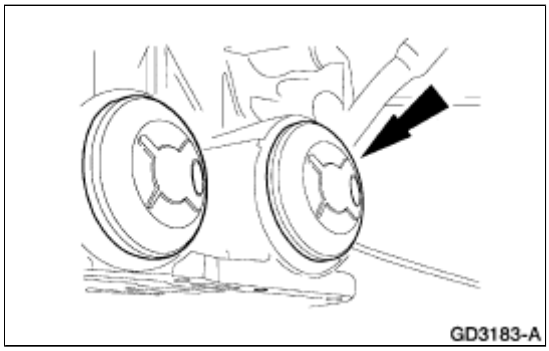
Installation

1. Assemble the front band servo cover, front band servo piston, and the servo piston spring.
    1. Install the front band servo piston into the front band servo cover.
    2. Install the servo piston spring on the front band servo piston.

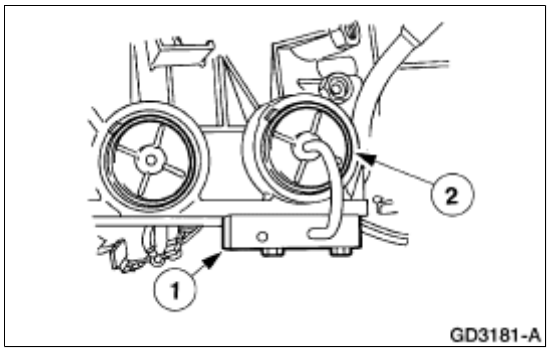


2. **CAUTION: Do not damage O-ring during installation. Do not press servo cover and O-ring past relief hole in case, or O-ring damage may occur.**

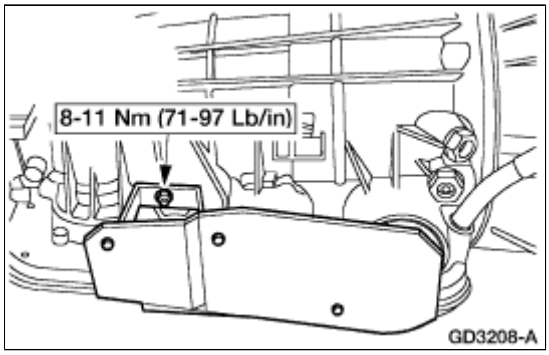
    Install the front band servo assembly into the transmission case (7005).
    - Lubricate the front band servo cover O-ring with petroleum jelly.



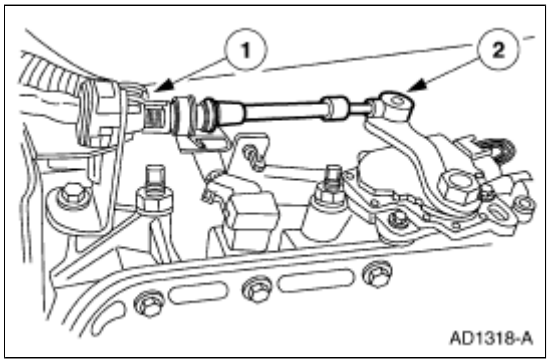
3. Use Servo Cover Compressor to install the front band servo cover retaining ring.
    1. Install the Servo Cover Compressor and compress the front band servo cover.
    2. Install the front servo cover retaining ring.



4. Install the main control valve body.
5. Adjust the front band. For additional information, refer to Front Band Adjustment in this section.
6. Position the transmission servo heat shield on the transmission and install the nut.



7. Install the three way catalytic converter. For additional information, refer to Section 309-00 .
8. Install the shift cable.
    1. Install the shift cable.
    2. Install the shift cable to the manual control lever.

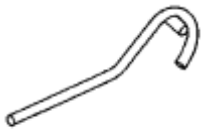


9. Install the digital transmission range (TR) sensor.
10. Lower the vehicle.
11. Connect the battery ground cable.
12. Fill the transmission to the proper fluid level and check for proper transmission operation.

- Use MERCON ® V; Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

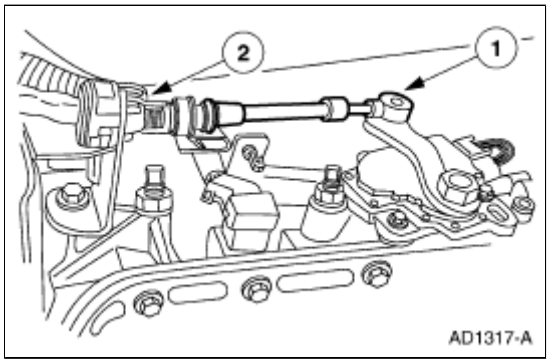
Intermediate Servo

Special Tool(s)

ST1806-A	Servo Cover Compressor 307-340 (T95L-77028-A)
 ST1770-B	Servo Removal Tool 307-347 (T97T-7D021-A)

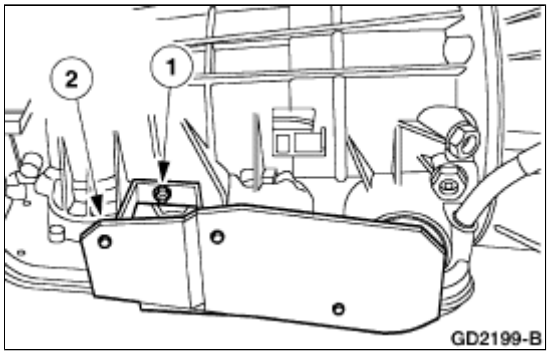
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the shift cable.
   1. Disconnect the shift cable from the manual control lever (7A256).
   2. Remove the shift cable from the bracket.

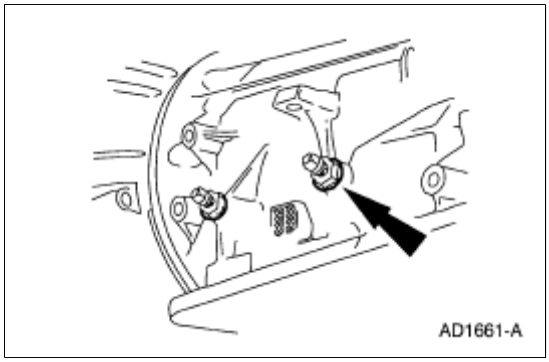


4. Remove the digital transmission range (TR) sensor. For additional information, refer to the Digital Transmission Range (TR) Sensor in this section.
5. Remove the three way catalytic converter (TWC) (5E212). For additional information, refer to Section 309-00 .
6. Remove the main control valve body (7A100). For additional information, refer to the Main Control Valve Body in this section.

7. Remove the transmission servo heat shield (7F013).
    1. Remove the transmission servo heat shield nut.
    2. Remove the transmission servo heat shield.

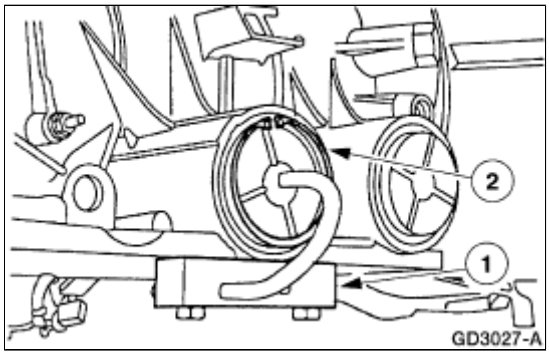


8. Remove the intermediate band locknut and unscrew the screw.
    - Discard the intermediate band locknut after removal.



9. **CAUTION: Servo cover is under spring tension. Use caution when removing.**

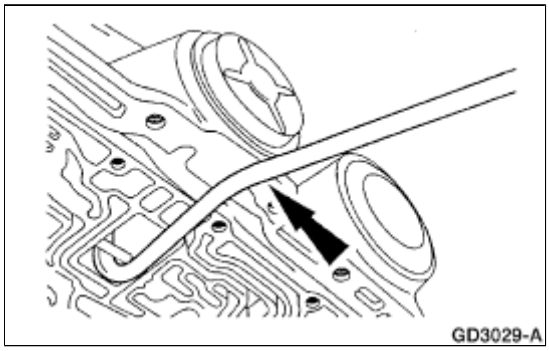
Using Servo Cover Compressor, remove the intermediate band servo cover retaining ring.
    1. Install the Servo Cover Compressor and compress the intermediate band servo cover.
    2. Remove the intermediate servo cover retaining ring.
        - Slowly remove tension on the J hook nut and remove the servo cover compressor.



10. **CAUTION: Servo removal tool should be used to prevent damage to the servo, servo cover, and bore.**

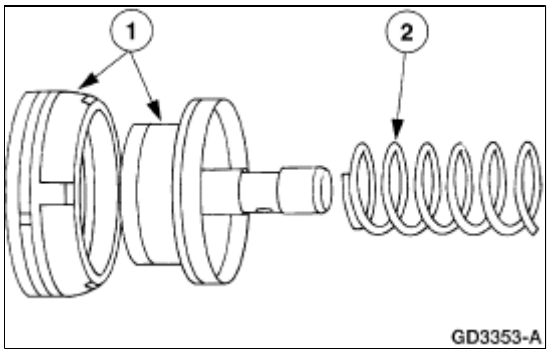
Use Servo Removal Tool to remove the intermediate band servo cover, intermediate band servo piston (7D021) and servo piston spring (7D028).

- Insert Servo Removal Tool into the transmission case, and remove servo cover, intermediate band servo piston and servo piston spring.



Installation

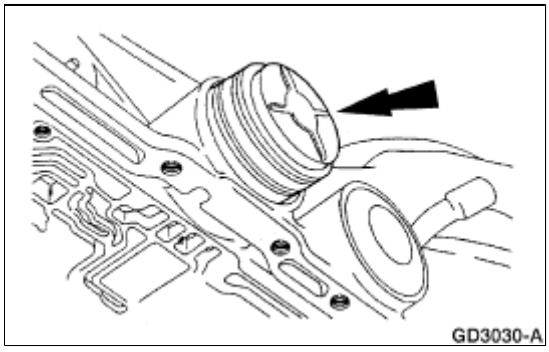
1. Assemble the intermediate band servo cover, intermediate band servo piston, and the servo piston spring.
    1. Install the intermediate band servo piston into the intermediate band servo cover.
    2. Install the servo piston spring on the intermediate band servo piston.



2. **CAUTION: Do not damage O-ring during installation. Do not press servo cover and O-ring past relief hole in case, or O-ring damage may occur.**

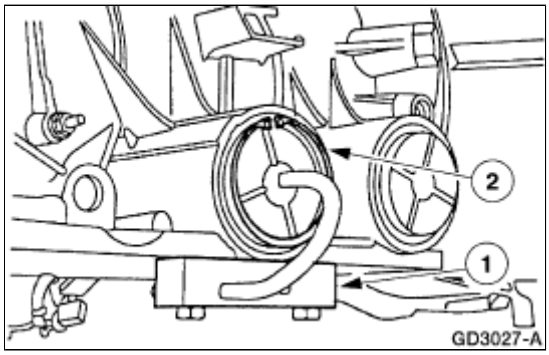
    Install the intermediate band servo piston assembly into the transmission case (7005).

    - Lubricate intermediate band servo cover O-ring with petroleum jelly.



3. Using Servo Cover Compressor, install the intermediate band servo cover retaining ring.

1. Install the Servo Cover Compressor and compress the intermediate band servo cover.
2. Install the intermediate servo cover retaining ring.

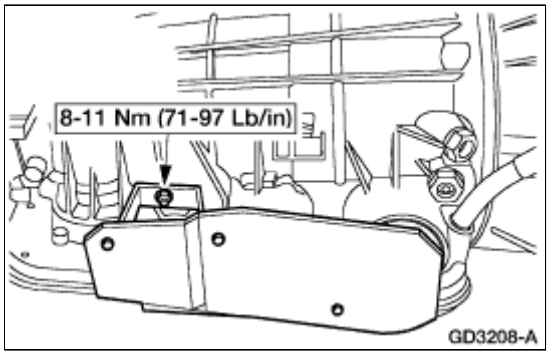


4. Adjust the intermediate band. For additional information, refer to Intermediate Band Adjustment in this section.

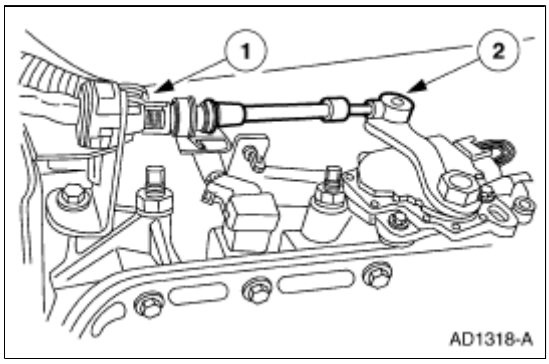
5. Install the main control valve body.

6. Install the digital transmission range (TR) sensor.

7. Position the transmission servo heat shield on the transmission and install the nut.



8. Install the shift cable.
   1. Install the shift cable.
   2. Install the shift cable to the manual control lever.



9. Install the three way catalytic converter.

10. Lower the vehicle.

11. Connect the battery ground cable.

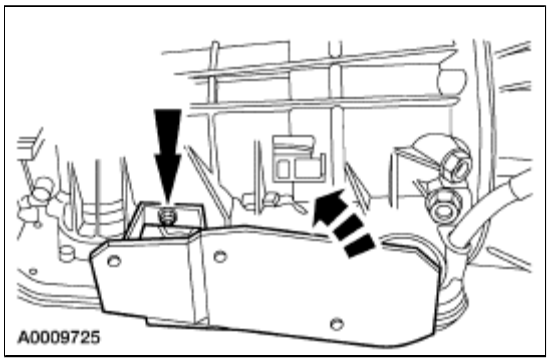
12. Fill the transmission to the proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

Park System

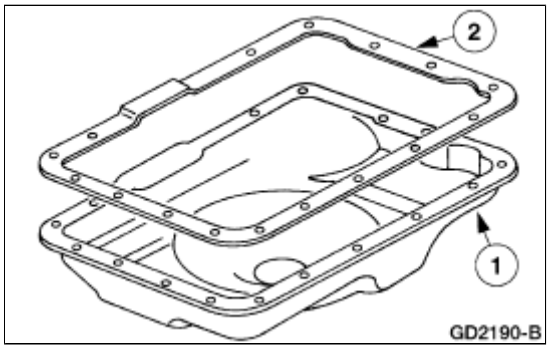
Removal

1. Disconnect the battery ground cable. For additional information; refer to Section 414-01 .
2. Raise and support the vehicle. For additional information; refer to Section 100-02 .
3. **NOTE:** Transmission servo heat shield needs to be unclipped from the fluid pan rail and positioned out of the way for fluid pan removal.

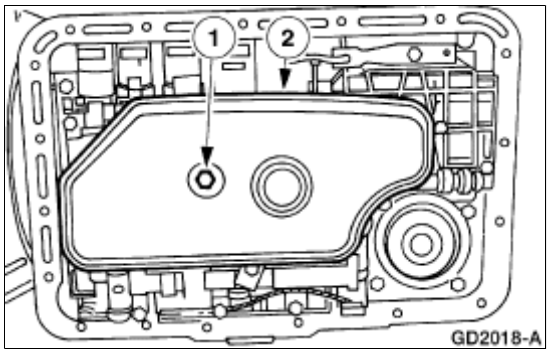
   Loosen the nut and position the heat shield out of the way.



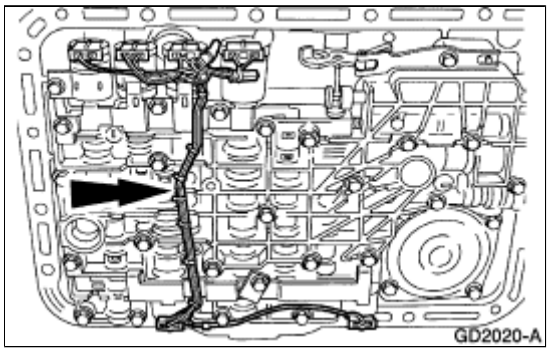
4. Remove the transmission fluid pan.
   1. Remove the transmission fluid pan.
   2. Remove and discard the transmission fluid pan gasket.



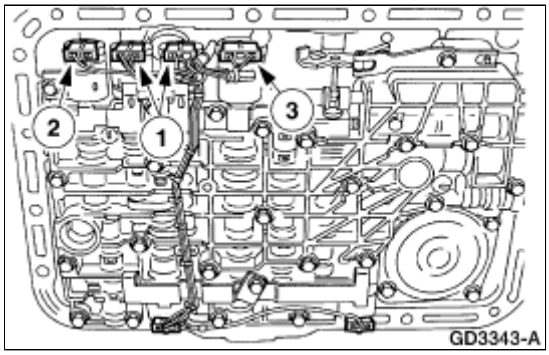
5. Remove the transmission fluid filter.
   1. Remove the transmission fluid filter screw.
   2. Remove the transmission fluid filter.



6. Remove wire loom guide and protector.
    - Carefully lift up on wire loom guide and protector and disengage the retaining pins from the solenoid clamps.

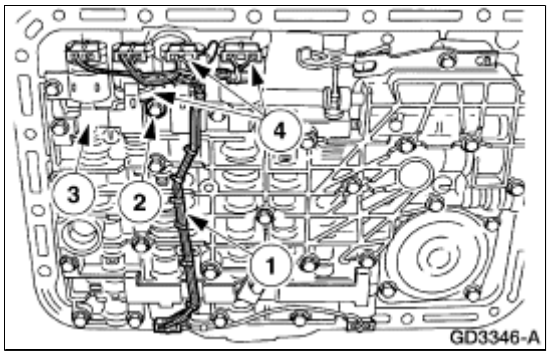


7. Disconnect the solenoid electrical connectors.
    1. Disconnect shift solenoids SSB and SSD electrical connectors.
    2. Disconnect the torque converter clutch (TCC) solenoid electrical connector.
    3. Disconnect the electronic pressure control (EPC) solenoid electrical connector.



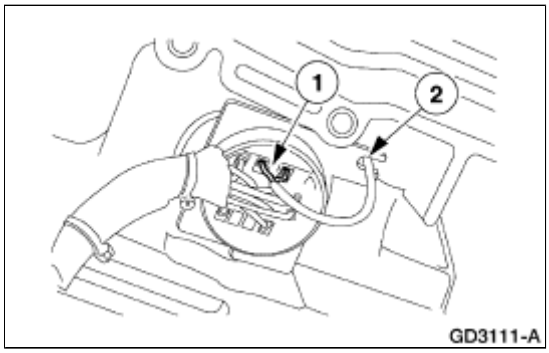
8. **CAUTION: The TCC solenoid and converter modulator valve may pop out of its bore. This may damage the solenoid or converter modulator valve.**

    Remove the EPC, SSB, and SSD solenoids.
    1. Remove the wire harness.
    2. Remove the solenoid clamp screws.
    3. Remove the solenoid clamp.
    4. Remove the EPC, SSB, and SSD solenoids.



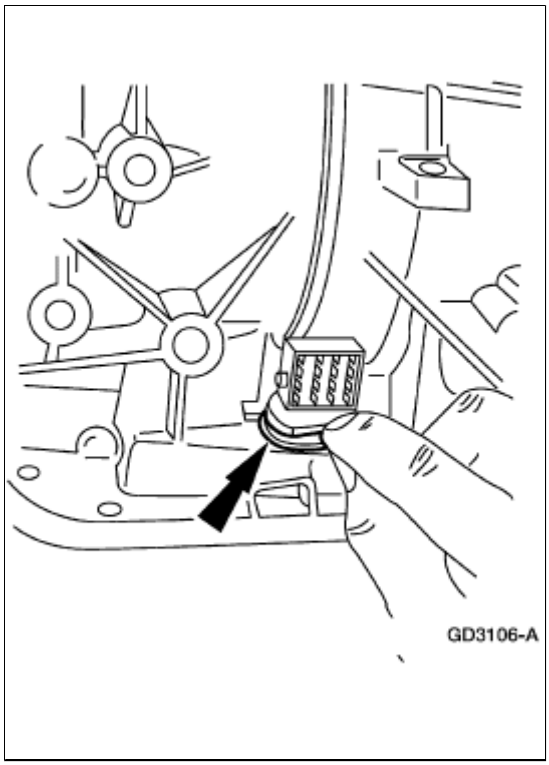
9. **CAUTION: Do not pry on the other wires or damage to the connector case surface may result.**

   Disconnect the turbine shaft speed (TSS) sensor electrical connector from the transmission case (16 pin) electrical connector.
   1. Disconnect the TSS sensor electrical connector.
   2. Remove the TSS sensor wire locator.



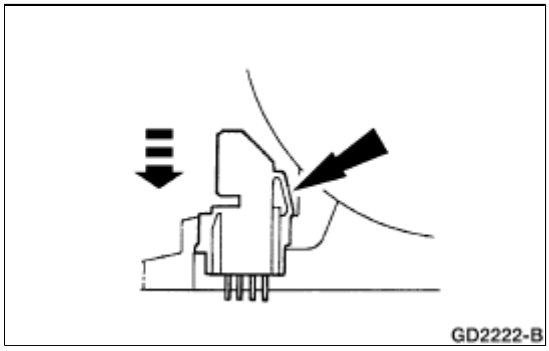
10. **CAUTION: Do not overstretch the retaining spring.**

    Remove the transmission case (16 pin) electrical connector retaining spring.

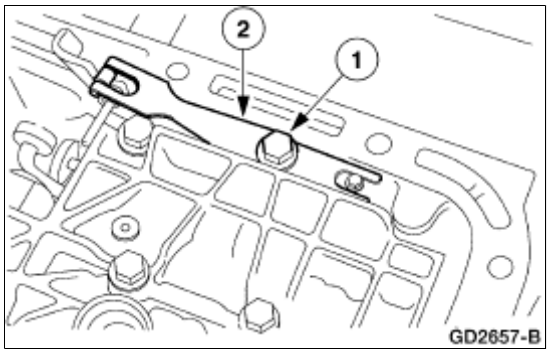


11. **CAUTION: Do not damage the connector or harness.**

    Remove the transmission case (16 pin) electrical connector.
    - Compress the tabs on the connector.
    - Push the connector out of the transmission case.

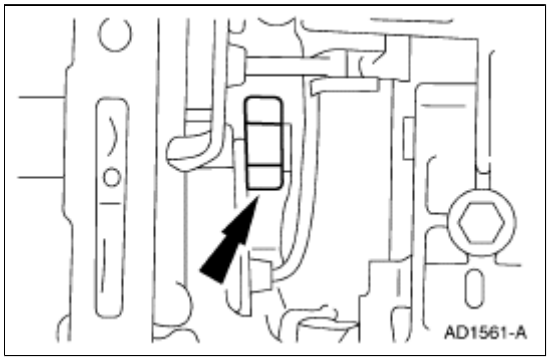


12. Remove the manual control valve detent lever spring.
    1. Remove the screw.
    2. Remove the spring.

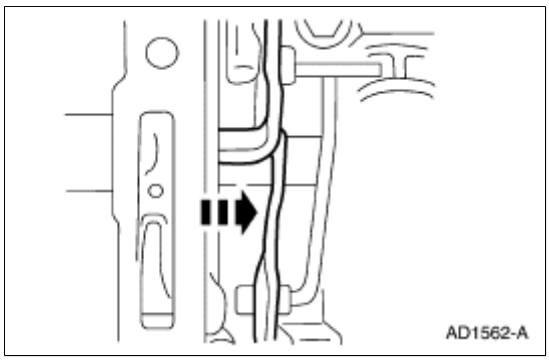


13. **CAUTION: To avoid damage, make sure the wrench does not strike the manual valve inner lever pin.**

    Remove the manual valve inner lever nut.

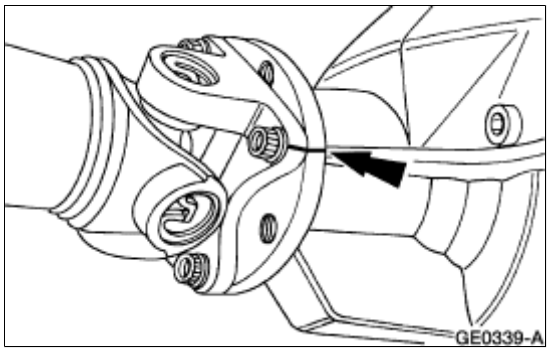


14. Remove the manual valve inner lever and parking lever actuating rod.

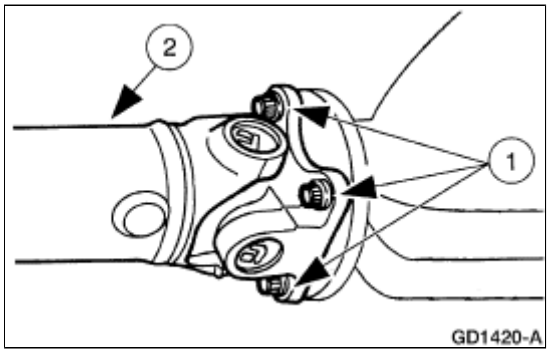


15. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they may be installed in their original alignment.

    Mark the rear driveshaft.



16. Remove the rear driveshaft.
    1. Remove the bolts.
    2. Remove the rear driveshaft.

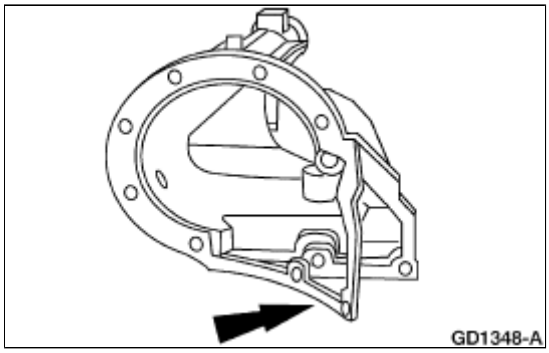


17. If equipped, remove the transfer case. For additional information, refer to Section 308-07B .

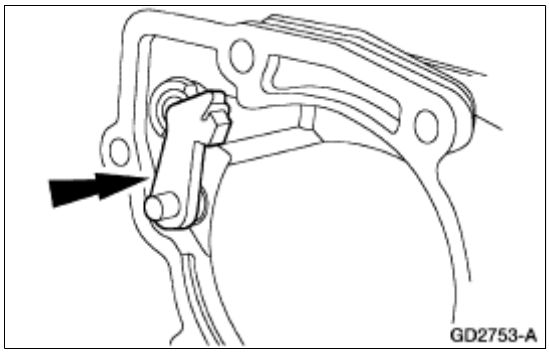
18. **NOTE:** If damage is found to the parking gear, the transmission must be removed and disassembled.

    NOTE: The parking pawl, parking pawl return spring and parking pawl shaft may fall out during removal of the extension housing.

    Remove the extension housing and discard the extension housing gasket.



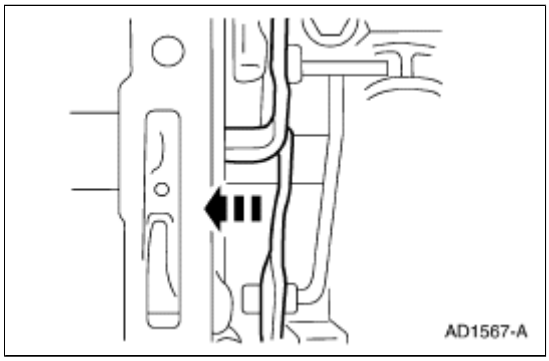
19. Inspect the parking pawl, parking pawl return spring and the parking pawl shaft.
    - Replace if required.



Installation

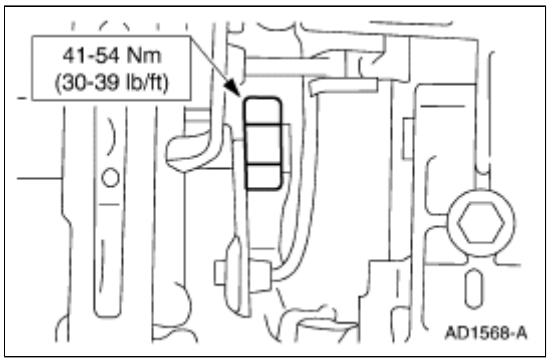
1. **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup. Verify that the output shaft is locked in the PARK position.**

   Align the flats of the manual valve inner lever with the flats on the manual control lever shaft. Install the manual valve inner lever and parking lever actuating rod onto the manual control lever shaft.

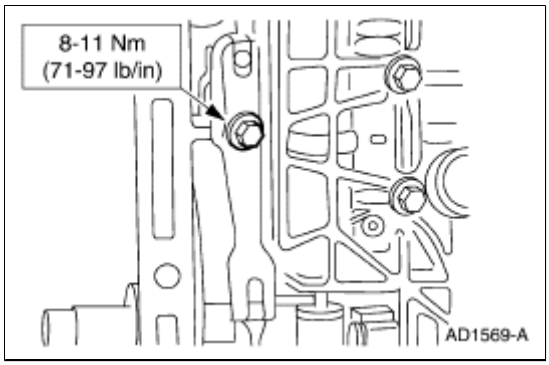


2. **CAUTION: Do not bend the manual valve inner lever pin.**

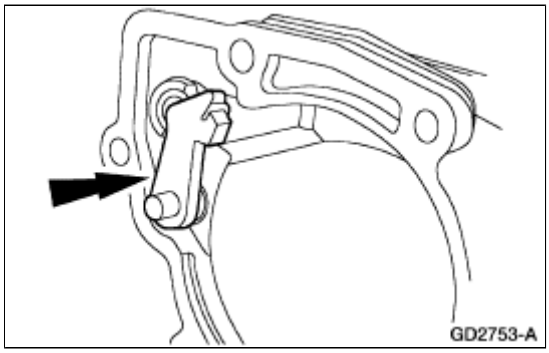
   Install the manual valve inner lever nut.



3. Install the manual valve detent spring.

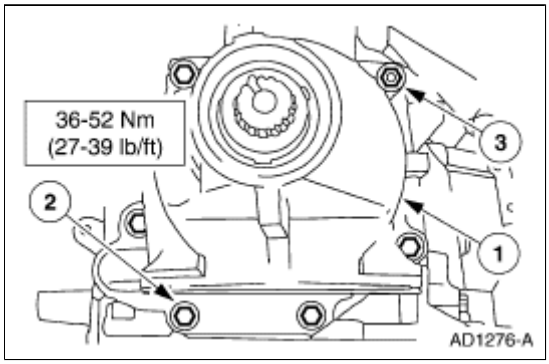


4. Clean the extension housing and install a new extension housing gasket. Make sure that the parking pawl, spring, and shaft is correctly installed.



5. **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup.**

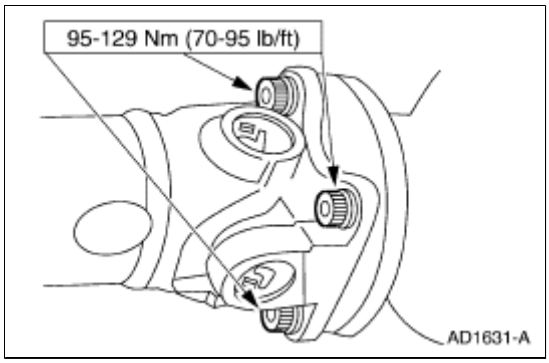
   Install the extension housing.
   1. Position the extension housing.
   2. Install the extension housing screws.
   3. Install the extension housing stud.



6. If equipped, install the transfer case.

7. **NOTE:** Align the drive shaft with the marks made during removal to ensure correct balance.

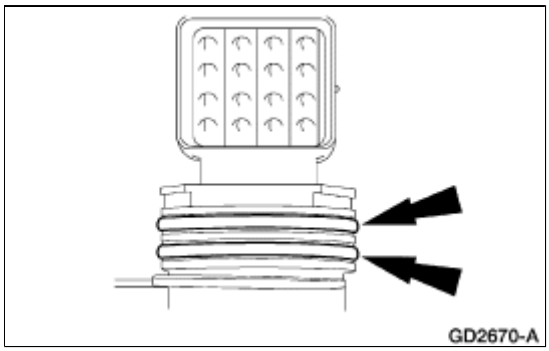
   Install the rear driveshaft bolts.



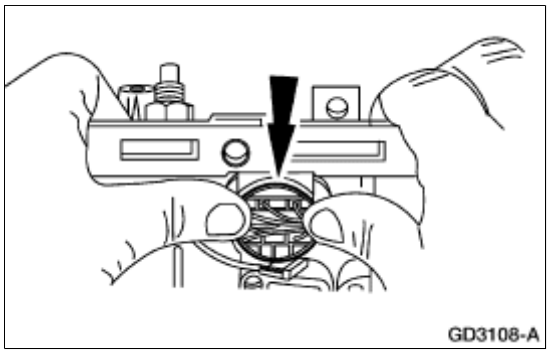
8. **NOTE:** Make sure the tab is in the lock position.

   NOTE: Install new O-rings on the transmission case (16 pin) electrical connector.

   Install the transmission case (16 pin) electrical connector.
   - Lubricate the transmission case (16 pin) electrical connector O-rings with petroleum jelly.

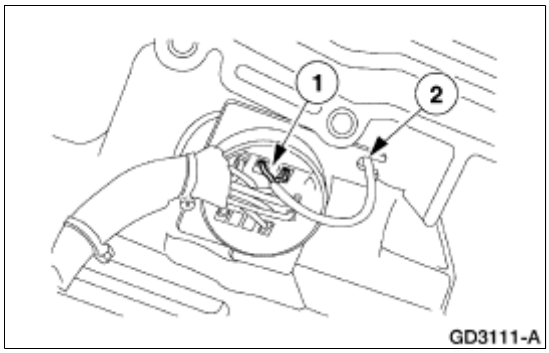


9. Press the transmission case (16 pin) electrical connector through the case until a click is heard.



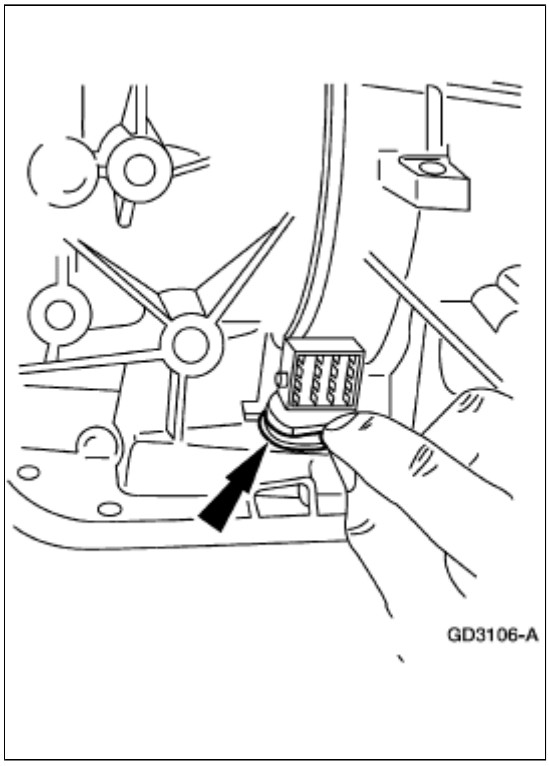
10. **CAUTION: Align the slot on the TSS sensor electrical connector with the slot in the 16 pin case connector.**

    Install the TSS sensor wire.
    1. Install the TSS sensor wire into (16 pin) electrical connector.
    2. Install the TSS sensor wire into locator.

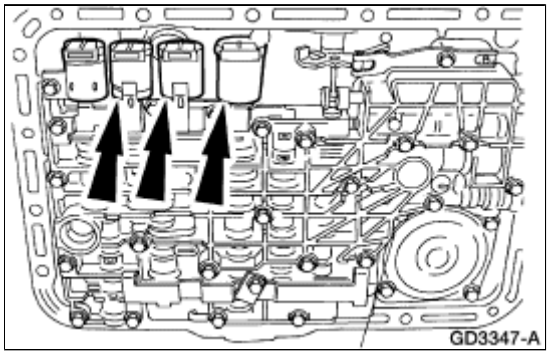


11. **CAUTION: Do not overstretch the retaining spring.**

    Install the transmission case (16 pin) electrical connector retaining spring.

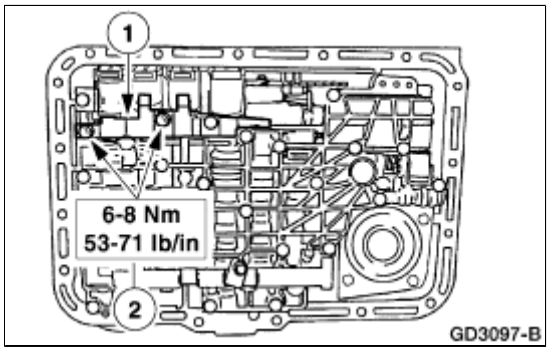


12. Install the EPC, SSD, and SSB solenoids.

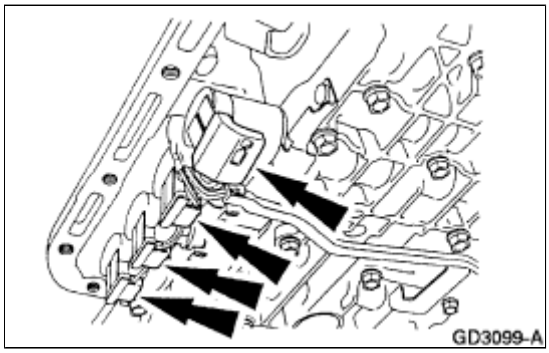


13. **CAUTION: The solenoid clamp must be installed in the TCC and EPC solenoid grooves, shift solenoid pockets and the No. 204 plug.**

Install the solenoid clamp.
1. Position the solenoid clamp on the main control valve body.
2. Install the solenoid clamp screws.

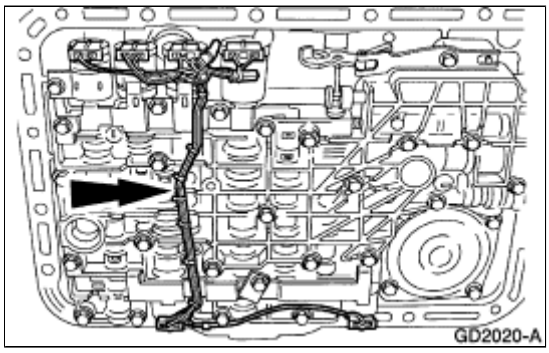


14. Connect the TCC, SSD, SSB, and EPC solenoid electrical connectors.



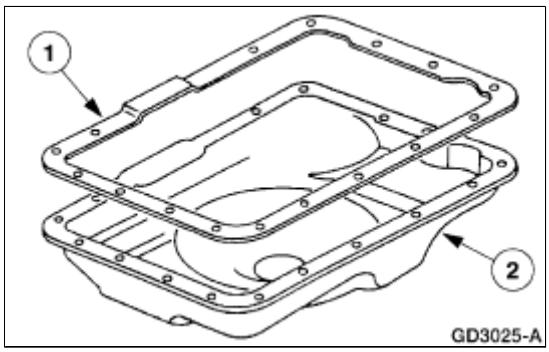
15. **CAUTION: Excessive pressure may break the retaining pins.**

Install the wire loom guide and protector.
- Align the retaining pins to the holes in the solenoid clamps and gently press in the wire loom guide and protector.

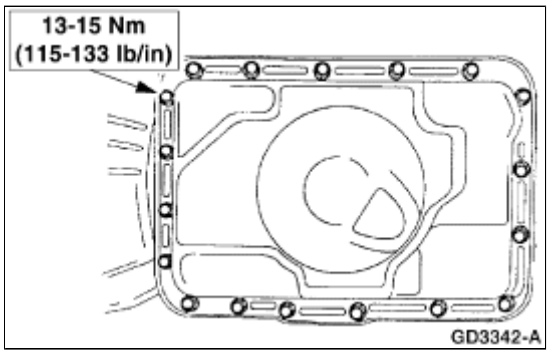


16. Install the transmission fluid pan.
    1. Install a new transmission fluid pan gasket on the transmission fluid pan.
    2. Install and align the transmission fluid pan.

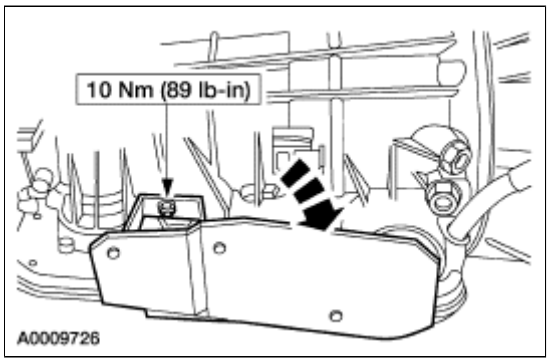
- Loosely install the transmission fluid pan screws.



17. Using a crisscross sequence, tighten the transmission fluid pan screws.



18. Position the servo heat shield over the servos and clip it to the pan rail.



19. Lower the vehicle.

20. Connect the battery ground cable.

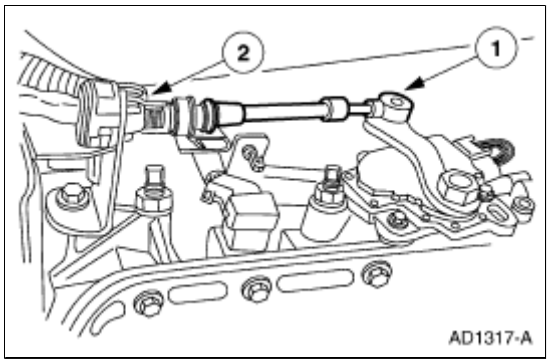
21. Fill transmission to proper fluid level and check for proper transmission operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

Front Band Adjustment

Special Tool(s)

ST1792-A	Band Adjuster Wrench Kit 307-S022 (T71P-77370-A)

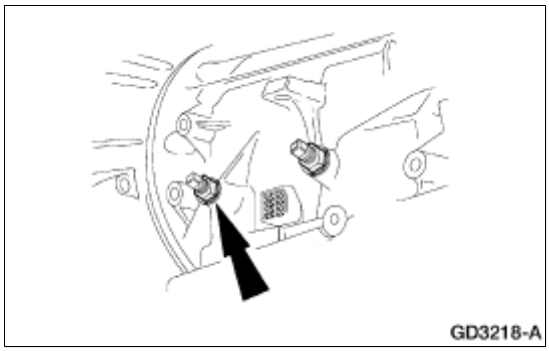
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
3. Disconnect the shift cable.
   1. Disconnect the shift cable from the manual control lever.
   2. Disconnect the shift cable from the bracket.



4. **CAUTION: Do not allow front band adjustment screw to back out. Band strut could fall out of position.**

   CAUTION: Throw the locknut away. The locknut is not reusable for assembly.

   Remove and discard the locknut.

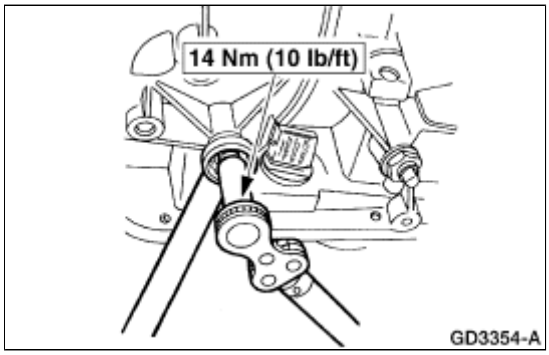


5. **CAUTION: Install, but do not tighten, a new locknut on the band adjustment screw. Apply petroleum jelly to the locknut seal.**

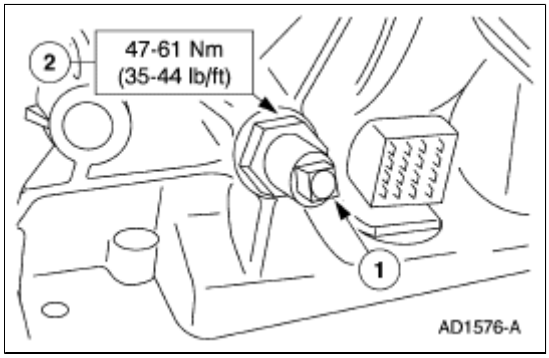
   CAUTION: The servo must be installed prior to band adjustment.

   NOTE: The wrench will click at the specified torque. Install new locknut, do not tighten at this time.

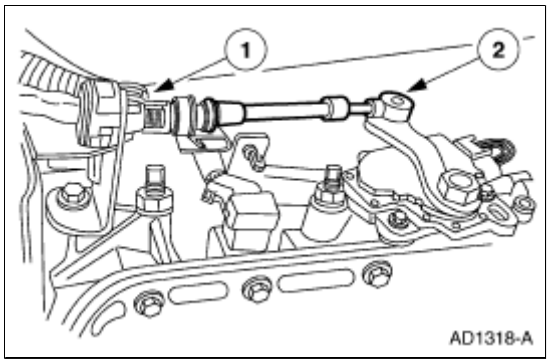
   Tighten front band adjustment screw using the Band Adjuster Wrench Kit and back off front band adjustment screw exactly two (2) turns and hold that position.



6. Tighten the front band locknut.
   1. Hold the front band adjustment screw stationary.
   2. Tighten the front band locknut.



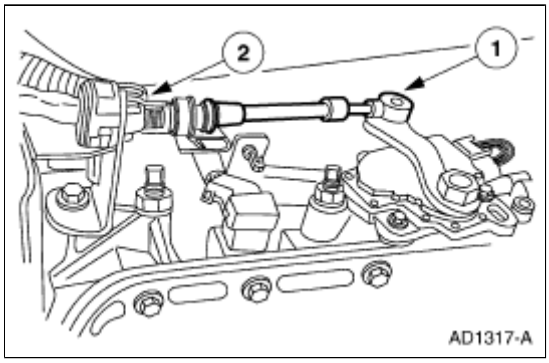
7. Install the shift cable.
   1. Install the shift cable.
   2. Install the shift cable to the manual control lever.



8. Lower the vehicle.

Intermediate Band Adjustment

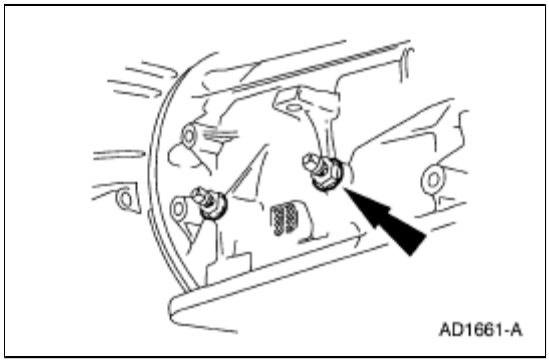
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the shift cable.
   1. Disconnect the shift cable from the manual control lever.
   2. Remove the shift cable from the bracket.



4. Remove the digital transmission range (TR) sensor. For additional information, refer to the Digital Transmission Range (TR) Sensor in this section.
5. **CAUTION: Do not allow the screw to back out. Band strut could fall out of position.**

   CAUTION: Throw the locknut away. The locknut is not reusable for assembly.

   Remove and discard the locknut.

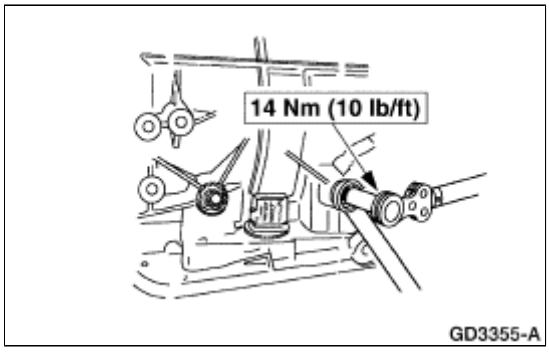


6. **CAUTION: Install, but do not tighten, a new locknut on the screw. Apply petroleum jelly to the locknut seal.**

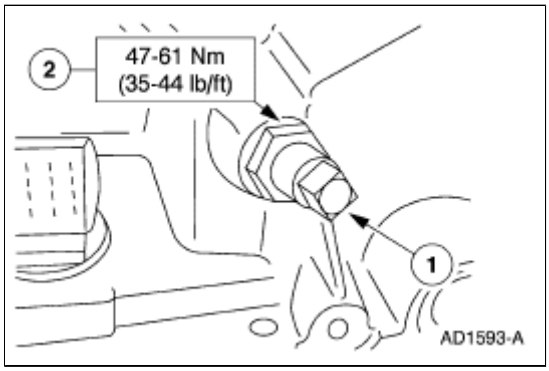
   CAUTION: The intermediate servo must be installed prior to band adjustment.

NOTE: The wrench will click at the specified torque. Install new locknut, do not tighten at this time.

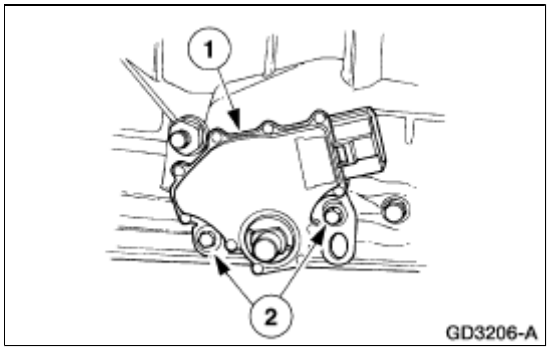
Tighten the screw using the Band Adjuster Wrench Kit and back off the screw exactly two (2) turns and hold that position.



7. Tighten the intermediate band locknut.
    1. Hold the screw stationary.
    2. Tighten the intermediate band locknut.



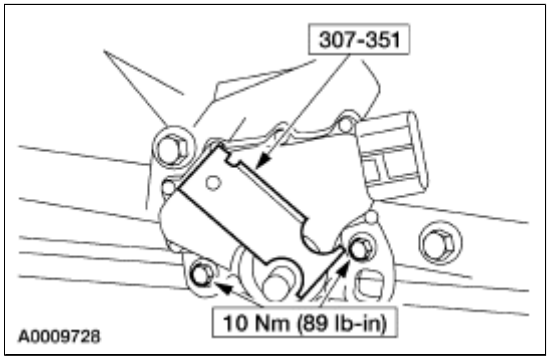
8. Install the digital TR sensor.
    1. Position the digital TR sensor.
    2. Loosely install the screws.



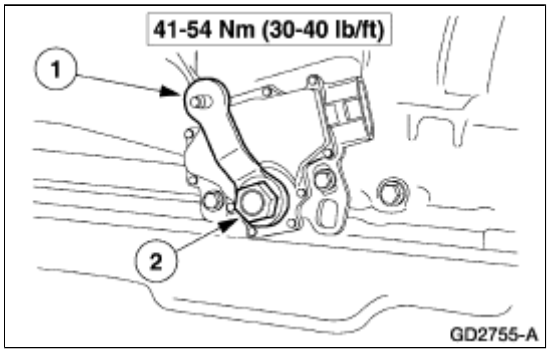
9. **CAUTION: Tightening one screw before tightening the other can cause the sensor to bind or become damaged.**

NOTE: The manual lever must be in the neutral position.

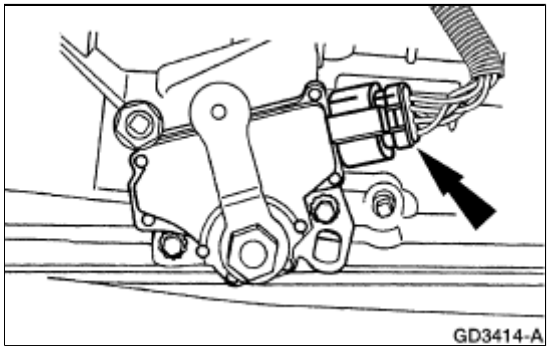
Using the special tool, align the digital TR sensor and tighten screws in an alternating sequence.



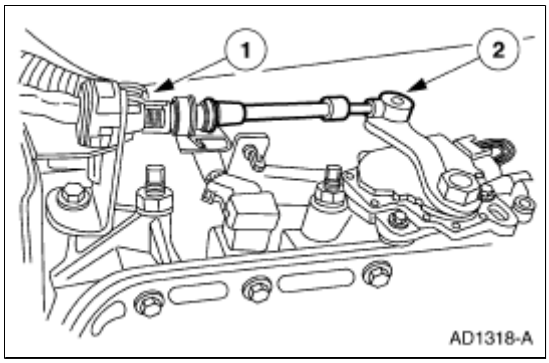
10. Install the manual control outer lever.
    1. Install the manual control outer lever.
    2. Install the manual control outer lever nut.



11. Connect the digital transmission range (TR) sensor electrical connector.



12. Connect the shift cable.
    1. Connect the shift cable to the bracket.
    2. Connect the shift cable to the manual control lever.

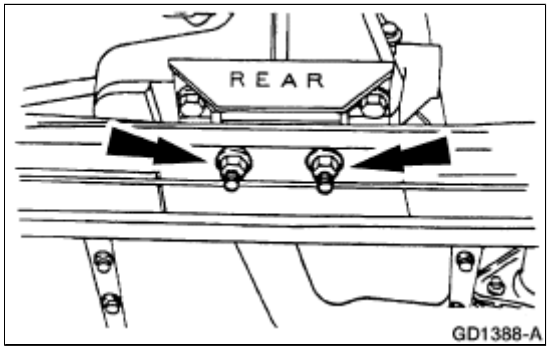


13. Verify that the shift cable is adjusted. For additional information, refer to Section 307-05 .
14. Lower the vehicle.
15. Connect the battery ground cable.

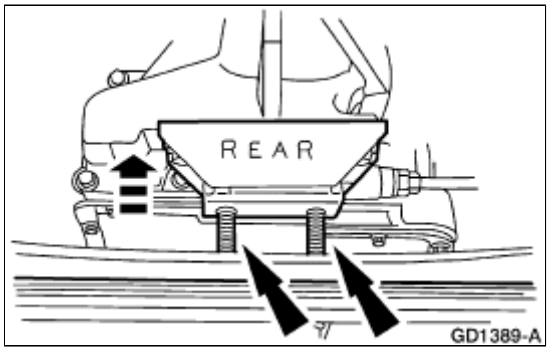
Transmission Insulator and Retainer

Removal

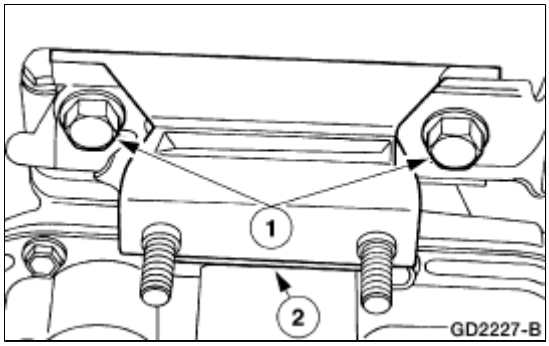
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the transmission mount nuts.



3. Raise and support the transmission.

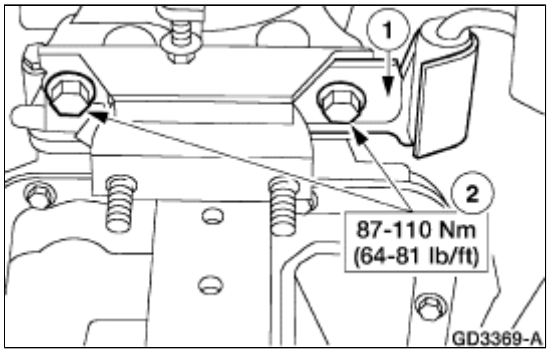


4. Remove the transmission mount.
    1. Remove the screws.
    2. Remove the transmission mount.

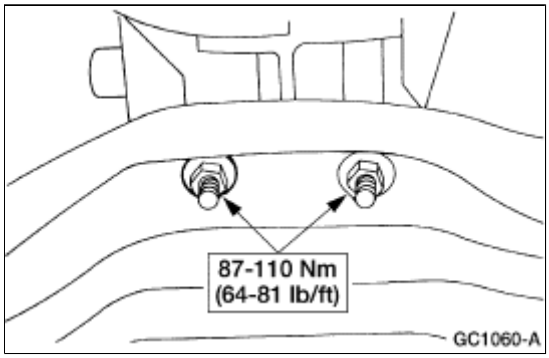


Installation

1. Install the transmission mount.
    1. Position the transmission mount on the extension housing.
    2. Install the transmission mount-to-extension housing screws.



2. Install the transmission mount into the crossmember and tighten the nuts.



3. Lower the vehicle.

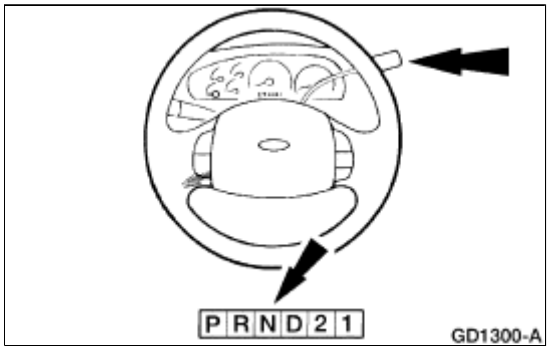
Transmission

Special Tool(s)

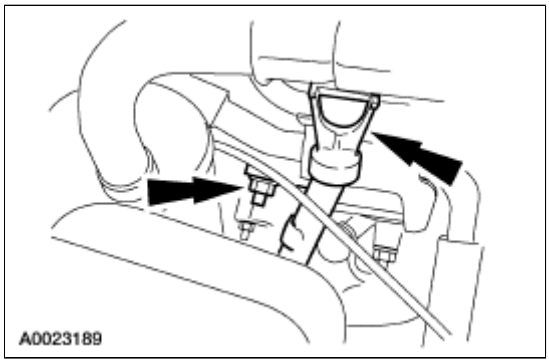
ST1636-A	Torque Converter Holding Tool 307-346 (T97T-7902-A)

NOTE: If the transmission is to be removed for a period of time, support the engine with a safety stand and a wood block.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Place the selector lever in NEUTRAL position.



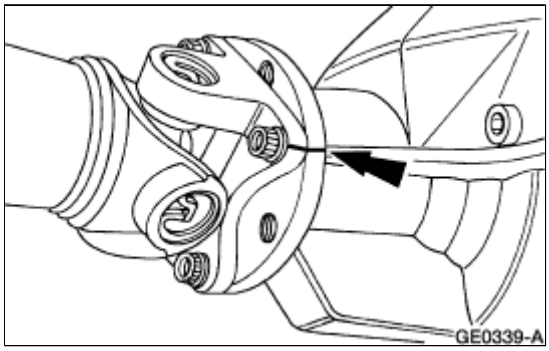
3. For vehicles equipped with a 4.0L SOHC engine, remove the nut and the transmission fill tube and indicator as an assembly.



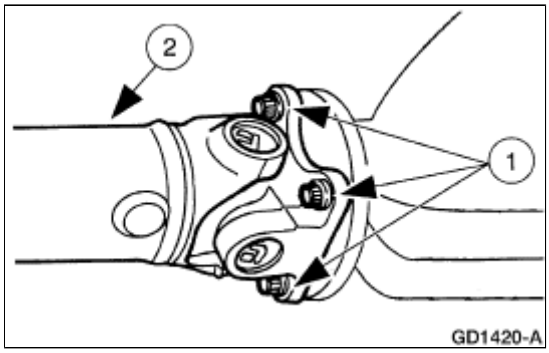
4. Raise and support the vehicle. For additional information, refer to Section 100-02 .
5. If transmission disassembly is required; drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

6. Vehicles equipped with 4WD, remove the transfer case. For additional information, refer to Section 308-07B .

7. To maintain initial driveshaft balance, mark the driveshaft yoke and axle flange, so they can be installed in their original positions.



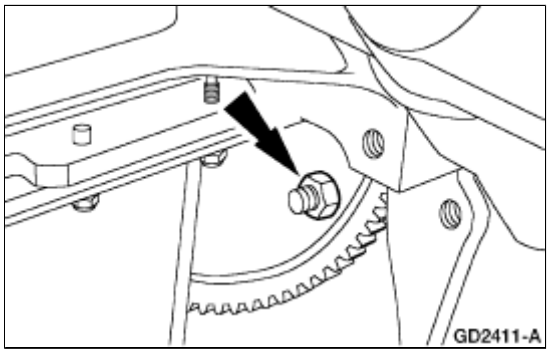
8. Remove the rear driveshaft.
    1. Remove the four bolts.
    2. Remove the driveshaft.



9. Remove the starter motor. For additional information, refer to Section 303-06 .

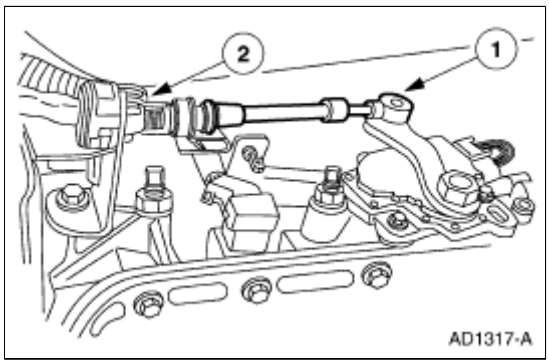
10. **NOTE:** Mark the torque converter and the flexplate for correct alignment at reinstallation.

    Remove the four nuts.
    - Rotate the crankshaft for access to the flexplate nuts.

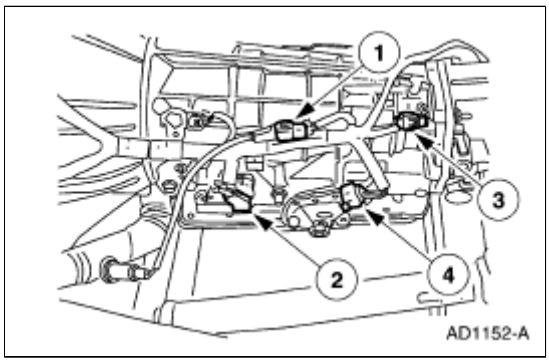


11. Disconnect the shift cable.
    1. Disconnect the shift cable from the manual control lever.

2. Disconnect the shift cable from the bracket.



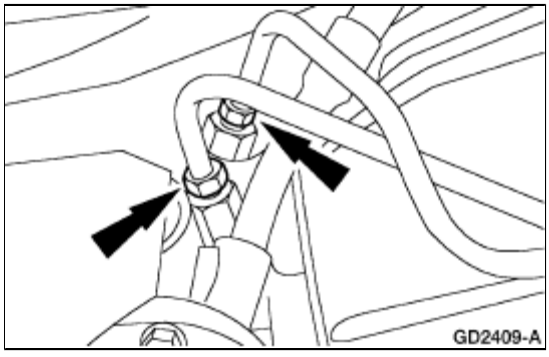
12. Remove the transmission wiring harness.
    1. Disconnect the heated oxygen sensor (HO2S) connector.
    2. Disconnect the transmission connector.
    3. Disconnect the output shaft speed (OSS) sensor connector.
    4. Disconnect the digital transmission range (TR) sensor connector.



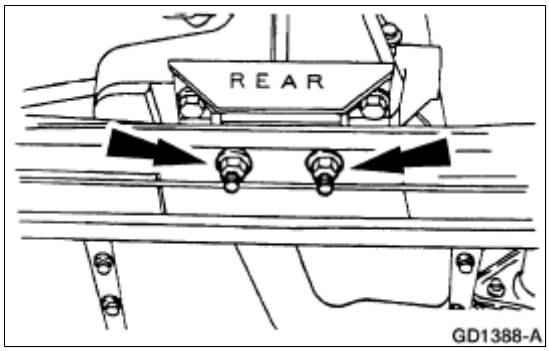
13. Remove the LH three-way catalytic converter. For additional information, refer to Section 309-00 .

14. **CAUTION: Care should be taken not to damage the cooler lines.**

    Hold the case fitting and remove the transmission cooler lines.

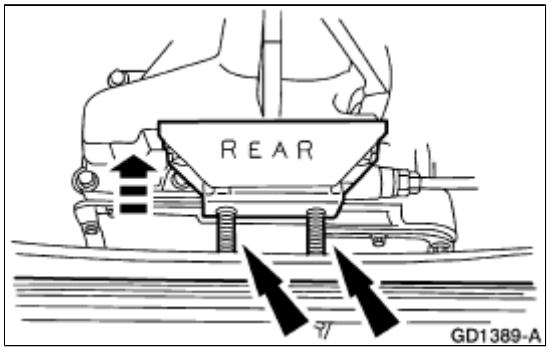


15. Remove the nuts.

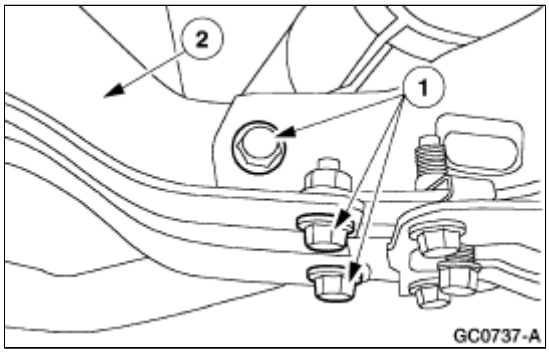


16. **CAUTION: Do not allow the transmission to hang freely.**

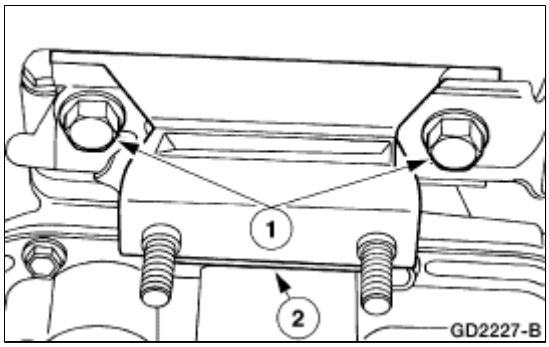
    Position the High-Lift Transmission Jack under the transmission.
    Raise and support the transmission.



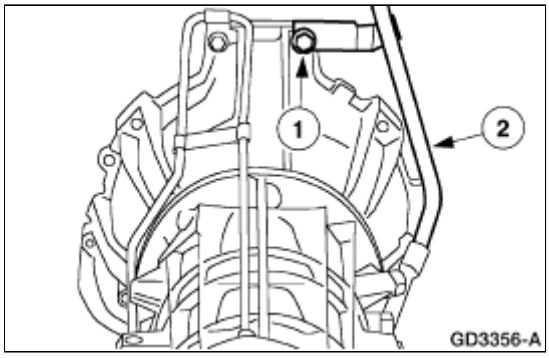
17. Remove the crossmember.
    1. Remove the six bolts (three each side).
    2. Remove the crossmember.



18. Remove the transmission mount.
    1. Remove the screws.
    2. Remove the transmission mount.

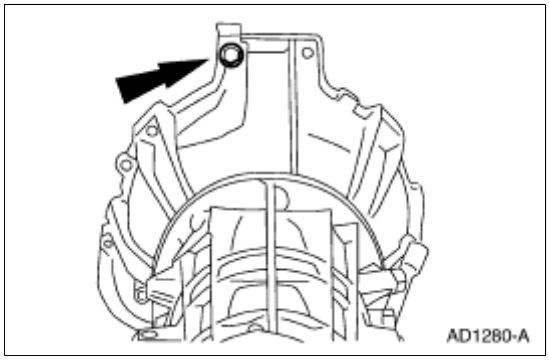


19. For vehicles equipped with a 4.0L EI engine, remove the upper filler tube.
    1. Remove the screw.
    2. Remove the upper filler tube.

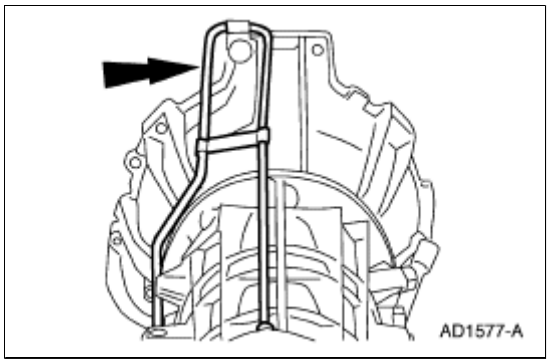


20. **NOTE:** Lower the High-Lift Jack to gain access to the screws.

    Remove the transmission-to-engine screws.

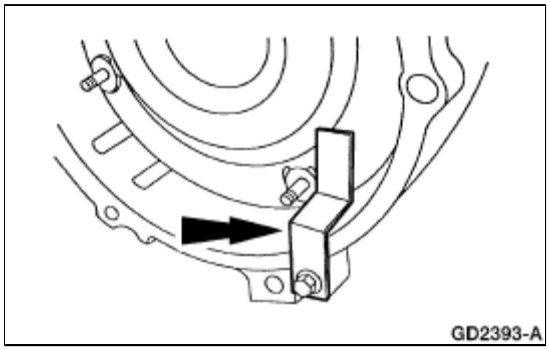


21. On 4x4 models remove the vent tube.



22. **WARNING: The torque converter is heavy and may result in injury if it falls out of the transmission. Secure the torque converter in the transmission. Failure to follow these instructions may result in personal injury.**

    Install the Torque Converter Holding Tool before lowering the transmission from the vehicle.



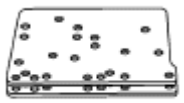
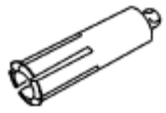
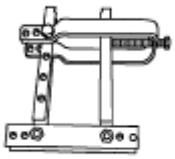
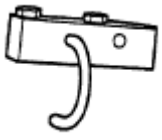
23. **WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions may result in personal injury.**

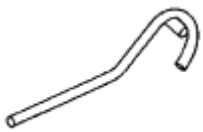
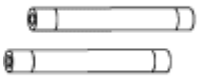
    Lower the transmission.

24. Carry out the Transmission Fluid Cooler Back Flushing/Cleaning. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Transmission

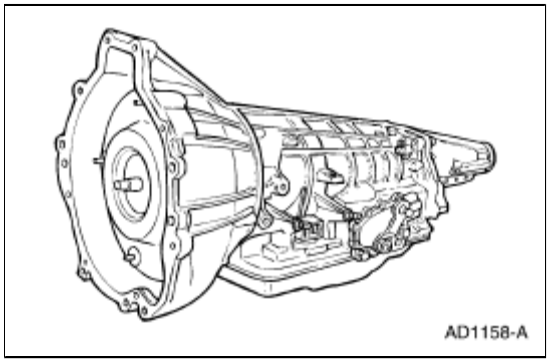
Special Tool(s)

 ST1637-B	Transmission Test Plate 307-342 (T95L-77000-AH)
ST1759-A	A4LD Holding Fixture Adapter 307-262 (T93T-77002-AH)
ST1186-A	Holding Fixture 307-003 (T57L-500-B)
	Housing Bushing Remover 308-070 (T77L-7697-E)
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1758-A	Seal Remover 307-309 (T94P-77001-BH)
 ST1760-A	Servo Cover Compressor 307-340 (T95L-77028-A)

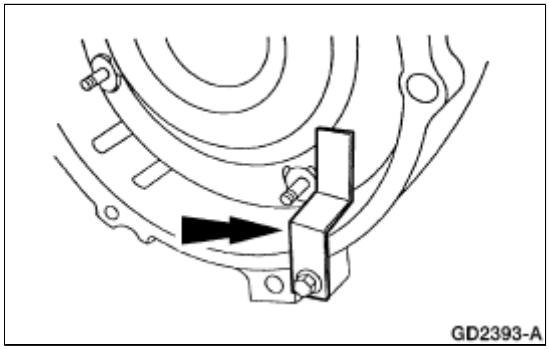
 ST1770-B	Servo Removal Tool 307-347 (T97T-7D021-A)
 ST1631-A	Torque Converter Handles 307-091 (T81P-7902-C)
ST1636-A	Torque Converter Holding Tool 307-346 (T97T-7902-A)

1. **WARNING: Do not remove the torque converter or the transfer case from the transmission while still on the jack, doing so could cause the transmission to fall. Failure to follow these instructions may result in personal injury.**

   Place the transmission on a workbench.

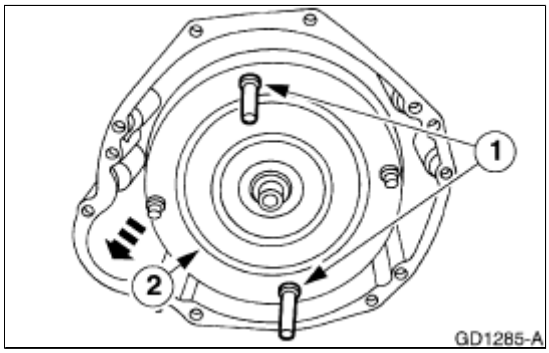

AD1158-A

2. Remove the Torque Converter Holding Tool.


GD2393-A

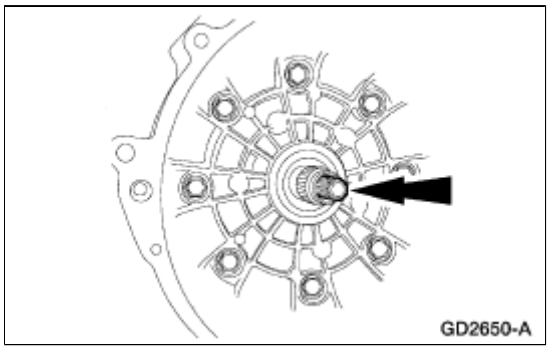
3. **WARNING: The torque converter is heavy, especially when full of fluid. Failure to follow these instructions may result in personal injury.**

   Using Torque Converter Handles, remove the torque converter.
   1. Install the Torque Converter Handles.
   2. Remove the torque converter.

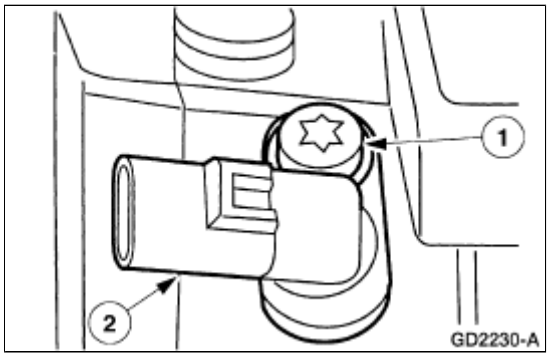


4. **NOTE:** The splines on the input shaft are not the same on both ends. The end with the shorter spline goes into the assembly.

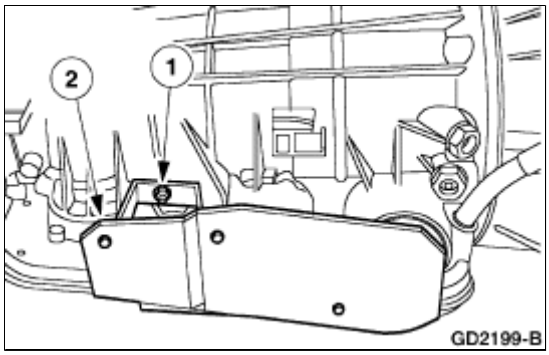
   Remove the input shaft.



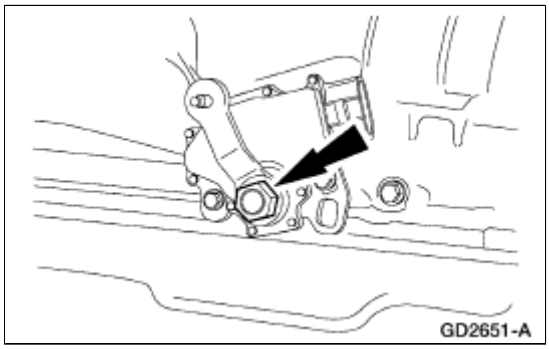
5. Remove output shaft speed (OSS) sensor.
   1. Remove the OSS screw.
   2. Remove OSS sensor.



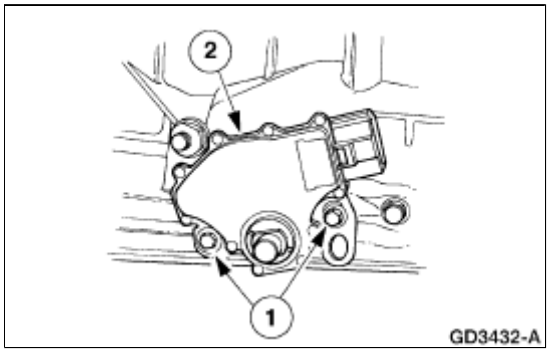
6. Remove transmission servo heat shield.
   1. Remove the nut.
   2. Remove the transmission servo heat shield.



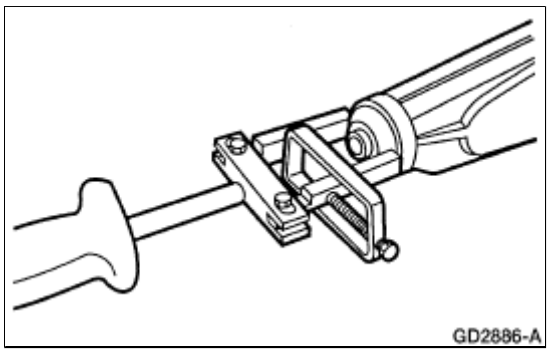
7. Remove manual control outer lever nut and manual control outer lever.



8. Remove the digital transmission range (TR) sensor.
    1. Remove the screws.
    2. Remove the digital TR sensor.

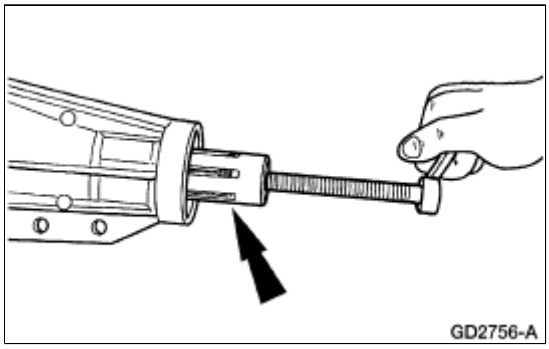


9. Use Seal Remover and Impact Slide Hammer and remove extension housing seal.



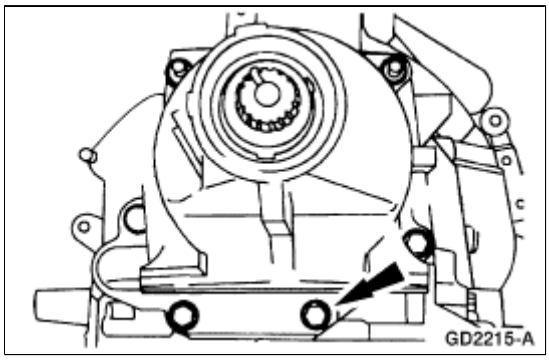
10. **NOTE:** Remove the extension housing bushing only if service is required.

    Use the Housing Bushing Remover to remove the extension housing bushing.
    - Inspect the extension housing bushing and driveshaft slip-yoke for nicks, gauges, scoring, and wear.

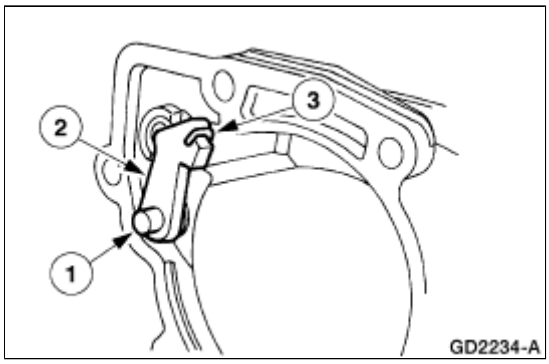


11. **CAUTION: The parking pawl, parking pawl return spring and parking pawl shaft could fall out during removal of the extension housing.**

    Remove the screws, studs, and the extension housing.
    - Discard the extension housing gasket.



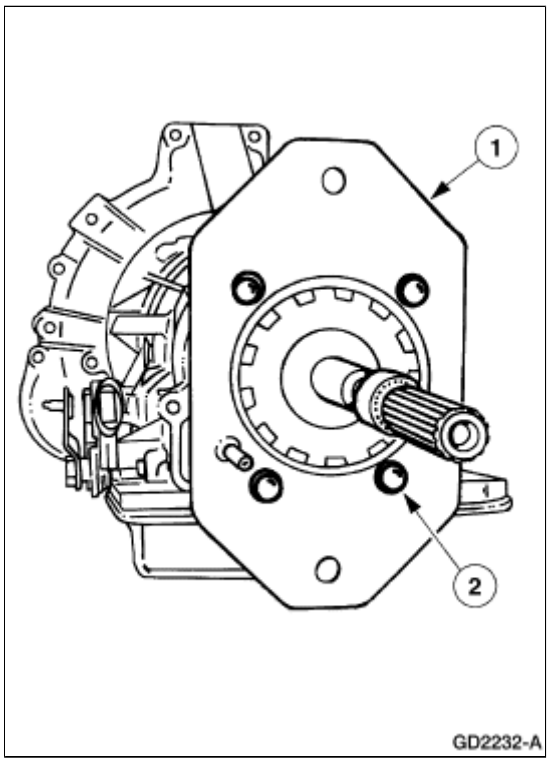
12. Remove the parking pawl assembly.
    1. Remove the parking pawl shaft.
    2. Remove the parking pawl.
    3. Remove the parking pawl return spring.



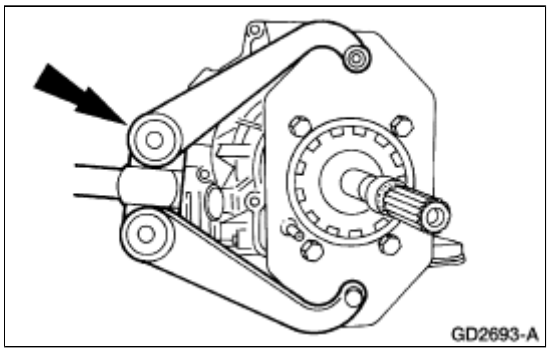
13. **CAUTION: The parking pawl actuating rod must slip freely into the clearance hole in the adapter plate.**

    NOTE: See the special service tool chart for a drawing of this optional adapter plate.

    Install the A4LD Holding Fixture Adapter.
    1. Position the A4LD Holding Fixture Adapter on the rear of the transmission case.
    2. Install the screws.

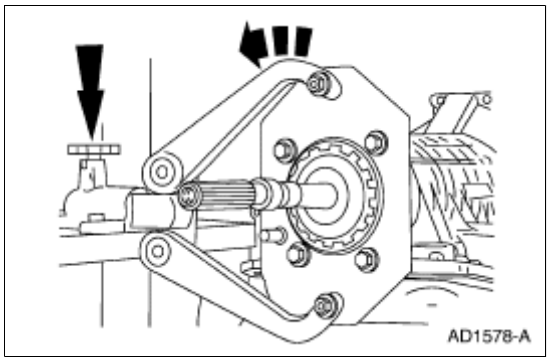


14. Attach the fixture arm of Holding Fixture to the A4LD Holding Fixture Adapter.



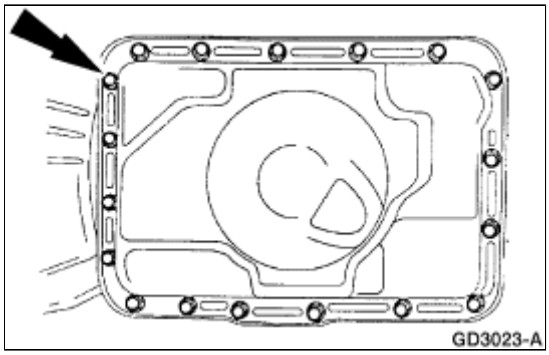
15. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

    Install the transmission into the Holding Fixture. Rotate transmission so fluid pan is facing up.

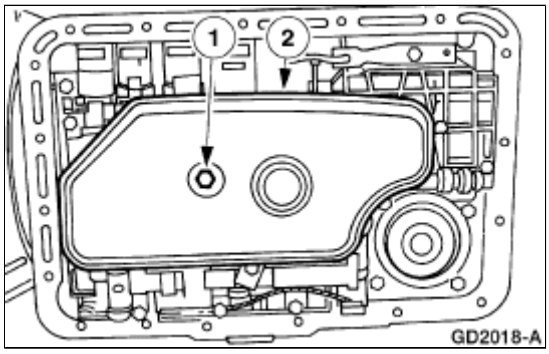


16. **CAUTION: Do not reuse the fluid pan gasket.**

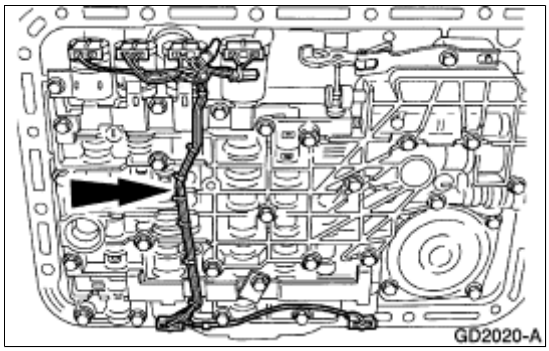
    Remove the transmission fluid pan and transmission pan gasket and then discard gasket.



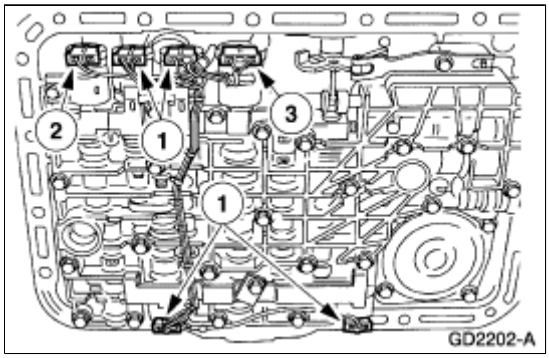
17. Remove the transmission fluid filter and discard.
    1. Remove the screw.
    2. Remove the transmission fluid filter.



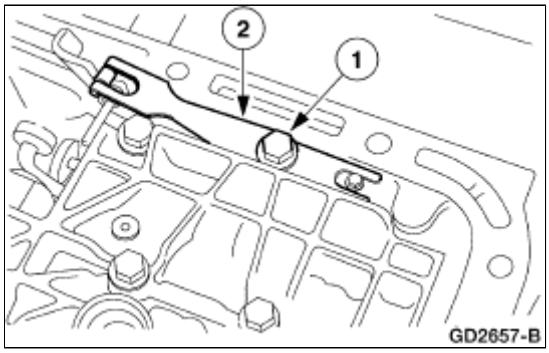
18. Carefully lift up on the wire loom guide and protector. Disengage the retaining pins from the solenoid clamps.



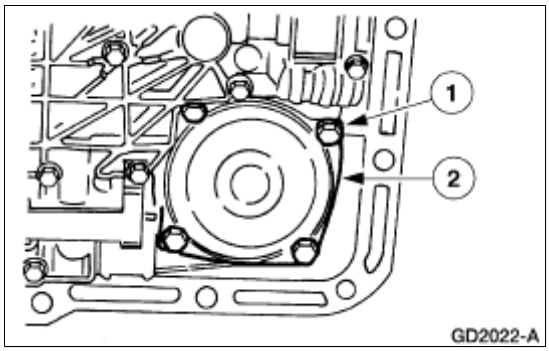
19. Disconnect the solenoid electrical connectors.
    1. Disconnect the SSA, SSB, SSC, and the SSD electrical connectors.
    2. Disconnect the torque converter clutch (TCC) solenoid electrical connector.
    3. Disconnect the electronic pressure control (EPC) solenoid electrical connector.



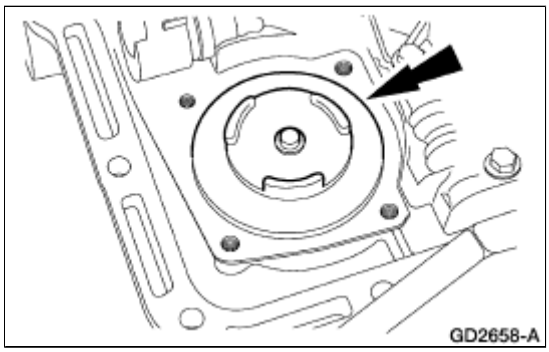
20. Remove the manual control valve detent lever spring.
    1. Remove the screw.
    2. Remove the manual control valve detent lever spring.



21. Remove the low/ reverse band servo cover.
    1. Remove the screws.
    2. Remove the low/reverse band servo cover and the low/ reverse servo separator plate cover gasket.
       - Discard the low/reverse servo separator plate cover gasket.

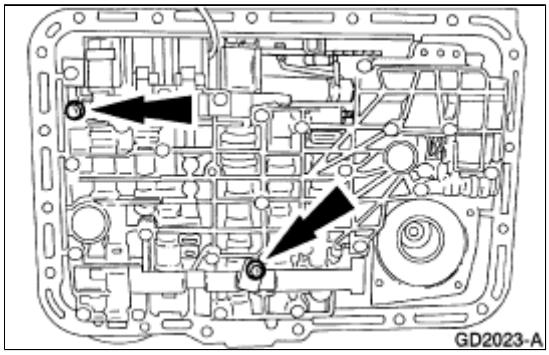


22. Remove the low/reverse band servo piston and rod assembly.

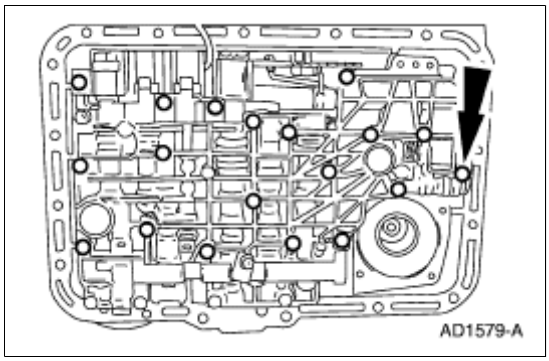


23. **CAUTION: To prevent solenoid valves from falling out, do not remove the two screws shown below.**

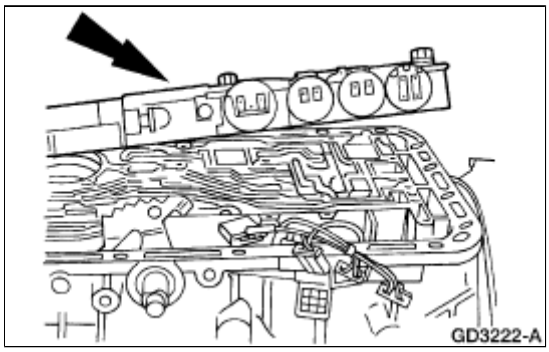
    Do not remove the two (gold colored) screws specified.



24. Remove the twenty-three body screws.

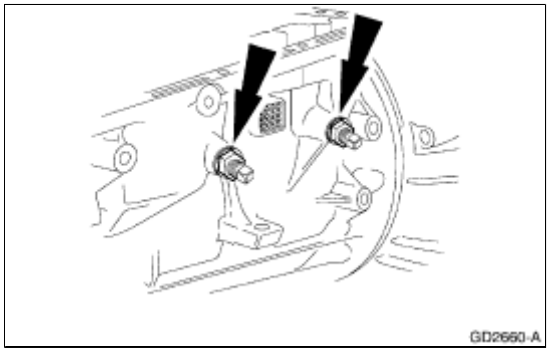


25. Remove the main control valve body, valve body separator plate and main control to separator plate gasket.
    - Discard gaskets.



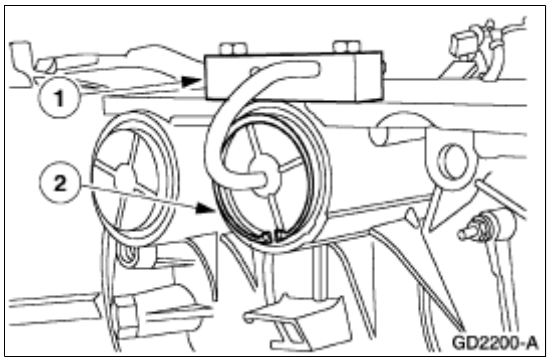
26. **CAUTION: Throw the locknuts away. The locknuts are not reusable for assembly.**

    Remove the locknuts. Back off the screws.



27. **CAUTION: Servo cover is under spring tension.**

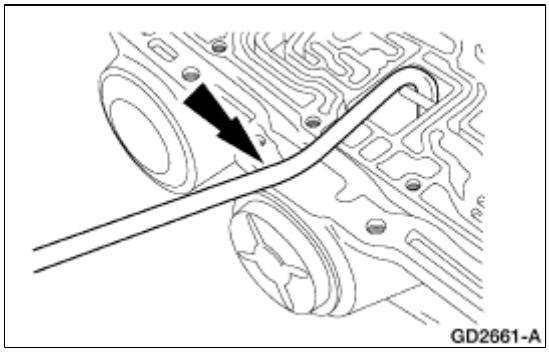
    Remove the intermediate servo cover retaining ring.
    1. Install Servo Cover Compressor and compress the intermediate servo cover.
    2. Remove the intermediate servo cover retaining ring.
    - Remove Servo Cover Compressor.



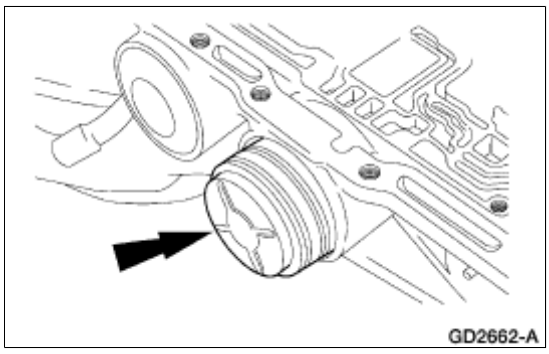
28. **NOTE:** Tag the servo cover, piston and spring. Label accordingly for assembly. The covers have letters cast on the outer surface for identification.

    NOTE: Use Servo Removal Tool to prevent damage to the servo, cover and bore.

    Use Servo Removal Tool to release the intermediate band servo piston.

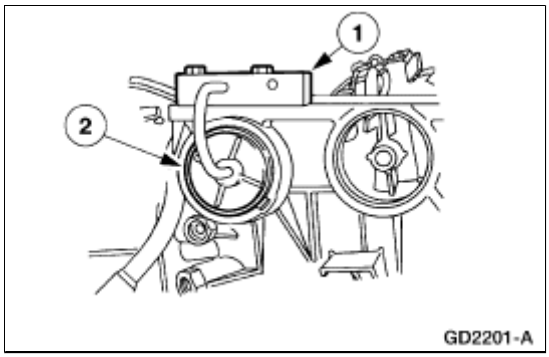


29. Remove the intermediate band servo cover, piston and spring.



30. **CAUTION: Servo cover is under spring tension.**

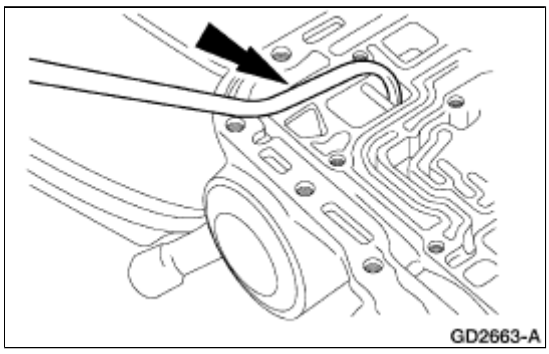
    Remove the overdrive servo cover.
    1. Install Servo Cover Compressor and compress the overdrive servo cover.
    2. Remove the overdrive servo cover retaining ring.
       - Remove Servo Cover Compressor.



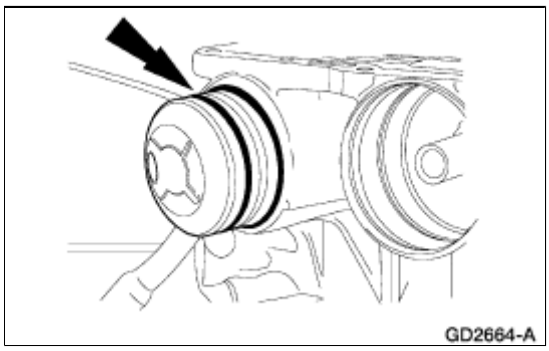
31. **NOTE:** Tag the servo cover, piston and servo piston spring. Label accordingly for assembly. The covers have letters cast on the outer surface for identification.

    NOTE: Use the Servo Removal Tool to prevent damage to the servo piston and bore.

    Use Servo Removal Tool to release the overdrive band servo piston.



32. Remove the overdrive band servo cover, piston and spring.

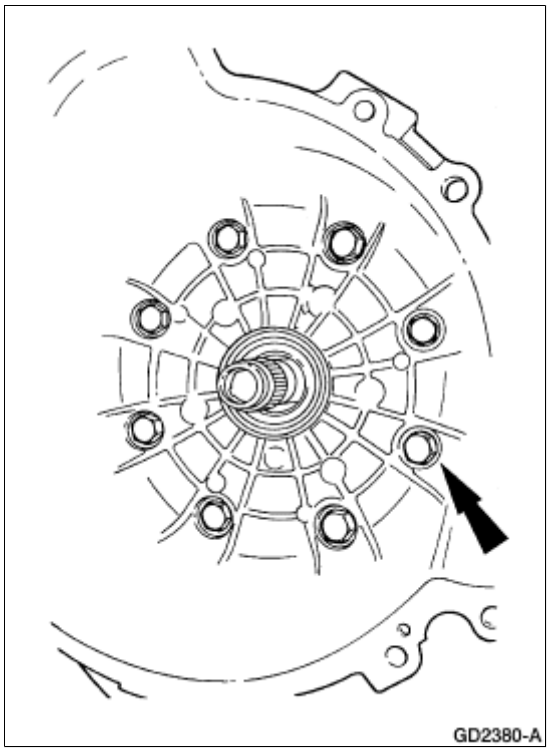


33. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

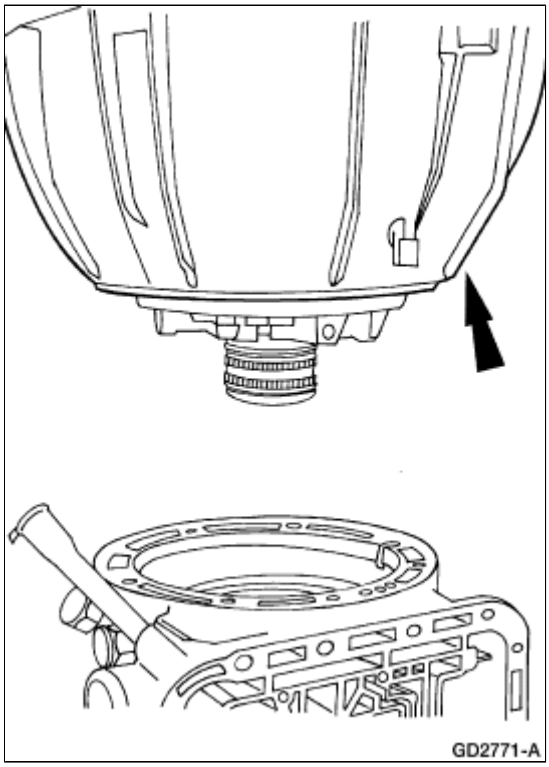
    Rotate the transmission so the converter housing faces up.

34. **CAUTION: Discard the screws. The screws are not reusable for assembly.**

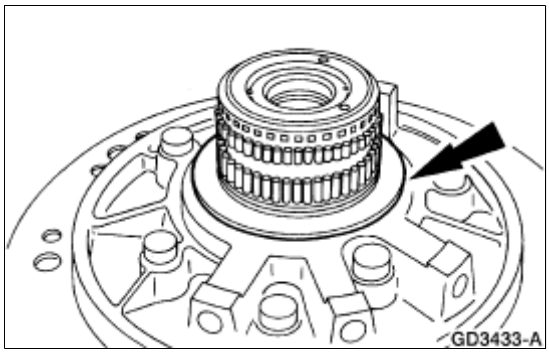
    Remove and discard the screws.



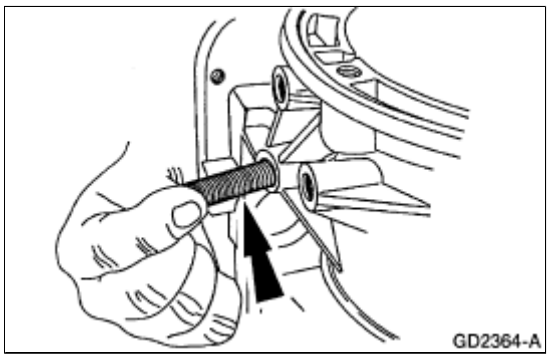
35. Remove the converter housing and fluid pump support.
    - Turn and lift the converter housing and fluid pump support from the case.



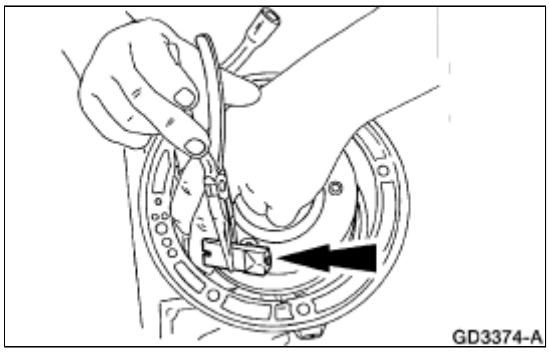
36. Remove the fluid pump input thrust washer (No. 1).
    - Tag and identify the thrust washer.



37. Remove the front band adjusting screw.

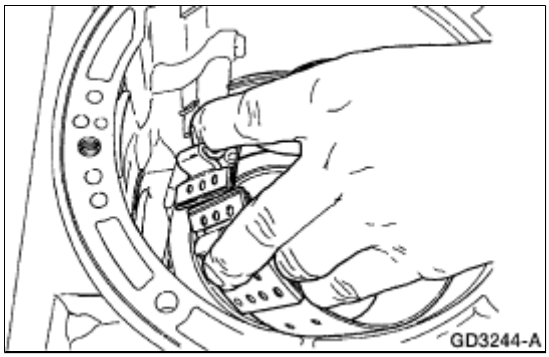


38. Compress the front band around the front brake and coast clutch drum and remove the front band anchor strut.

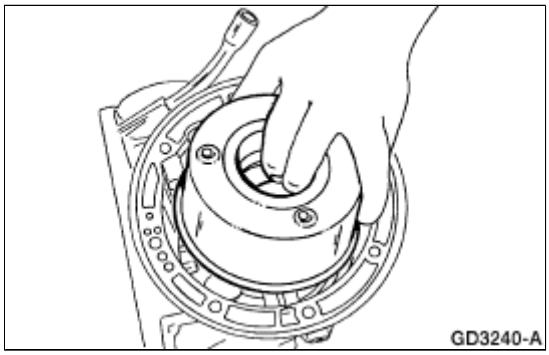


39. **CAUTION: Identify the anchor and apply ends of the front band.**

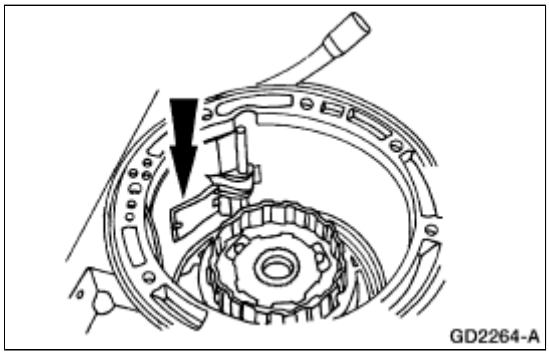
Remove the front band.



40. Remove the front brake and coast clutch drum.

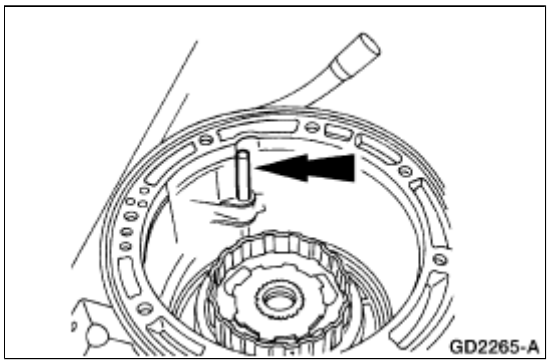


41. Remove the front band apply strut.



42. **NOTE:** The front band lever shaft is longer than the intermediate band lever shaft.

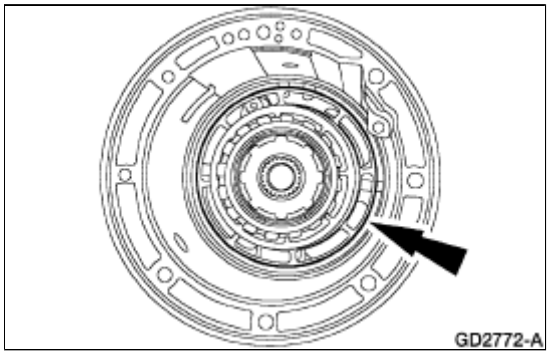
    Remove the front band actuating lever shaft.



43. **CAUTION: Do not bend trigger wheel.**

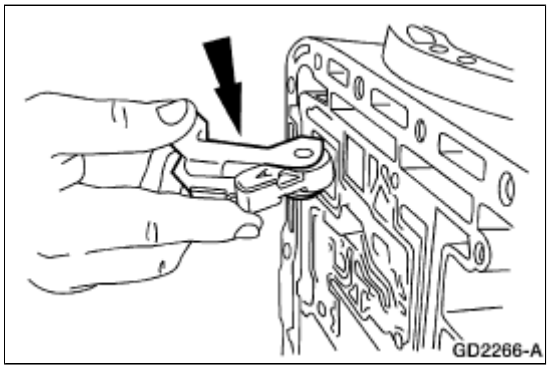
    NOTE: The No. 2 thrust bearing is in this assembly.

    Remove the planetary gear front carrier.

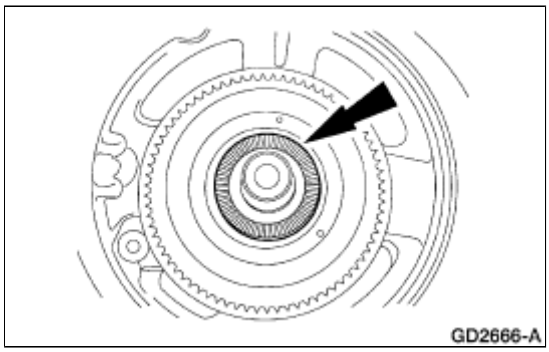


44. **NOTE:** Tag and identify the front band servo lever. The front band servo lever has a letter stamped on the side.

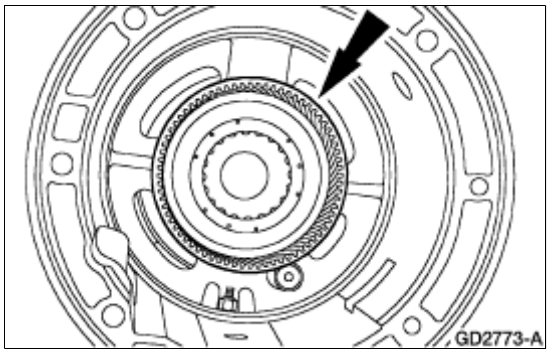
    Remove the front band servo lever and front band lever to case bracket.



45. Remove the front planet thrust bearing (No. 2).

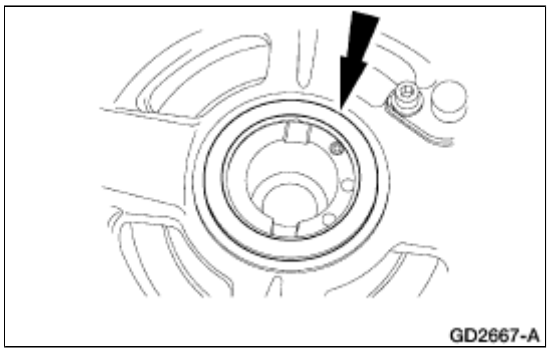


46. Remove the front ring gear, front one-way clutch assembly, and center shaft as an assembly.



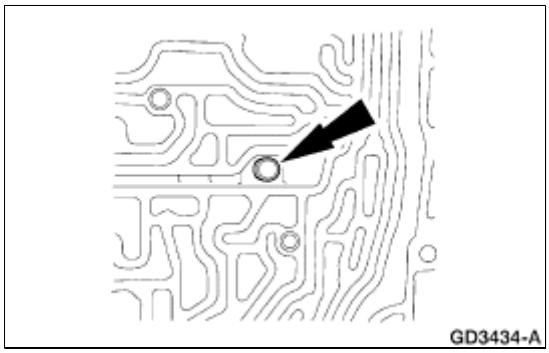
47. **NOTE:** Tag and identify the center shaft thrust bearing (No. 3) for assembly.

    Remove the No. 3 center shaft thrust bearing.

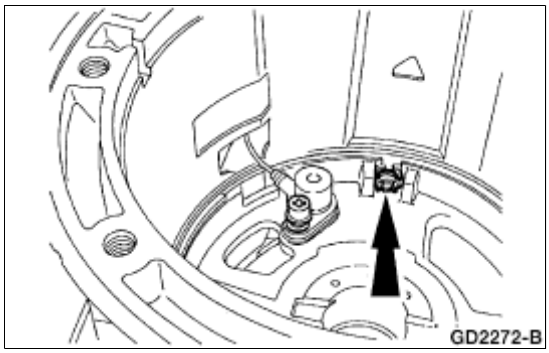


48. **CAUTION: The center support locknut could fall into the remaining assembly if not removed.**

    Remove the center support cap screw.



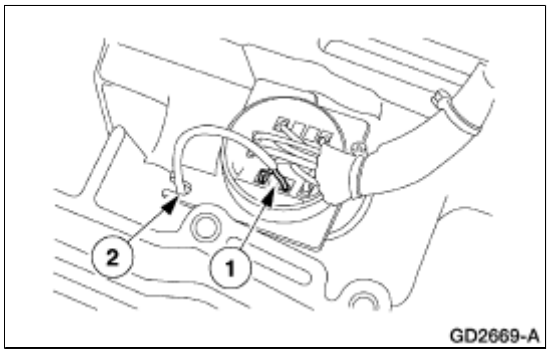
49. Remove the locknut and cage.



50. **CAUTION: Do not pry on other wires or damage the connector or case surface.**

Disconnect the turbine shaft speed (TSS) sensor electrical connector.

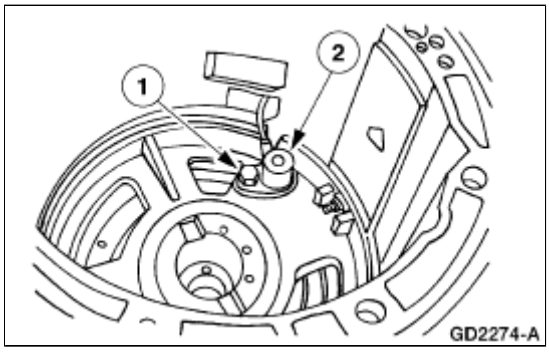
1. Remove the TSS sensor electrical connector from the transmission case (16 pin) electrical connector.
2. Remove the TSS sensor connector wires from wire locator.



51. **CAUTION: Carefully route the TSS connector and wiring into the transmission through the opening in the case.**

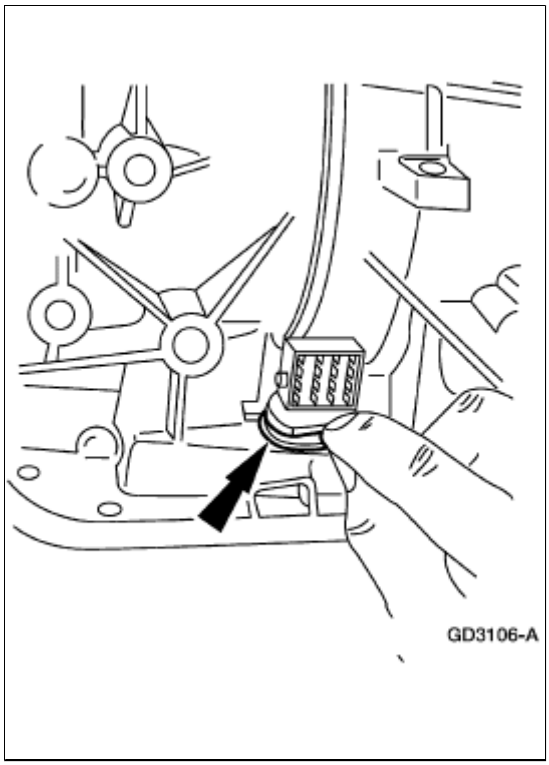
Remove the TSS sensor.

1. Remove the screw.
2. Remove the TSS sensor.



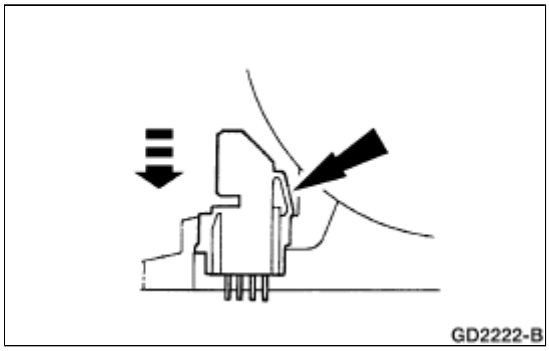
52. **CAUTION: Do not overstretch the retaining spring.**

Remove the transmission case (16 pin) electrical connector retaining spring.

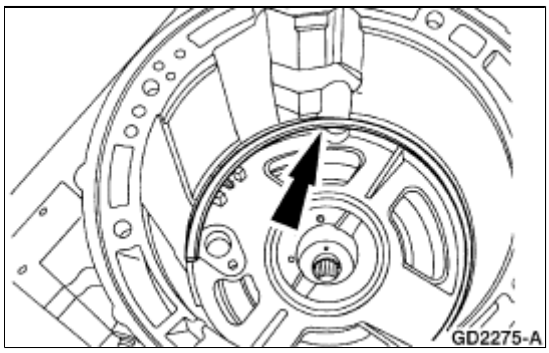


53. **CAUTION: Do not damage the connector or harness.**

Compress the tabs on the transmission case (16 pin) electrical connector.
Push the transmission case (16 pin) electrical connector out of transmission case.

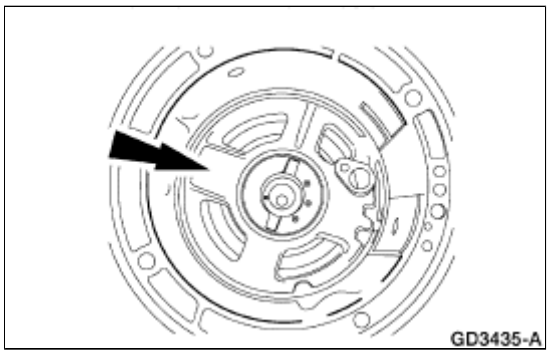


54. Remove the center support retaining ring.



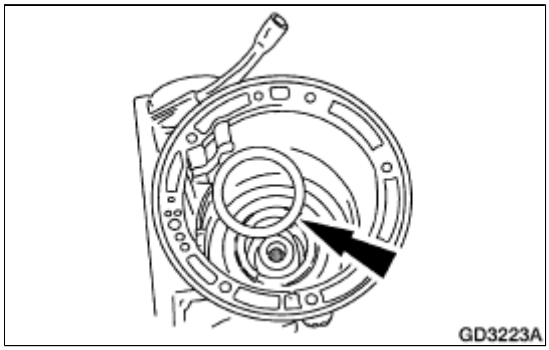
55. **NOTE:** When removing the center support, pull evenly around the center support web.

    Remove the center support.

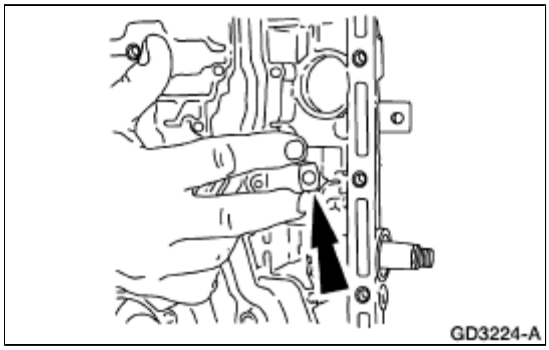


56. **NOTE:** Tag and identify the No. 4 intermediate brake drum thrust bearing.

    Remove the intermediate brake drum thrust bearing (No. 4).

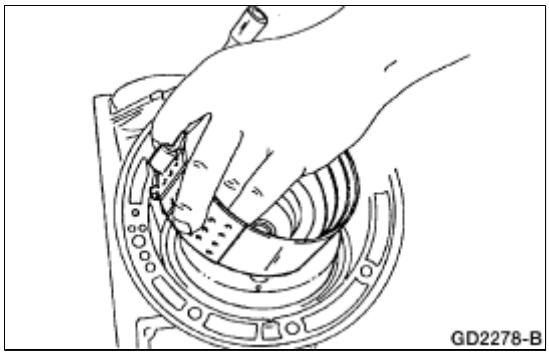


57. Remove the intermediate band anchor strut and adjusting screw.

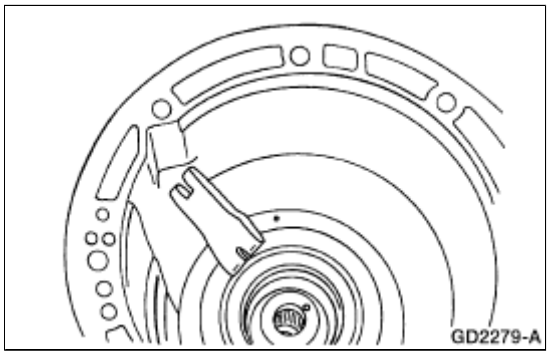


58. **CAUTION: Identify the anchor and apply ends of the intermediate band.**

    Remove the intermediate band.

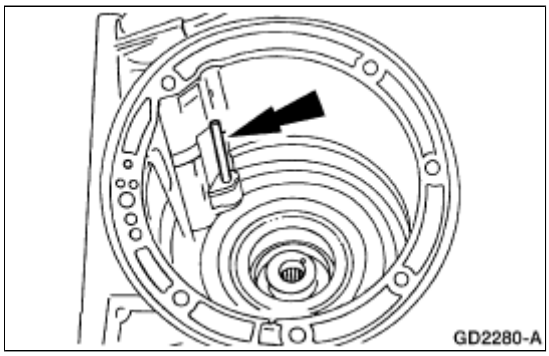


59. Remove the intermediate band apply strut.



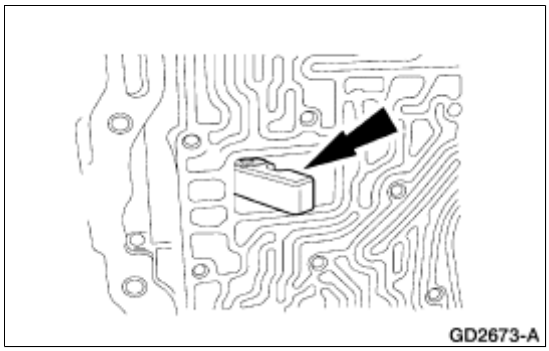
60. **NOTE:** The intermediate band lever shaft is shorter than the front band lever shaft.

    Remove the intermediate band actuating lever shaft.



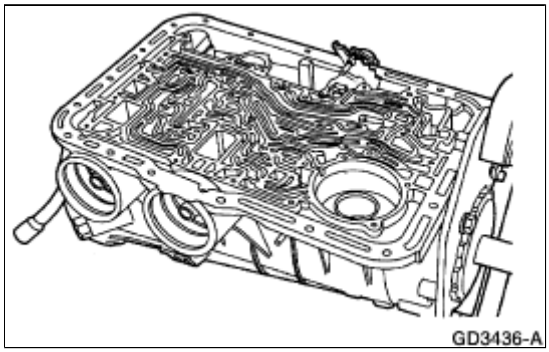
61. **NOTE:** Tag and identify the intermediate servo band lever. The intermediate servo band lever has a letter stamped into its side.

    Remove the intermediate servo actuating lever.



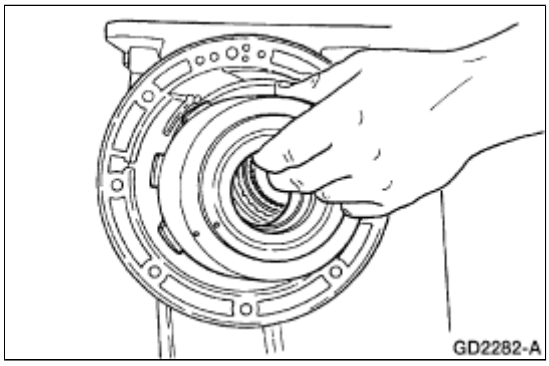
62. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

    Rotate the transmission so the transmission fluid pan surface is facing up.

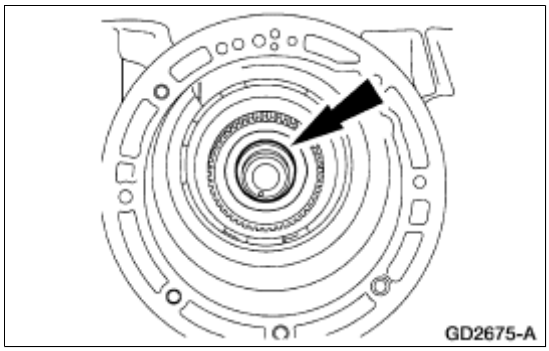


63. **NOTE:** The forward clutch cylinder thrust bearing (No. 5) may come out with the intermediate brake and direct clutch drum.

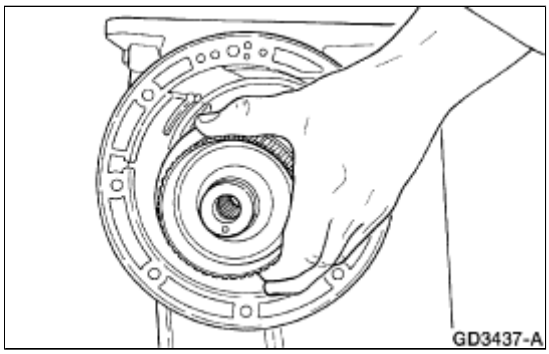
    Remove the intermediate brake and direct clutch drum.



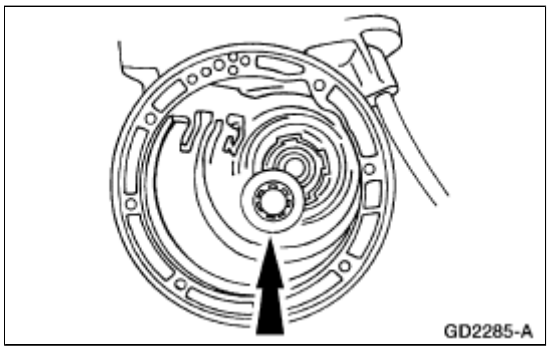
64. Remove the forward clutch cylinder thrust bearing (No. 5); tag and identify.



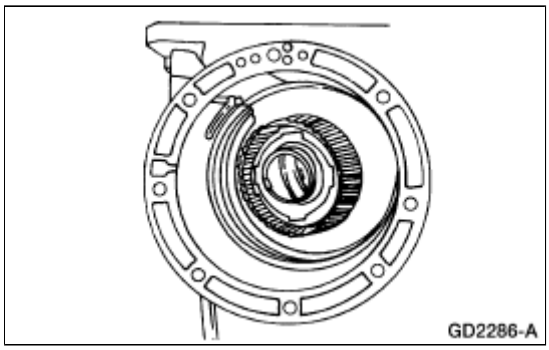
65. Remove the forward clutch cylinder.



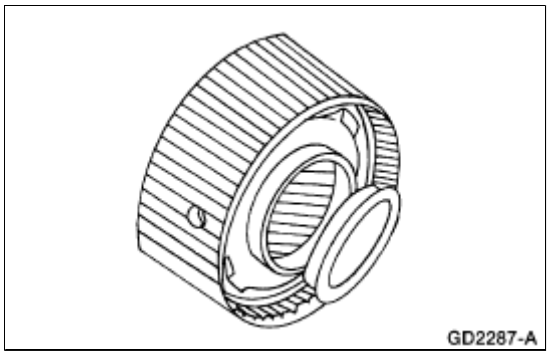
66. Remove the forward ring gear hub thrust bearing (No. 6A).



67. Remove the forward ring gear and forward ring gear hub as an assembly.

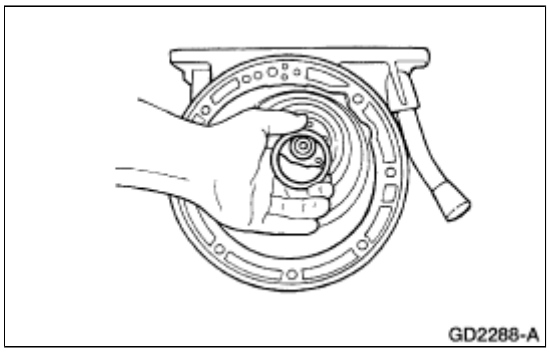


68. Remove forward clutch thrust washer (No. 6B) from the forward ring gear hub.

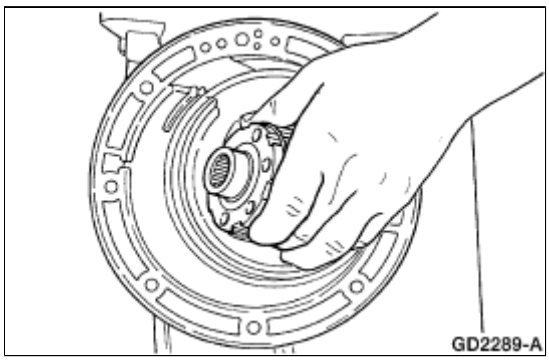


69. **NOTE:** Check black oxidized side during removal to ensure correct placement during reassembly. Black oxidized side must be toward planetary assembly. The uncoated side must face up.

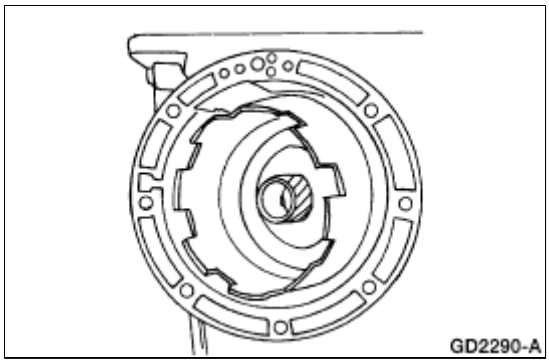
    Remove the forward planet thrust bearing (No. 7).



70. Remove the forward planetary assembly.

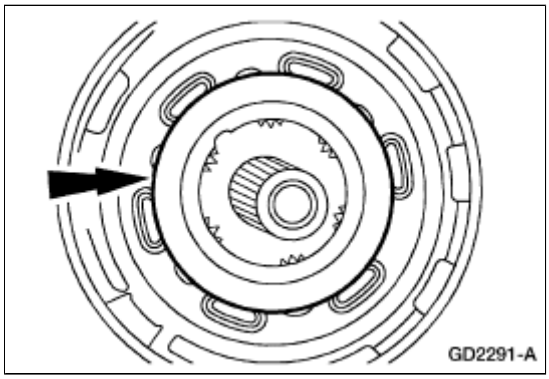


71. Remove input shell with the forward sun gear.

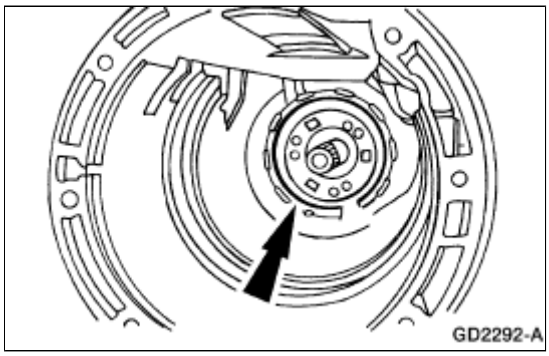


72. **NOTE:** Tag and identify the low/reverse planetary carrier thrust bearing (No. 8).

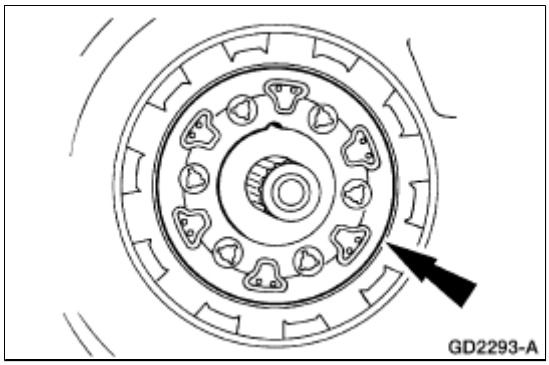
    Remove the low/reverse planetary carrier thrust bearing (No. 8).



73. Remove the low/reverse planetary retaining ring.

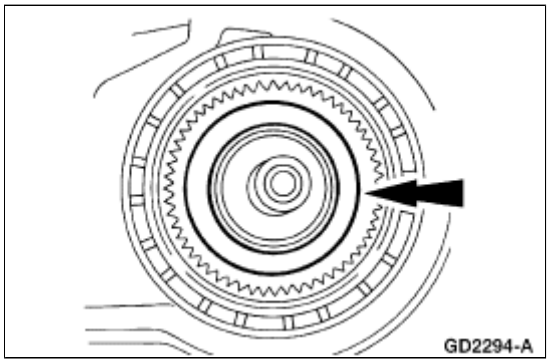


74. Remove low/reverse planetary assembly.

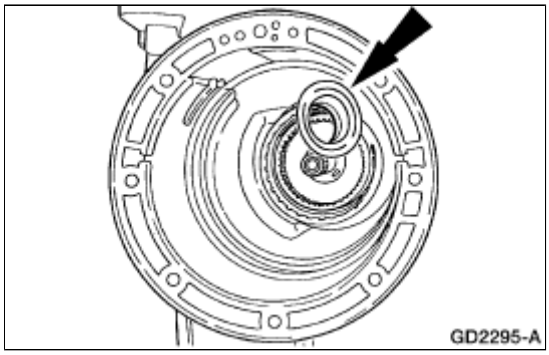


75. **NOTE:** Tag and identify the low/reverse planetary carrier thrust bearing (No. 9).

    Remove the low/reverse planetary carrier thrust bearing (No. 9).

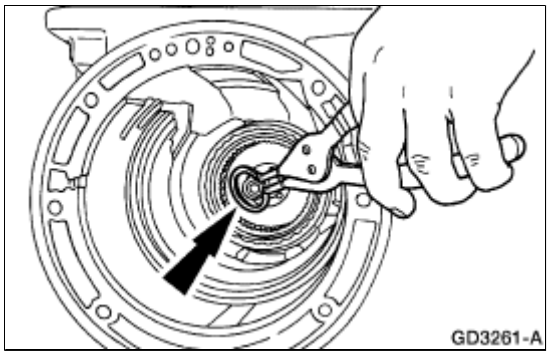


76. Remove the output shaft sleeve.

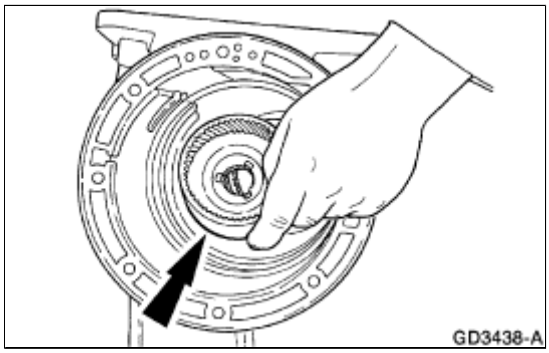


77. **CAUTION: Discard the output shaft retaining ring. A new retaining ring must be used for assembly.**

    Remove and discard the output shaft retaining ring.

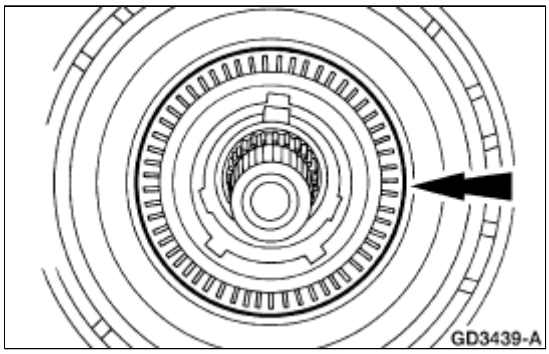


78. Remove the output shaft ring gear and the output shaft hub.



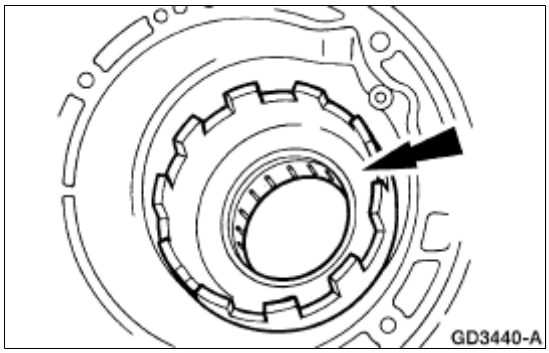
79. **NOTE:** Tag and identify the output shaft hub thrust bearing (No. 10).

    Remove the output shaft thrust bearing (No. 10).

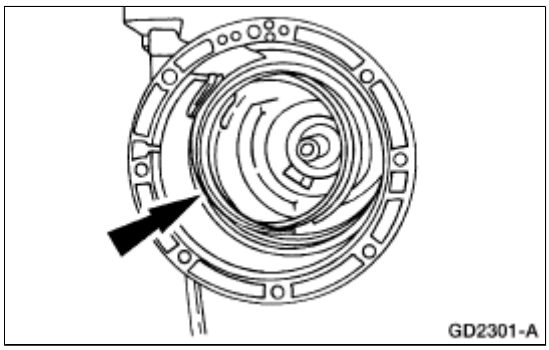


80. **NOTE:** The inner race of the rear one-way clutch is not removable. It is serviced in the case.

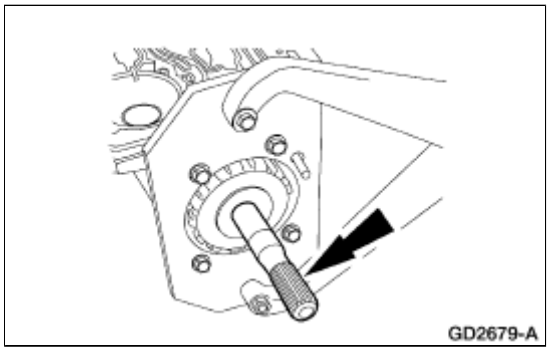
    Remove the low/ reverse brake drum and one-way clutch assembly.



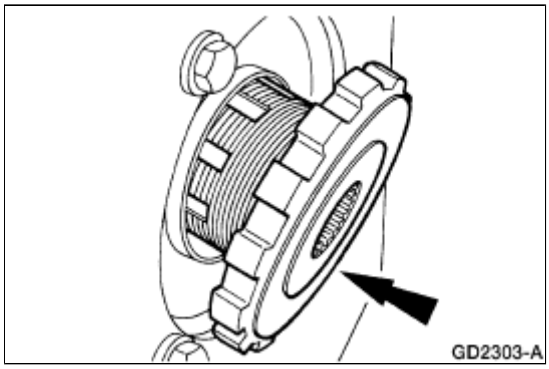
81. Remove the reverse band.



82. Remove the output shaft.

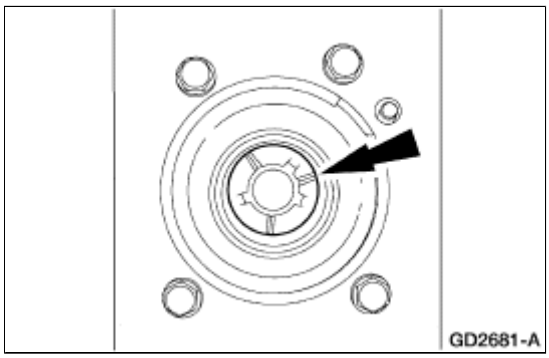


83. Remove the park gear.



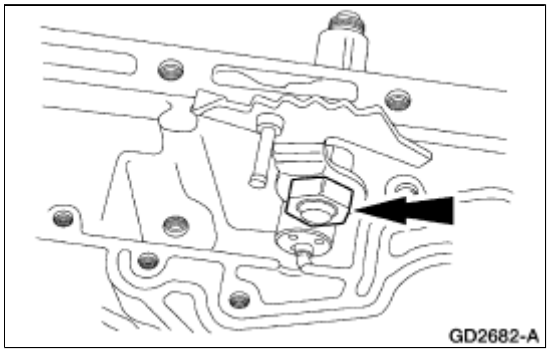
84. **NOTE:** Tag and identify the output shaft thrust washer (No. 11).

Remove the output shaft thrust washer (No. 11).

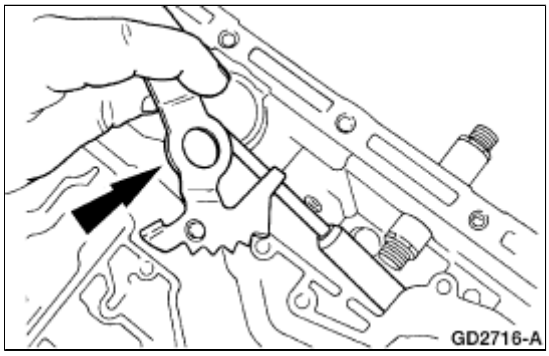


85. **CAUTION: To avoid damage, make sure wrench does not strike the manual valve inner lever pin.**

Remove the manual control valve inner lever nut.



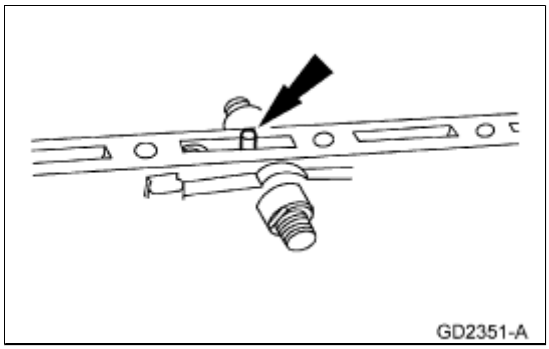
86. Remove the manual control valve inner lever and the parking lever actuating rod.



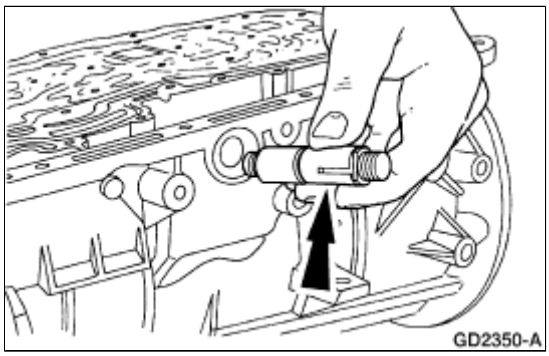
87. **CAUTION: Do not damage the case fluid pan rail.**

Remove the manual control lever shaft spring pin.

- Tap lightly on each side of the manual control lever shaft spring pin with a drift punch.
- Pry the spring pin out of its bore.

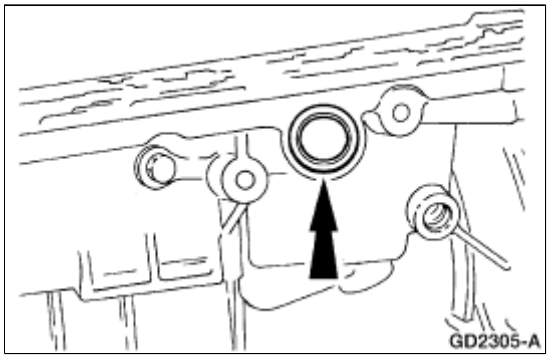


88. Remove the manual control lever shaft.



89. **CAUTION: Do not damage the bore.**

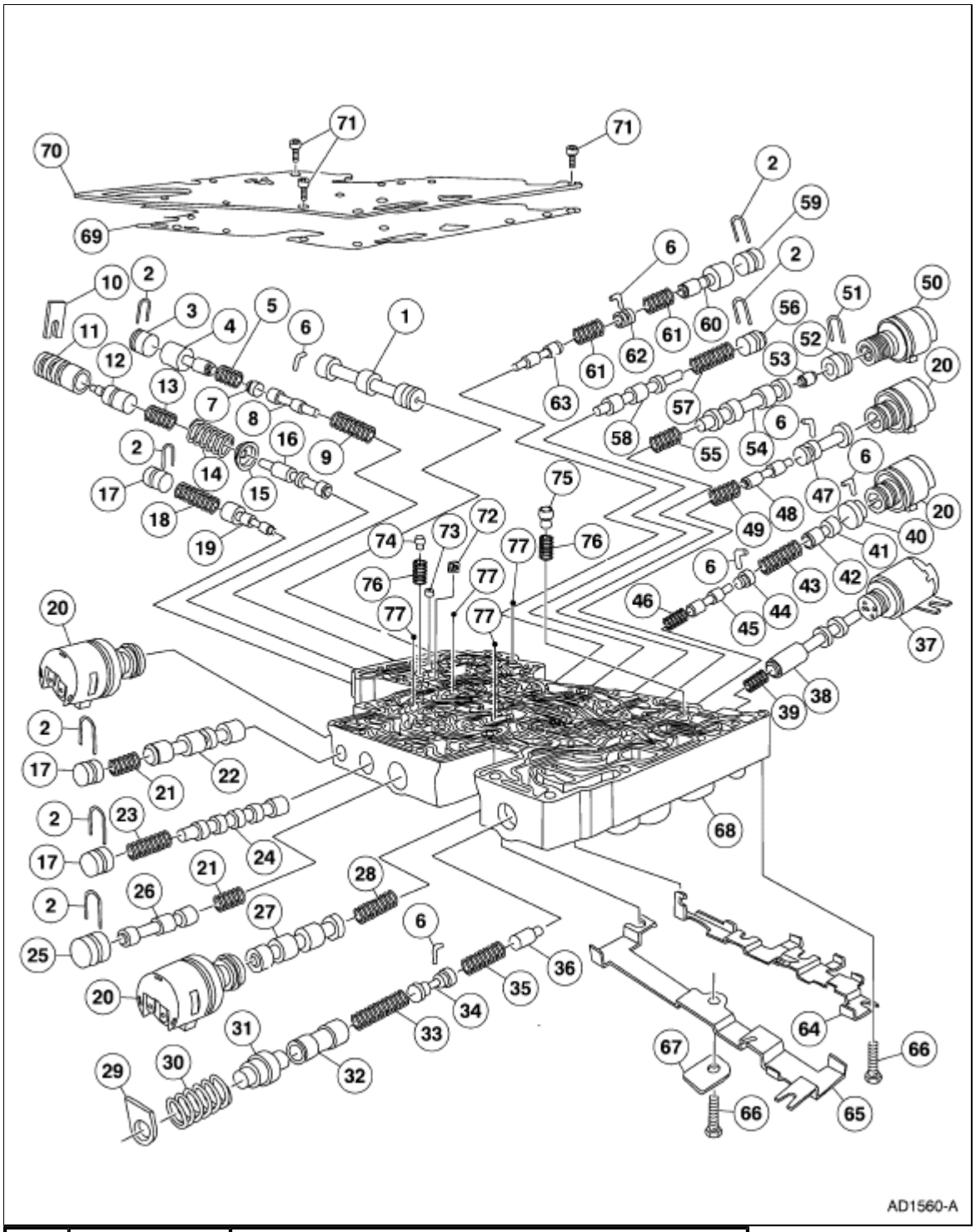
Remove the manual control lever seal.



Main Control Valve Body

Special Tool(s)

ST1639-A	Valve Body Aligner (.235) 307-333 (T95L-70010-B)
ST1639-A	Valve Body Aligner (.248) 307-334 (T95L-70010-C)



Item	Part Number	Description
1	—	Valve — manual
2	7E335	Retainer — valve plug (7 required)
3	—	Plug — valve retainer
4	—	Valve — forward modulator
5	—	Spring — forward modulator

6	7E335	Retainer — valve plug (6 required)
7	—	Plug — valve retainer
8	—	Valve — EPC boost
9	—	Spring — EPC boost
10	7E336	Retainer — valve plug
11	—	Sleeve — pressure boost
12	—	Valve — pressure boost
13	—	Spring — pressure boost
14	—	Spring — oil pressure regulator
15	—	Retainer — main regulator spring
16	—	Valve — pressure regulator
17	—	Plug — valve retainer (3 required)
18	—	Spring — forward engagement
19	—	Valve — forward engagement control
20	7G484	Solenoid — shift (4 required)
21	—	Spring — 4-3 (K.D./T.D.) (2 required)
22	—	Valve — 4-3 (K.D.)
23	—	Spring — manual low (1)
24	—	Valve — manual low (1)
25	—	Plug — valve retainer
26	—	Valve — 4-3 (T.D.)
27	—	Valve — 1-2 and 4-5 shift
28	—	Spring — 1-2 and 4-5 shift
29	7E366	Retainer — valve plug
30	—	Spring — thermostat bypass
31	—	Valve — thermostatic bypass
32	—	Valve — thermostat bypass
33	—	Spring — thermostat bypass
34	—	Plug — valve retainer
35	—	Spring — cooler limit
36	—	Valve — cooler limit
37	7G136	Solenoid — converter clutch (PWM)
38	—	Valve — converter clutch
39	—	Spring — converter clutch
40	—	Plug — valve retainer
41	—	Valve — converter clutch
42	—	Spring — converter clutch
43	—	Spring — converter clutch (3.0L and 4.0L only)
44	—	Plug — valve retainer

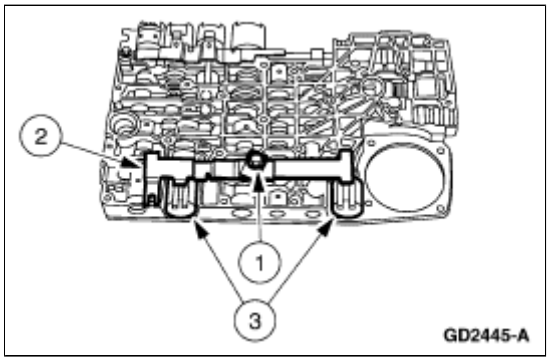
45	—	Valve — coast clutch
46	—	Spring — coast clutch
47	—	Plug — valve retainer
48	—	Valve — 4-3 downshifts
49	—	Spring — 4-3 downshifts
50	7G383	Solenoid — EPC (VFS)
51	7E335	Retainer — valve plug
52	—	Plug — valve retainer
53	—	Valve — 2-3 shift
54	—	Valve — 2-3 shift
55	—	Spring — 2-3 shift
56	—	Plug — valve retainer
57	—	Spring — 3-4 shift
58	—	Valve — 3-4 shift
59	—	Plug — valve retainer
60	—	Valve — reverse modulation
61	—	Spring — reverse modulation (2 required)
62	—	Plug — valve retainer
63	—	Valve — reverse modulation
64	7L491	Clamp — SSA/SSC
65	7L491	Clamp — SSB/SSD/EPC/TCC
66	E800155-S72	Screw — retain solenoid clamps (2 required)
67	7D132	ID plate
68	—	Body — valve
69	7D100	Gasket — separator plate
70	7A008	Plate — separator
71	E804357-S	Screw — retain separator plate (3 required)
72	7N113	Screen — EPC limit circuit
73	7D376	Extension housing lube orifice
74	7D376	Valve — EPC limit (metal)
75	7E368	Valve — converter relief (plastic)
76	7E340	Spring — EPC limit/converter relief (2 required)
77	7E195	Ball (4 required)

Disassembly

1. **CAUTION: The SSC solenoid may pop out of its bore. This may damage the solenoid.**

   Remove the SSA and the SSC clamp and SSA and SSC solenoid.
   1. Remove the solenoid clamp screw.

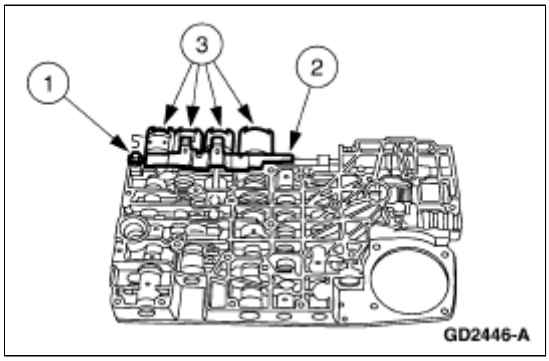
2. Remove the solenoid clamp.
3. Remove the SSA and SSC solenoids.



2. **CAUTION: The torque converter clutch solenoid (TCC) solenoid may pop out of its bore. This may damage the solenoid.**

CAUTION: The converter modulator valve may come out after the TCC solenoid. This may cause damage to the valve.

Remove the SSB, SSD, torque converter clutch solenoid, and the EPC solenoid.
1. Remove the solenoid clamp screw.
2. Remove the solenoid clamp.
3. Remove the SSB, SSD, torque converter clutch solenoid and the EPC solenoids.



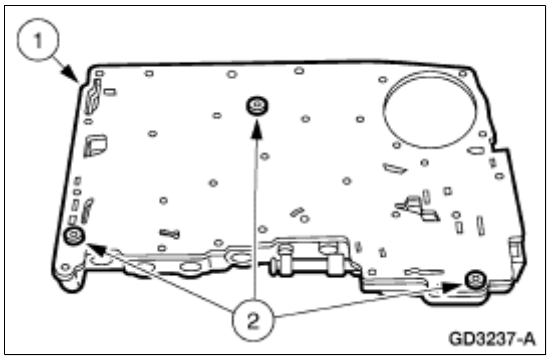
3. Rotate the main control valve body so that the main control to case gasket is facing up.

4. **CAUTION: Valves may come out when rotating the main control valve body.**

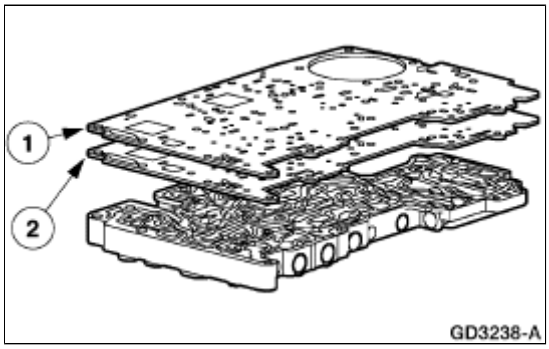
CAUTION: The extension housing lube orifice and relief valves may stick to the separator plate.

NOTE: Discard the main control to case gasket.

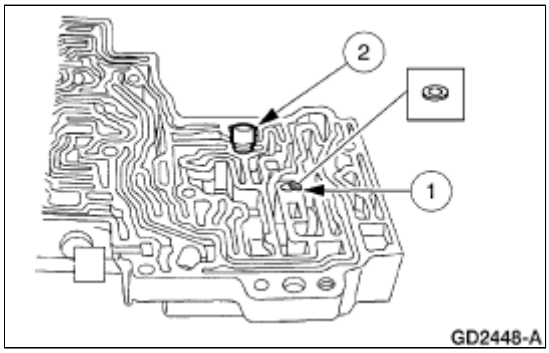
Remove the valve body separator plate screws.
1. Remove the main control to case gasket and discard.
2. Remove the valve body separator plate screws.



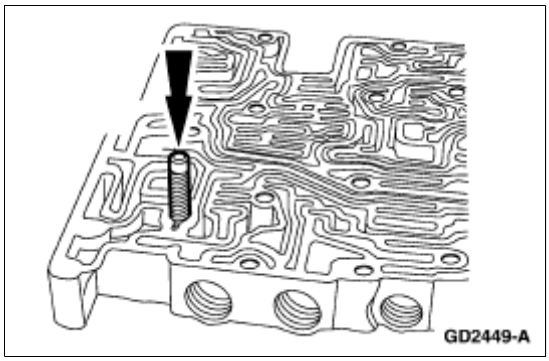
5. Remove valve body separator plate and main control to separating plate gasket.
    1. Remove valve body separator plate.
    2. Remove main control to separator plate gasket and discard.



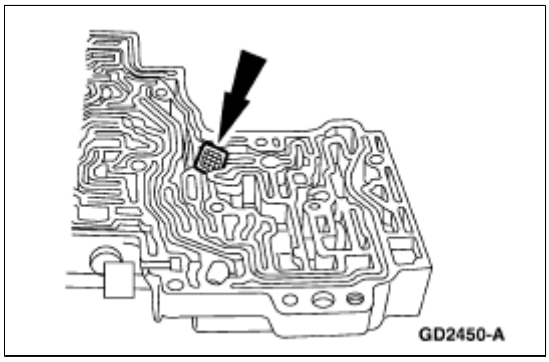
6. Remove the extension housing lube orifice and the metal silver electronic pressure control (EPC) limit relief valve and spring.
    1. Remove the extension housing lube orifice.
    2. Remove the silver metal EPC limit relief valve and spring.



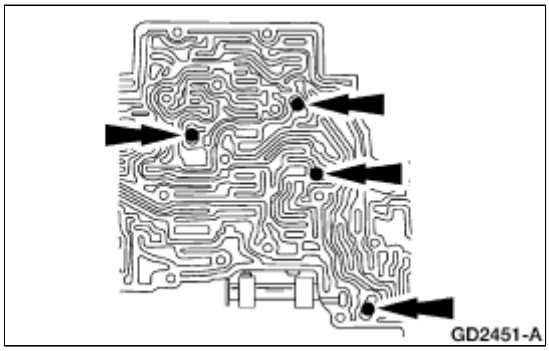
7. Remove the black plastic converter relief valve and spring.



8. Remove the electronic pressure control (EPC) limit circuit screen.



9. Remove the four main control valve body check balls.



Assembly

1. **CAUTION: Do not lose parts when cleaning or servicing.**

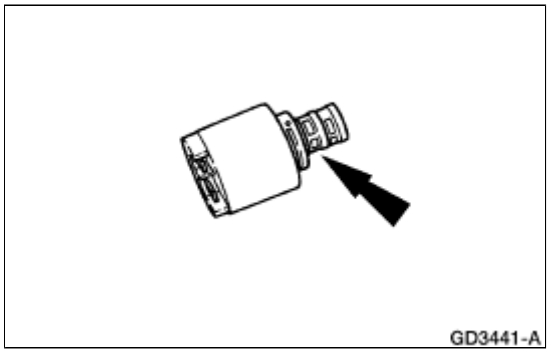
   Thoroughly clean all parts in solvent and blow dry with moisture free compressed air.

2. **CAUTION: Do not stone, file, or sand the valves. This will remove the anodized finish and may result in further main control or transmission damage.**

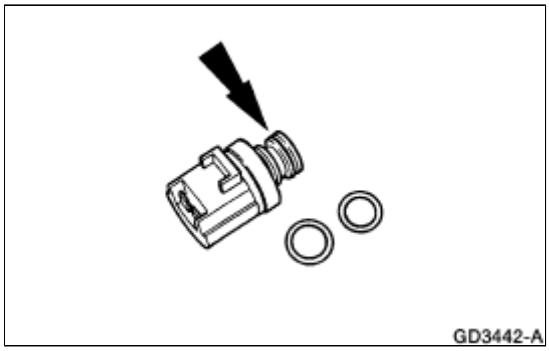
   After cleaning the main control valve body, carry out the following:
   - Inspect all valve and plug bores for scoring or burrs.
   - Check all fluid passages for obstructions.
   - Inspect all valves and plugs for burrs.

- Inspect all mating surfaces for burrs or distortion.
- Inspect all springs for distortion.
- Check all valves and plugs for free movement in their respective bores.
  - Valves and plugs, when dry, must fall from their own weight into their respective bores.
- Roll the manual valve on a flat surface to check for a bent condition.

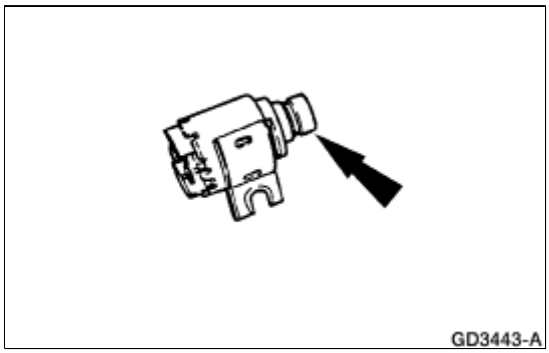
3. Clean and inspect the EPC solenoid screens.



4. Remove and replace all shift solenoid O-rings.

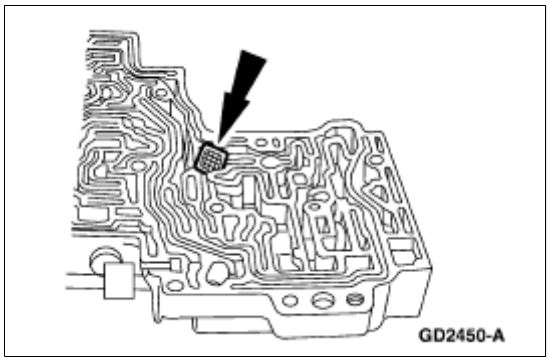


5. Clean and inspect the torque converter clutch solenoid.

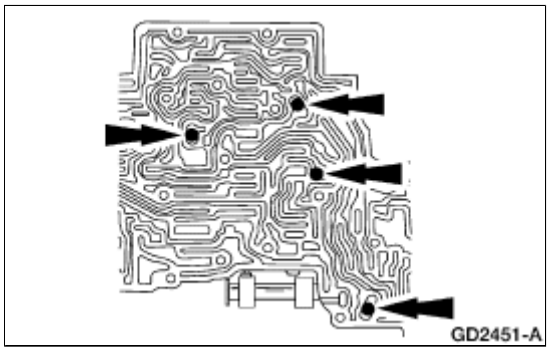


6. **CAUTION: Make sure that the screen is properly located.**

   Clean and inspect the electronic pressure control (EPC) limit circuit screen. Install the EPC limit circuit screen.

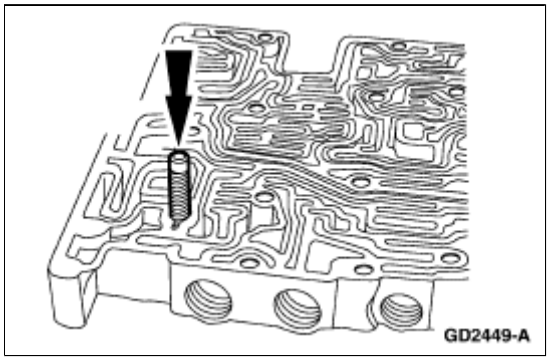


7. Install the four main control valve body check balls.



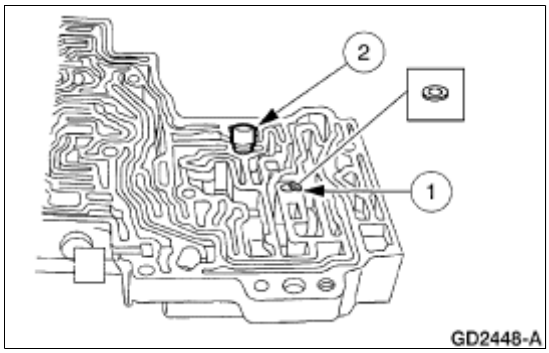
8. **CAUTION: The springs and valves are not interchangeable. Damage to transmission may occur.**

   Install the dark color plastic converter relief valve and spring.



9. **NOTE:** The springs and valves are not interchangeable.

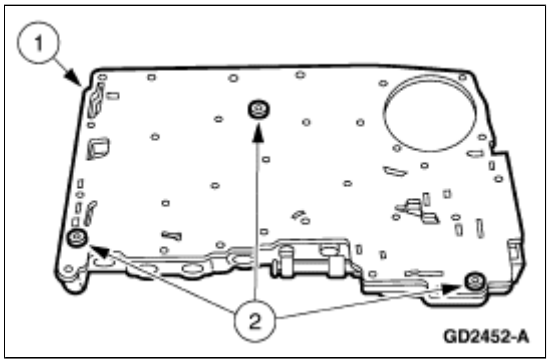
   Install the extension housing lube orifice and the metal silver electronic pressure control (EPC) limit relief valve and spring.
   1. Install the extension housing lube orifice.
   2. Install the silver metal EPC limit relief valve and spring.



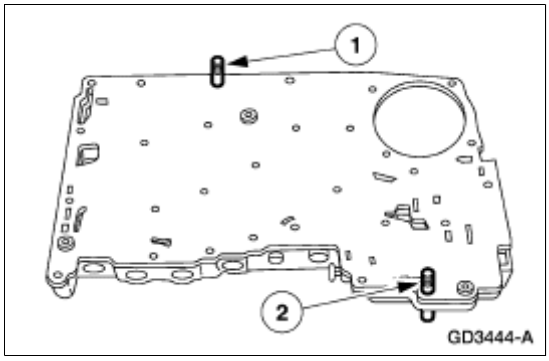
10. **NOTE:** Apply petroleum jelly on the valve body separator plate to hold the main control to separator plate gasket in place.

    NOTE: Use new separator plate main control to separator plate gasket on installation.

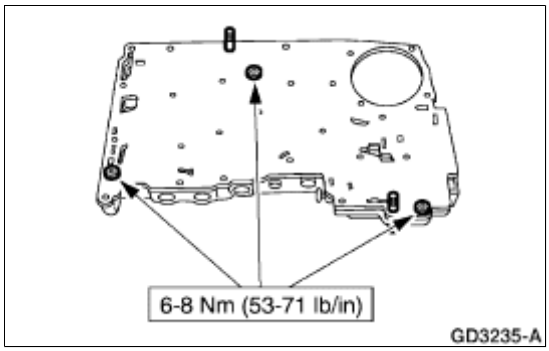
    Install the main control valve body separator plate and gasket to the main control.
    1. Position the main control valve body separator plate to the main control gasket and install separator plate to main control valve body.
    2. Install, do not tighten, the three screws.



11. Install the Valve Body Aligner into the main control valve body.
    1. Install the Valve Body Aligner (.248).
    2. Install the Valve Body Aligner (.235).



12. Tighten the screws.

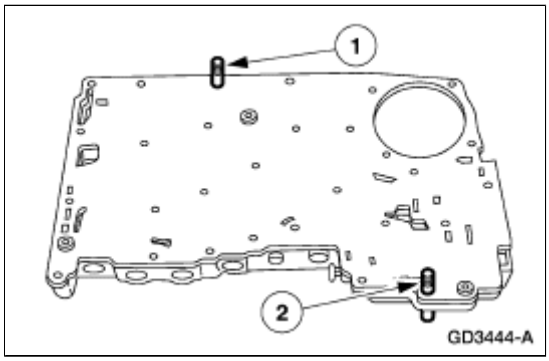


13. **NOTE:** Apply petroleum jelly on the separator plate surface to hold the gasket in place.

    NOTE: Use new separator plate gasket on installation.

    Install new main control to case gasket.

14. Remove the Valve Body Aligner from the main control valve body.
    1. Remove the Valve Body Aligner (.248).
    2. Remove the Valve Body Aligner (.235).



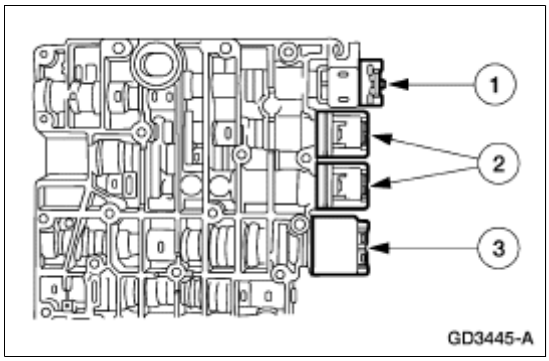
15. Rotate the main control valve body so the valve body separator plate is facing down.

16. **CAUTION: All solenoid electrical connectors must face upward on installation.**

    NOTE: All shift solenoids are interchangeable.

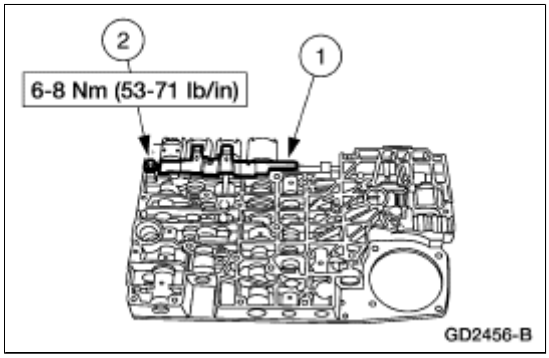
    NOTE: If the TCC valve came out during disassembly, use caution when installing the torque converter clutch solenoid.

    Install the SSB, SSD, TCC and EPC solenoids.
    1. Install the TCC solenoid.
    2. Install the SSB and SSD solenoids.
    3. Install the EPC solenoid.



17. **CAUTION: The solenoid clamp must be installed in the TCC and EPC solenoid grooves, shift solenoid pockets and the No. 204 plug.**

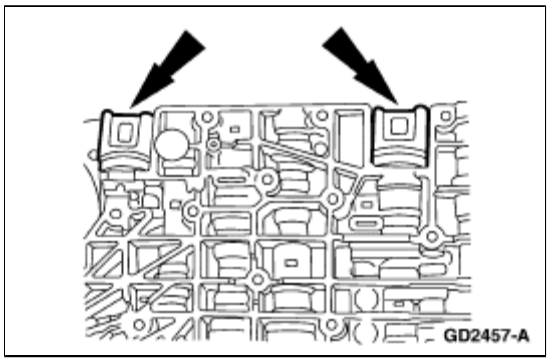
Install the solenoid clamp and the screw.
1. Position the solenoid clamp on the main control valve body.
2. Install the screw.



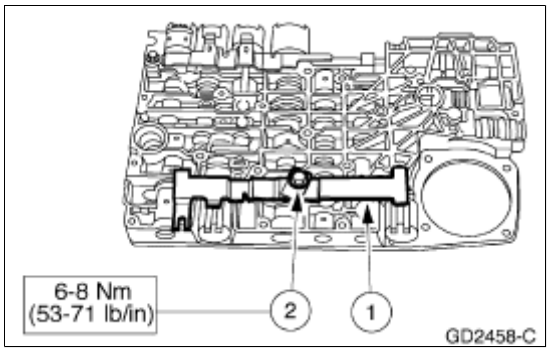
18. **CAUTION: The shift solenoid electrical terminals must face up on installation.**

NOTE: The shift solenoids are interchangeable.

Install the SSA and the SSC shift solenoids.

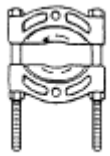
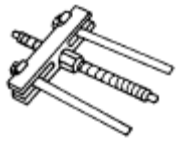
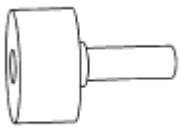
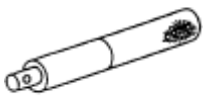
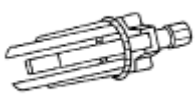


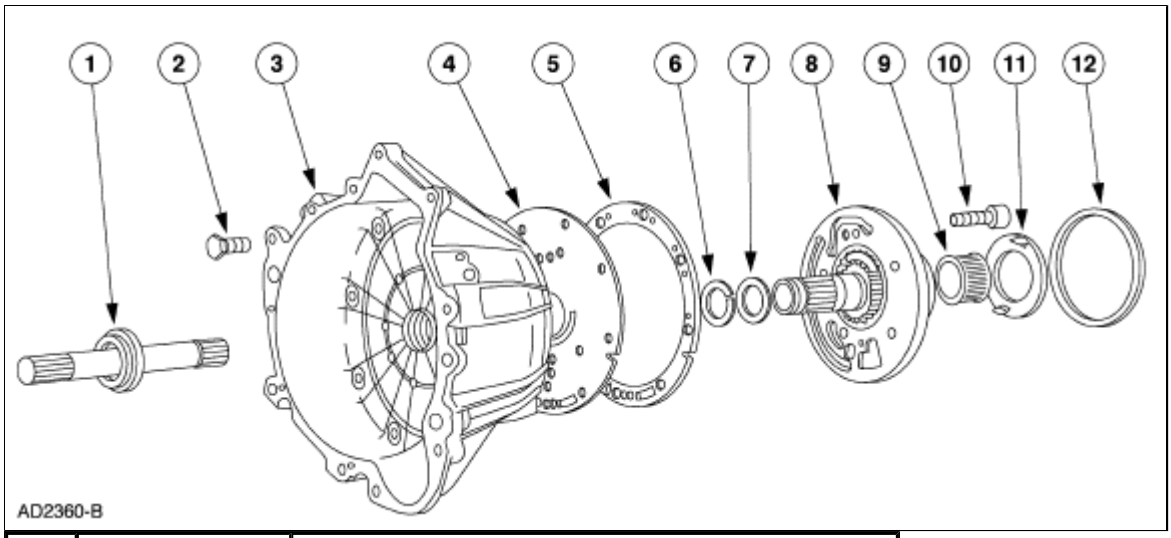
19. Install the solenoid clamp and the screw.
1. Position the solenoid clamp on the main control valve body.
2. Install the screw.


6-8 Nm
(53-71 lb/in)
2
1
GD2458-C

Converter Housing and Fluid Pump

Special Tool(s)

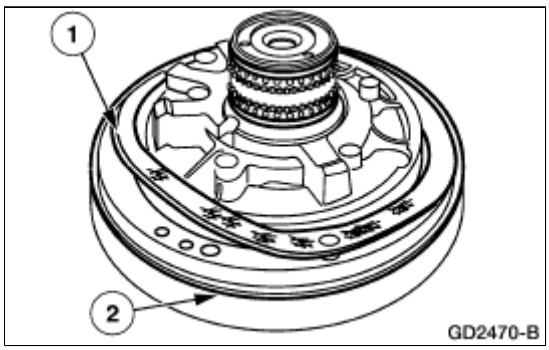
ST1833-A	Converter Seal Replacer 307-349 (T97T-77000-A)
ST1543-A	Step Plate 205-D018 (D80L-630-7)
 ST1368-A	Pinion Bearing Cone Remover 205-D002 (D79L-4621-A)
 ST1516-A	Front Hub Tool 204-069 (T81P-1104-C)
 ST2187-A	Bearing Replacer 307-373
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1213-A	Puller 307-001 (TOOL-1175-AC)



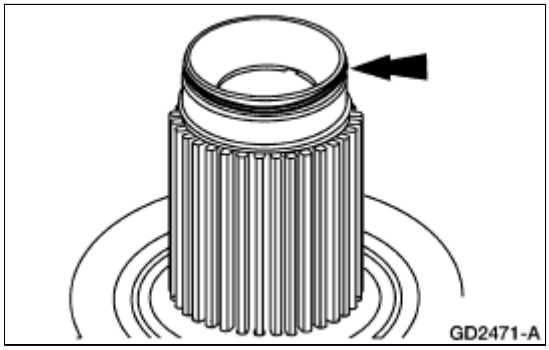
Item	Part Number	Description
1	7A248	Converter hub-to-converter housing seal
2	E804595-S200	Converter housing-to-case screw and seal (8 required)
3	7976	Converter housing
4	7B472	Fluid pump adapter plate
5	7A136	Fluid pump gasket
6	7L323	Fluid pump support seal ring
7	W701431-S300	Fluid pump shaft-to-inner gear O-ring
8	7A103	Fluid pump assembly
9	7M155	Bearing assembly
10	W701429-S309M	Fluid pump-to-converter housing screws (6 required)
11	7D014	No. 1 fluid pump input thrust washer (selective)
12	7A248	Seal ring — fluid pump.

Disassembly

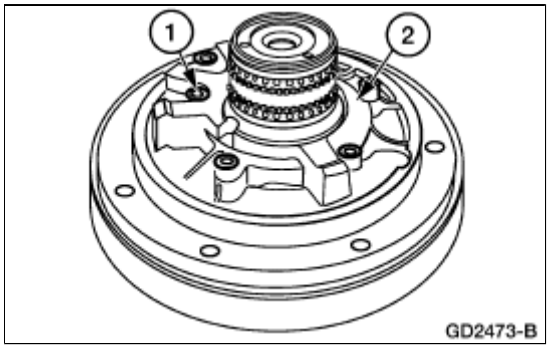
1. Remove the fluid pump gasket and fluid pump seal rings.
    1. Remove and discard the fluid pump gasket.
    2. Remove and discard the fluid pump seal ring (square cut).



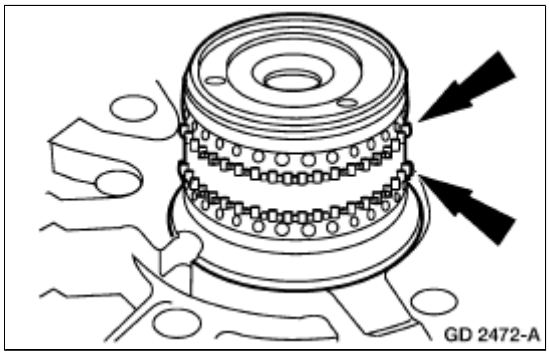
2. Remove the fluid pump support seal ring.



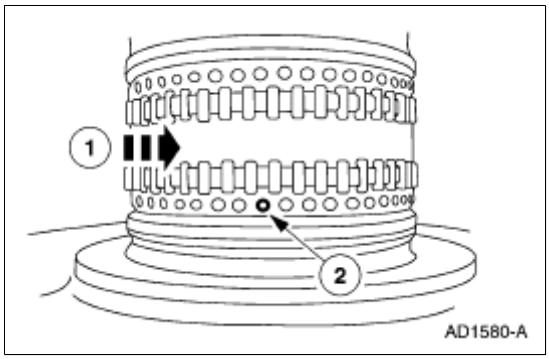
3. Remove the fluid pump housing.
    1. Remove the six fluid pump screws.
    2. Remove the fluid pump support and gear and the fluid pump adapter plate.



4. Inspect the fluid pump support needle bearings and cage for scored or missing rollers and alignment of lube holes.

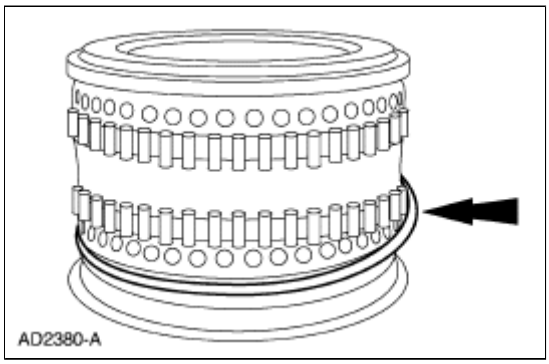


5. Inspect the coast clutch feed hole for blockage or damage.
    1. Rotate the pump bearing and locate the coast clutch feed hole.
    2. Inspect the coast clutch feed hole for blockage or damage.



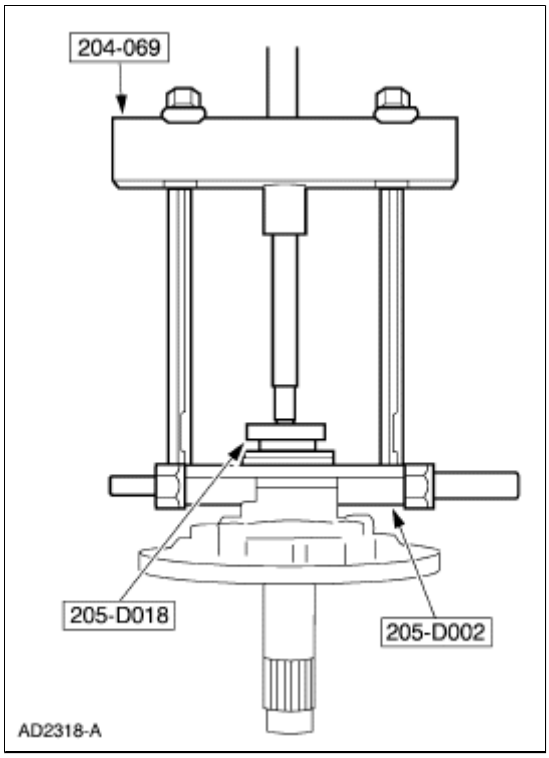
6. **NOTE:** Inspect the needle bearing for damage and install new if necessary.

   Remove the lower seal.



7. **NOTE:** This step only needs to be carried out if there is damage to the bearing.

   Assemble the special tools onto the front pump assembly.

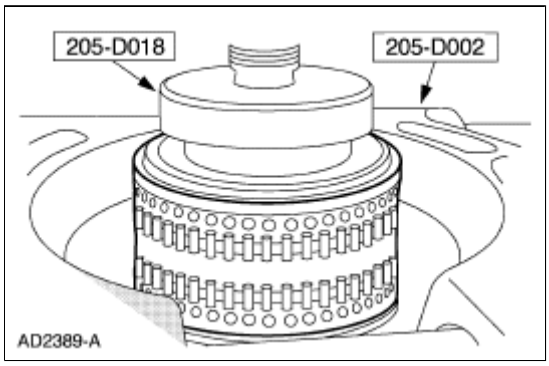


8. **CAUTION: Do not over tighten the tool or damage to the bearing may occur.**

   NOTE: This step only needs to be carried out if there is damage to the bearing.

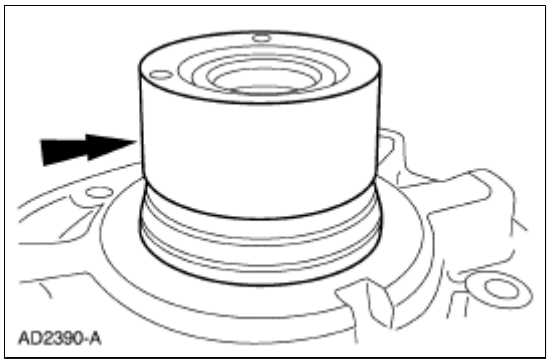
   NOTE: The Pinion Bearing Cone Remover Tool must fit into the lower seal groove.

   Using the special tools, remove the needle bearing.



9. **NOTE:** This step only needs to be carried out if there is damage to the bearing.

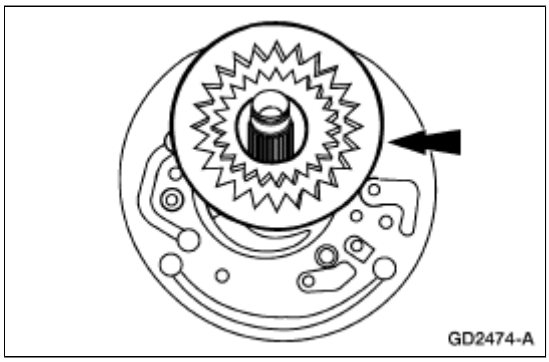
   Inspect the front pump outer race for scoring or nicks, if any damage is found the pump assembly will need to be replaced.



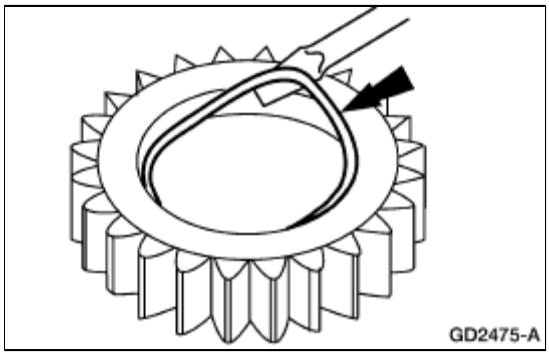
10. **NOTE:** A rough casting on the pump surface crescent is not a flaw.

    NOTE: The fluid pump gears are part of the pump assembly and are not serviced separately.

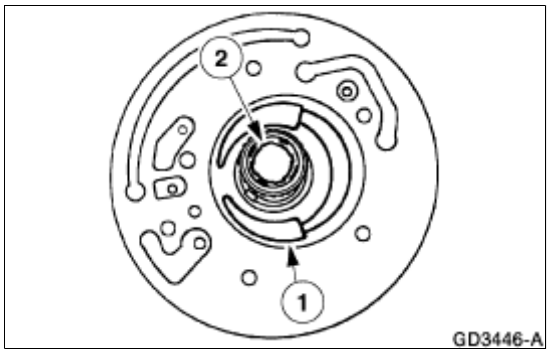
    Remove the fluid pump gears and front pump adapter plate.



11. Remove the drive gear O-ring and discard. Inspect the fluid pump gears for cracks and scoring. Replace front pump support and gear assembly if damaged.



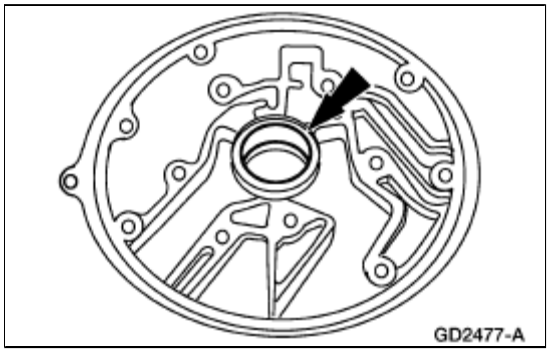
12. Inspect front pump.
    1. Inspect the front pump support gear pockets for scoring and wear.
    2. Clean and inspect the front and rear input shaft bushings.



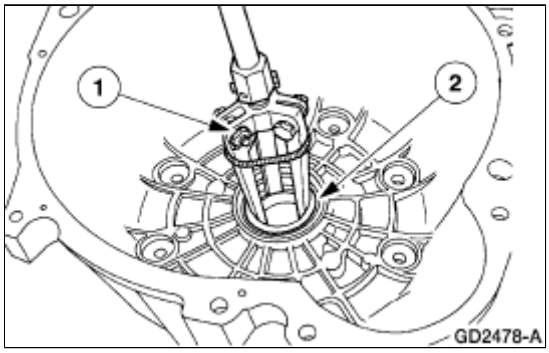
13. Inspect the fluid pump adapter plate for scoring and wear.

14. **NOTE:** The fluid pump-to-converter housing bushing is not serviced separately. If service is required, the converter housing must be replaced.

    Inspect the fluid pump-to-converter housing bushing and converter hub-to-converter housing seal. Replace converter housing assembly if necessary.



15. Remove the converter hub-to-converter housing seal.
    1. Install the Seal Remover into the converter hub-to-converter housing seal.
    2. Remove the converter hub-to-converter housing seal.



Assembly

1. Thoroughly clean all parts and blow dry with moisture free compressed air.

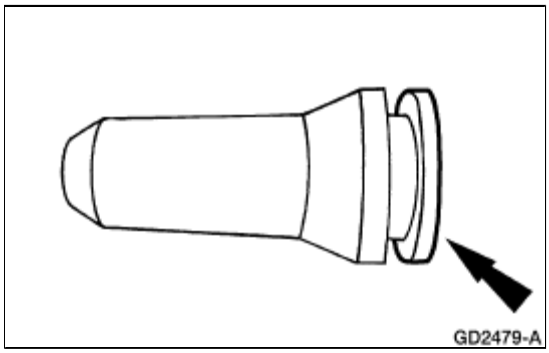
2. **NOTE:** Minor burrs and scoring may be removed with crocus cloth. If damage is found, the pump must be replaced as an assembly.

Inspect the converter housing and fluid pump components for the following:

- Cracks and scoring of the pump gears.
- Front and rear input shaft bushings for scoring and wear.
- Fluid pump support needle bearing and cage for scored or missing rollers.
- Pump gear pockets for scoring and wear.
- Fluid pump adapter plate for scoring and wear.
- Fluid pump to converter housing bushing for scoring and wear.
- Pump body and case for burrs.
- Fluid passages for obstructions.
- Converter housing for cracks.

3. **NOTE:** Check and make sure that the garter spring in the seal has not popped off of the converter hub-to-converter housing seal.

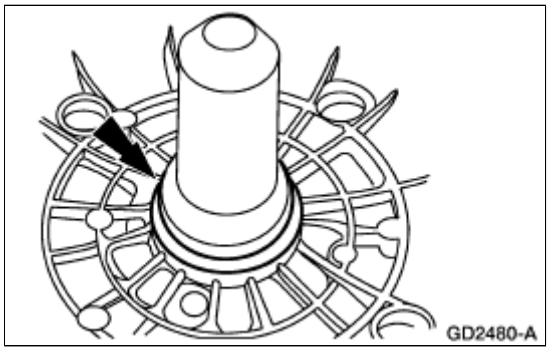
   Install a new converter hub to housing seal onto the Converter Seal Replacer.



4. **CAUTION: Place the converter housing on a block of wood or equivalent to protect the converter hydraulic passages on the backside.**

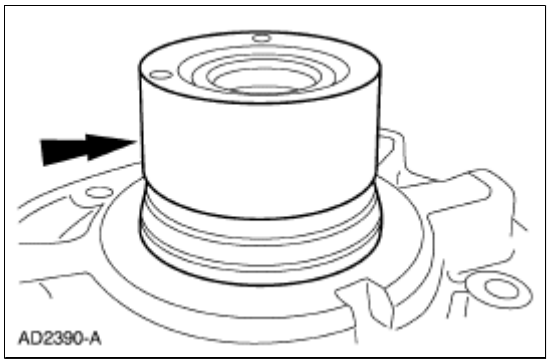
   NOTE: Do not finish converter housing and fluid pump reassembly at this time. Assembly is completed during transmission assembly to correctly set front end clearance.

   Use the Converter Seal Replacer and install the new converter hub-to-converter housing seal into the converter housing, until it bottoms in the housing.



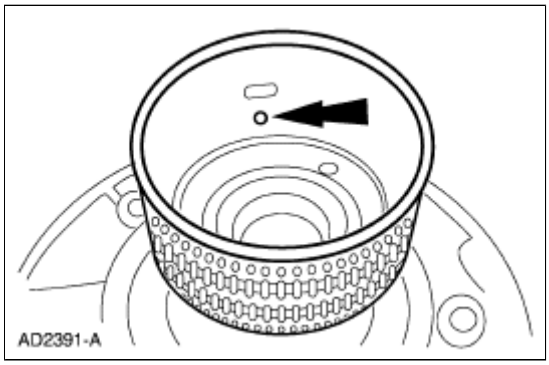
5. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Clean and lubricate the outer surface with petroleum jelly.



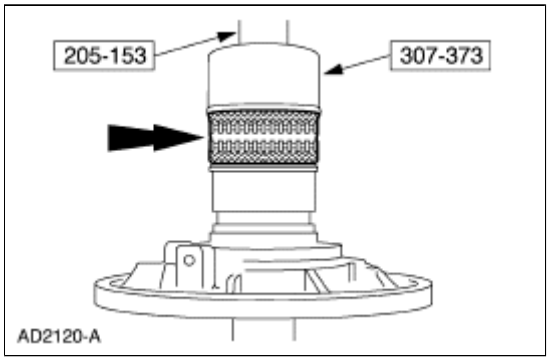
6. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Place the bearing over the pump assembly making sure that the lube feed hole is facing down.



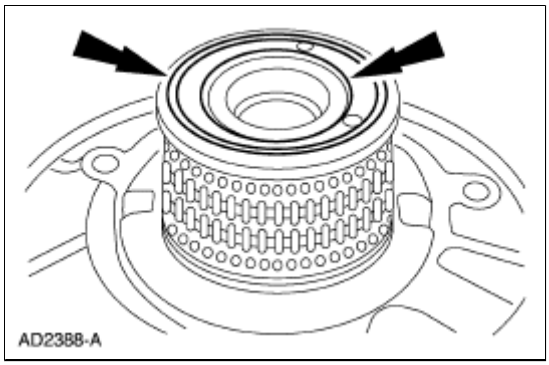
7. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Using the special tool, install the bearing.



8. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Inspect that the bearing is properly seated on the pump. Inspect the top portion of the pump that it was not damaged, and the bearing rotates freely.

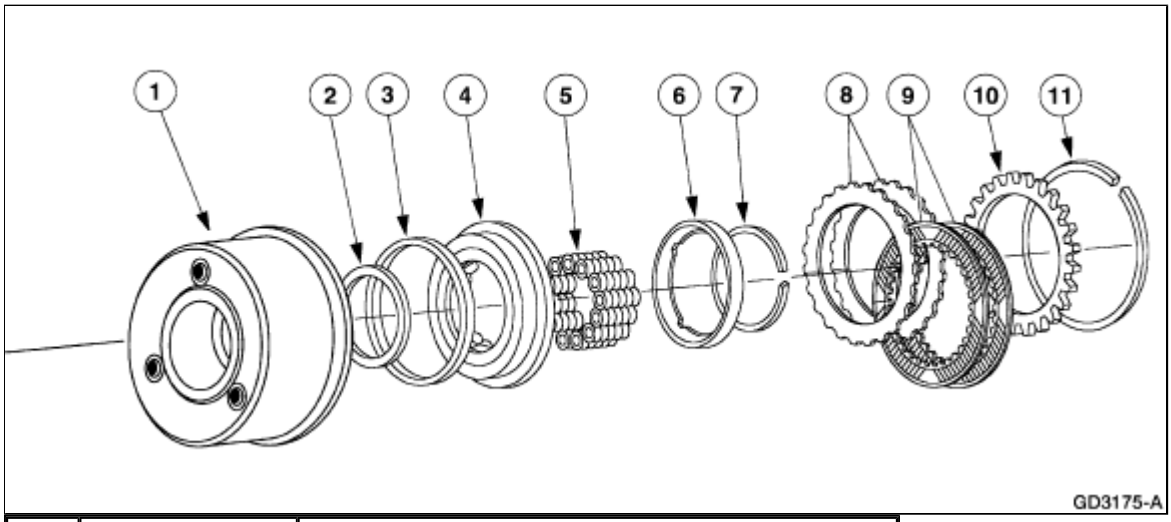

AD2388-A

Front Brake and Coast Clutch Drum Assembly

Special Tool(s)

ST1190-A	Clutch Spring Compressor 307-015 (T65L-77515-A)
ST2127-A	Coast Clutch Outer Seal Sizing Tool 307-353

Front Brake and Coast Clutch Drum Assembly



Item	Part Number	Description
1	7L669	Front Brake and Coast Clutch Drum
2	7D404	Coast Clutch Piston Inner Seal Ring
3	7A548	Coast Clutch Piston Outer Seal Ring
4	7A258	Coast Clutch Piston
5	7A480	Coast Clutch Piston Spring (20 Req'd)
6	7A527	Coast Clutch Piston Spring Retainer
7	E860125-S	Retaining Ring
8	7B442	Coast Clutch External Plate — Steel (2 Req'd)

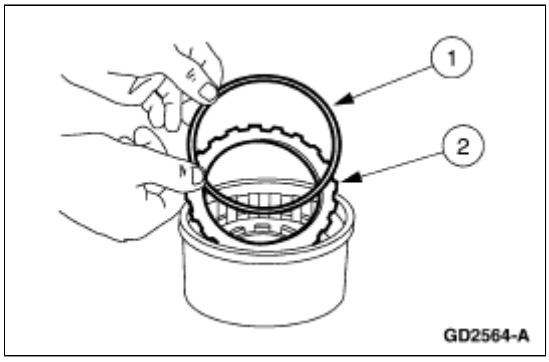
9	7B164	Coast Clutch Internal Plate — Friction (2 Req'd)
10	7B066	Coast Clutch Pressure Plate
11	E860126S/129S	Retaining Ring (Select Fit)

Disassembly

1. **CAUTION: If new plates are being used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.**

   CAUTION: This is a select fit ring. See assembly procedure if the ring or clutch plate is replaced.

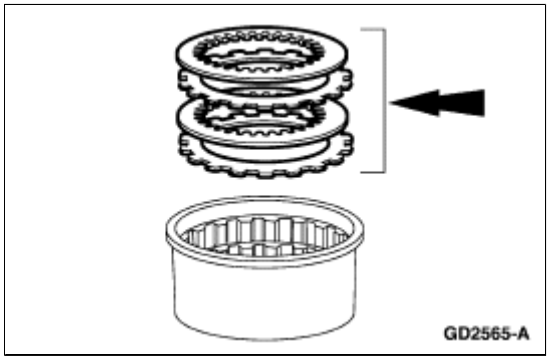
   Remove the coast clutch pressure plate.
   1. Remove the coast clutch retaining ring.
   2. Remove the coast clutch pressure plate.



2. **CAUTION: If new clutch plates are being used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.**

   CAUTION: Coast clutch friction plates are directional. Note direction of grooves for installation.

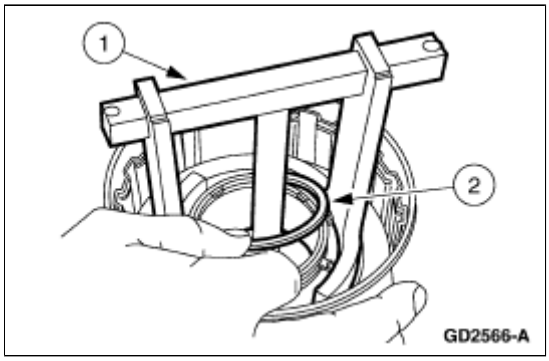
   Remove the coast clutch disc pack.
   - Inspect for wear, replace as necessary.



3. **WARNING: Use caution when releasing tool pressure on the rear clutch piston spring. Failure to follow these instructions may result in personal injury.**

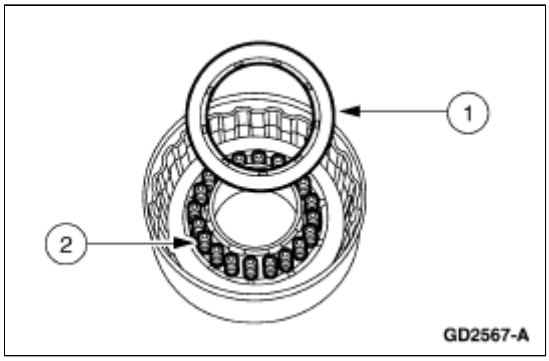
   CAUTION: Do not fully compress the Clutch Spring Compressor or damage to the spring retainer may occur.

   Remove the coast clutch piston retaining ring.
   1. Use Clutch Spring Compressor to compress the coast clutch piston springs.
   2. Remove the coast clutch piston retaining ring.



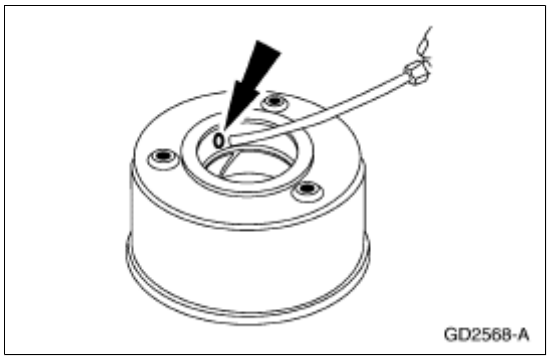
4. Relieve the direct clutch spring tension and remove the Clutch Spring Compressor.

5. Remove the coast clutch piston springs.
   1. Remove the coast clutch piston spring retainer.
   2. Remove the (20) clutch piston springs.

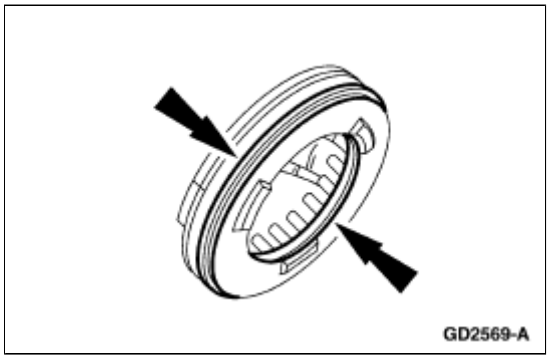


6. **WARNING: Air pressure must not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air, and make sure drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Remove the coast clutch piston.
   - Apply air pressure to the hole in the drum to remove coast clutch piston while blocking other hole with finger.



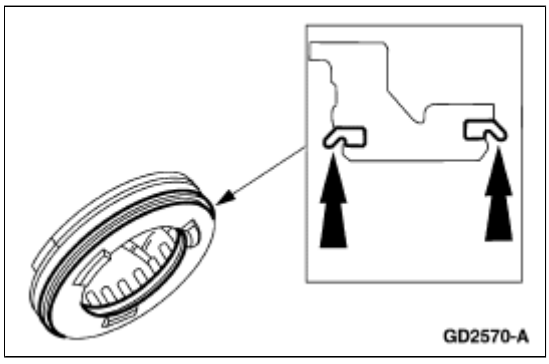
7. Remove the coast clutch piston inner seal and the coast clutch piston outer seal.
   - Clean and replace as necessary.



Assembly

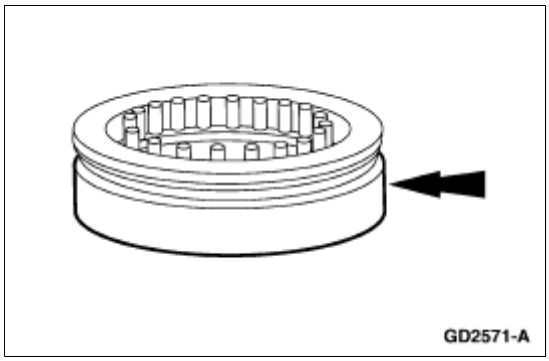
1. **CAUTION: The lip seals must be positioned as shown. Care must be taken to prevent roll over of the lip seal.**

   Install the new coast clutch piston inner and outer seal.



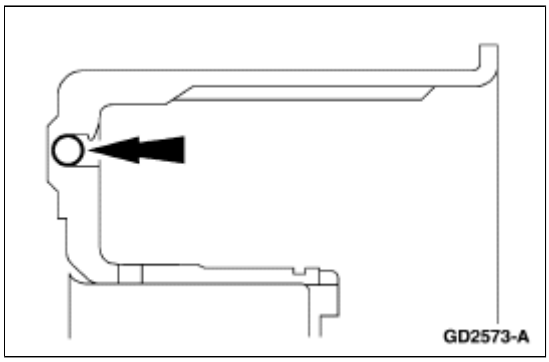
2. **CAUTION: Lubricate the coast clutch piston inner and outer seal.**

   Install the coast clutch piston into Coast Clutch Outer Seal Sizing Tool.

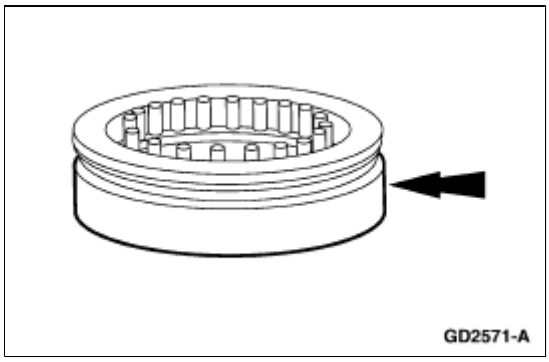


3. Inspect the coast clutch components for damage or wear. Replace as necessary.
   - Inspect the drum band surface, bushing, and thrust surfaces for scores. Minor scores may be removed with a crocus cloth. Badly scored parts must be replaced.
   - Inspect the clutch piston bore and the clutch piston and the piston inner and outer bearing surfaces for scores.
   - Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
   - Inspect the clutch plates for wear, scoring and fit on the clutch hub serrations. Replace all plates that are badly scored, worn or do not fit freely in the hub serrations.
   - Inspect the clutch pressure plate for scores on the clutch plate surface. Check the clutch release spring(s) for distortion.

4. Verify the check ball in the front band brake and coast clutch drum is free to move and clear of debris.

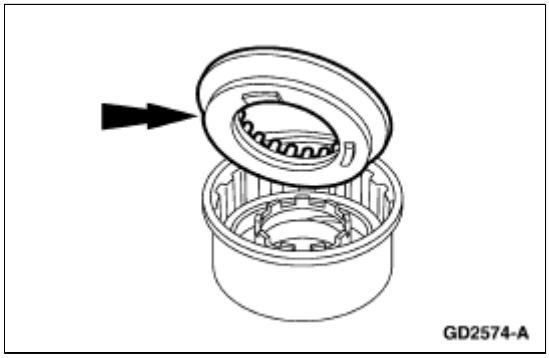


5. Carefully remove the coast clutch piston from the Coast Clutch Outer Seal Sizing Tool.

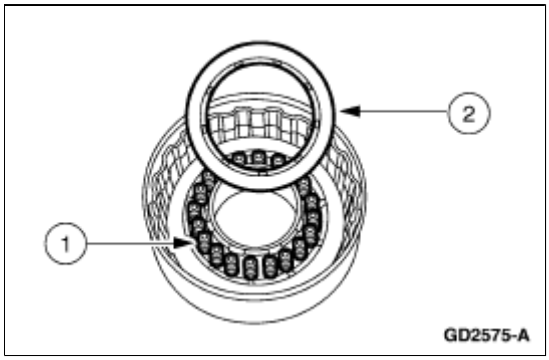


6. **CAUTION: Care must be taken to prevent damage to the seals during installation.**

Install the coast clutch piston into the front band brake and coast clutch drum.

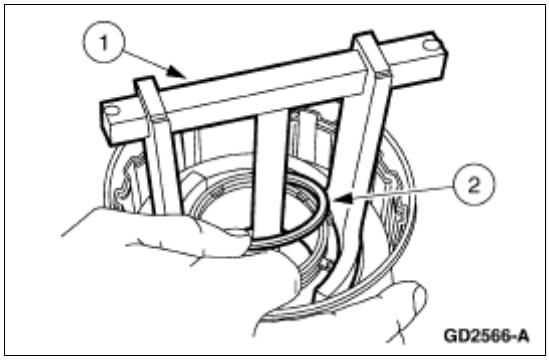


7. Install the coast clutch piston springs.
    1. Install the twenty (20) coast clutch piston springs.
    2. Position the coast clutch piston spring retainer on the coast clutch piston springs.



8. **CAUTION: Do not fully compress the Clutch Spring Compressor or damage to the coast clutch piston spring retainer may occur.**

    Install the coast clutch piston spring retainer ring.
    1. Use Clutch Spring Compressor to compress the coast clutch piston springs.
    2. Install the coast clutch piston retaining ring.

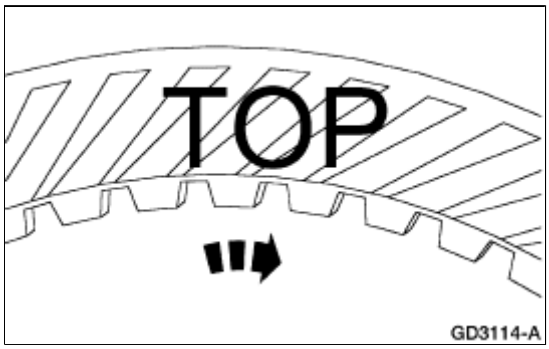


9. Relieve the direct clutch spring tension and remove the Clutch Spring Compressor.

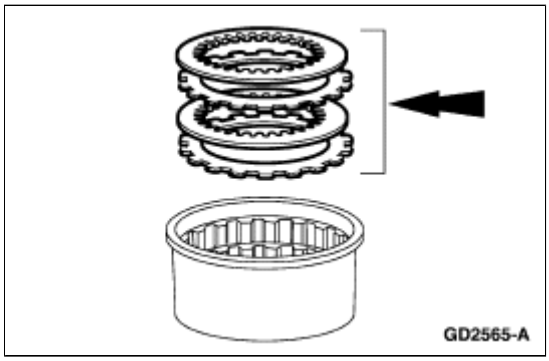
10. **CAUTION: Coast clutch friction plates are directional and must be installed with grooves clockwise (I.D. to O.D.). The word "TOP" should face up.**

CAUTION: If new clutch plates are being used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.

When installing friction plates, the word "TOP" should face up. If reusing plates, grooves must be installed clockwise. Install the coast clutch disc pack.



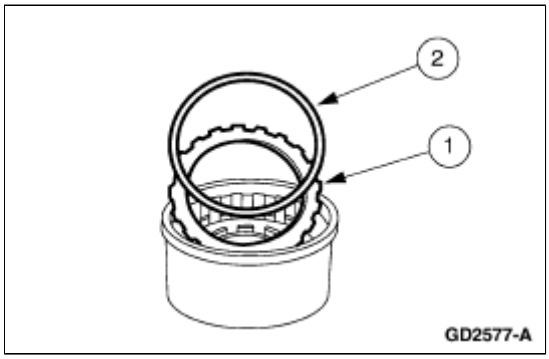
11. Install the two steel clutch plates and two friction clutch plates in alternating order starting with a steel clutch plate.



12. **CAUTION: The retaining ring is select fit.**

Install the coast clutch pressure plate.

1. Install the clutch pressure plate.
2. Install the original coast clutch retaining ring.



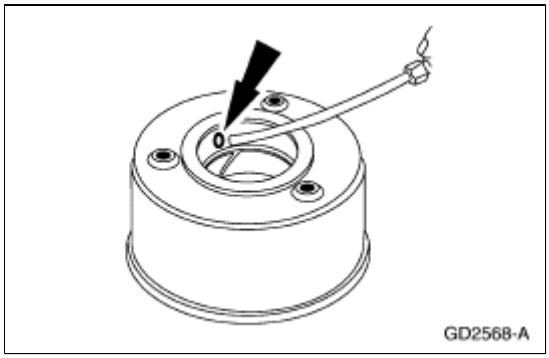
13. **WARNING: Air pressure must not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air. Make sure drum is facing down as shown. Failure to follow these**

instructions may result in personal injury.

NOTE: The coast clutch piston is applied with air pressure and released when the air is removed.

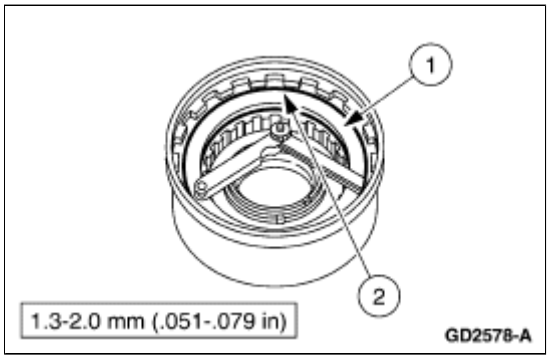
Air check the assembly.

- Apply air pressure to the hole in the drum while blocking the other hole with a finger.



14. Check the coast clutch disc pack free play.
    1. Push down on the coast clutch pressure plate.
    2. Check clearance between the coast clutch retaining ring and coast clutch pressure plate. Clearance should be 1.3-2.0 mm (.051-.079 in). If clearance is not within the specification, replace with the proper coast clutch retaining ring that will correct free play adjustment.

	Thickness		Diameter	
Part Number	mm	In	mm	In
E860126-S	1.37	.0539	130.1	5.122
E860127-S	1.73	.0681	130.1	5.122
E860128-S	2.08	.0819	130.1	5.122
E860129-S	2.44	.0961	130.1	5.122

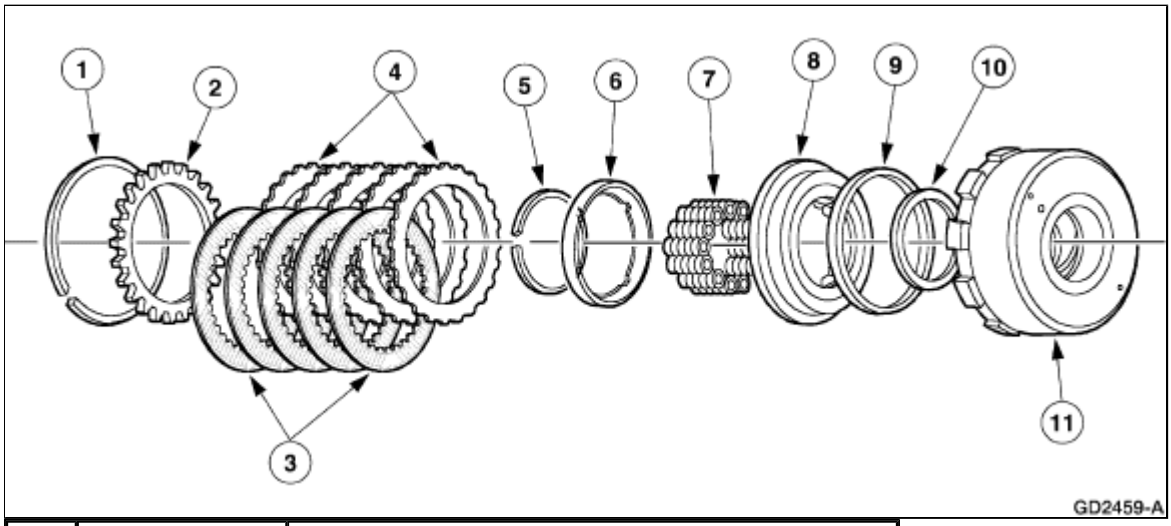


Intermediate Brake and Direct Clutch Drum Assembly

Special Tool(s)

ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
ST1756-A	Sizer, Piston Seal 307-336 (T95L-70010-E)
ST1756-A	Sizer, Piston Seal 307-335 (T95L-70010-D)

Intermediate Brake and Direct Clutch Drum Assembly



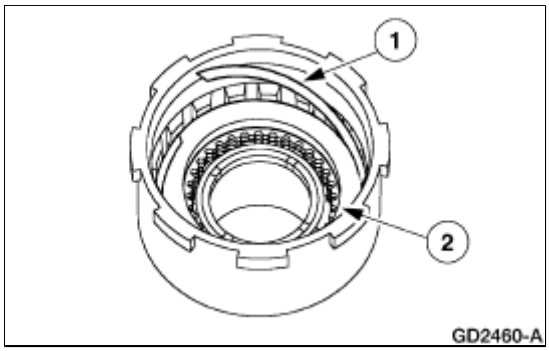
Item	Part Number	Description
1	E860126S/129S	Retaining ring (select fit)
2	7B066	Direct clutch pressure plate
3	7B164	Direct clutch internal plate — friction
4	7B442	Direct clutch internal plate — steel

5	E860125-S	Direct clutch retaining ring
6	7A527	Direct clutch piston spring retainer
7	7A480	Direct clutch piston springs (20 required)
8	7A258	Direct clutch piston
9	7A548	Direct clutch piston outer seal ring
10	7D404	Direct clutch piston inner seal ring
11	7D044	Intermediate brake and direct clutch drum assembly

Disassembly

1. **CAUTION: The retaining ring is a select fit. See assembly procedure if the ring or clutch pack is replaced.**

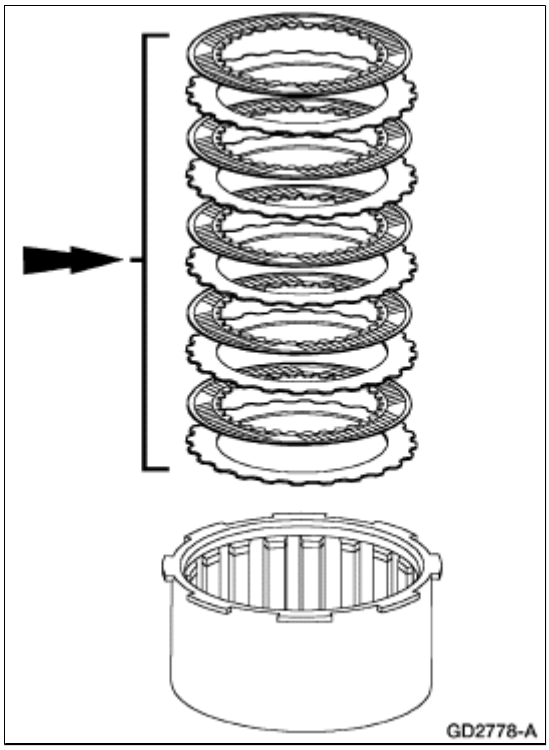
   Remove the direct clutch retaining ring and the direct clutch pressure plate.
   1. Remove the direct clutch retaining ring.
   2. Remove the direct clutch pressure plate.



2. **CAUTION: Clutch plates are directional. Note the direction of the grooves for installation.**

   CAUTION: If new clutch plates are being used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.

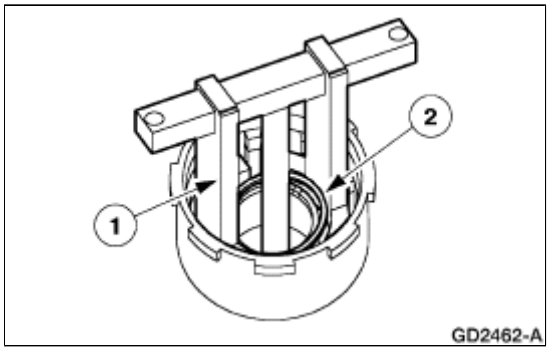
   Remove the direct clutch disc pack.
   - Inspect and replace the steel and friction plates if worn, damaged, or overheated.
   - Measure and record the thickness of the steel plates for assembly.



3. **WARNING: After removing the retaining ring, use care when releasing the pressure on the springs. Failure to follow these instructions may result in personal injury.**

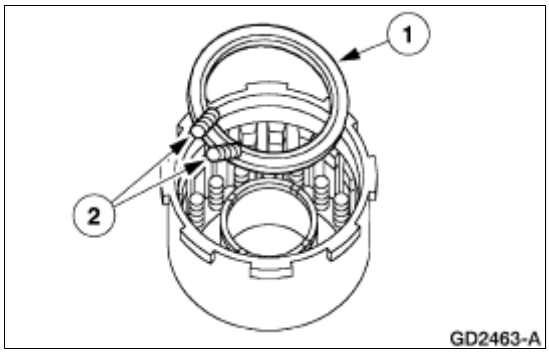
   CAUTION: Do not fully compress the Clutch Spring Compressor or damage to the spring retainer may occur.

   Use a Clutch Spring Compressor to remove the direct clutch piston retaining ring.
   1. Install the Clutch Spring Compressor and compress the direct clutch piston springs.
   2. Remove the direct clutch piston retaining ring.



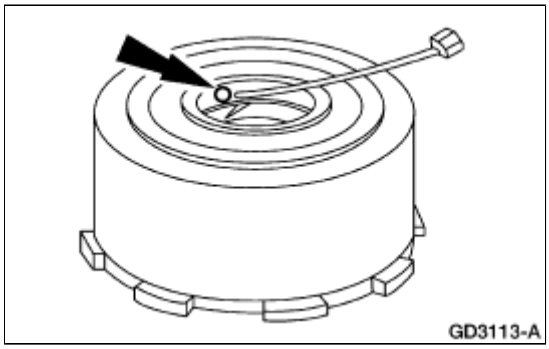
4. Relieve the direct clutch spring tension and remove the Clutch Spring Compressor.

5. Remove the direct clutch piston spring retainer and the twenty (20) direct clutch piston springs.
   1. Lift the direct clutch piston spring retainer off the direct clutch piston springs.
   2. Remove the direct clutch piston springs.

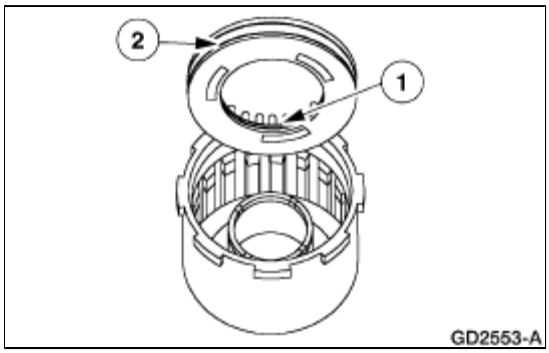


6. **WARNING: Do not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air. Make sure drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Using compressed air, remove the direct clutch piston from the intermediate brake and direct clutch drum.
   - Apply air pressure to the hole in the drum while blocking the other with a finger.



7. Remove the direct clutch piston inner and outer seal.
   1. Remove the direct clutch piston inner seal.
   2. Remove the direct clutch piston outer seal.

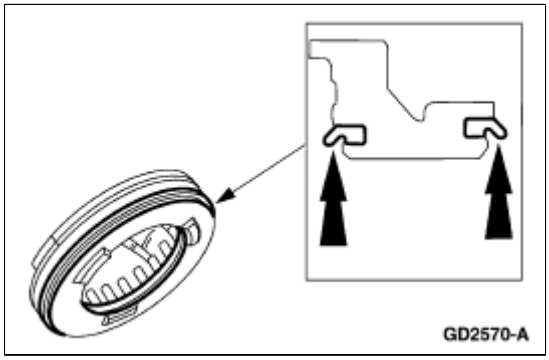


Assembly

1. **CAUTION: The lip seals must be positioned as shown. Care must be taken to prevent rollover of the lip seal.**

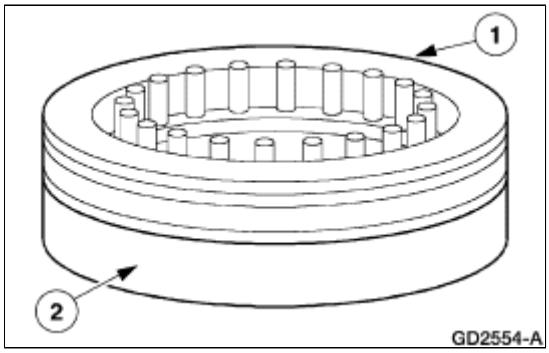
   NOTE: Use new seals to help prevent seal failures.

Install the new direct clutch piston inner seal and the direct clutch piston outer seal.



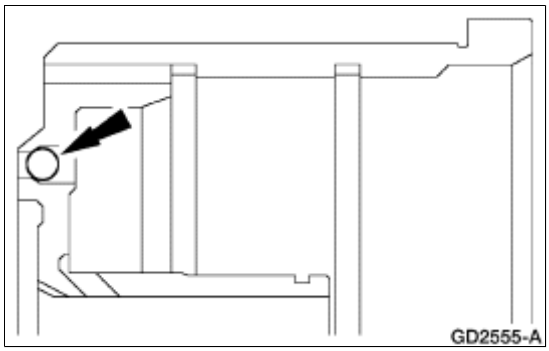
2. **CAUTION: Lubricate the direct clutch piston inner and outer seals with MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.**

   Install the direct clutch piston into the Direct Clutch Outer Seal Sizing Tool.
   1. Press together until seated.
   2. Install the direct clutch piston into the Direct Clutch Outer Seal Sizing Tool.

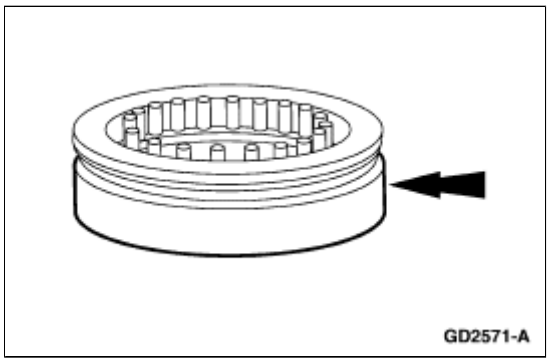


3. Inspect the intermediate brake and direct clutch drum and components for the following:
   - Intermediate brake and direct clutch band surface for scoring.
   - Clutch piston bore and the piston inner and outer bearing surfaces for scoring.
   - The fluid passages for obstructions. All fluid passages must be clean and free of debris.
   - Inspect the clutch plates for wear, scoring and fit on the clutch hub serrations. Replace all plates that are badly scored, worn or do not fit freely in the hub serrations.
   - Inspect the direct clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release springs for distortion.

4. Verify that the intermediate brake and direct clutch drum check ball is clean and free of debris.

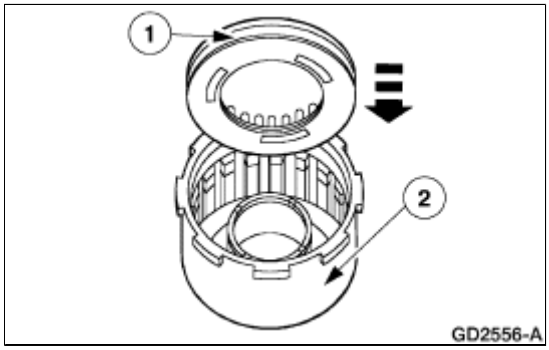


5. Carefully remove the direct clutch piston from the Direct Clutch Outer Seal Sizing Tool.

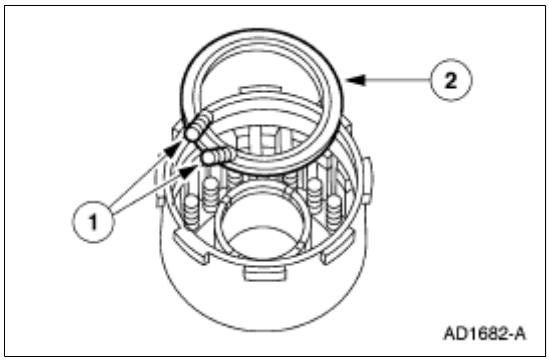


6. **CAUTION: Care must be taken to prevent damage to the seals during installation.**

   Install the direct clutch piston.
   1. Position the direct clutch piston in the intermediate brake and direct clutch drum.
   2. Push down evenly around the piston circumference.



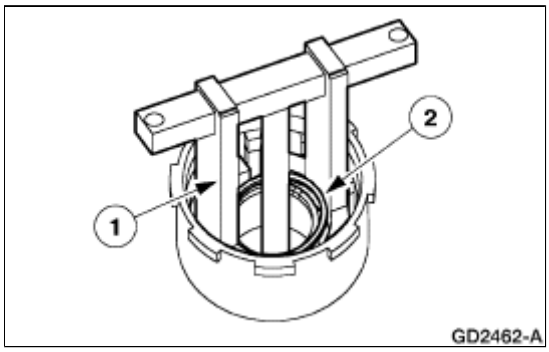
7. Install the direct clutch piston spring retainer and the twenty (20) direct clutch piston springs.
   1. Install the direct clutch piston springs.
   2. Place the direct clutch piston spring retainer on the direct clutch piston springs.



8. **WARNING: After removing the retaining ring, use care when releasing the pressure on the springs. Failure to follow these instructions may result in personal injury.**

   CAUTION: Do not fully compress the Clutch Spring Compressor or damage to the spring retainer may occur.

   Use a Clutch Spring Compressor to install the direct clutch piston retaining ring.
   1. Install the Clutch Spring Compressor and compress the direct clutch piston springs.
   2. Install the direct clutch piston retaining ring.

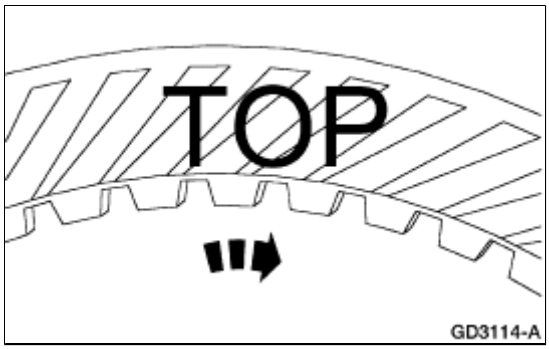


9. Relieve the direct clutch spring tension and remove the Clutch Spring Compressor.

10. **CAUTION: The direct clutch friction plates are directional and must be installed with grooves pointing clockwise (I.D. to O.D.) and the word (TOP) facing up.**

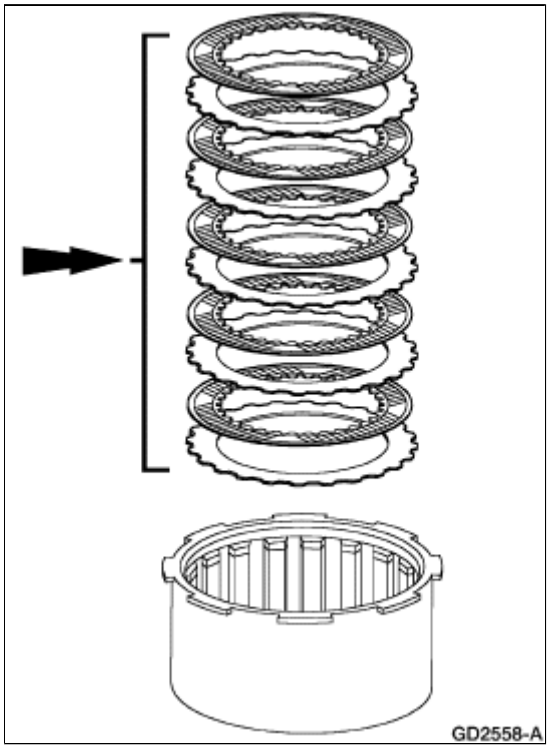
    CAUTION: If new plates are used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.

    When installing friction plates, the word (TOP) should face up. If reusing plates, grooves must be installed clockwise. Install the direct clutch disc pack.



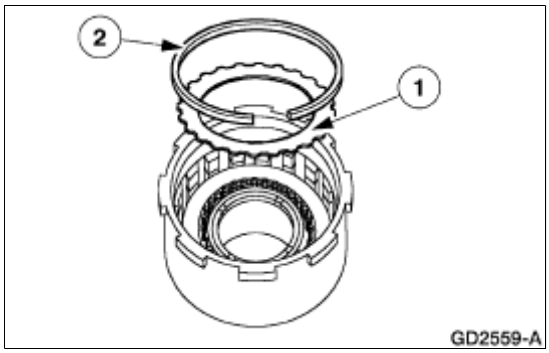
11. **NOTE:** If the steel plates are being replaced, make sure to use the correct steel plates. For SOHC use 1.71 mm (0.06 in) steel plates. For EI use 2.14 mm (0.08 in) steel plates.

    Install the steel clutch plates and friction clutch plates in alternating order starting with a steel clutch plate.



12. **CAUTION: The retaining ring is a select fit.**

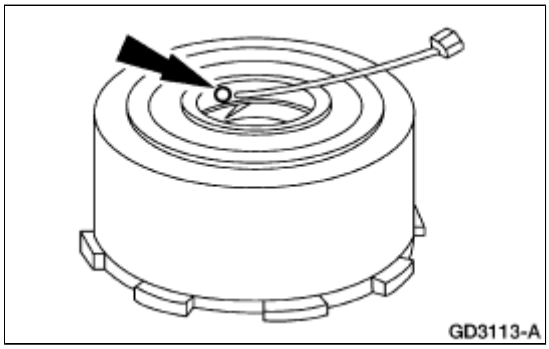
    Install the direct clutch pressure plate.
    1. Install the direct clutch pressure plate.
    2. Install the original direct clutch retaining ring on the direct clutch disc pack.



13. **WARNING: Air pressure must not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air. Make sure the drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

    NOTE: The direct clutch piston must apply with air pressure and release when the air is removed.

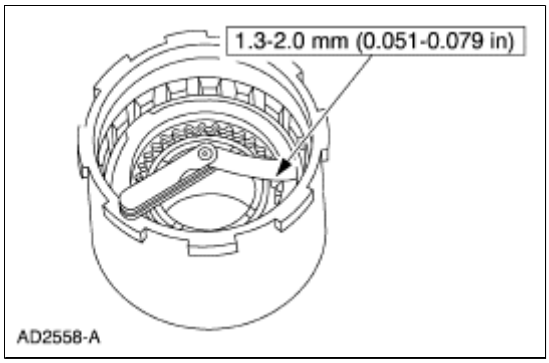
    Check the operation using compressed air.
    - Apply air pressure to the hole in the drum while blocking the other hole with a finger.



14. Push down on direct clutch disc pack and check gap between the direct clutch retaining ring and the direct clutch pressure plate with a feeler gauge.
    - If specifications do not match use a select fit direct clutch retaining ring to match specifications and verify with a feeler gauge.

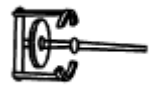
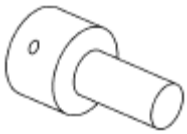
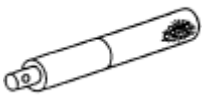
Direct Clutch

	Thickness		Diameter	
Part Number	mm	In	mm	In
E860126-S	1.37	0.0539	130.1	5.122
E860127-S	1.73	0.0681	130.1	5.122
E860128-S	2.08	0.0819	130.1	5.122
E860129-S	2.44	0.0961	130.1	5.122

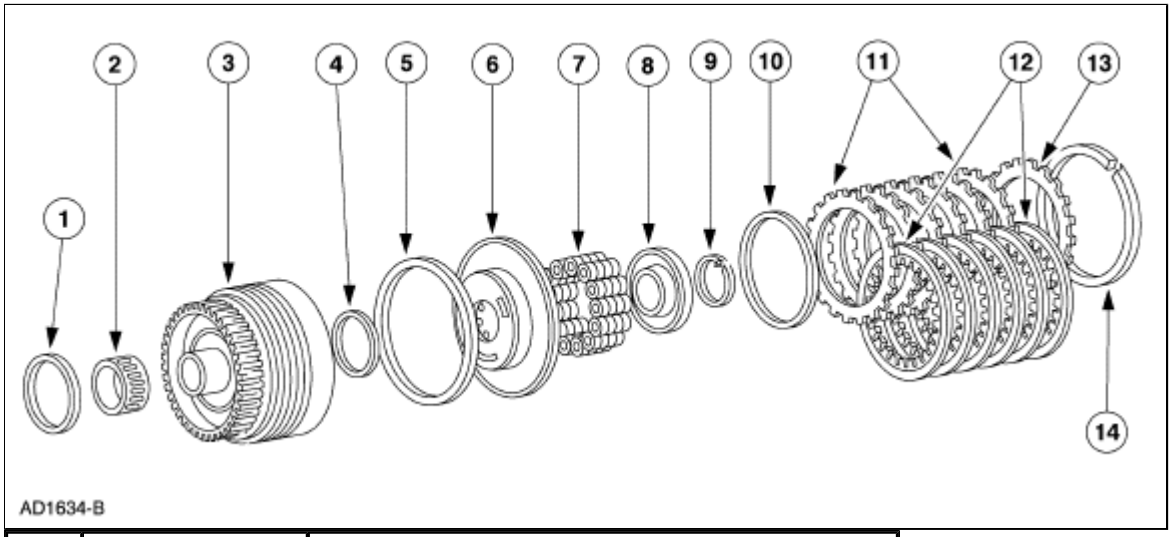

1.3-2.0 mm (0.051-0.079 in)
AD2558-A

Forward Clutch

Special Tool(s)

 ST1190-A	Clutch Spring Compressor 307-015 (T65L-77515-A)
ST1813-A	Inner Seal Protector 307-051 (T74P-77548-A)
ST1812-A	Outer Seal Protector 307-052 (T74P-77548-B)
 ST2185-A	Bearing Replacer 307-375
 ST1326-A	Handle 205-153 (T80T-4000-W)
ST1543-A	Step Plate 205-D012 (D80L-630-1)
ST2382-A	3 Jaw Puller 303-D120

Forward Clutch Assembly

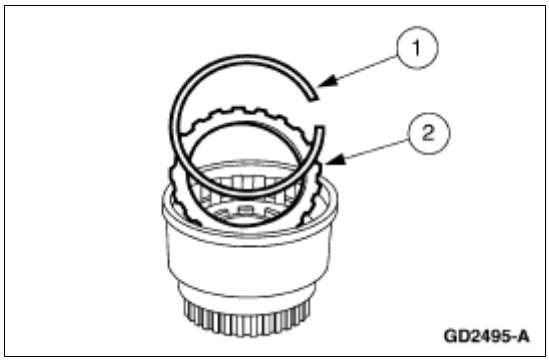


Item	Part Number	Description
1	7M153	Forward clutch cylinder thrust bearing (No. 5)
2	7M154	Forward clutch cylinder needle bearing
3	7A360	Forward clutch cylinder assembly
4	7A548	Forward clutch piston inner seal ring
5	7A548	Forward clutch piston outer seal ring
6	7A262	Forward clutch piston
7	7A480	Forward clutch piston spring (15 required)
8	7A527	Forward clutch piston spring retainer
9	E860109-S	Forward clutch retaining ring
10	7B070	Forward clutch cushion spring
11	7B442	Forward clutch external plate — steel
12	7B164	Forward clutch internal plate — friction
13	7B066	Forward clutch pressure plate
14	E860115S/118S	Forward clutch retaining ring (select fit)

Disassembly

1. **CAUTION: The retaining ring is a select fit. See assembly procedure if the ring or clutch plate pack is replaced.**

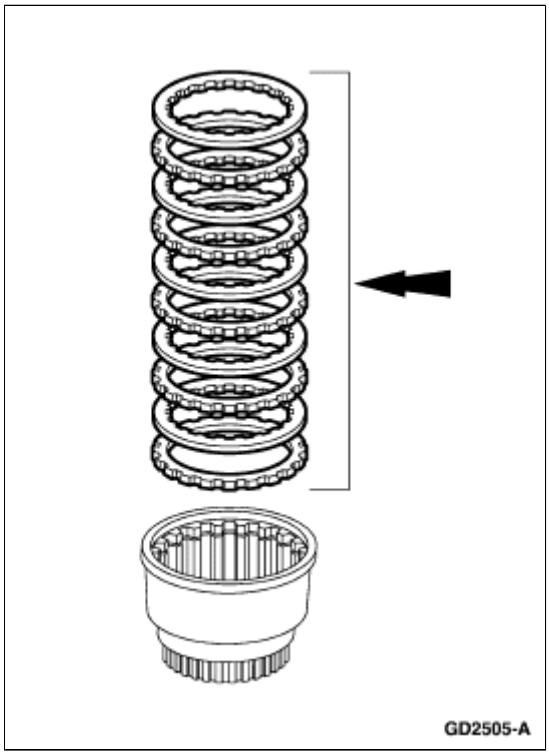
   Remove the forward clutch pressure plate.
   1. Remove the forward clutch retaining ring.
   2. Remove the forward clutch pressure plate.



2. **CAUTION: If new plates are being used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.**

   CAUTION: Clutch discs are directional. Note direction of grooves for installation.

   Remove the forward clutch disc pack.
   - Inspect the forward clutch plates for wear, damage or overheating.

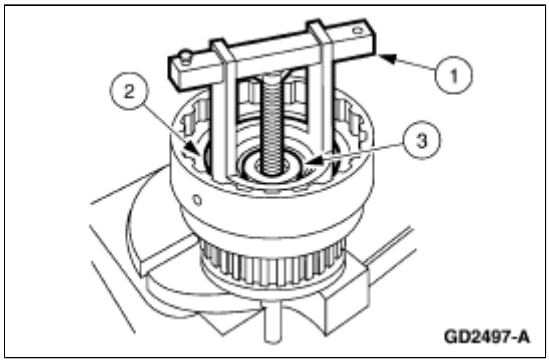


3. **WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions may result in personal injury.**

   CAUTION: Do not fully depress the Clutch Spring Compressor or damage to the spring retainer may occur.

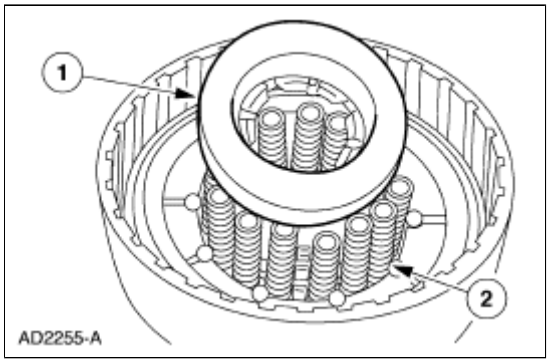
   Use Clutch Spring Compressor to remove the forward clutch piston retaining ring.

1. Install the Clutch Spring Compressor.
2. Compress the forward clutch piston springs.
3. Remove the forward clutch piston spring retaining ring.



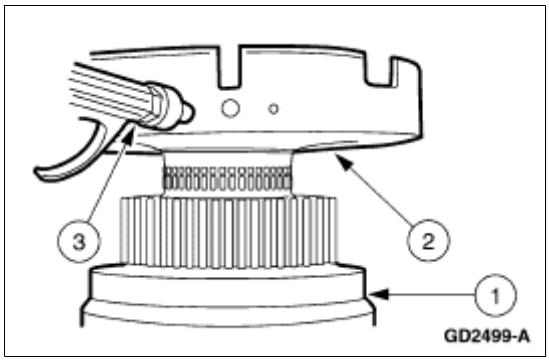
4. Relieve the forward clutch spring tension and remove the Clutch Spring Compressor.

5. Remove the forward clutch piston spring retainer and 15 forward clutch piston springs.
   1. Remove the forward clutch piston spring retainer.
   2. Remove the 15 forward clutch piston springs.
      - Inspect the forward clutch piston springs for distortion.

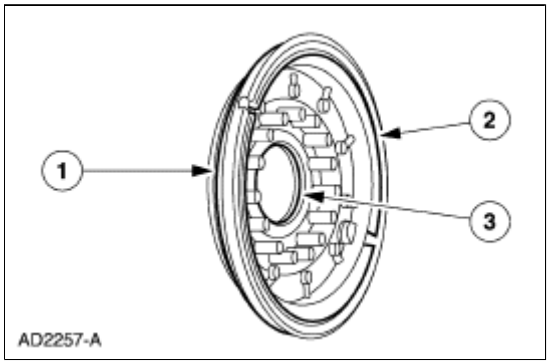


6. **WARNING: Air pressure must not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air. Make sure the cylinder is facing down as shown. Failure to follow these instructions may result in personal injury.**

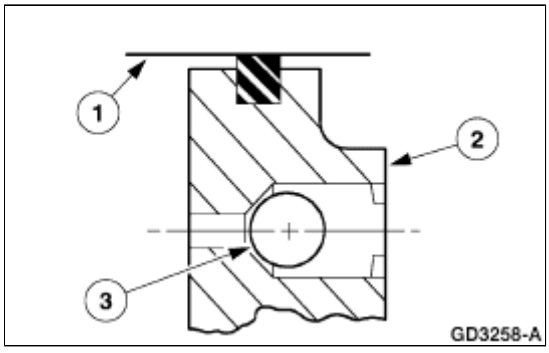
   Remove the forward clutch piston.
   1. Place the forward clutch cylinder with forward clutch piston facing down.
   2. Install the center support on the forward clutch cylinder.
   3. Apply air pressure to the left port of the center support.



7. Remove and discard the forward clutch piston seals.
    1. Remove the forward clutch piston outer seal and inspect the forward clutch piston for cracks.
    2. Remove forward clutch cushion spring.
    3. Remove the forward clutch piston inner seal.



8. Inspect the remaining forward clutch drum components for damage or wear, replace components as necessary:
    1. Inspect the forward clutch cylinder surfaces for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Replace the forward clutch cylinder if it is badly scored or damaged.
    2. Inspect forward clutch piston for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Replace forward clutch cylinder if it is badly scored or damaged.
    3. Make sure the check ball is free and clear of debris, has freedom of movement, and is properly seated.

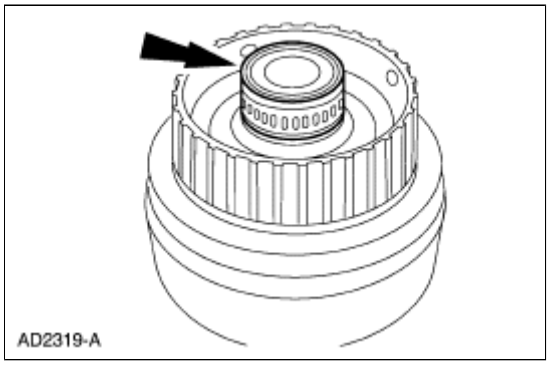


9. Inspect the forward clutch drum components.
    - Inspect clutch plate serration for scores or burrs.
    - Inspect fluid passages for obstructions. Clean out all passages.
    - Inspect the friction clutch plates, steel clutch plates and clutch pressure plate for worn or

scored bearing surface. Replace all parts that are deeply scored.
- Check clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.
- Check clutch hub thrust surfaces for scores and clutch hub splines for wear.
- Inspect for damage or wear to the clutch disc grooves and retaining ring grooves.

10. **NOTE:** Inspect the needle bearing for damage and install new if necessary.

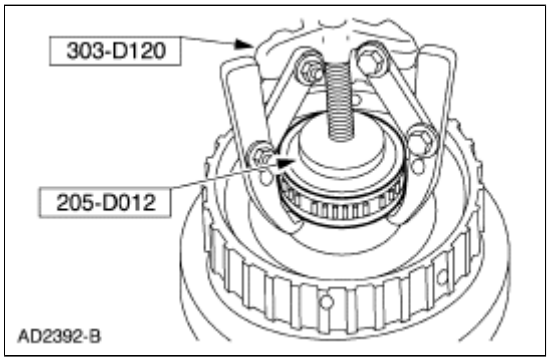
    Inspect the needle bearing for damage.



11. **CAUTION: Do not overtighten the tool or damage to the forward clutch bearing may occur**

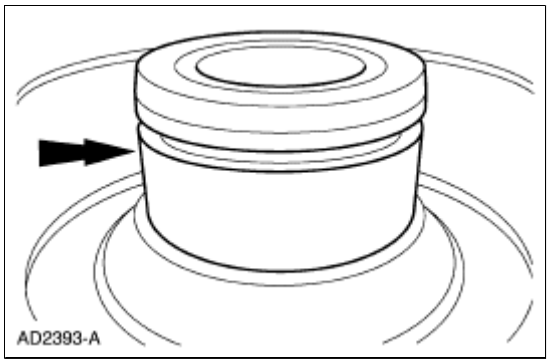
    NOTE: This step only needs to be carried out if there is damage to the bearing.

    Using the special tools, remove the forward clutch bearing.



12. **NOTE:** This step only needs to be carried out if there is damage to the bearing.

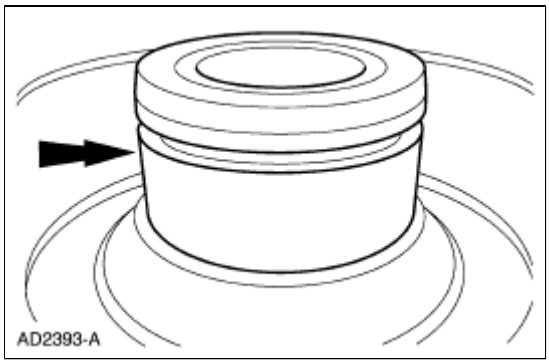
    Inspect the forward clutch outer race for scoring or nicks, if any damage is found the forward clutch drum will need to be replaced.



Assembly

1. Thoroughly clean all parts in solvent and blow dry with moisture free compressed air.
2. **NOTE:** This step only needs to be carried out if the bearing was removed.

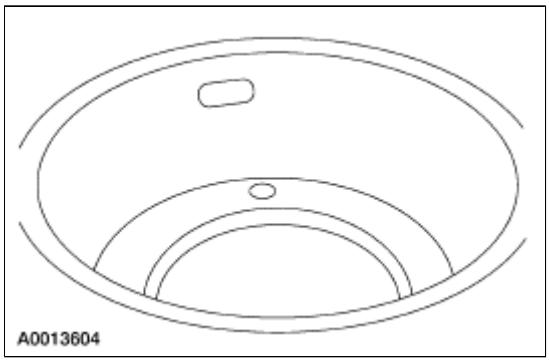
   Clean and lubricate the outer surface with clean transmission fluid.



3. **NOTE:** This step only needs to be carried out if the bearing was removed.

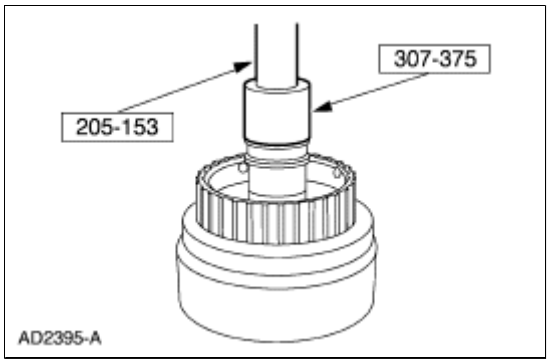
   NOTE: The rectangular hole in the inside of the forward clutch bearing must face up (away from the forward clutch drum)

   Install the forward clutch bearing with the rectangular hole facing up.



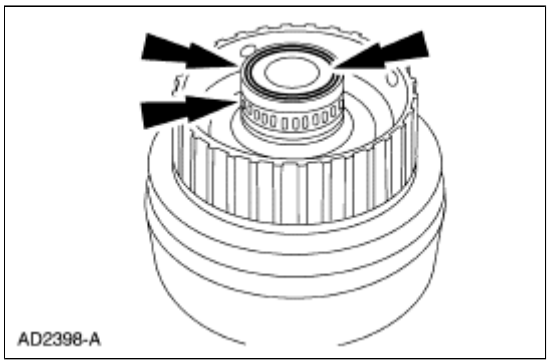
4. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Using the special tools, install the forward clutch bearing.



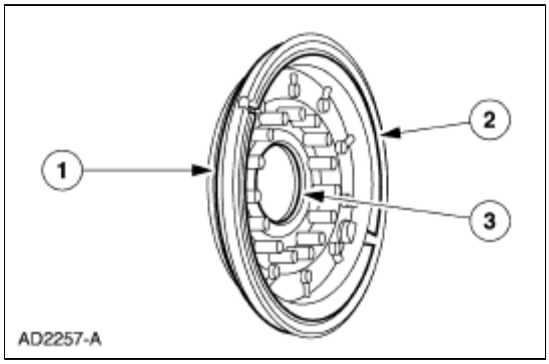
5. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Inspect that the bearing is properly seated on the drum. Inspect the top portion of the drum that it was not damaged, and the bearing rotates freely.



6. **CAUTION: If there is evidence of clutch plate burning, replace the forward clutch cushion spring.**

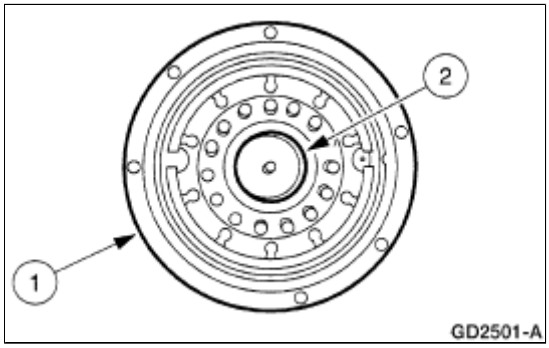
   Install new forward clutch piston seals.
   1. Install the forward clutch piston outer seal.
   2. Install forward clutch cushion spring.
   3. Install the forward clutch piston inner seal.



7. **NOTE:** Lubricate the forward clutch piston inner and outer seal with clean MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification.

   Install lip seal protector tools on the forward clutch piston.
   1. Install the Outer Seal Protector to the forward clutch piston outer seal.

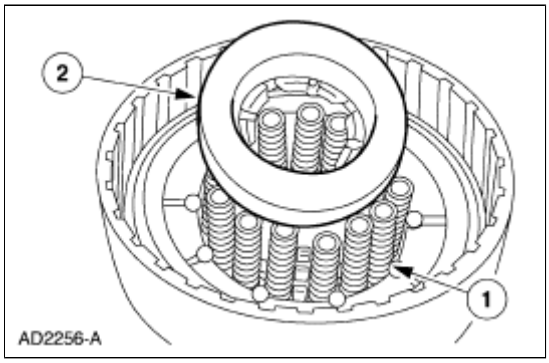
2. Install the Inner Seal Protector to the forward clutch piston inner seal.



8. **CAUTION: Care must be taken to prevent damage to the seals.**

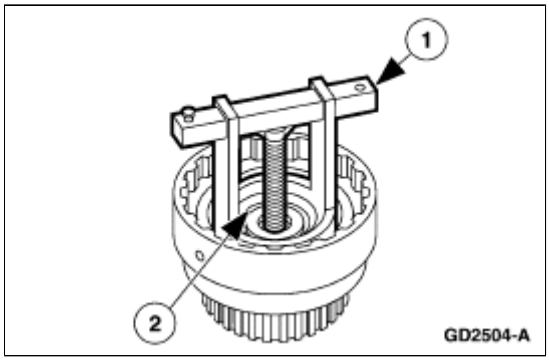
   As you install the forward clutch piston into the forward clutch cylinder, remove the Inner and Outer Seal Protectors.

9. Install the 15 forward clutch piston springs and the forward clutch piston spring retainer.
   1. Install the 15 forward clutch piston springs.
   2. Install the forward clutch piston spring retainer.



10. **CAUTION: Do not fully depress the Clutch Spring Compressor or damage to the spring retainer may occur.**

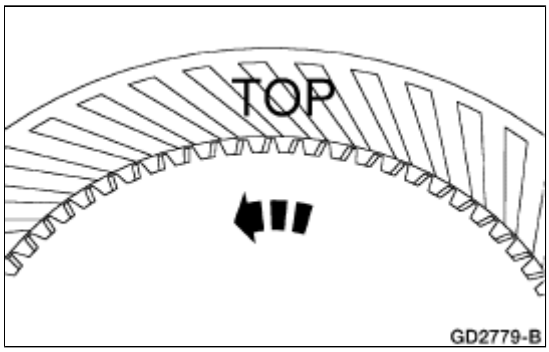
    Use the Clutch Spring Compressor to install the forward clutch piston spring retaining ring.
    1. Install the Clutch Spring Compressor and compress the forward clutch springs.
    2. Install the forward clutch piston spring retaining ring.



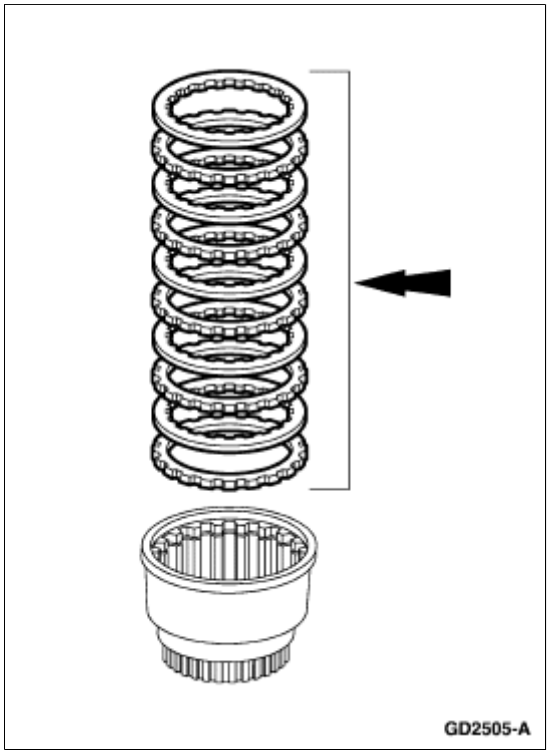
11. **CAUTION: The forward clutch friction plates are directional and must be installed with grooves pointing counterclockwise (I.D. to O.D.) and the word "TOP" facing up.**

    CAUTION: If new plates are used, they should be soaked in clean transmission fluid for at least 30 minutes before assembly.

    When installing friction plates, the word "TOP" should face up. If reusing plates, grooves must be installed counterclockwise. Install the direct clutch disc pack.

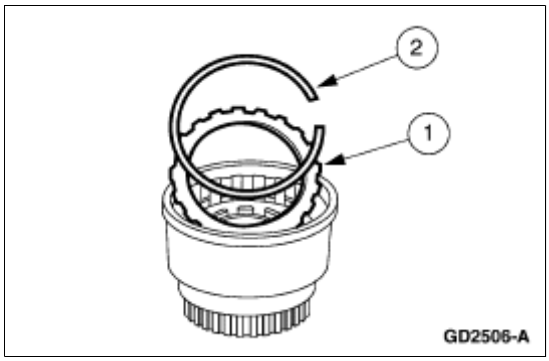


12. Install the steel clutch plates and friction clutch plates (quantity model dependent) in alternating order starting with a steel clutch plate.



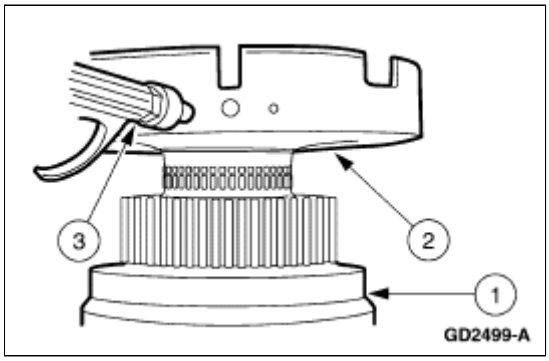
13. **CAUTION: The retaining ring is a select fit.**

    Install the forward clutch pressure plate and the original selective retaining ring.
    1. Install the forward clutch pressure plate.
    2. Install the forward clutch retaining ring.



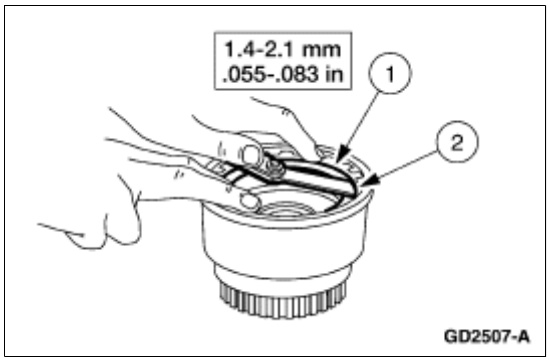
14. **WARNING: Air pressure must not exceed 138 kpa (20 psi). Wear safety glasses when using compressed air. Make sure the drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

    Air check the forward clutch piston.
    1. Place the forward clutch cylinder with forward clutch piston facing down.
    2. Install the transmission center support on the forward clutch cylinder.
    3. Apply air pressure to the left port of the center support.



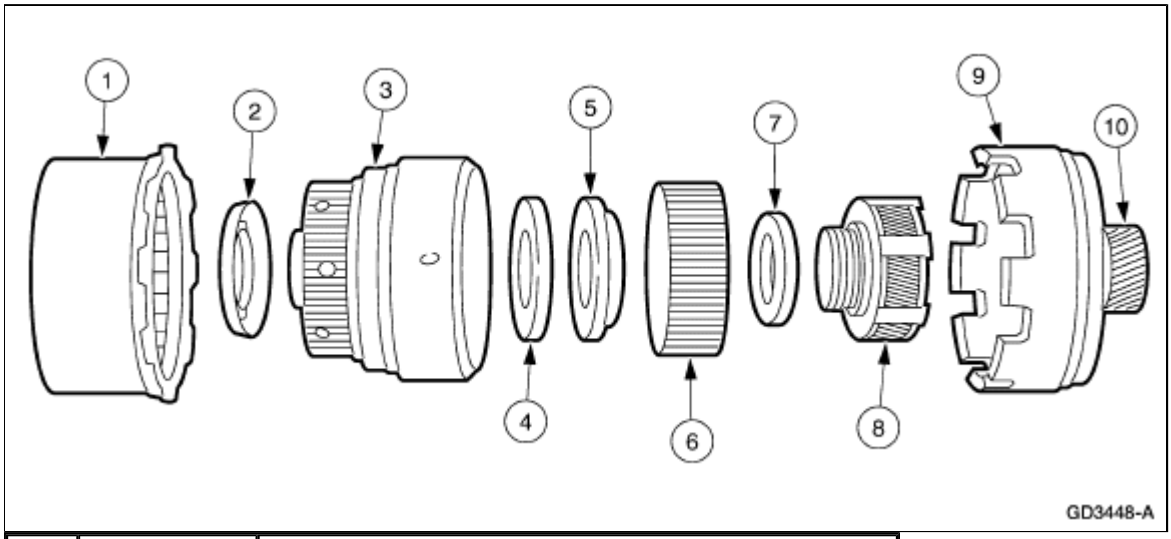
15. Check forward clutch disc pack free play.
    1. Press down on forward clutch disc pack.
    2. Using a feeler gauge, check the gap between the forward clutch retaining ring and the forward clutch pressure plate.
    - If the clearance is not within specifications, install the correct size retaining ring.

	Thickness		Diameter	
Part Number	mm	In	mm	In
E860115-S	1.37	.0539	125.1	4.925
E860116-S	1.73	.0681	125.1	4.925
E860117-S	2.08	.0819	125.1	4.925
E860118-S	2.44	.0961	125.1	4.925


1.4-2.1 mm
.055-.083 in
1
2
GD2507-A

Forward Geartrain

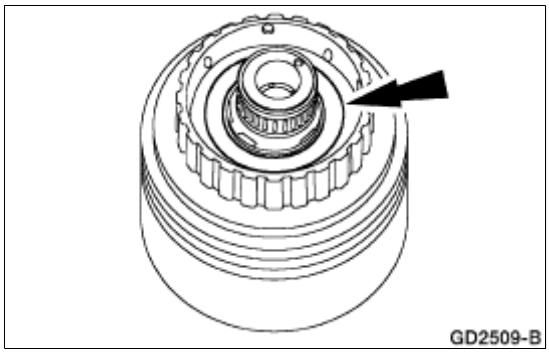
Forward Geartrain Assembly



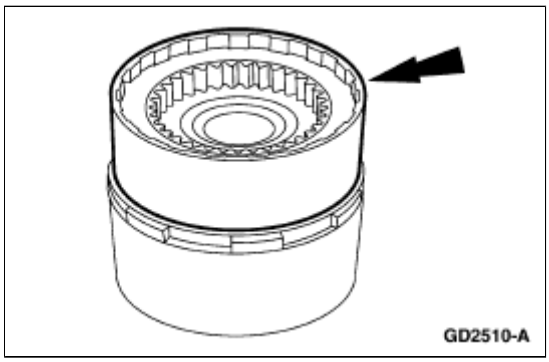
Item	Part Number	Description
1	—	Intermediate brake and direct clutch drum assembly
2	7M153	No. 5 forward clutch cylinder thrust bearing
3	—	Forward clutch cylinder assembly
4	7D234	No. 6A forward ring gear hub thrust bearing
5	7D090	No. 6B forward clutch thrust washer
6	7D392	Forward ring gear
7	7F374	No. 7 forward planetary thrust bearing
8	7A398	Forward planetary
9	7D064	Input shell
10	7D063	Forward sun gear

Assembly

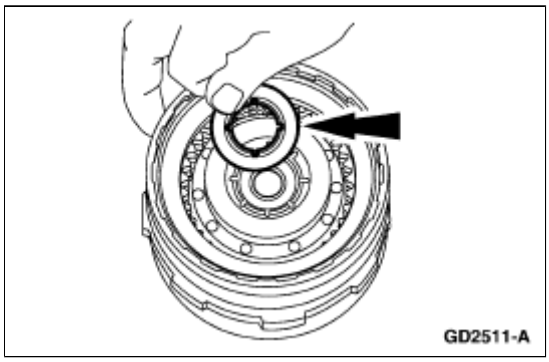
1. Install the forward clutch cylinder thrust bearing (No. 5) on the forward clutch cylinder assembly.
    - Use petroleum jelly to hold the forward clutch cylinder thrust bearing (No. 5) in place.



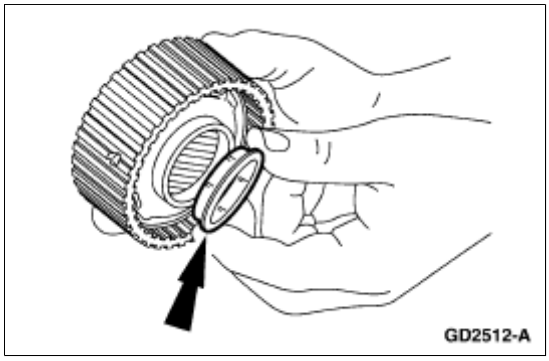
2. Install the forward clutch cylinder assembly into the intermediate brake and direct clutch drum assembly.



3. Install the forward ring gear hub thrust bearing (No. 6A) with the tabs facing up.

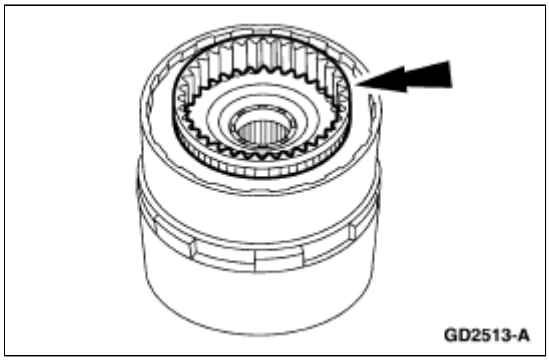


4. Install the forward clutch thrust washer (No. 6B) into the forward ring gear hub.
   - Use petroleum jelly to hold the forward clutch thrust washer (No. 6B) in place.



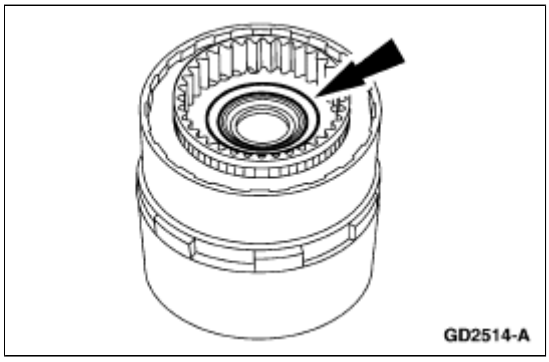
5. **NOTE:** Make sure the forward ring gear hub thrust bearing (No. 6A) and forward clutch thrust washer (No. 6B) are inside the forward ring gear.

   Install the forward ring gear (7D392) into the forward clutch cylinder.



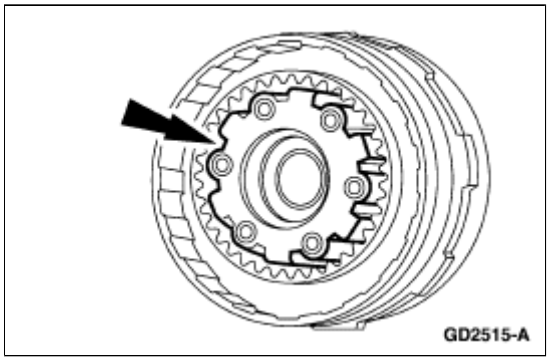
6. **CAUTION: Black oxidized color of thrust bearing must face up towards the planetary assembly.**

   Install the forward planetary thrust bearing (No. 7) into the forward ring gear.



7. **NOTE:** The forward planetary assembly is serviced with a 6 pinion assembly in all applications.

   Install the forward planetary assembly into the forward ring gear.

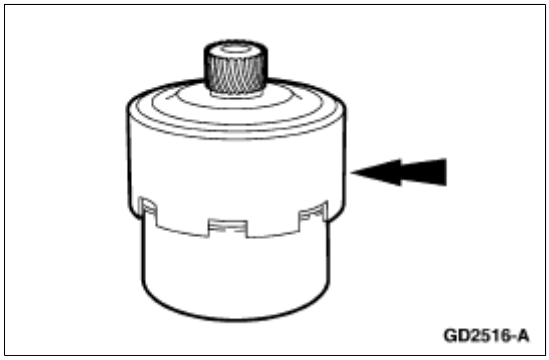


8. **NOTE:** There is not a bushing inside the forward sun gear or washer on the back of the input shell.

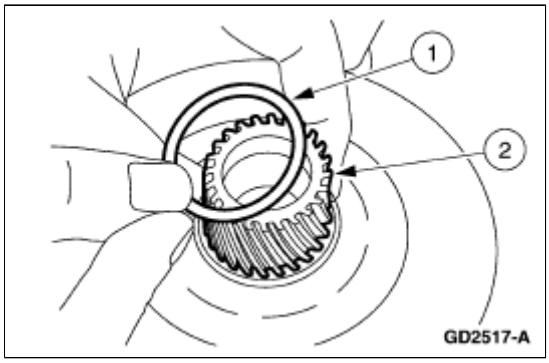
   NOTE: If the sun gear or input shell is damaged perform the following steps, if not, install the input shell and forward sun gear assembly into planetary gearset.

NOTE: Ensure the forward sun gear aligns with the forward planetary assembly. Ensure the input shell aligns with the intermediate brake and direct clutch.

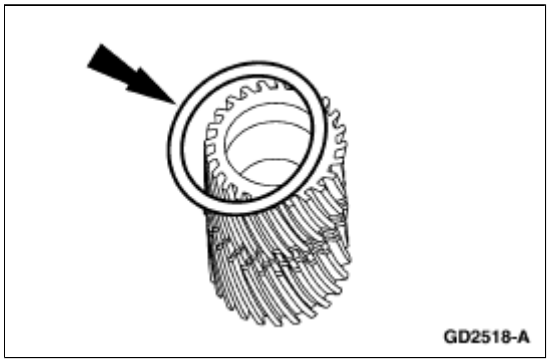
Inspect sun gear and input shell for damage or wear. If sun gear or input shell are damaged, repair/install new as necessary. Install the input shell and forward sun gear assembly into planetary gearset.



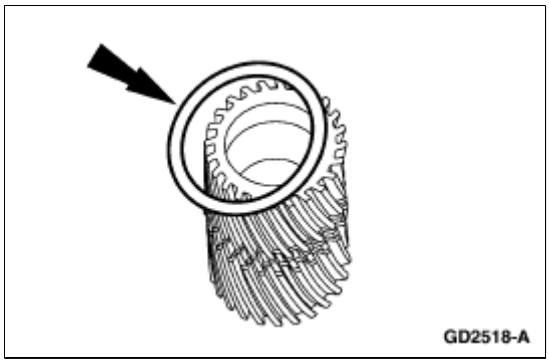
9. Remove the rear retaining ring, sun gear, and the retaining ring from the sun gear.
    1. Remove the rear retaining ring.
    2. Remove the sun gear.



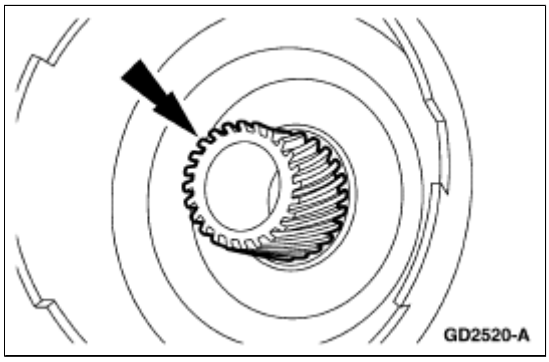
10. Remove the front retaining ring from the sun gear.



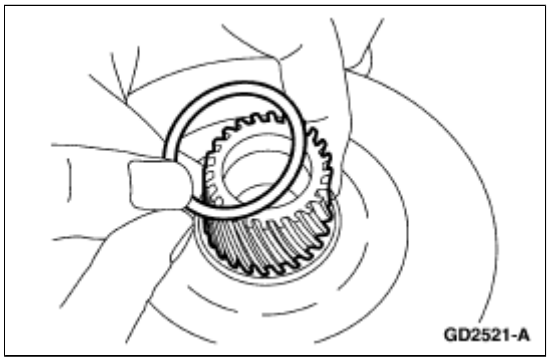
11. Install a new retaining ring onto the sun gear.



12. Install the sun gear into the input shell.



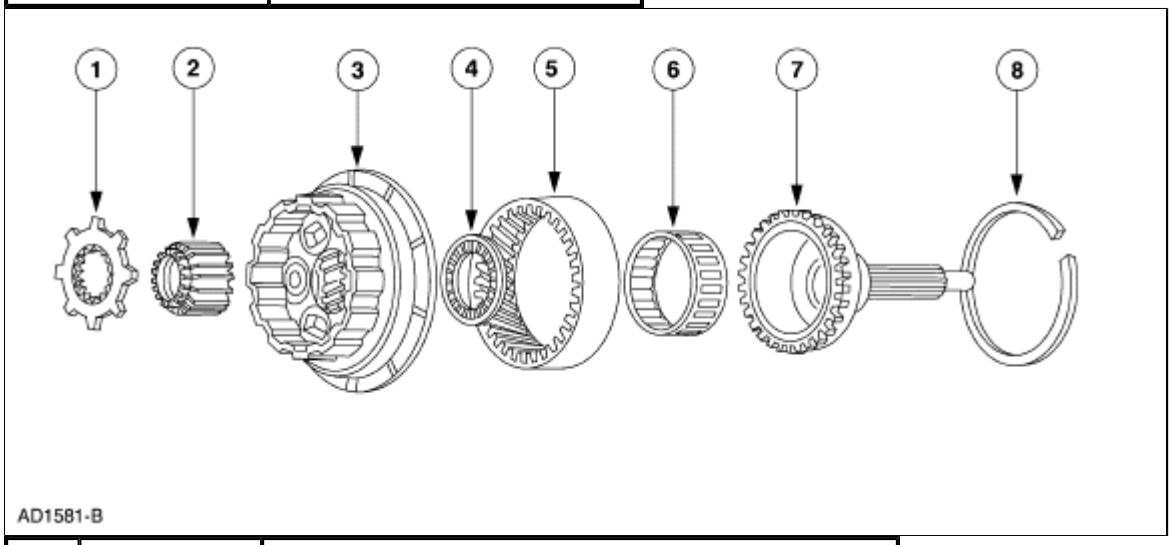
13. Install a new rear retaining ring.



Front Planetary and One-Way Clutch Assembly

Special Tool(s)

ST2189-A	One-Way Clutch Sleeve 307-391
ST2190-A	One-Way Clutch Pusher 307-392

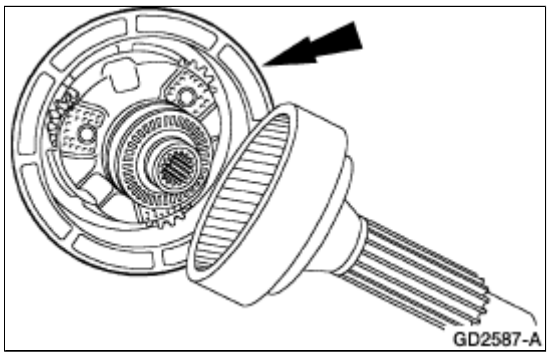


AD1581-B

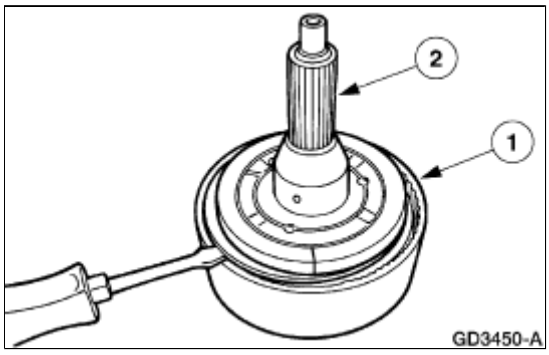
Item	Part Number	Description
1	7660	Coast Clutch Adapter
2	7D063	Front Sun Gear
3	7B446	Front Planetary Gear Carrier Assembly
4	7L495	No. 2 Front Planetary Thrust Bearing
5	7653	Front Ring Gear
6	7C109	Front One-Way Clutch Bearing
7	7A658	Center Shaft and Front One-Way Clutch Assembly
8	E860119-S	Retaining Ring

Disassembly

1. Inspect the one-way clutch.
    - Temporarily insert the front planetary gear carrier assembly into the center shaft and one-way clutch assembly for verification of the one-way clutch.
    - The planetary gear must rotate counterclockwise and hold when rotated clockwise.
    - Remove the planetary gear carrier assembly.

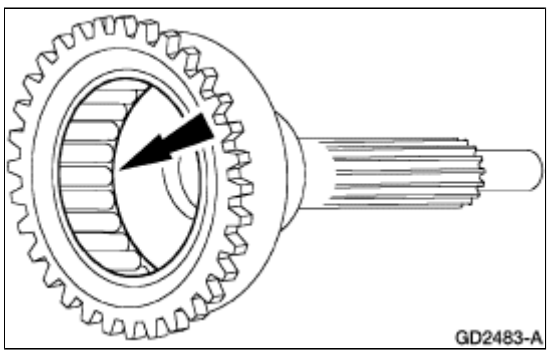


2. Remove the overdrive center shaft from the front ring gear.
    1. Remove the front center shaft retaining ring.
    2. Remove the center shaft from the ring gear.



3. **NOTE:** If the inner race of the front planetary gear is damaged, the front one-way clutch can be replaced. If the center shaft is damaged the complete front one-way clutch must be replaced as an assembly.

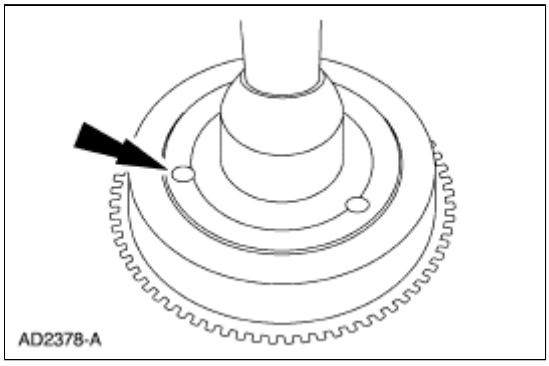
    Clean and inspect the front one-way clutch and center shaft.
    - Inspect the roller cage for cracks.
    - Inspect the roller clutch for wear.
    - Inspect the press fit of the one-way clutch to the center shaft.
    - Inspect the spring and roller cage for bent or damaged spring retainers.



4. **CAUTION: Do not score the center shaft bore.**

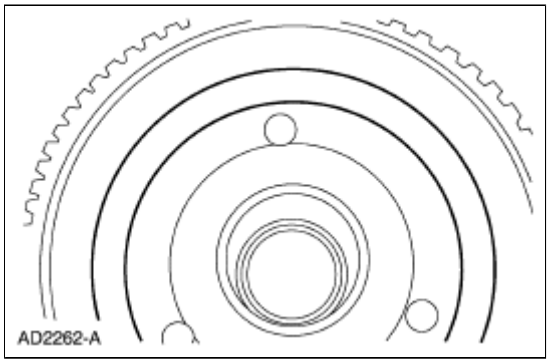
   NOTE: This step only needs to be carried out if there is damage to the bearing.

   Insert a screwdriver through the holes, remove the front one-way clutch from the center shaft.



5. **NOTE:** This step only needs to be carried out if there is damage to the bearing.

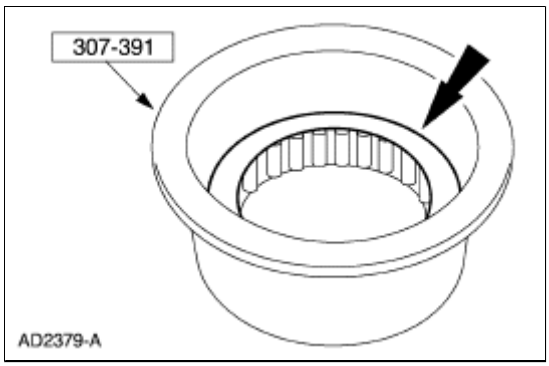
   Inspect the center shaft bore for damage. If the outer race of the center shaft bore is damaged, the front one-way clutch and center shaft must be replaced



Assembly

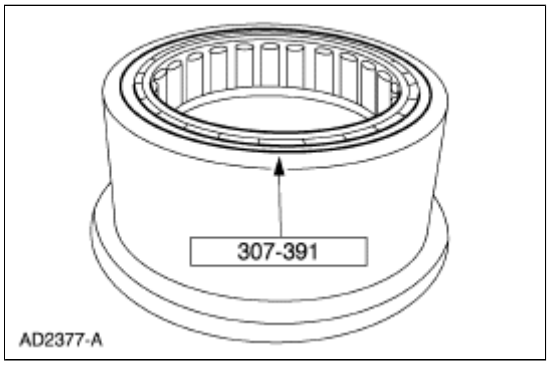
1. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Install the front one-way clutch into the special tool with the brass end cap facing up.



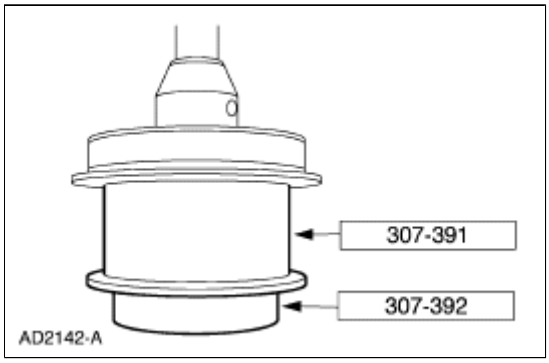
2. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Inspect that the front one-way clutch is flush with the special tool.



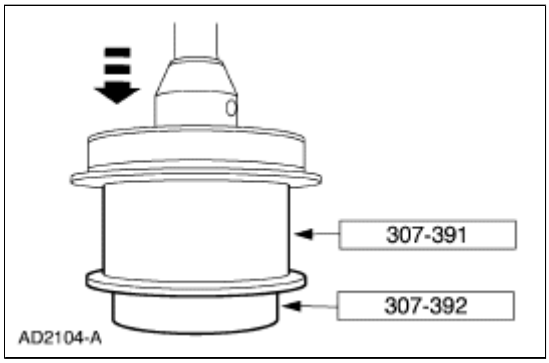
3. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Assemble the special tools with the front one-way clutch onto the center shaft.



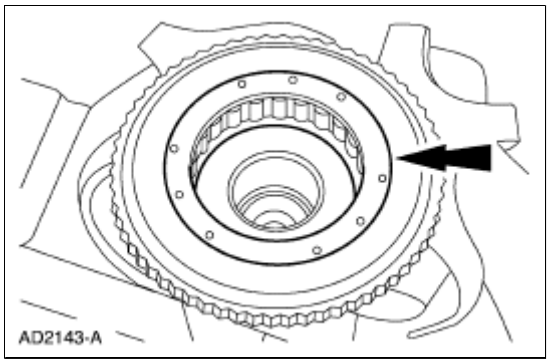
4. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Push down on the center shaft to seat the front one-way clutch into the center shaft.

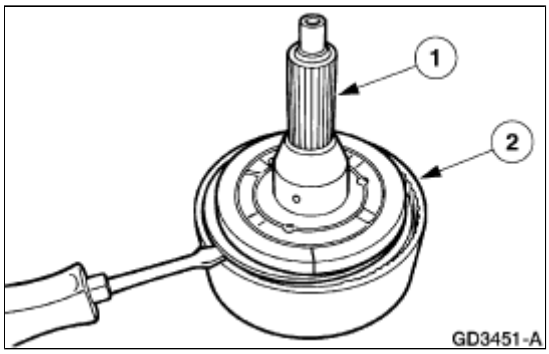


5. **NOTE:** This step only needs to be carried out if the bearing was removed.

   Inspect the front one-way clutch for proper installation and function. The front one-way clutch tabs should be flush with the center shaft.



6. Install the center shaft and one-way clutch onto the front ring gear.
    1. Install the center shaft and one-way clutch.
    2. Install the center shaft retaining ring.



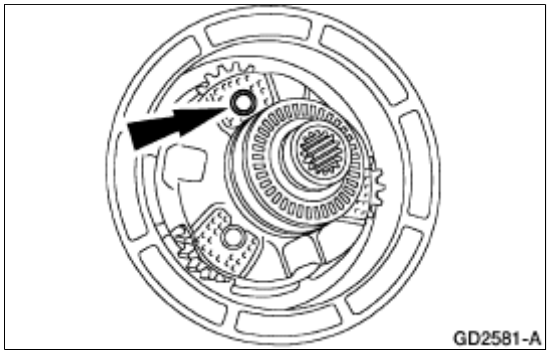
Front Planetary Gears

Disassembly

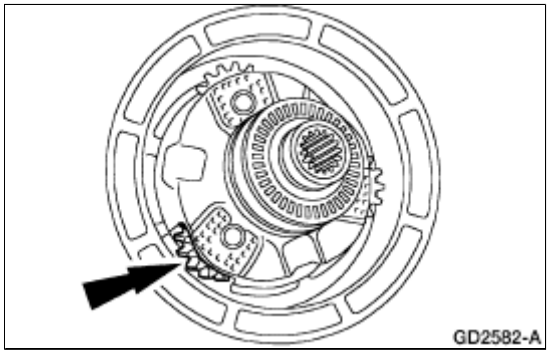
1. **CAUTION: Planetary gears must be replaced. Do not restake them.**

   NOTE: Individual parts of the planetary carriers are not serviceable.

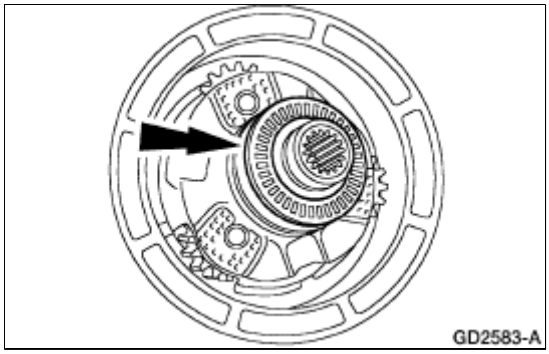
   Before installing a planetary assembly, the shaft retaining pins should be checked for adequate staking. Use a new planetary assembly if either of the following conditions exist. Check the pins and shafts in the planetary assemblies for loose fit and or complete disengagement.



2. Inspect the pinion gears for damaged or excessively worn teeth, and for free rotation.

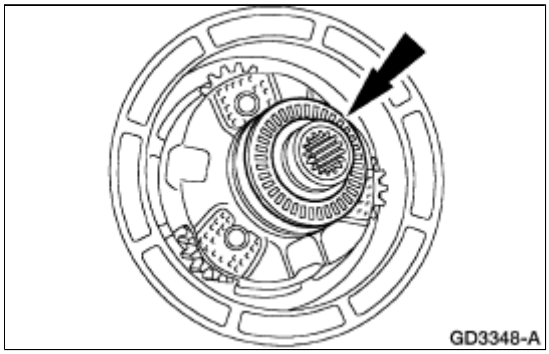


3. Inspect the front one-way clutch inner race for scoring. If the front one-way clutch inner race is scored or damaged the front planetary gear, center shaft, and one-way will need to be replaced.



4. Inspect the inner and outer races for scored or damaged surface areas where the rollers contact the races.

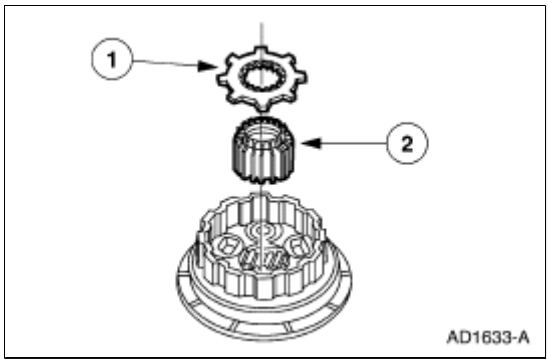
5. Remove and inspect the No. 2 front planetary thrust bearing on the nose of the front planetary gear carrier assembly.



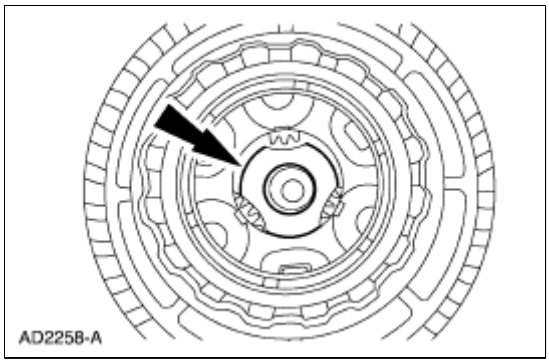
6. **NOTE:** Note the location of the part number stamped on the coast clutch adapter (7660) for assembly.

   NOTE: Inspect the sun gear for damaged or worn teeth.

   Remove the front sun gear.
   1. Remove the coast clutch to front carrier adapter.
   2. Remove the front sun gear.



7. Inspect the No. 12 bearing for damage.

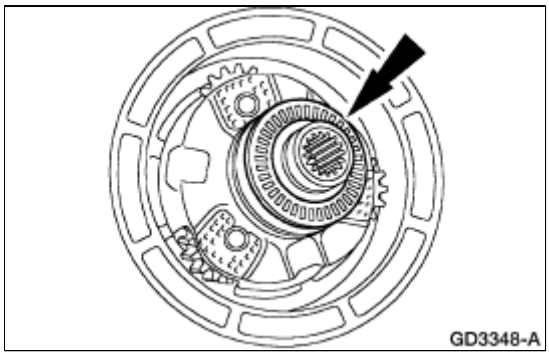


Assembly

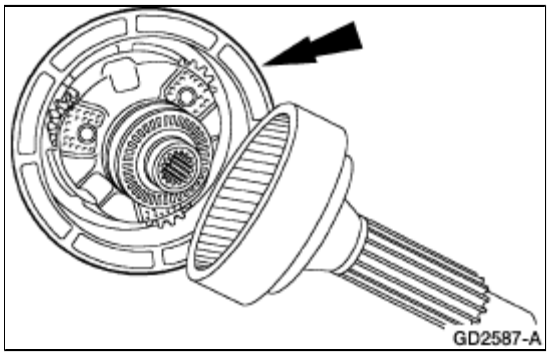
1. **NOTE:** Thoroughly clean all parts and blow dry with moisture free compressed air.

   NOTE: Use petroleum jelly to hold the front planetary thrust bearing (No. 2) in place.

   Install the No. 2 front planetary thrust bearing.

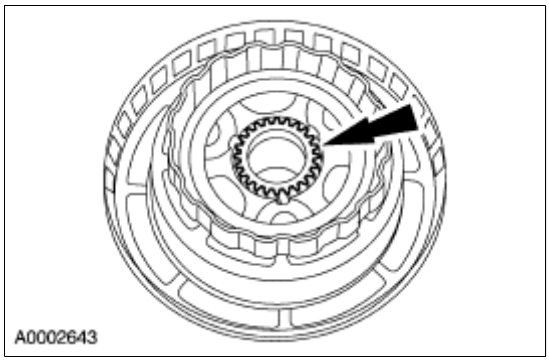


2. Install the front planetary gear carrier into the center shaft and front ring gear (7A153).



3. **CAUTION: Make sure that the No. 12 bearing is in place in the overdrive planetary prior to installing the overdrive sun gear.**

   Install the front sun gear with the recessed gear teeth facing toward the adapter.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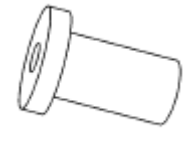
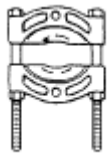
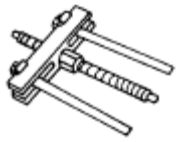
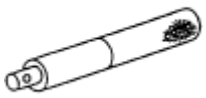
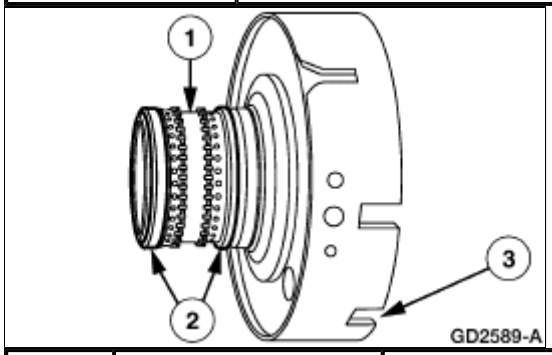
Center Support

Special Tool(s)

 ST2186-A	Bearing Replacer 307-374
ST1543-A	Step Plate 205-D018 (D80L-630-7)
 ST1368-A	Pinion Bearing Cone Remover 205-D002 (D79L-4621-A)
 ST1516-A	Front Hub Tool 204-069 (T81P-1104-C)
 ST1326-A	Handle 205-153 (T80T-4000-W)



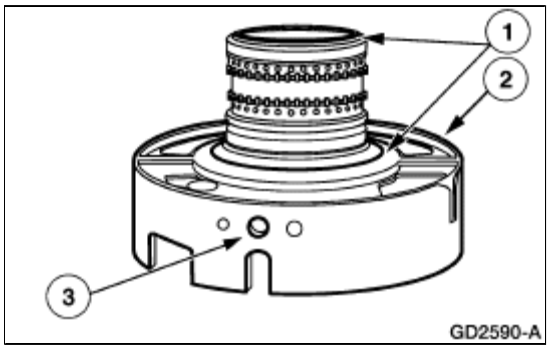
Item	Part Number	Description

1	7M155	Bearing
2	—	Seal Rings (Part of 7M155)
3	7A130	Center Support

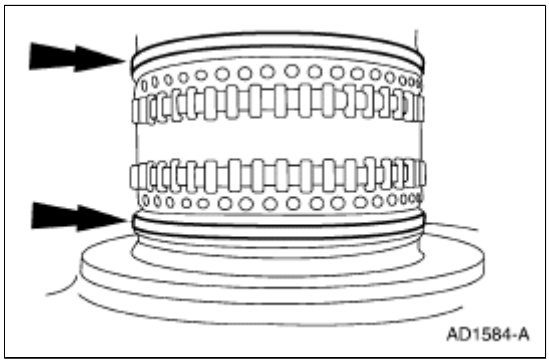
NOTE: Thoroughly clean center support assembly and blow dry with compressed air.

NOTE: The center support is serviced as an assembly. Any damage requires replacement of entire component.

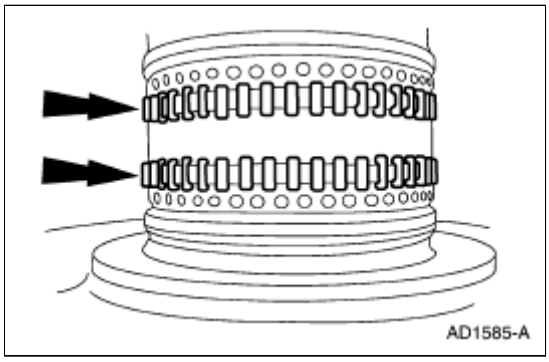
1. Inspect the center support assembly for wear or damage.
    1. Inspect the thrust surfaces for wear, scoring or damage.
    2. Inspect the center support sealing surface.
    3. Inspect the fluid passage for blockage or damage.



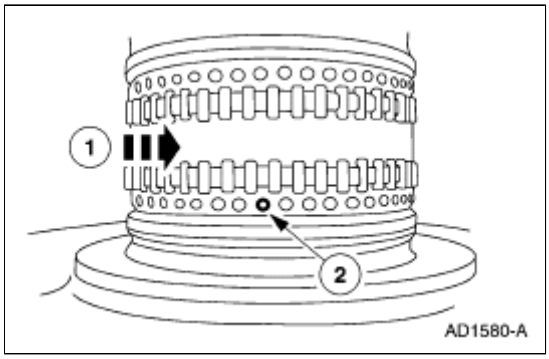
2. Inspect the seal rings for damage.



3. Inspect the bearing for missing rollers or damage.



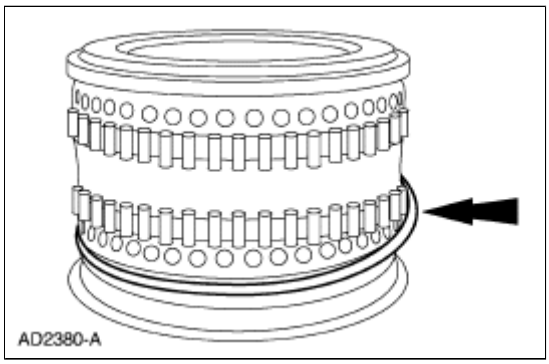
4. Inspect the direct clutch feed hole for blockage or damage.
    1. Rotate center support bearing to locate the direct clutch feed hole.
    2. Inspect the direct clutch feed hole for blockage or damage.



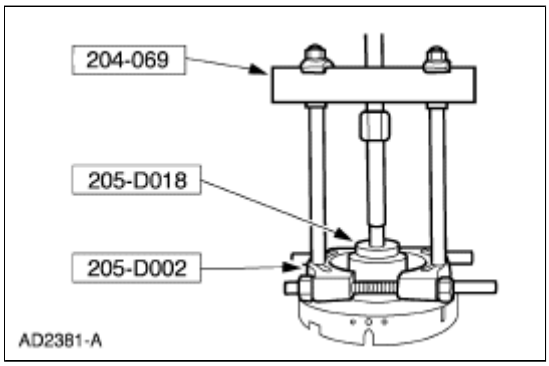
5. **NOTE:** Carry out the rest of the procedure only if there is damage to the bearing.

   NOTE: Inspect the needle bearing for damage and install new if necessary.

   Remove the lower seal.



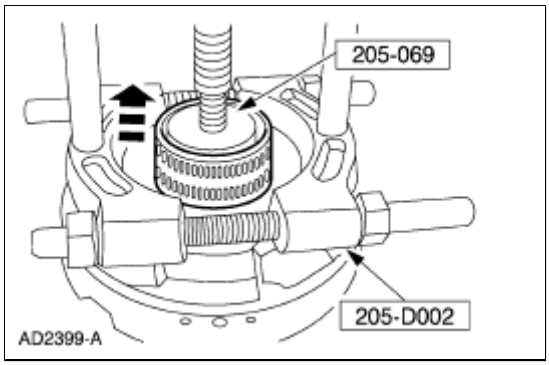
6. Assemble the special tools onto the center support.



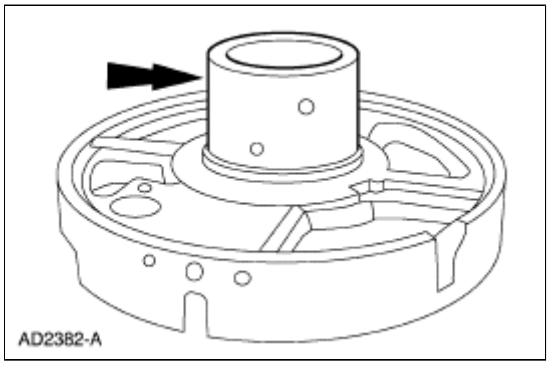
7. **CAUTION: Do not overtighten the tool or damage to the bearing may occur.**

   NOTE: The Pinion Bearing Cone Remover Tool must fit into the lower seal groove.

   Using the special tools, remove the needle bearing.

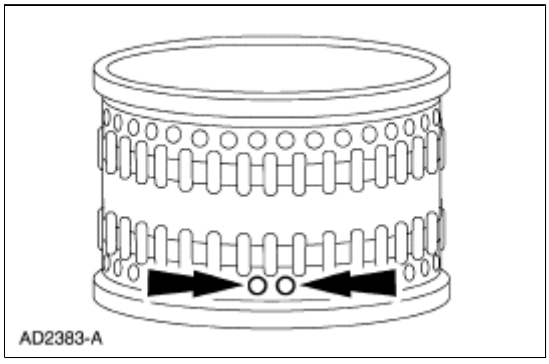


8. Inspect the front pump outer race for scoring or nicks, if any damage is found the pump assembly will need to be replaced.

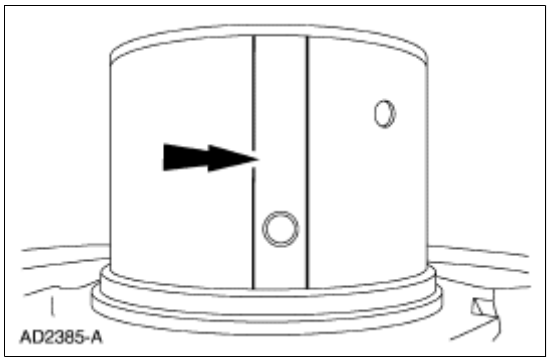


Assembly

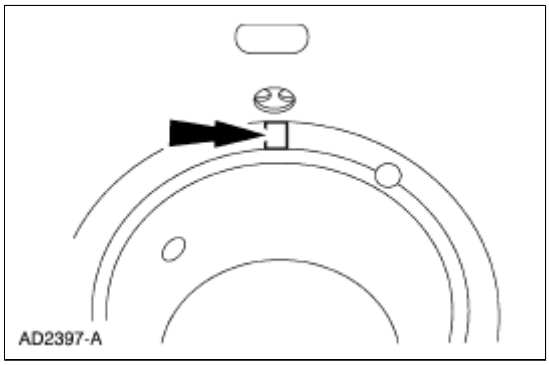
1. Align two of the center lower bearing holes with the lube hole in the bottom of the bearing.



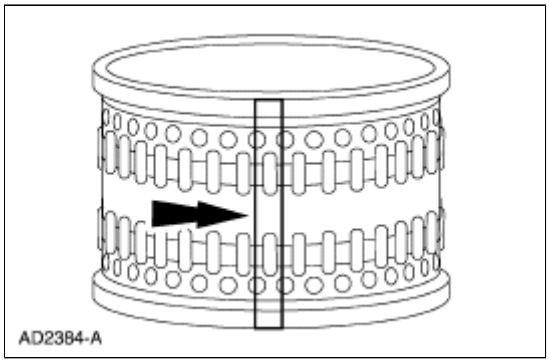
2. Using a black felt tip marker draw a line from the top of the center support snout to the hole at the bottom of the center support. This will be used as an alignment when installing the bearing.



3. Make an alignment mark on the top of the center support



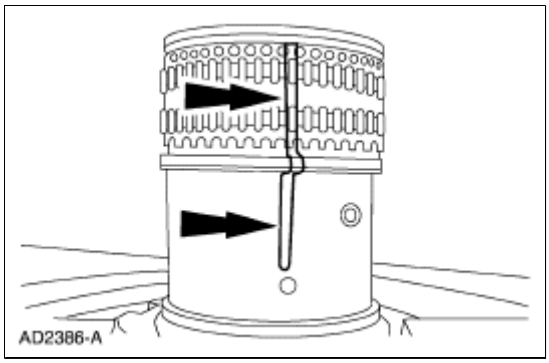
4. Using a black felt tip marker draw a line from the bottom lower holes to the top of the bearing. This will be used as an alignment when installing the bearing.



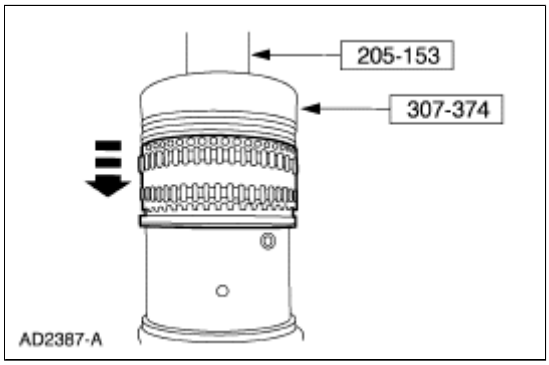
5. **CAUTION: The alignment marks on the bearing and the support must be aligned or a transmission failure could occur.**

   NOTE: The small hole on the inside of the bearing must be in the down position. (toward the center support)

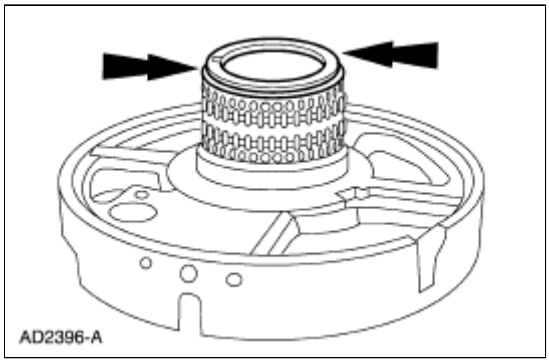
   Install the bearing onto the center support.



6. Using the special tools, install the center support bearing.



7. After the center support bearing has been installed inspect the top of the bearing and center support for any damage.

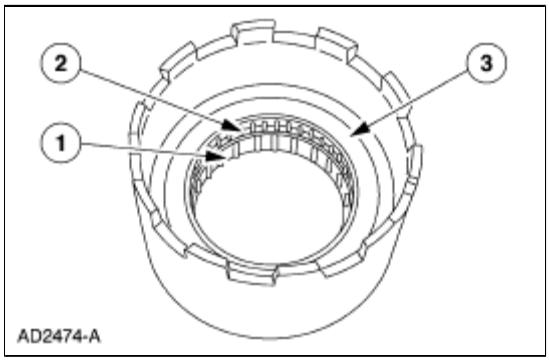


Reverse Brake Drum

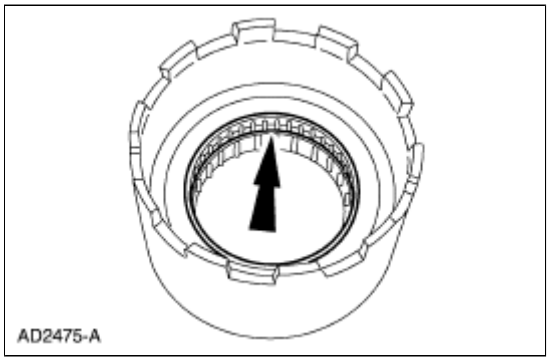
Disassembly

1. **NOTE:** New low reverse one-way clutch and rollers can now be installed. The following procedure only needs to be carried out if there is damage to the low reverse one-way clutch and roller bearing.

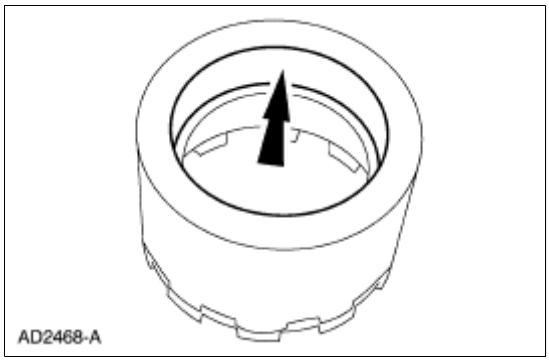
   Inspect the reverse brake drum for damage.
   1. Inspect the low reverse one-way clutch.
   2. Inspect the roller bearing.
   3. Inspect the reverse brake drum.



2. With the reverse clutch drum supported use a flat drift punch to tap the one-way clutch and the roller bearing out of the drum.

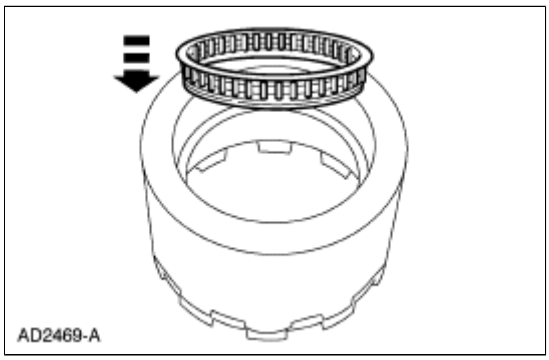


3. Inspect the low reverse one-way clutch inner race and roller bearing inner race for scoring, and nicks. If damage is indicated a new reverse clutch drum will need to be installed as an assembly.

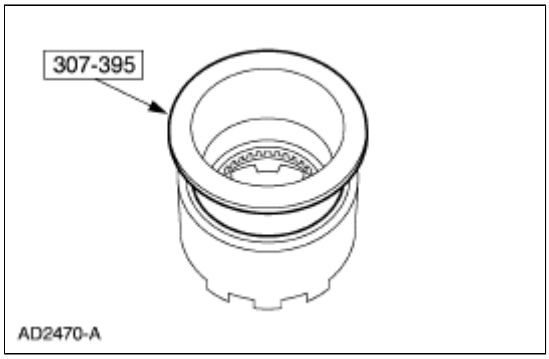


Assembly

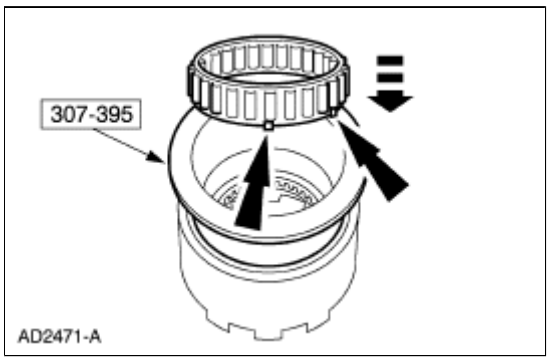
1. Install the roller bearing with the lip facing up toward the low reverse one-way clutch.



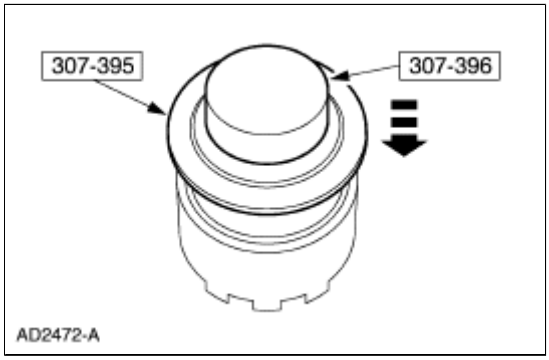
2. Install the special tool.



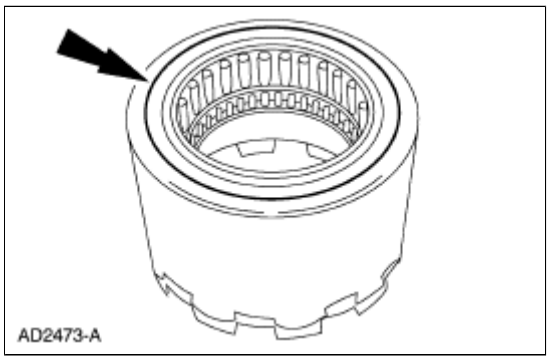
3. Install the low reverse one-way clutch with the tabs facing down toward the roller bearing.



4. Using the special tools, install the one-way clutch by pressing down on the tool to seat the bearing

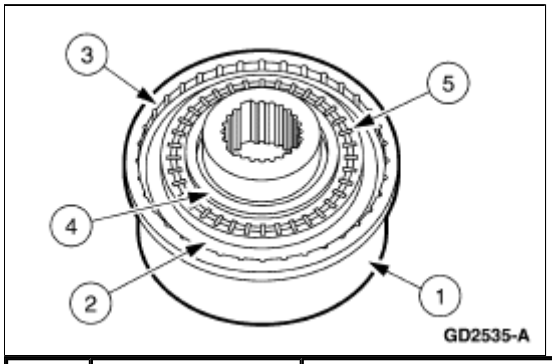


5. Inspect the reverse clutch drum to see if the low reverse one-way clutch is seated correctly.



Output Shaft Ring Gear and Hub Shaft Assembly

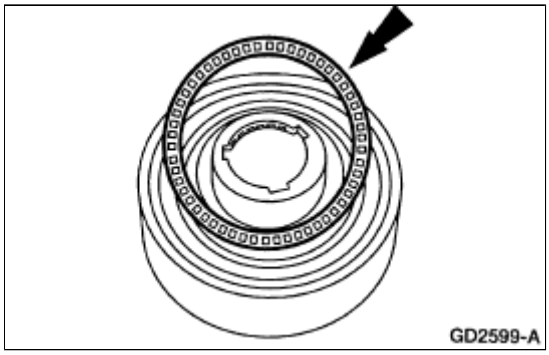
Disassembly



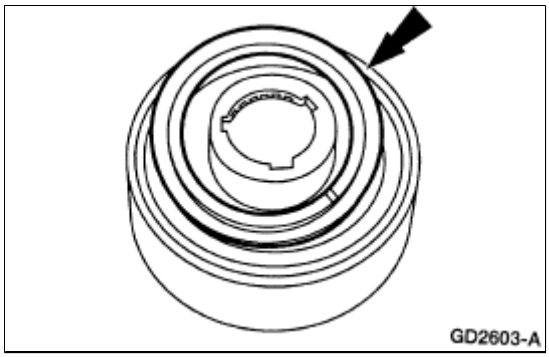
Item	Part Number	Description
1	7A153	Shaft ring gear
2	7D164	Output shaft hub
3	E860122-S	Retaining ring
4	7M150	Needle bearing race assembly (No. 10A)
5	7M150	Needle bearing (No. 10B)

1. Inspect the output shaft ring gear, output shaft hub, needle bearing (10B), and needle bearing race (10A) assembly for damage. If service is required use the following procedure.

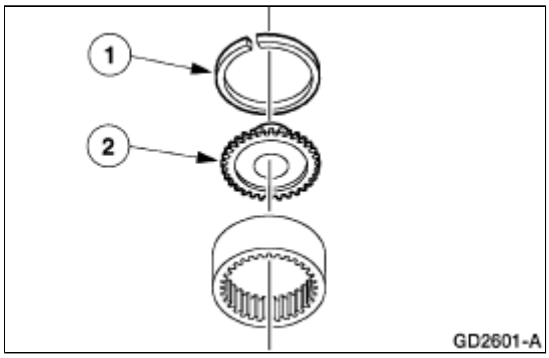
2. Remove the No. 10B needle bearing.



3. Remove the No. 10A needle bearing race assembly.

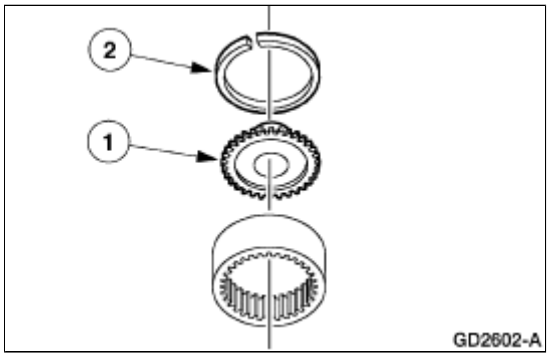


4. Remove the output shaft hub from the output shaft ring gear.
    1. Remove the retaining ring.
    2. Remove the output shaft hub.

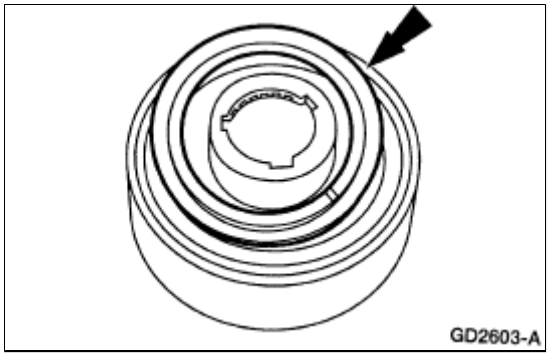


Assembly

1. Install the output shaft hub onto the output shaft ring gear.
    1. Install the output shaft hub.
    2. Install the retaining ring.

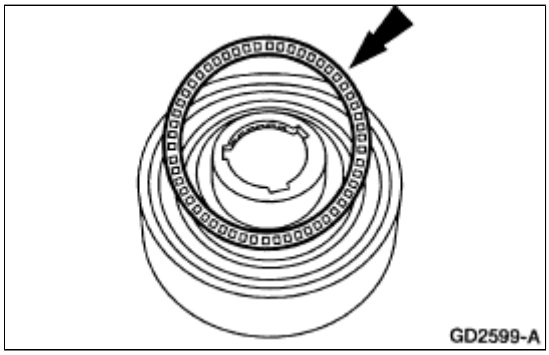


2. Install the No. 10A needle bearing race assembly.
    - Snap the needle bearing race assembly onto the output shaft hub.



3. **NOTE:** Use petroleum jelly to hold needle bearing to.

   Install the No. 10B needle bearing onto output shaft ring gear and output shaft hub.



Torque Converter

1. A new torque converter (7902) must be installed if one or more of the following statements are true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - Converter stud(s), impeller hub or bushing are damaged.
    - Discoloration of the torque converter (due to overheating).
    - The torque converter is found to be out of specification when performing one of the following torque converter checks:
        - One-way clutch check
        - End play check
        - Stator to turbine interference check
        - Stator to impeller interference check
        - Torque converter leak check
    - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
        - Major metallic failure
        - Multiple clutches or clutch plate failures
        - Sufficient component wear which results in metallic contamination

Torque Converter Cleaning And Inspection

1. If the torque converter is being replaced, continue with Substep 2 of Step 2.

2. If the torque converter is not being replaced, the following procedures must be carried out:
    1. The torque converter must be thoroughly cleaned.
        - Torque converters with drain plugs can be cleaned by using a suitable torque converter fluid cooler cleaner.
        - Torque converters without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with new fluid specified for transmission, and reinstall.
    2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    3. All cooler lines must be thoroughly cleaned by backward and forward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    4. All cooler bypass valves (CBV), if equipped, must be thoroughly cleaned.
    5. Carry out Transmission Fluid Cooler Flow Test. For additional information, refer to the Transmission Fluid Cooler Flow Test in Diagnostics in this section.
    6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, the fluid cooler, cooler bypass valve, and or cooler lines must be replaced. For additional information, refer to Section 307-02 .
    7. If the coolers are to be replaced, refer to Section 303-03 . Use only factory approved service parts.

Torque Converter Flushing

1. **CAUTION: Mineral spirits used to clean the torque converter must be fresh, non-chlorinated and non-halogenated.**

   Following the instructions included with any suitable torque converter fluid cooler cleaner, flush the torque converter.

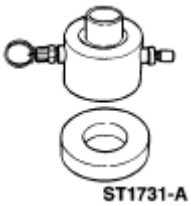
2. After flushing, drain the remainder of the solvent.

3. Add 1.9 liter (2 qt.) of clean MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON ® V specification into the converter fluid filler tube and agitate by hand.

4. Thoroughly drain the solution.

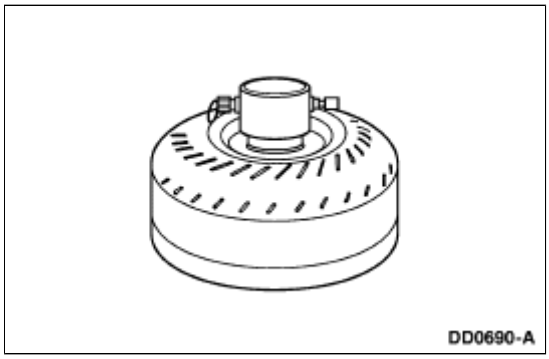
Torque Converter Leak Check

Special Tool(s)

 ST1731-A	Torque Converter Leak Tester 307-F015 (014-R1075) or equivalent

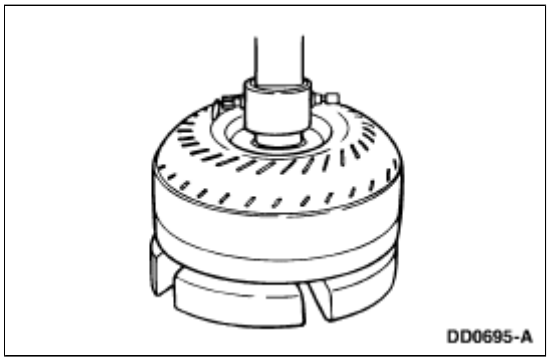
1. Clean the outside surface of the torque converter (7902).

2. Install the Torque Converter Leak Tester into the converter hub.


DD0690-A

3. **WARNING: Always follow correct safety procedures while using the press. Failure to follow these instructions can result in personal injury.**

   Install the torque converter with installed leak check tool into the Arbor press.
   Secure the press. Apply enough force from the press to seal the tool into the torque converter.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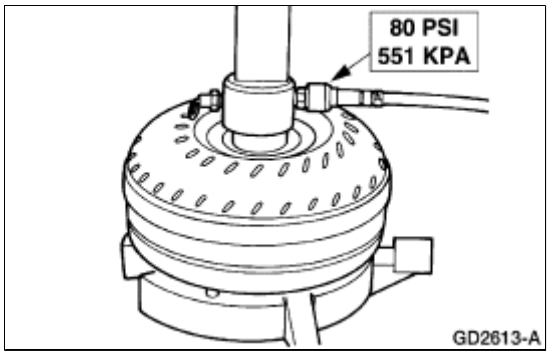
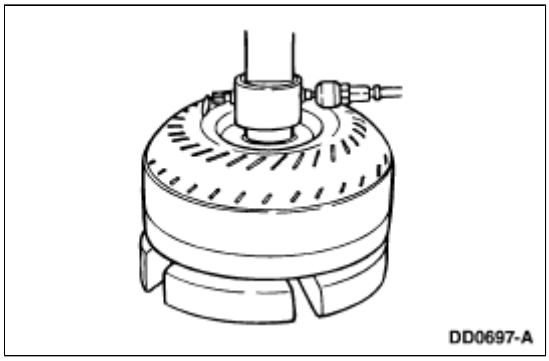
4. **NOTE:** Use clean, dry shop air.

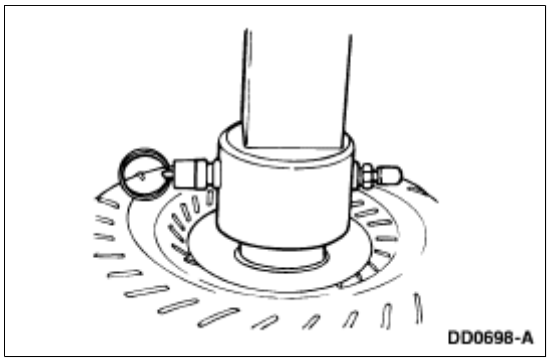
   Apply air pressure to valve on leak check tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, the seams and the studs. A soap bubble solution can be applied around those areas to aid in the diagnosis. If any leaks are present, install a new converter.

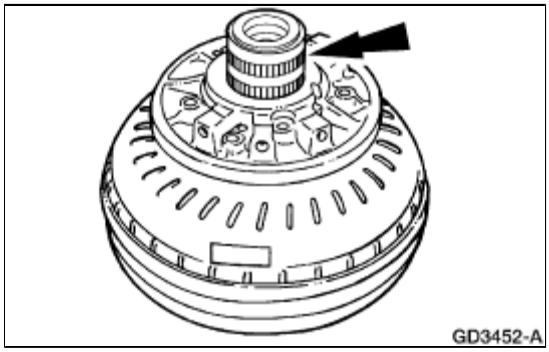


6. Remove the air hose. Release the pressure, and then slowly release the press. Remove the converter. Remove the tool.

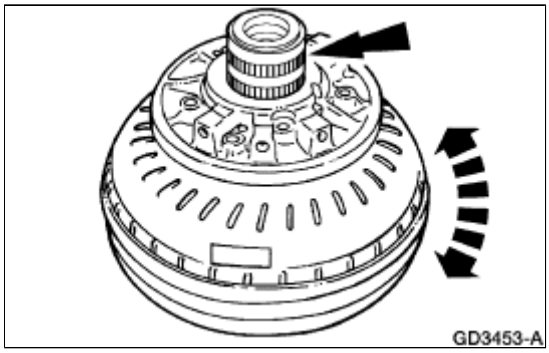


Torque Converter Impeller to Pump Stator Interference Check

1. Install the fluid pump support into the torque converter (7902). Engage the splines of the one-way clutch inner race with the mating splines of the front pump support.

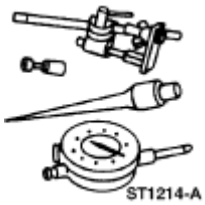
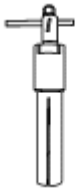


2. While holding the fluid pump support stationary, rotate the torque converter clockwise and counterclockwise. The torque converter should rotate freely with no signs of scraping. If there are signs of scraping, install a new torque converter.

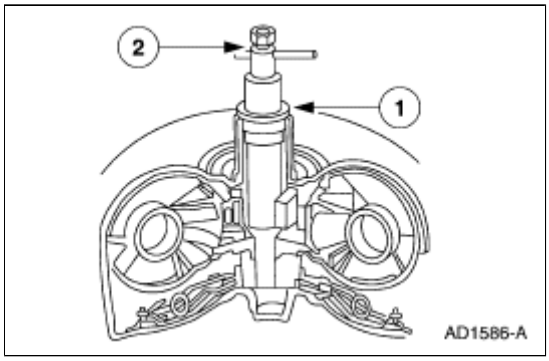


End Play Check

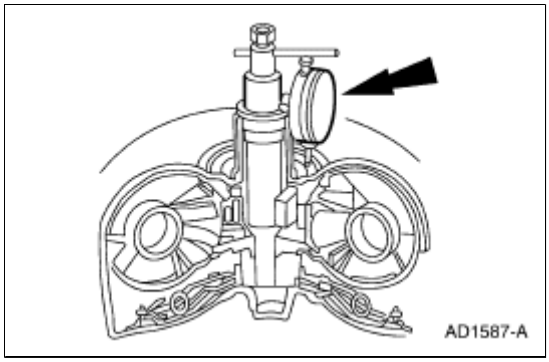
Special Tool(s)

 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C)
 ST2128-A	End Play Checking Tool 307-360

1. Install the End-Play Checking Tool into the torque converter (7902).
    1. Insert the End-Play Checking Tool into the torque converter until it bottoms.
    2. Tighten the inner post until the tool is securely locked.



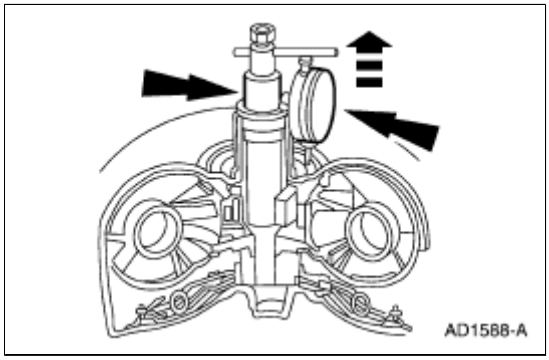
2. Attach the Dial Indicator with Bracketry to the End Play Checking Tool. Position the dial indicator bottom on the converter impeller housing and zero the dial.



3. Lift up on the end play checking tool and note the dial indicator reading. If the reading exceeds end play limits, install a new torque converter.

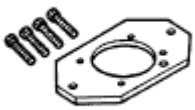
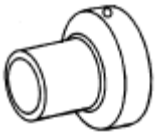
Torque Converter End Play

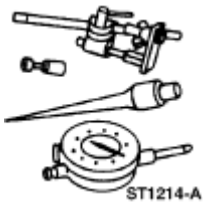
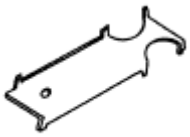
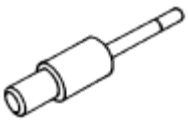
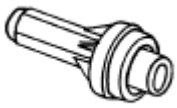
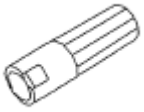
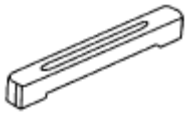
New or Rebuilt Torque Converter	Used Torque Converter
0.58 mm Max. (0.023 in.)	1.27 mm Max. (0.050 in.)

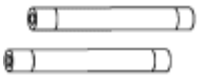


Transmission

Special Tool(s)

 ST1759-A	A4LD Holding Fixture 307-262 (T93T-77002-AH)
ST1792-A	Band Adjuster Wrench Kit 307-S022 (T71P-77370-A)
ST1200-A	Bearing Cup Remover 308-047 (T77F-1102-A)
 ST1635-A	Output Shaft Bearing Replacer 307-348 (T97T-77110-A)
ST1186-A	Holding Fixture 307-003 (T57L-500-B)
ST1815-A	Converter Guide Pins 307-331 (T95L-7902-A)
ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A) or equivalent

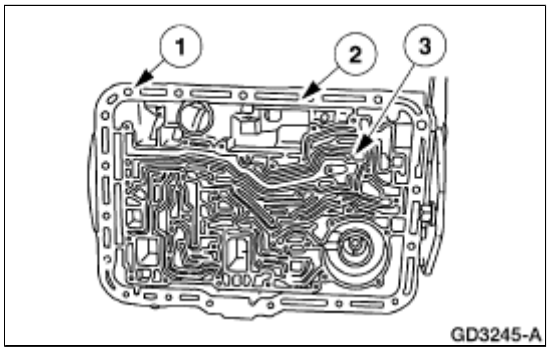
 ST1214-A	Dial Indicator With Bracketry 100-002 (TOOL-4201-C) or equivalent
 ST1633-A	TRS Alignment Tool 307-351 (T97L-70010-A)
ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1790-A	Housing Bushing Replacer 307-065 (T77L-7697-F)
 ST1791-A	Extension Housing Seal Replacer 307-038 (T74P-77052-A)
ST1817-A	Oil Pump Aligning Gauge 307-S039 (T74P-77103-X)
 ST1826-A	Front Pump Seal Sizer 307-338 (T95L-70010-G)
 ST1816-A	Gauge Bar 307-263 (T93T-77003-AH)
	Impact Slide Hammer 100-001 (T50T-100-A)

ST1185-A	
ST1760-A	Servo Cover Compressor 307-340 (T95L-77028-A)
ST1199-A	Oil Seal Replacer 307-050 (T74P-77498-A)
 ST1631-A	Converter Handles 307-091 (T81P-7902-C)
ST1814-A	TSS Gauge 307-337 (T95L-70010-F)
ST1639-A	Valve Body Alignment Pin (.235) 307-333 (T95L-70010-B)
ST1639-A	Valve Body Alignment Pin (.248) 307-334 (T95L-70010-C)
ST1636-A	Torque Converter Holding Tool 307-346 (T97T-7902A)

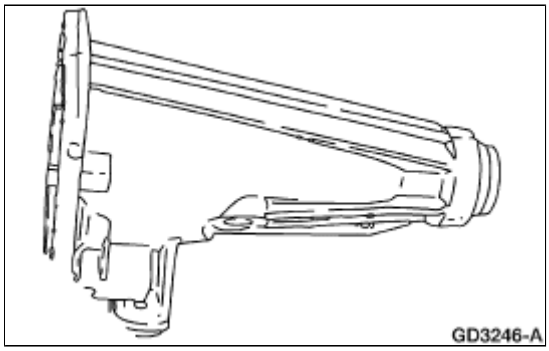
1. Thoroughly clean the transmission case and extension housing in solvent and blow dry with

compressed air.

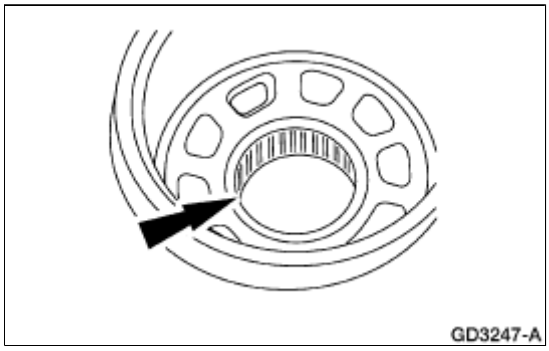
2. Inspect the transmission case for the following:
    1. Stripped bolt hole threads.
    2. Gasket and mating surfaces for burrs or nicks.
    3. Obstructions to vent and fluid passages.
    - Cracks or warpage.



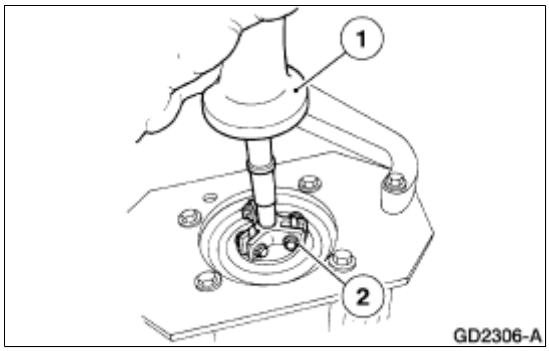
3. Inspect the extension housing for cracks, burrs or warpage.



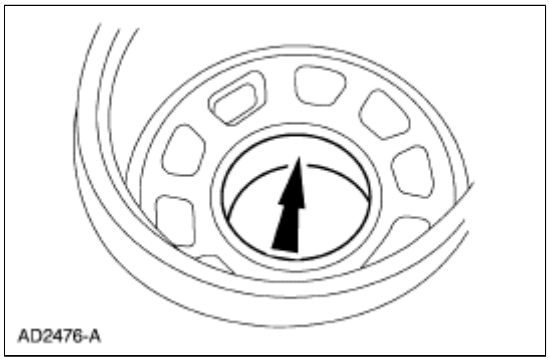
4. Inspect case bearing for damage. Replace as needed. Follow Steps 6-8 if replacing the case bearing. If not replacing the case bearing, proceed to Step 8.



5. Remove the case bearing.
    1. Install the Bearing Cup Remover with Slide Hammer into case bearing.
    2. Remove the case bearing.
    - Use an oil stone to remove any nicks or burrs in the bearing case bore.

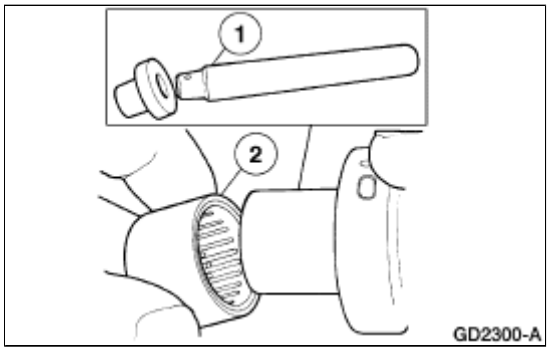


6. Inspect the rear case inner race for burrs, nicks, and scoring. If any damage has been found the case will need to be replaced.

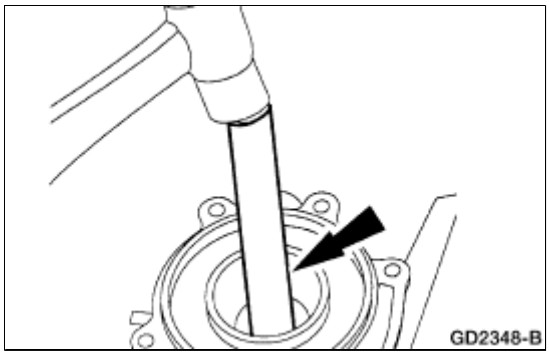


7. **CAUTION: Make sure bearing seal ring is facing drive handle.**

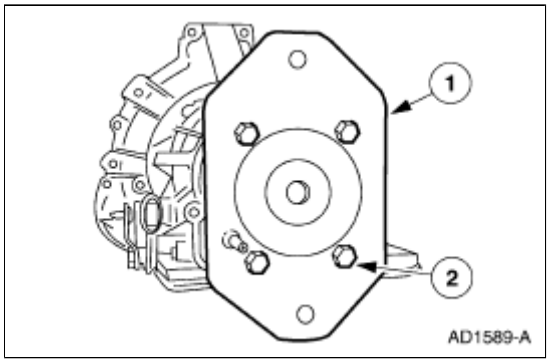
   Install a new case bearing.
   1. Assemble and install the Handle and Bearing Installer.
   2. Position new case bearing onto bearing installer tool.



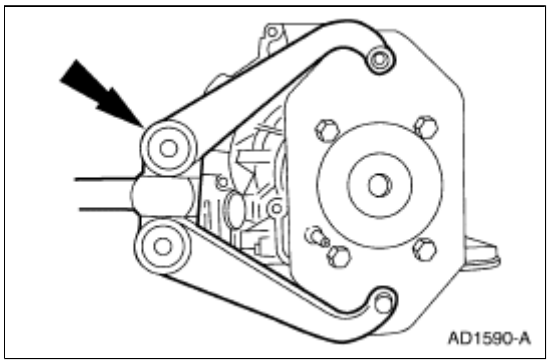
8. Tap case bearing into case bearing bore.



9. Install the A4LD Holding Fixture.
    1. Position the A4LD Holding Fixture on the rear of the transmission case.
    2. Install the A4LD Holding Fixture bolts.

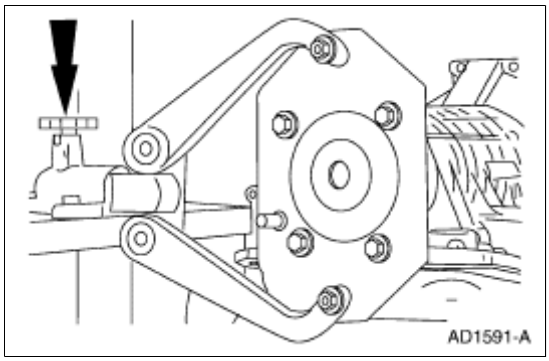


10. Attach the fixture arm of the Bench Mounted Holding Fixture to the A4LD Holding Fixture Adapter.

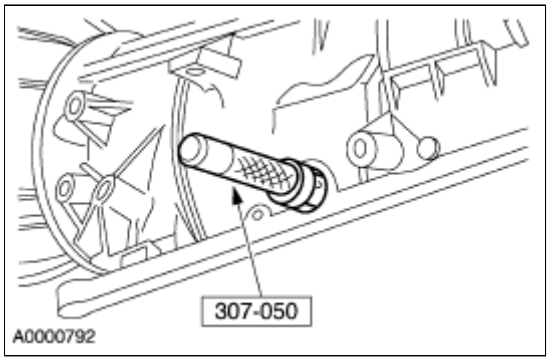


11. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

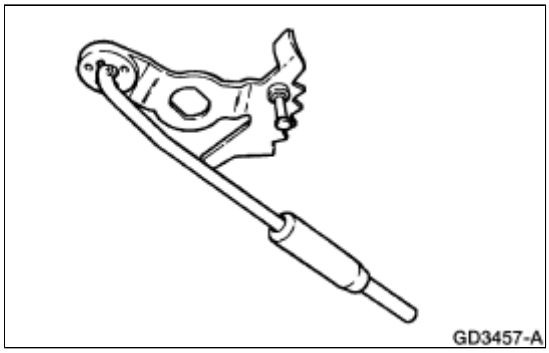
    Install transmission into the Holding Fixture.
    - Rotate the transmission so that the fluid pan rail is facing up.



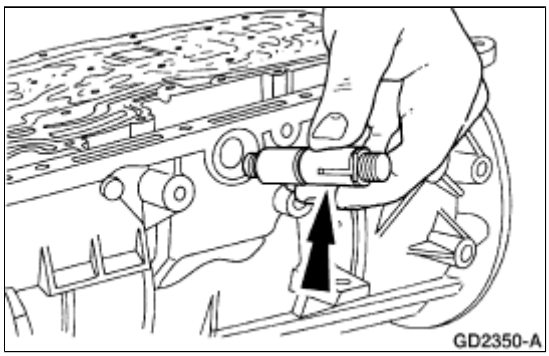
12. Using the special tool, install the manual control lever shaft seal.
    - Lubricate the manual control lever shaft seal with petroleum jelly.



13. Assemble the manual valve inner lever and parking lever actuating rod as shown.



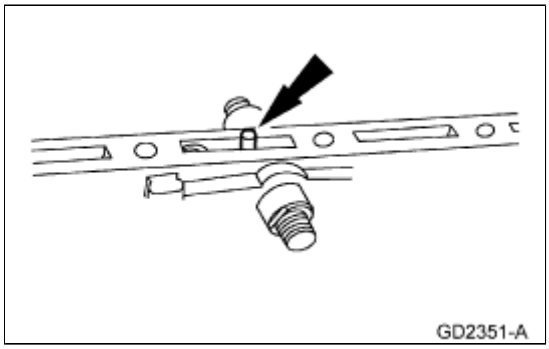
14. Install the manual control lever shaft.



15. **CAUTION: Use care not to damage the fluid pan rail surface when installing the retaining pin.**

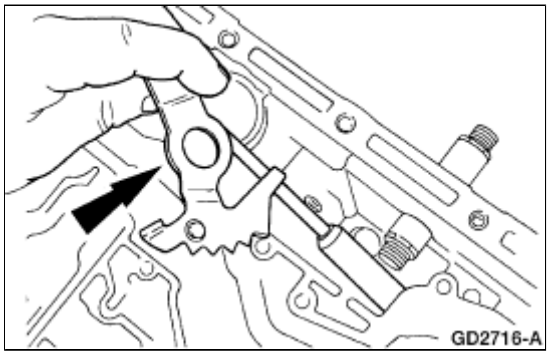
    NOTE: Align the manual control lever shaft alignment groove with the manual control lever shaft spring pin bore in the transmission case.

    Install the manual control lever shaft spring pin.
    - Tap the manual control lever shaft spring pin into the transmission case.



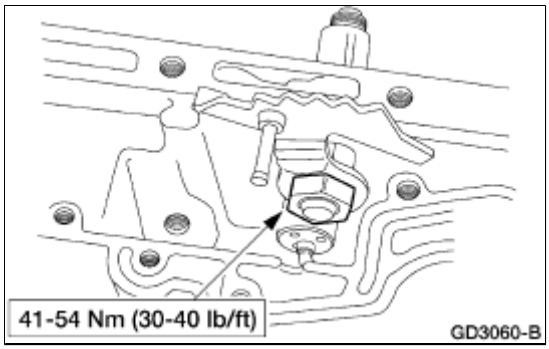
16. **CAUTION: Align the flats on the manual valve inner lever with the flats on the manual control lever shaft.**

    Install the manual valve inner lever and parking lever actuating rod on to the manual control lever shaft.



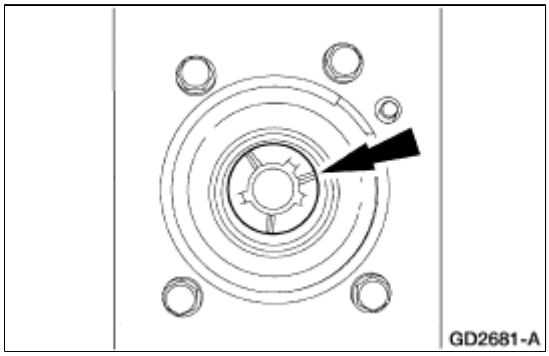
17. **CAUTION: To avoid damage, do not allow the wrench to strike the manual valve inner lever pin.**

    Install the manual valve inner lever nut on the manual control lever shaft and tighten.

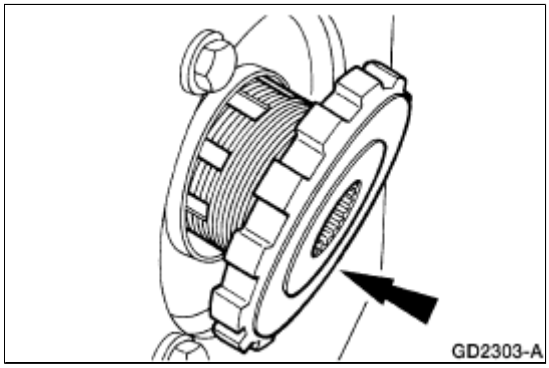


18. **CAUTION: The tabs on the output shaft thrust washer (No. 11) point into the case. Make sure the thrust washer is properly seated.**

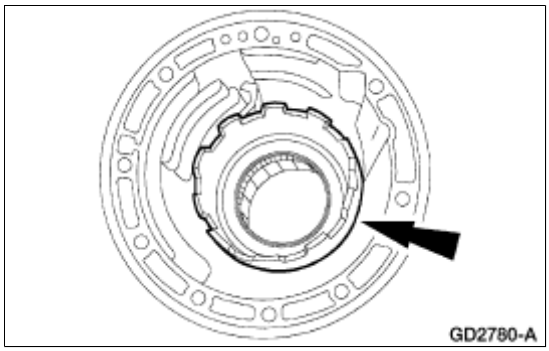
    Install the output shaft thrust washer (No. 11).
    - Coat the output shaft thrust washer with petroleum jelly.



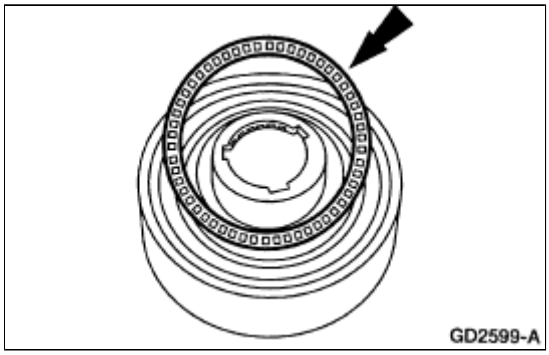
19. Install the park gear.



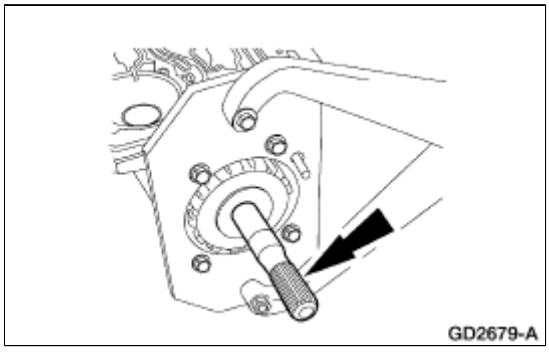
20. Install the low/ reverse brake drum.
    - Rotate the low/ reverse brake drum clockwise to install.



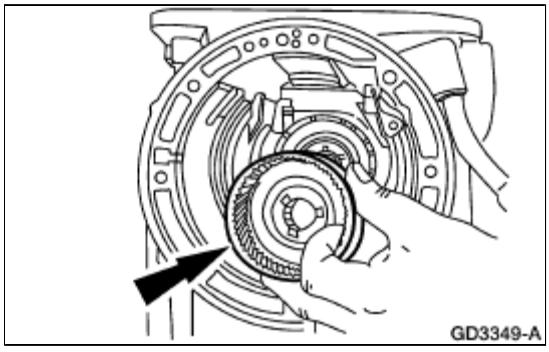
21. If not already installed during subassembly, install the No. 10B needle bearing onto the output shaft ring gear and hub assembly.
    - Coat the needle bearing with petroleum jelly.



22. Install the output shaft through the output shaft park gear.

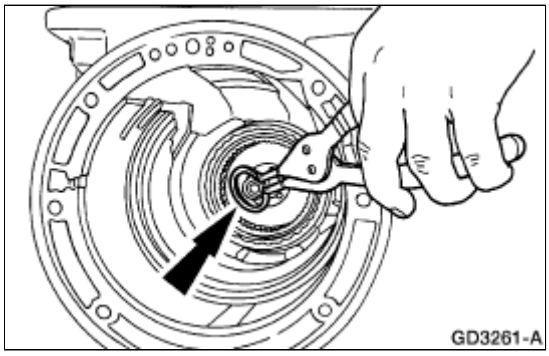


23. Install the output shaft ring gear and output shaft hub.



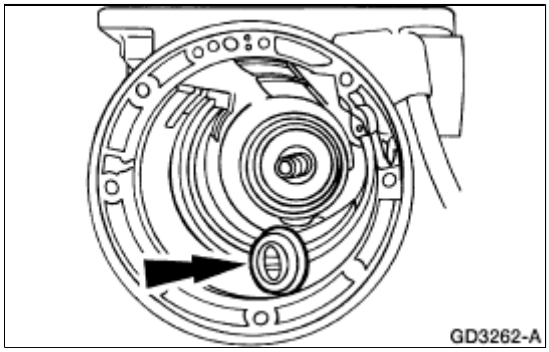
24. **CAUTION: Always install a new output shaft retaining ring.**

    Install a new output shaft retaining ring.

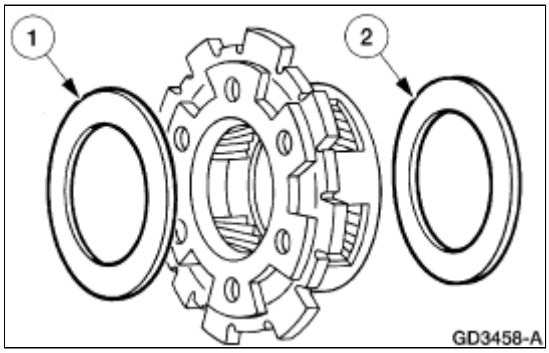


25. **NOTE:** Install the output shaft sleeve with the cone facing up.

    Install the output shaft sleeve.

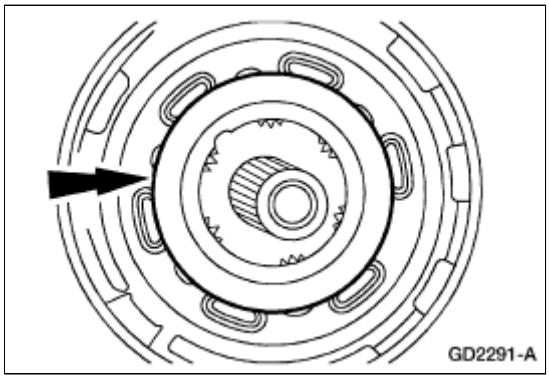


26. Install low/reverse planetary carrier needle bearings.
    1. Install low/reverse planetary carrier needle bearing (No. 8) on the front face of the low/reverse planetary.
    2. Install low/reverse planetary carrier needle bearing (No. 9) on the rear face of the low/reverse planetary.
    - Coat the low/reverse planet carrier needle bearing (No. 8) and low/reverse planetary carrier needle bearing (No. 9) with petroleum jelly.



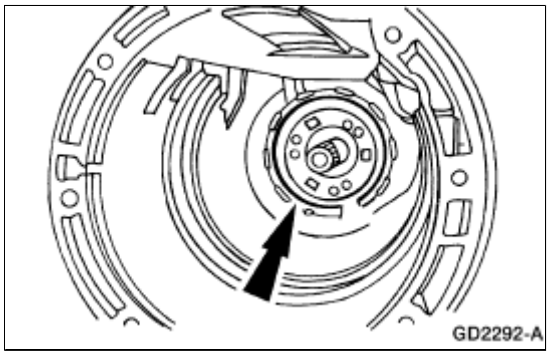
27. **CAUTION: Make sure needle bearings stay in place.**

Install the low/reverse planetary assembly with No. 8 and No. 9 low/reverse planetary carrier needle bearings into the output shaft ring gear.



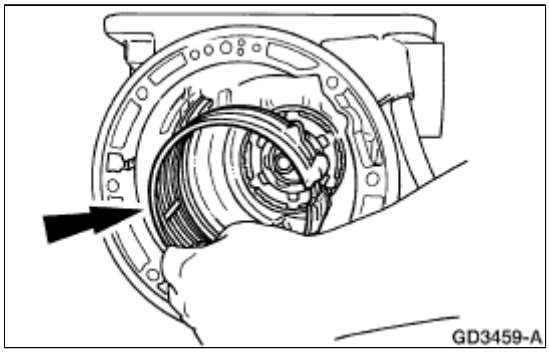
28. **CAUTION: The low/reverse brake drum must be pulled forward to install the low/reverse planet retaining ring.**

Install the low/reverse retaining ring into the low/reverse brake drum groove.

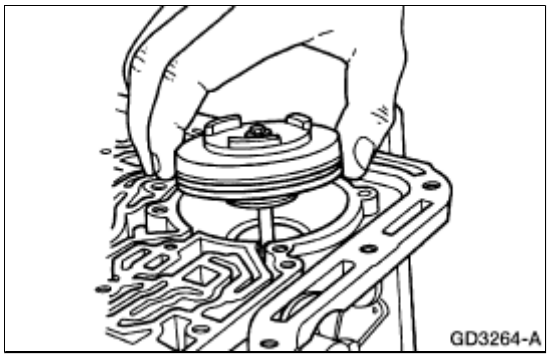


29. **CAUTION: Make sure band is resting on the two anchor pins in the case.**

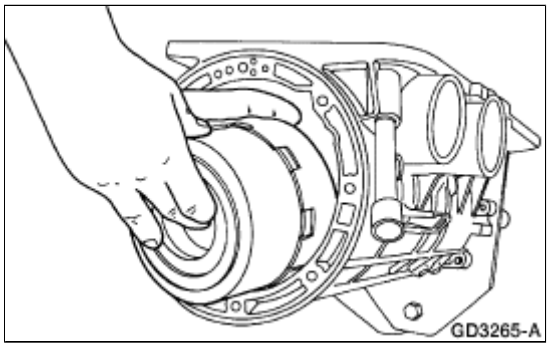
Install the low/reverse band over the low/ reverse brake drum.



30. Temporarily install the low/ reverse band servo piston and rod to hold the low/reverse band in position.



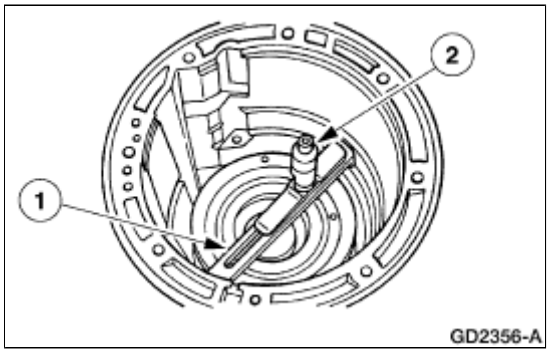
31. Install the previously assembled forward geartrain assembly.



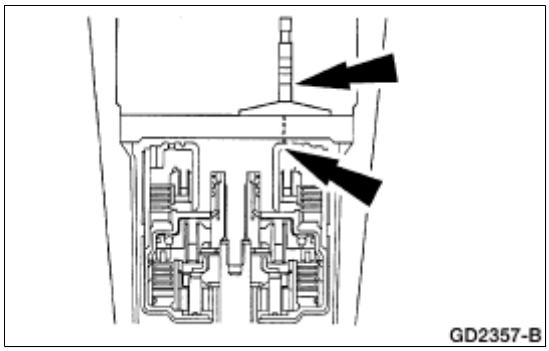
32. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

    Rotate transmission assembly so that the converter housing surface is facing up.

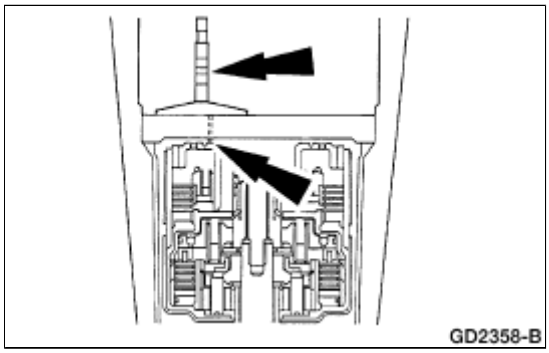
33. Select the intermediate brake drum thrust bearing (No. 4) as follows:
    1. Install the Gauge Bar on case assembly shoulder.
    2. Set the depth micrometer on top of the Gauge Bar.



34. Calculate the thrust bearing thickness.
    - Extend the micrometer probe until it contacts the intermediate brake drum thrust bearing surface. Record the reading. This is dimension A.

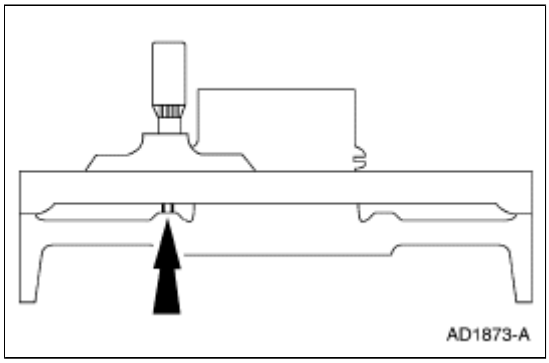


35. Place the micrometer on the opposite side of the Gauge Bar and repeat measurement. This is dimension B.

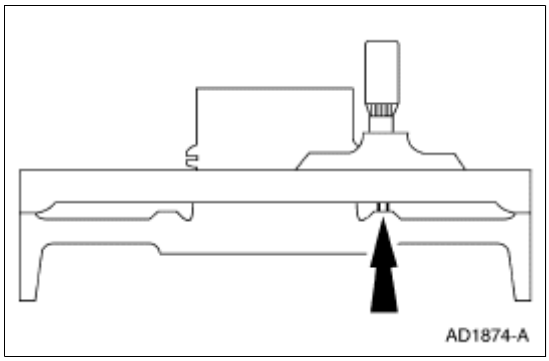


36. Add dimension A and B, divide the total of A and B by 2. Then subtract the gauge bar thickness 17.78 mm (0.700 in). Record this reading as dimension C.

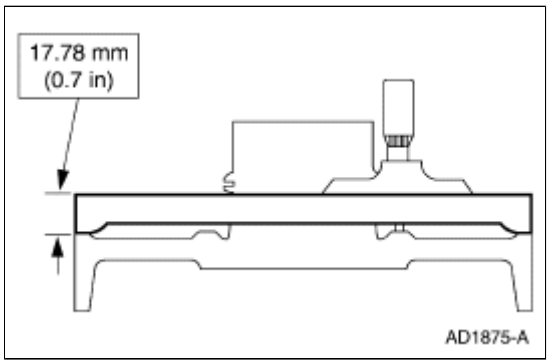
37. Place the Gauge Bar across the center support. Place the micrometer on the top of the Gauge Bar.
    1. Extend the micrometer probe until it makes contact with the center support thrust bearing surface. Record this reading as dimension D.



38. Place the micrometer on the opposite side of the center support.
    1. Extend the micrometer probe until it makes contact with the center support thrust bearing surface. Record this reading as dimension F.



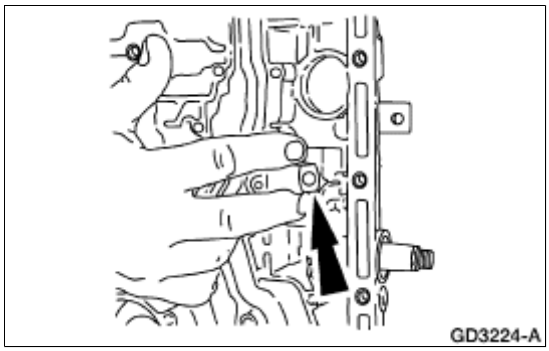
39. Add dimensions D and F; divide the total of D and F by two. Subtract the Gauge Bar thickness 17.78 mm (0.700 in) dimension E. The result is dimension G.



40. Add dimensions C and G. This total is dimension H. Use the following chart to select the proper #4 thrust bearing. Reference end play is 0.20-0.54 mm (0.008-0.021 in).

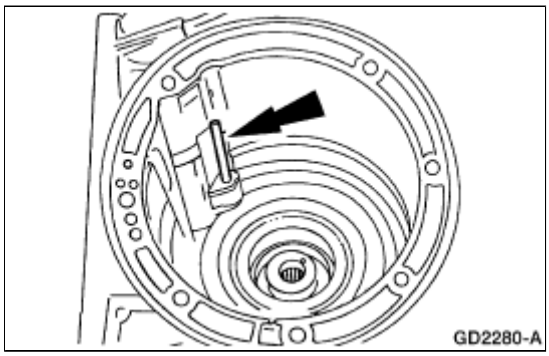
Dimension H	Service Part Number	Bearing Thickness	Identification (Notches)
3.01-3.15 mm (0.119-0.124 in)	XW4Z-7D014-CA	2.65-2.80 mm (0.104-0.110 in)	None
3.17-3.34 mm (0.125-0.132 in)	XW4Z-7D014-DA	2.80-2.95 mm (0.110-0.116 in)	One
3.36-3.54 mm (0.133-0.140 in)	XW4Z-7D014-EA	3.00-3.15 mm (0.118-0.124 in)	Two
3.57-3.71 mm(0.141-0.147 in)	XW4Z-7D014-FA	3.20-3.35 mm (0.126-0.132 in)	Three

41. Install the intermediate servo actuating lever.

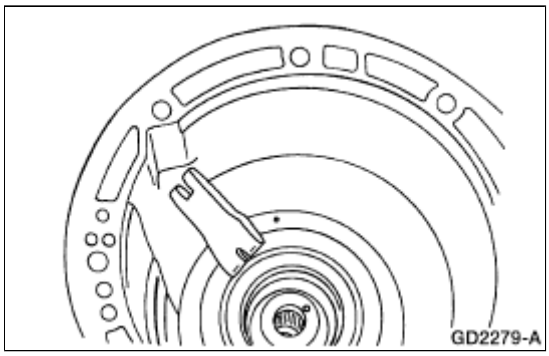


42. **NOTE:** The intermediate band lever shaft is shorter than the front band lever shaft.

    Install the intermediate band actuating lever shaft through the intermediate servo actuating lever.

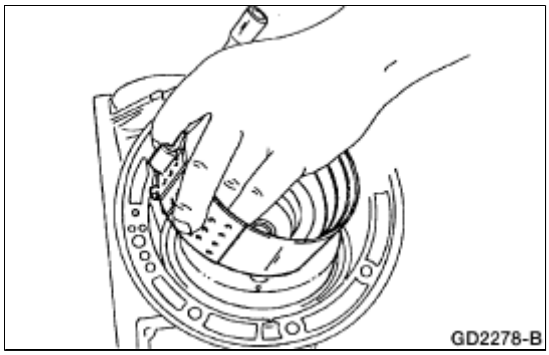


43. Install the intermediate band apply strut on the intermediate servo actuating lever.



44. **NOTE:** Make sure that the intermediate apply strut is aligned with the band notch.

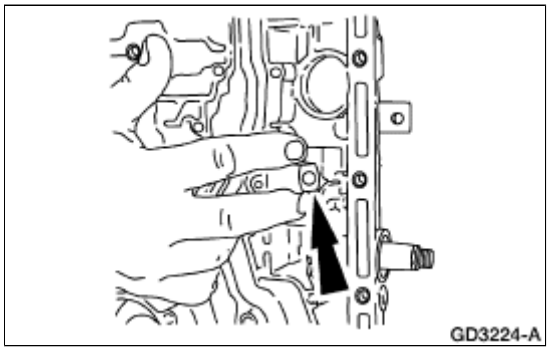
    Install the intermediate band.



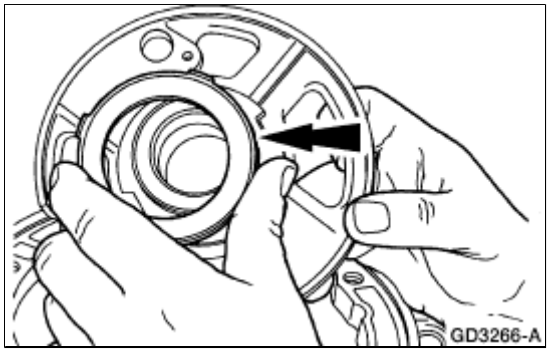
45. **NOTE:** Use the intermediate band adjusting screw as a temporary alignment guide.

    NOTE: The intermediate and front band anchor struts and band adjustment screws are the same.

    Install the intermediate band anchor strut and the intermediate band adjustment screw.



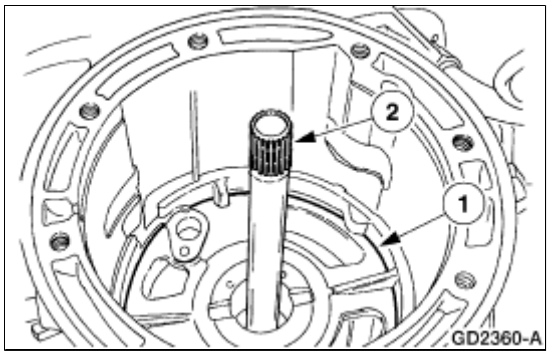
46. Install the selected intermediate brake drum thrust washer (No. 4) on the center support.
    - Coat the intermediate brake drum thrust washer with petroleum jelly.



47. **CAUTION: Do not apply pressure to the center support while installing. Damage to sealing rings could result. Make sure the rear planetary support is seated.**

    NOTE: Align the center support screw hole with correct case hole.

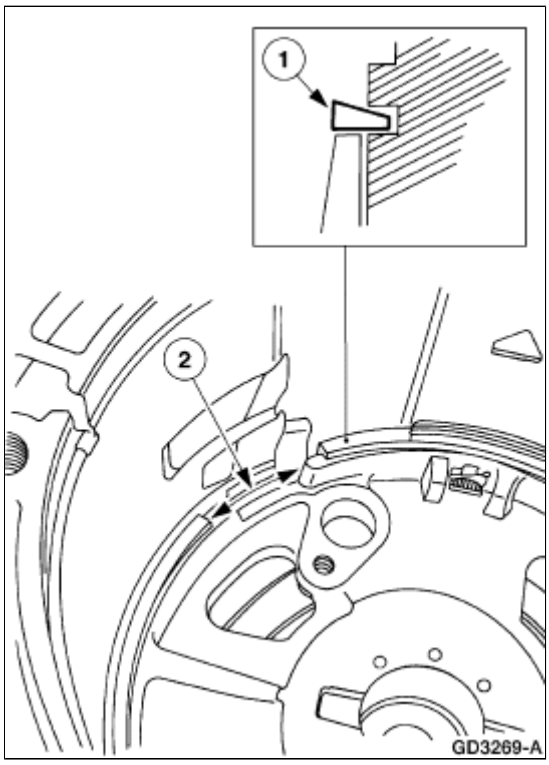
    Install the center support.
    1. Position the center support into the intermediate brake and direct clutch drum.
    2. Temporarily insert input shaft and gently wiggle it until the center support is seated against the case shoulder, then remove the input shaft.



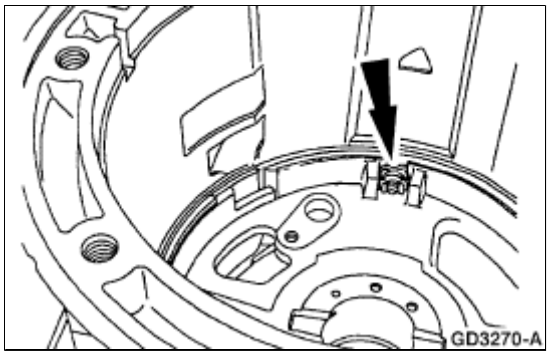
48. **CAUTION: Install the center support retaining ring with the tapered side facing up.**

CAUTION: Make sure the notch opening is not obstructed by the center support retaining ring.

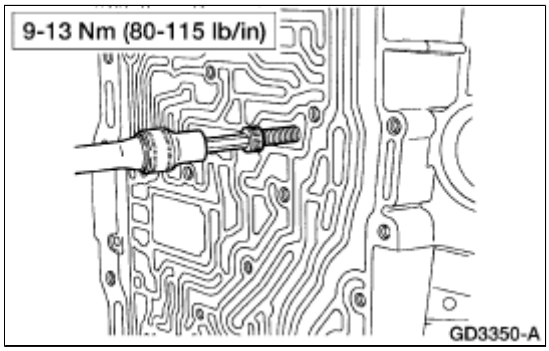
Install the center support retaining ring.
1. Position center support retaining ring with the tapered side facing up.
2. Install the center support retaining ring so that the notch opening is not obstructed.



49. Install the center support locknut and cage.



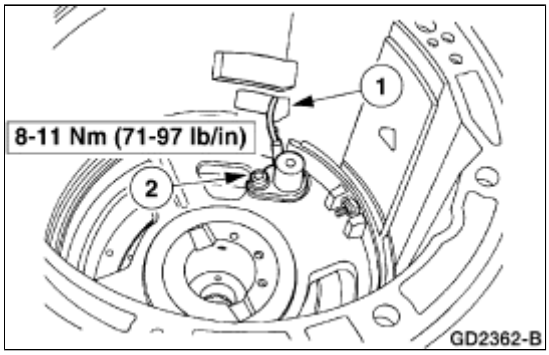
50. Install the center support-to-case cap screw.



51. **CAUTION: Carefully route the turbine shaft speed (TSS) sensor connector and wiring harness through the opening in the case. Do not damage the wiring.**

NOTE: Route TSS sensor electrical connector and wiring through transmission case opening.

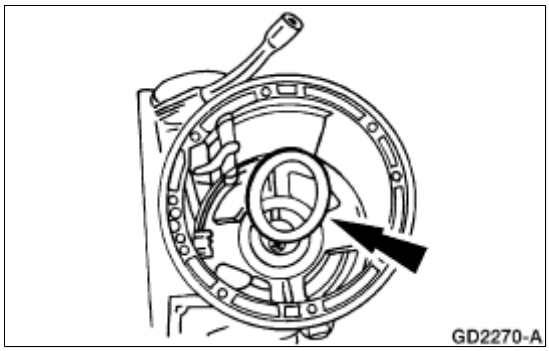
Install the Turbine Shaft Speed (TSS) sensor.
1. Install the TSS sensor.
2. Install TSS sensor screw.



52. **CAUTION: Use only the center shaft thrust bearing (No. 3).**

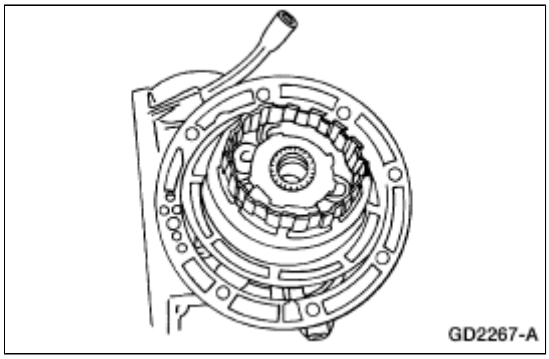
NOTE: The center shaft thrust bearing (No. 3) has no notches on the outer race.

Install the center shaft thrust bearing (No. 3).



53. **CAUTION: Do not bend the trigger wheel.**

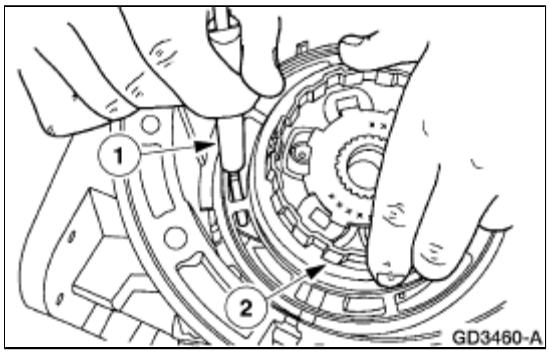
Install the front planetary and the one-way clutch assembly.



54. **CAUTION: The trigger wheel triggering window should pass over the thin blade of the Turbine Shaft Speed (TSS) sensor Gauge. If it does not, the front planetary carrier and trigger wheel must be replaced.**

Using the Turbine Shaft Speed (TSS) sensor Gauge, check TSS sensor air gap.

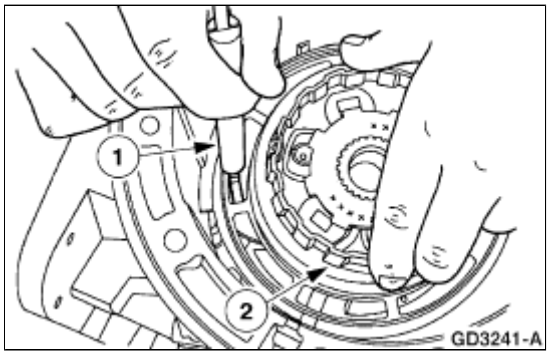
1. Place the thin blade of the Turbine Shaft Speed (TSS) sensor Gauge over the TSS sensor.
2. Rotate the trigger wheel and repeat checks for all windows.



55. **CAUTION: The trigger wheel triggering window should not pass over the thick blade of the Turbine Shaft Speed (TSS) sensor Gauge. If it does, the front planetary carrier and trigger wheel must be replaced.**

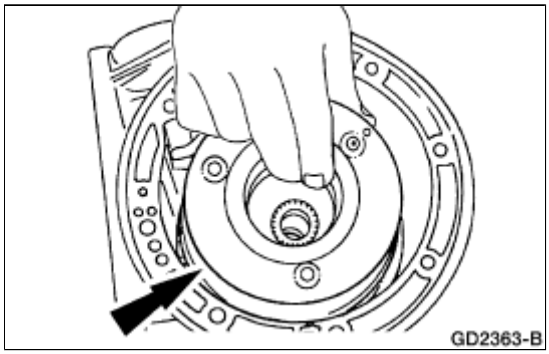
Use the Turbine Shaft Speed (TSS) sensor Gauge to check TSS sensor air gap.

1. Place the thick blade of the Turbine Shaft Speed (TSS) sensor Gauge over the TSS sensor.
2. Rotate the trigger wheel and repeat checks for all windows.

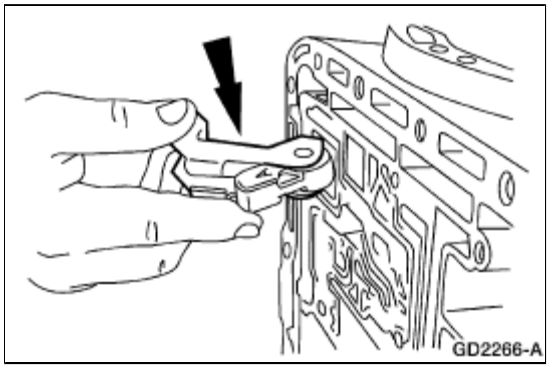


56. **NOTE:** Align the clutch plates and front adapter gear.

    Install the front brake drum and coast clutch drum assembly.

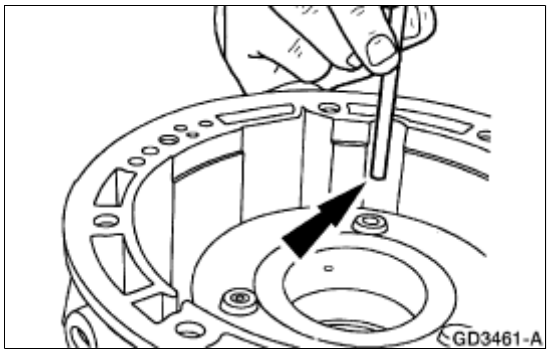


57. Install the front servo band lever and front band lever-to-case bracket into the transmission case.

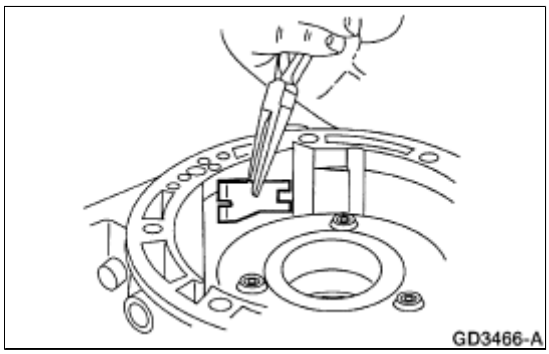


58. **NOTE:** The front band lever shaft is longer than the intermediate band actuating lever shaft.

    Install the front band actuating lever shaft through the front servo band lever.

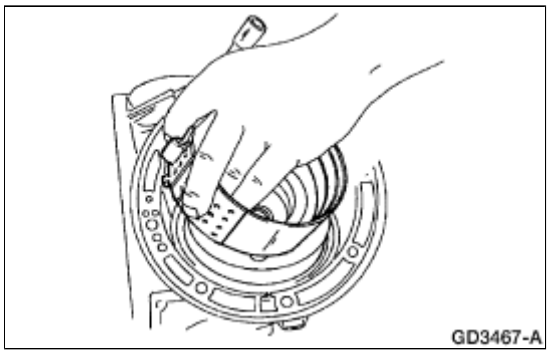


59. Install the front band apply strut.



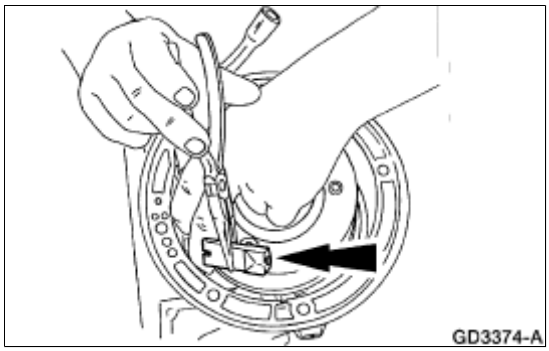
60. **NOTE:** If the front band is reused, it must be installed in the same position as when removed.

    Install the front band over the front brake and coast clutch drum.

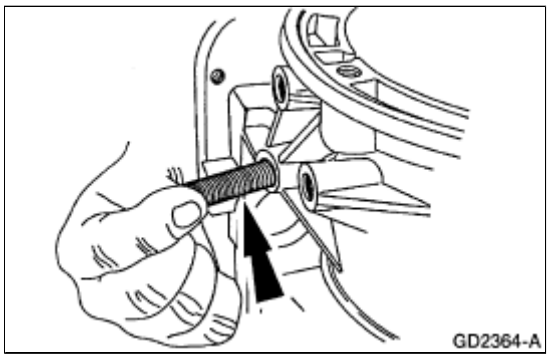


61. **NOTE:** Use the band adjustment screw as a temporary alignment guide.

    Install the front band anchor strut.



62. Install the front band adjusting screw.

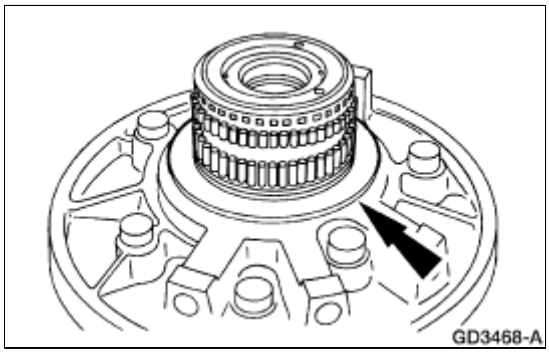


63. **CAUTION: Make sure that the pump body is seated against the thrust washer and the front brake and coast clutch drum. The pump body must be below the level of the case gasket surface.**

CAUTION: The tabs on the washer go into the pump face.

Perform front end play check procedure as follows:

- Coat the fluid pump inlet thrust washer (No. 1) with petroleum jelly.
- Install the fluid pump inlet thrust washer (No. 1) on the rear of the fluid pump and place pump into position in case.

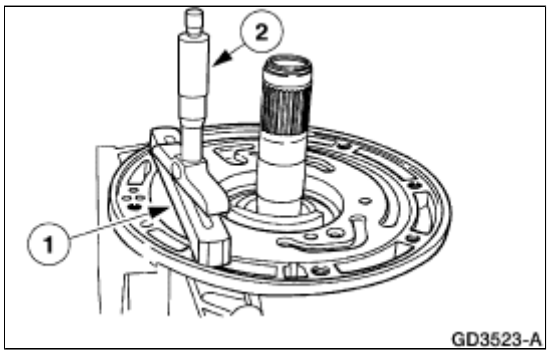


64. **CAUTION: The gauge bar must rest on the gasket surface.**

Measure the front end play clearance.

1. Place Gauge Bar across the case.

2. Place depth micrometer on Gauge Bar and extend micrometer probe until it contacts the fluid pump face.
   - Read the measurement and subtract Gauge Bar thickness 17.78 mm (0.700 inch). This is dimension A.
   - Repeat the measurement at the opposite side of the transmission case. This is dimension B.
   - Add dimensions A and B together and divide by two. This is front end clearance dimension C.



65. **CAUTION: If the average front end clearance is below the specification, choose a thinner washer. If the average is above the specification, choose a thicker washer.**

NOTE: The front end play specification is 0.18-0.70 mm (0.007-0.028 in).

Use dimension C and the chart below to select the correct thickness fluid pump inlet thrust washer (No. 1).

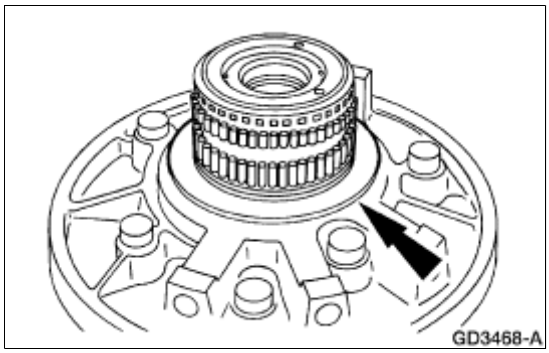
Front End Play Selective Thrust Washer No. 1

Front End Play "C" 0.18 - 0.70 mm (0.007 - 0.028 in) Without Gasket		
Selective Pump Support Thrust Washer		
Part Number	**Thickness**	**Color**
F77Z-7D014-VA	1.35 - 1.40 mm (0.035 - 0.055 inch)	Blue
F77Z-7D014-TA	1.55 - 1.60 mm (0.061 - 0.063 inch)	White
F77Z-7D014-MA	1.75 - 1.80 mm (0.069 - 0.071 inch)	Green
F77Z-7D014-NA	1.85 - 1.90 mm (0.073 - 0.075 inch)	Red
F77Z-7D014-PA	1.95 - 2.00 mm (0.077 - 0.079 inch)	Beige
F77Z-7D014-RA	2.05 - 2.10 mm (0.081 - 0.083 inch)	Black
F77Z-7D014-SA	2.15 - 2.20 mm (0.085 - 0.087 inch)	Yellow

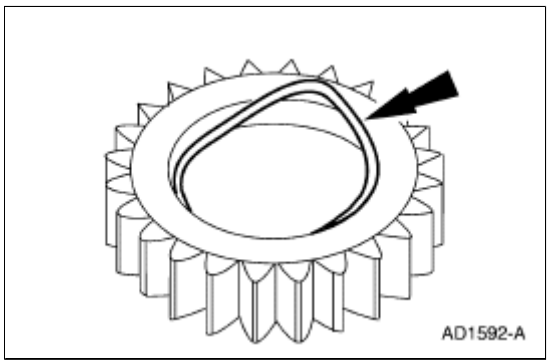
66. **CAUTION: Make sure that the pump body is seated against the thrust washer and the front brake and coast clutch drum. The pump body must be below the level of the case gasket surface.**

CAUTION: The tabs on the washer go into the pump face.

Remove pump and install No. 1 thrust washer onto pump. After installing selected front pump thrust washer No. 1, repeat front end play check. Make sure correct end play, then remove pump for assembly.

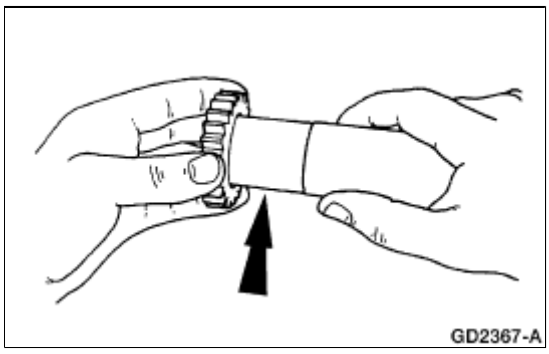


67. Install a new O-ring in fluid pump drive gear.



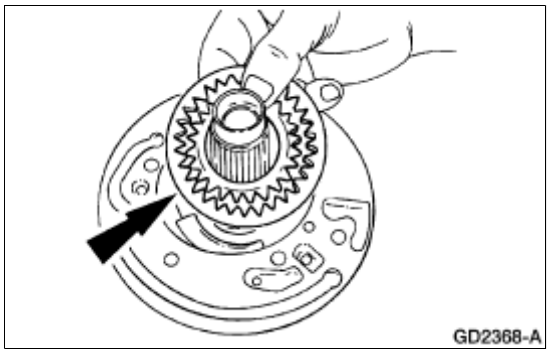
68. **CAUTION: Lubricate the Front Pump Seal Seating Tool with Ford Multi-Purpose Grease D0AZ-19584-A meeting Ford specification ESA-M1C45-A.**

Install the fluid pump drive gear on Fluid Pump Seal Seating Tool to seat O-ring. Remove the tool.



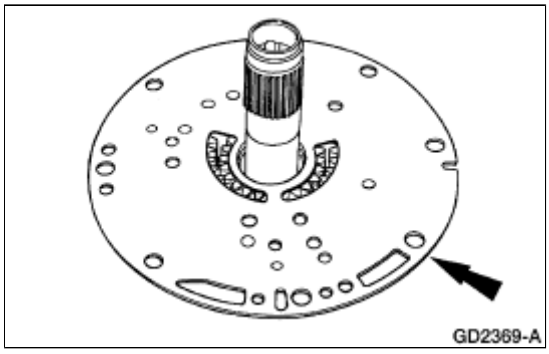
69. **CAUTION: The chamfer on the inside edge of the small gear must be up when in the pump housing gear pocket. The dimple on the larger gear must be down when in the pump housing gear pocket.**

Install the pump gears into the fluid pump housing. Apply Ford Multi-Purpose Grease D0AZ-19584-A meeting Ford specification ESA-MC193-B to pump gear to prevent scoring at start up.



70. **CAUTION: Make sure the holes in the plate line up with the holes in the pump.**

Install the fluid pump adapter plate.

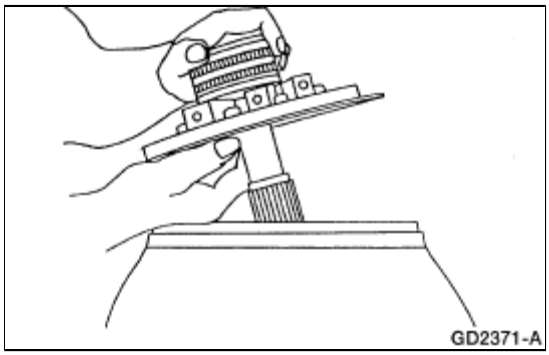


71. **CAUTION: Do not allow the pump gears to come out of the pump housing pocket.**

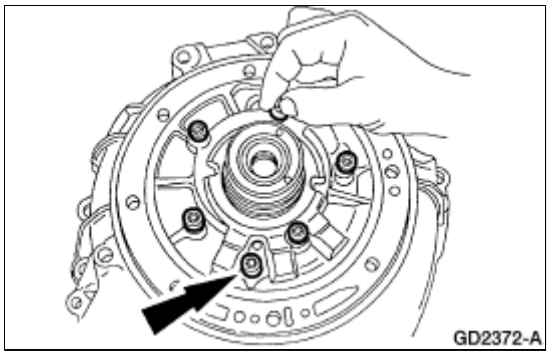
NOTE: The notch on the outside of the adapter plate will be at the 9 o'clock position relative to the converter housing.

Install the fluid pump on the converter housing.

- Hold the fluid pump adapter plate against the pump housing. Turn the pump and adapter plate over and place on the converter housing.

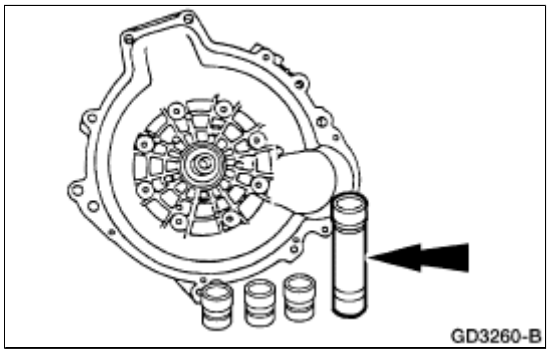


72. Loosely install the fluid pump screws.

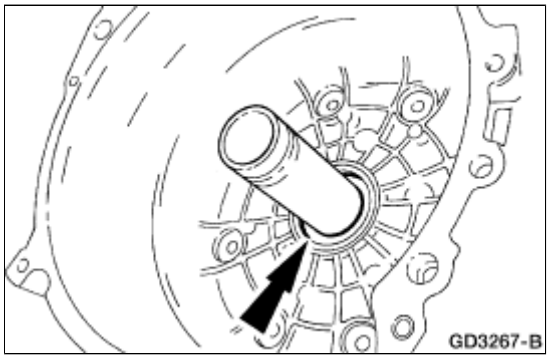


73. **CAUTION: Fluid Pump Alignment Set must be used to properly align the fluid pump to the fluid adapter plate. This will prevent seal leakage, gear noise, broken gears and bushing failure.**

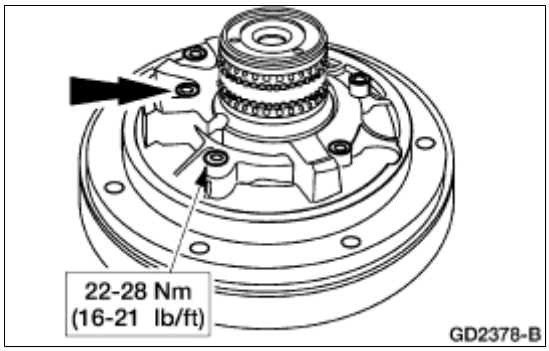
    Align the fluid pump to the fluid pump adapter plate and select the gauge from the Fluid Pump Alignment Set that is the snuggest fit when placed over the fluid pump.



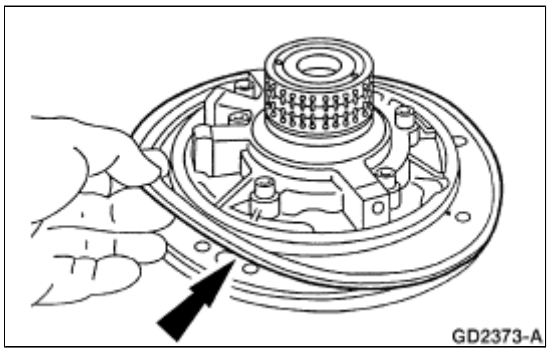
74. Thread the gauge into Pump Alignment Handle and slide the tool over the fluid pump until it bottoms out in the fluid pump gear pocket.



75. Tighten the fluid pump bolts in a star pattern and remove the pump alignment handle.

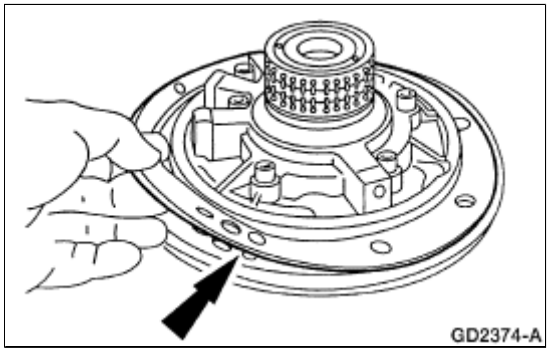


76. Install a new fluid pump seal ring.
    - Coat the fluid pump seal ring with petroleum jelly.



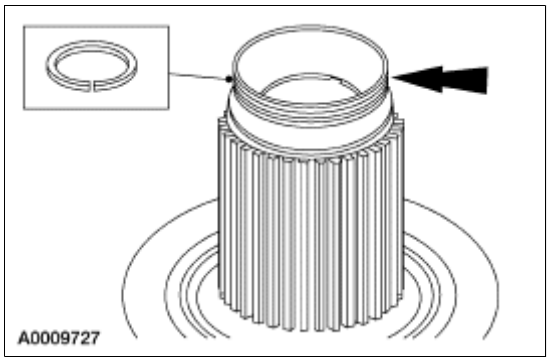
77. **NOTE:** Make sure the fluid pump seal ring is installed on the housing and pump assembly.

    Install a new fluid pump gasket.
    - Hold the fluid pump gasket in place with petroleum jelly.

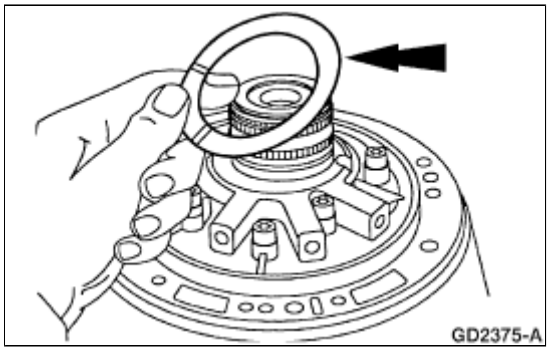


78. **CAUTION: Verify correct seal installation. Make sure seal grooves are clean and free of burrs.**

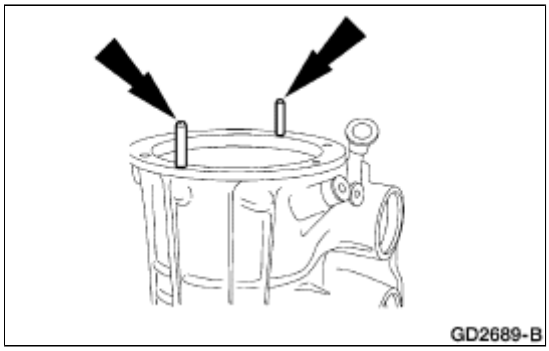
    Install the front pump support seal.



79. Install the selected No. 1 fluid pump thrust washer.
    - Coat the fluid pump thrust washer with petroleum jelly.

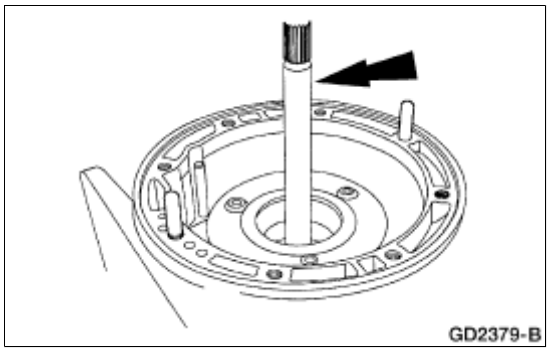


80. Install Converter Guide Pins into the transmission case.



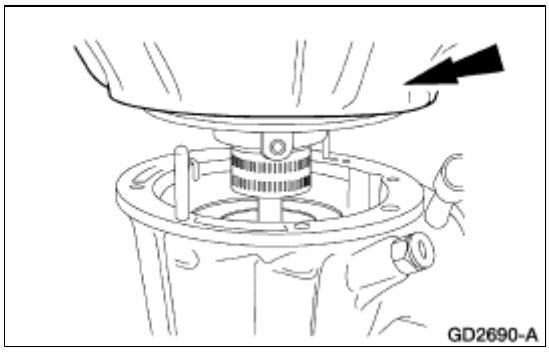
81. **CAUTION: The splines on the ends of the input shaft are not the same length. The shorter splines go into the assembly.**

    Install the input shaft.



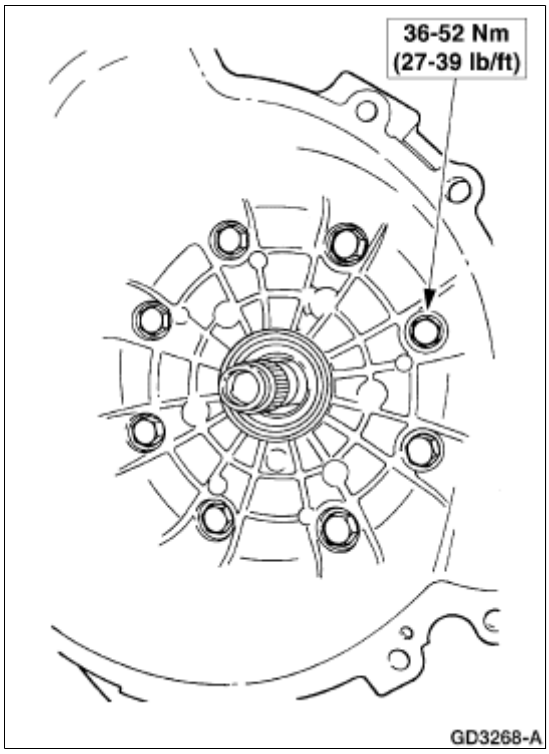
82. **CAUTION: Make sure that the fluid pump inlet thrust washer (No. 1) selective thrust washer, fluid pump gasket, and the fluid pump-to-case O-ring remain in the correct position throughout this step.**

Install the fluid pump and converter housing onto the case.

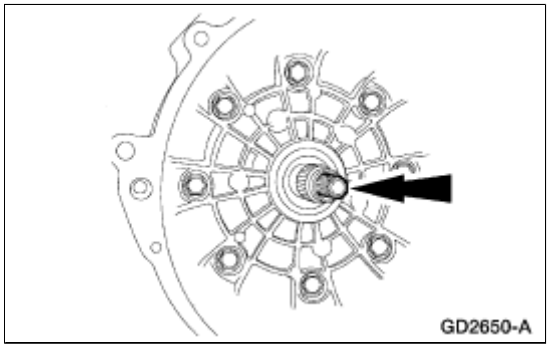


83. **NOTE:** Lubricate O-rings on converter housing screws.

Remove Converter Guide Pins. Install the new converter housing-to-case screws. Tighten the screws in a star pattern.



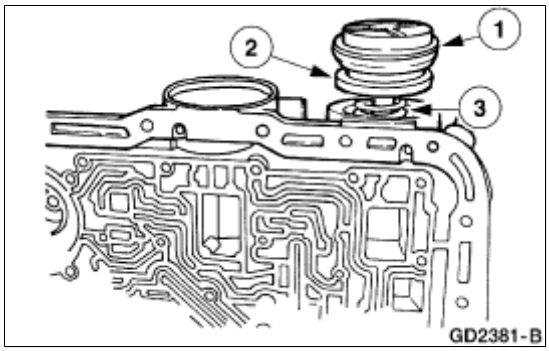
84. Remove the input shaft.



85. **WARNING: Make sure the lock pin on the Holding Fixture is secure. Failure to follow these instructions may result in personal injury.**

Rotate transmission assembly so the fluid pan rails are facing up.

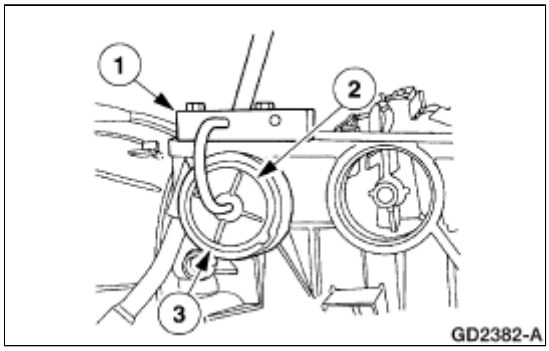
86. Assemble the front servo assembly.
    1. Install the front servo cover O-ring on front servo cover. Coat the front servo cover O-ring with petroleum jelly.
    2. Install front servo piston into the front servo cover.
    3. Install the front servo piston spring (7D028) on the front servo piston.



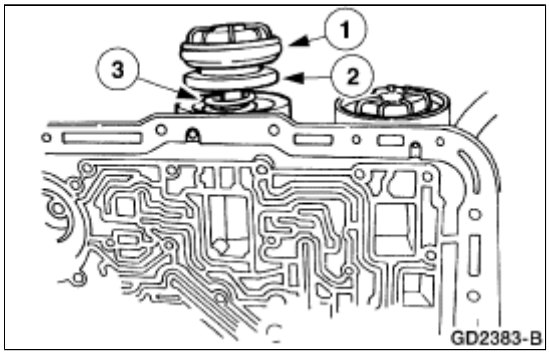
87. **CAUTION: Do not damage the front servo to case O-ring during installation.**

CAUTION: Do not press the front servo cover and O-ring past the relief hole in the case or O-ring damage may occur.

Using the Servo Cover Compressor, install the front servo assembly into the case.
1. Install Servo Cover Compressor.
2. Insert the front servo assembly into front servo bore in the transmission case.
3. Compress front servo cover and install the front servo cover retaining ring.



88. Assemble the intermediate servo assembly.
1. Install the intermediate servo cover O-ring on intermediate servo cover. Coat the intermediate servo cover O-ring with petroleum jelly.
2. Install intermediate servo piston into the intermediate servo cover.
3. Install the intermediate servo piston spring on the intermediate servo piston.

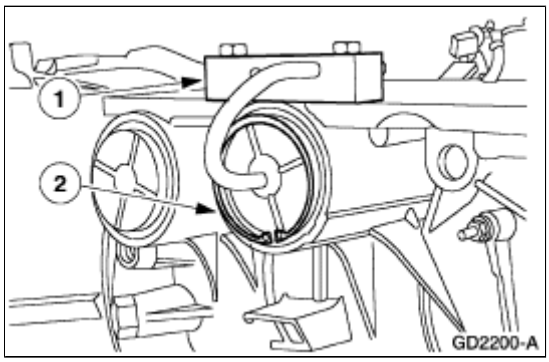


89. **CAUTION: Do not damage servo cover to case O-ring during installation.**

CAUTION: Do not press the intermediate servo cover and O-ring past the relief hole in the case or O-ring damage may occur.

Install the intermediate servo assembly into the case.

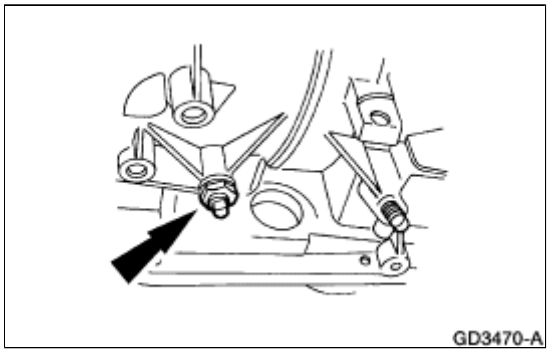
1. Install Servo Cover Compressor.
2. Insert the intermediate servo assembly into intermediate servo bore in the transmission case. Compress servo cover and install the intermediate servo cover retaining ring.



90. **CAUTION: Do not allow front band adjustment screw to back out. Band strut could fall out of position.**

CAUTION: Install, but do not tighten, a new locknut on the band adjustment screw. Apply petroleum jelly to the locknut seal.

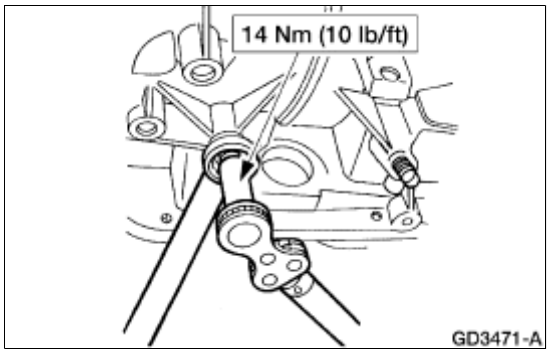
Install new locknut on the band adjustment screw.



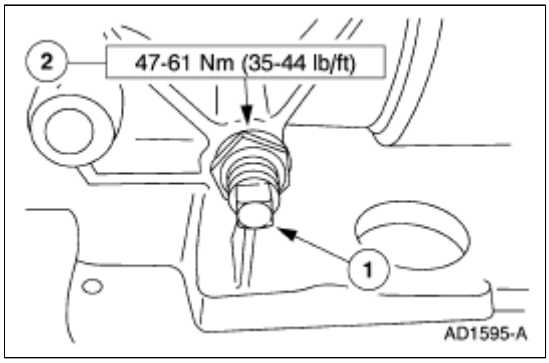
91. **CAUTION: The front servo must be installed prior to band adjustment.**

NOTE: The wrench will click at the specified torque.

Tighten front band adjustment screw using the Band Adjuster Wrench Kit and back off front band adjustment screw exactly two (2) turns and hold that position.



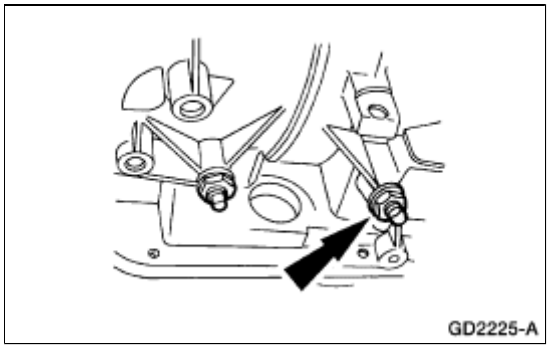
92. Tighten the front band locknut.
    1. Hold the front band adjustment screw stationary.
    2. Tighten the front band locknut.



93. **CAUTION: Do not allow intermediate band adjusting screw to back out. Band strut could fall out of position.**

    CAUTION: Install, but do not tighten, a new locknut on the band adjustment screw. Apply petroleum jelly to the locknut seal.

    Install new nut on the band adjustment screw.

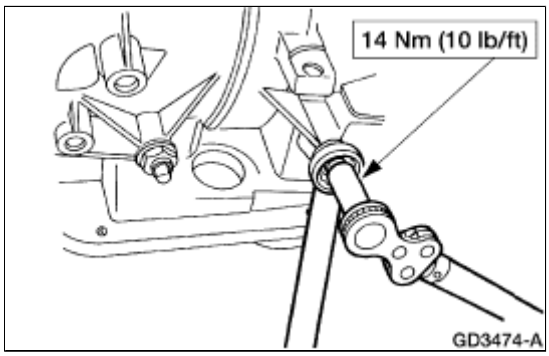


94. **CAUTION: The intermediate servo must be installed prior to band adjustment.**

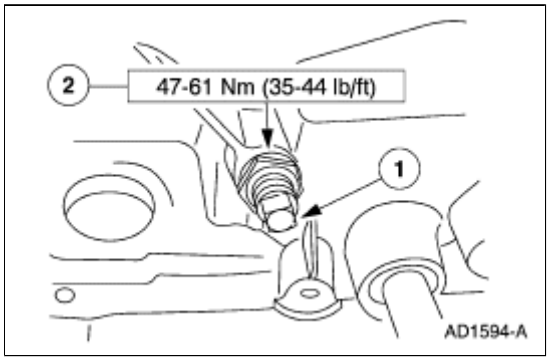
    NOTE: The wrench will click at the specified torque.

    Tighten intermediate band adjusting screw using the Band Adjuster Wrench Kit and back off

intermediate band adjusting screw exactly two (2) turns and hold that position.



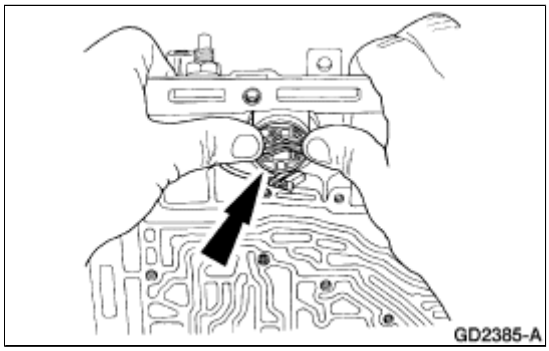
95. Tighten the intermediate band locknut.
    1. Hold the intermediate band adjustment screw stationary.
    2. Tighten the intermediate band locknut.



96. **CAUTION: Install new O-rings on the 16-pin electrical connector. Coat the O-rings with petroleum jelly.**

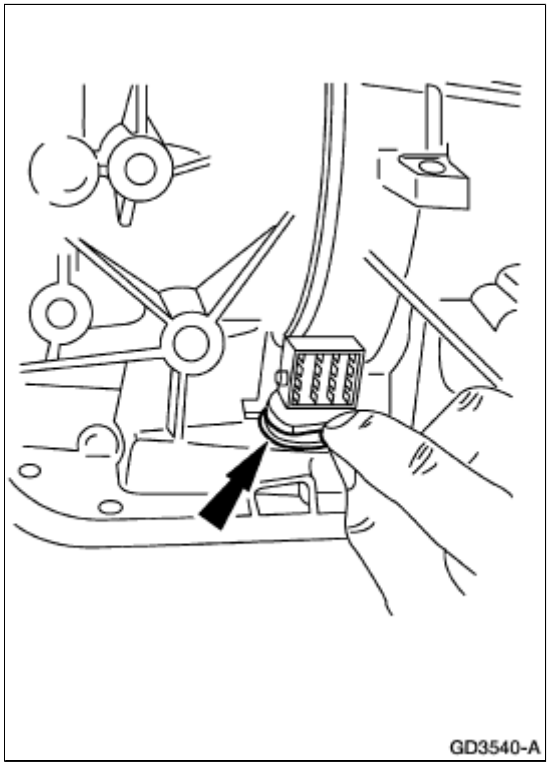
    NOTE: Make sure that the tab is in the lock position.

    Position the transmission case (16-pin) electrical connector into the case bore.
    - Press the transmission case (16-pin) electrical connector through the case until a click is heard.



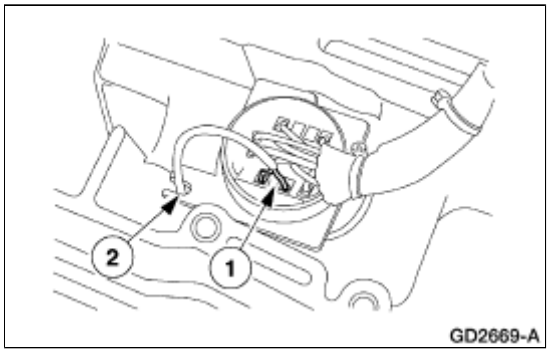
97. **CAUTION: Do not overstretch the retaining spring.**

Install the 16-pin electrical connector retaining spring.

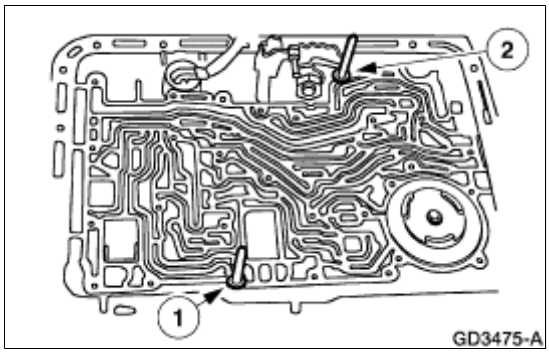


98. **CAUTION: Align the slot on the turbine shaft speed (TSS) sensor electrical connector with the slot in the 16-pin electrical connector.**

Install the TSS sensor electrical connector into the transmission case (16-pin) electrical connector.
1. Connect the TSS sensor electrical connector.
2. Insert the TSS sensor electrical connector wires into the retaining slot in the 16-pin electrical connector.



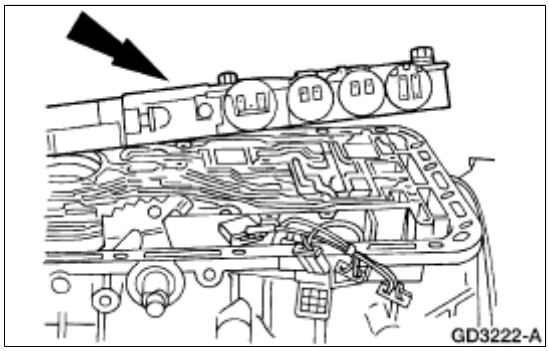
99. Install the Valve Body Guide Pins into the transmission case.
1. Install the large Valve Body Guide Pin (.248).
2. Install the small Valve Body Guide Pin (.235).



100. **CAUTION: Make sure main control valve body gasket is aligned.**

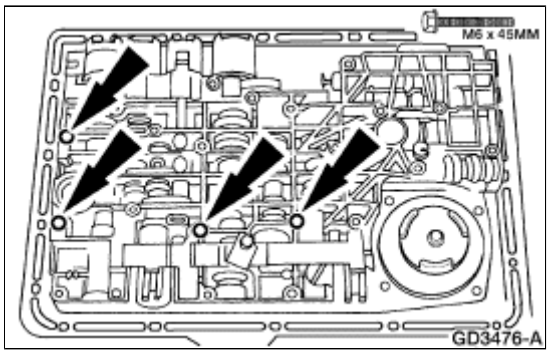
CAUTION: Make sure that the manual valve is correctly aligned with the manual valve inner pin when the main control valve body is installed.

Position the main control valve body into the transmission case.



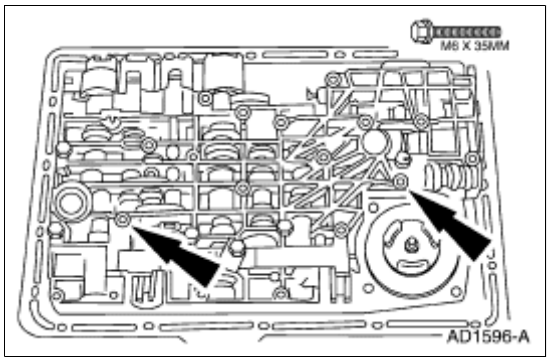
101. **NOTE:** The screws will be tightened in later steps.

Loosely install the four M6 x 45 mm screws.



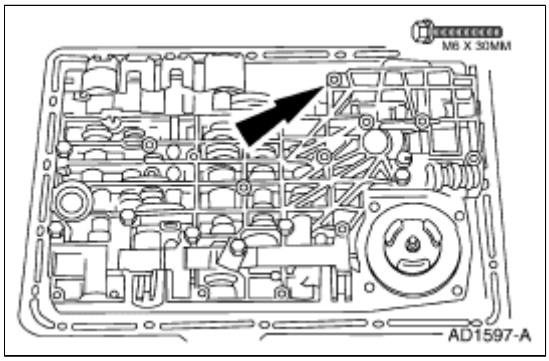
102. **NOTE:** The main control valve body screws will be tightened in later steps.

Loosely install the two M6 x 35 mm screws.

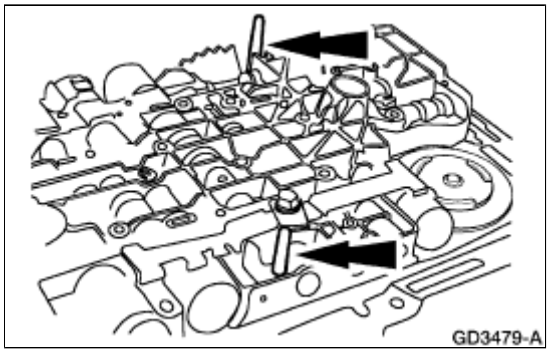


103. **NOTE:** The main control valve body screw will be tightened in later steps.

Loosely install M6 x 30 mm screw.

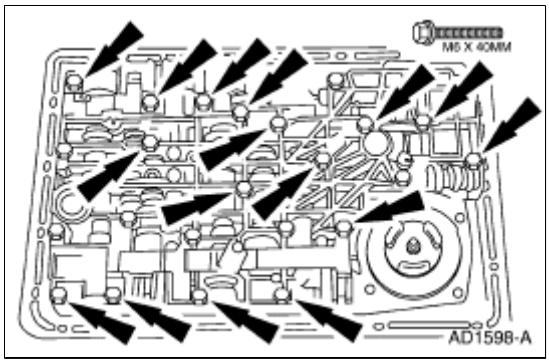


104. Remove the valve body guide pins.

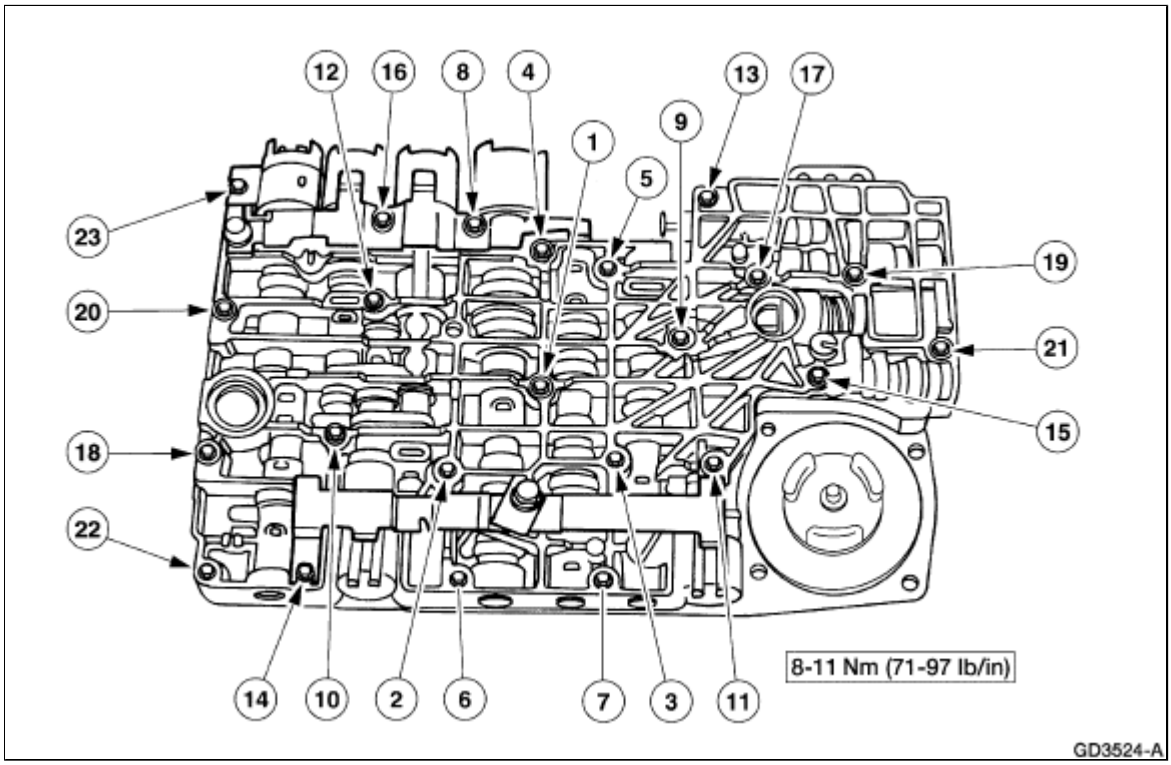


105. **NOTE:** The main control valve body screws will be tightened in later steps.

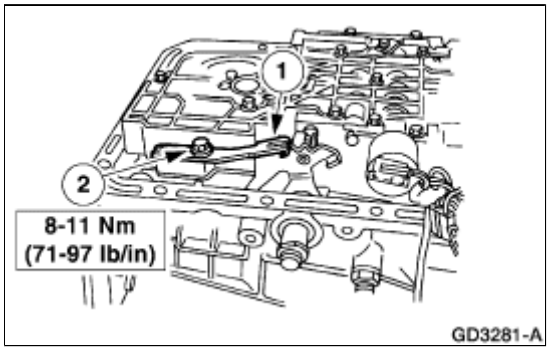
Loosely install the sixteen M6 x 40 mm screws.



106. Tighten the screws in the sequence shown.

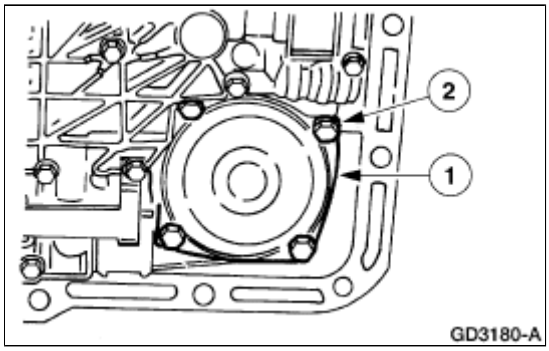


107. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring on the main control valve body.
    2. Install the screw.

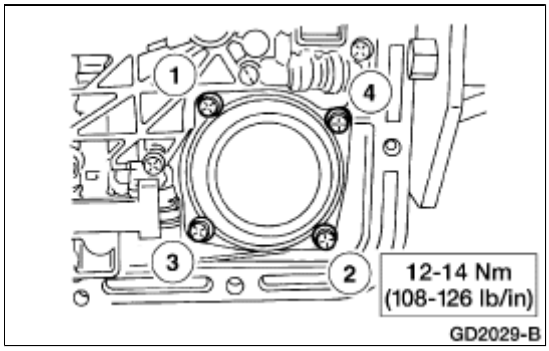


108. Install the low/ reverse band servo cover and reverse servo separator plate cover gasket.

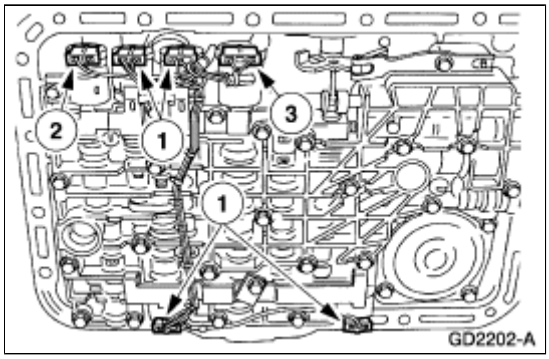
1. Position the low/ reverse band servo cover and low/ reverse servo separator plate cover gasket on the transmission case.
2. Loosely install the screws.



109. Tighten the screws in the sequence shown.



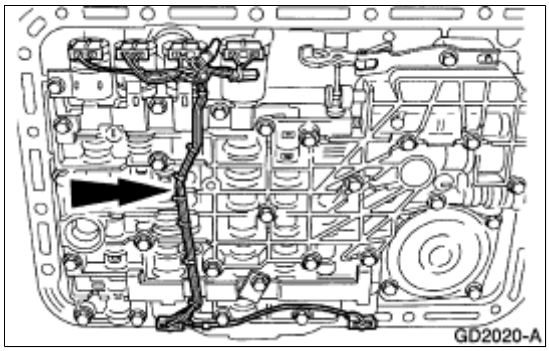
110. Connect the solenoid electrical connectors.
    1. Connect shift solenoids SSA, SSB, SSC and SSD electrical connectors.
    2. Connect the torque converter clutch (TCC) solenoid electrical connector.
    3. Connect the electronic pressure control (EPC) solenoid electrical connector.



111. **CAUTION: Excessive pressure may break the locating pins.**

Install wiring loom protector and guide.

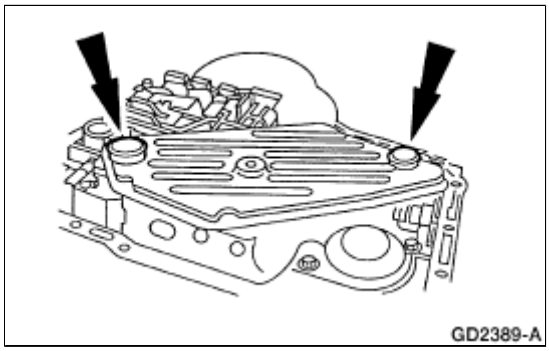
- Align the pins in the holes of the solenoid clamps and gently push down.



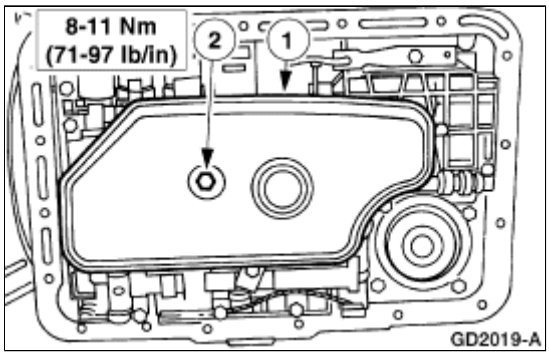
112. **CAUTION: Make sure that both fluid pan filter O-rings are properly installed on the fluid pan filter prior to installation.**

Install the fluid pan filter O-rings.

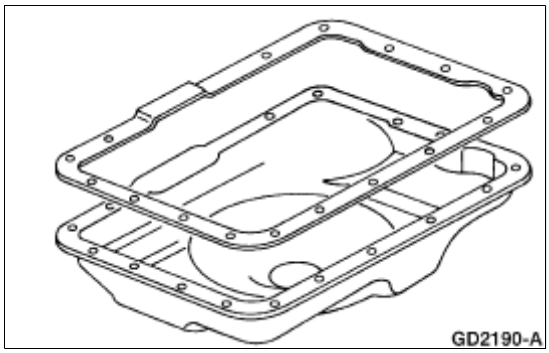
- Coat the fluid pan filter O-rings with MERCON ® V; Automatic Transmission fluid XT-5-QM meeting Ford specification MERCON ® V.



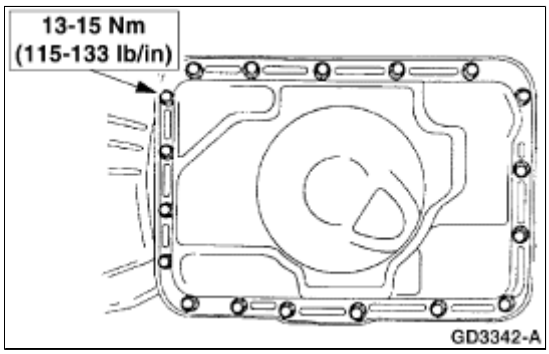
113. Install the fluid pan filter.
    1. Position fluid pan filter on the main control valve body.
    2. Install the screw.



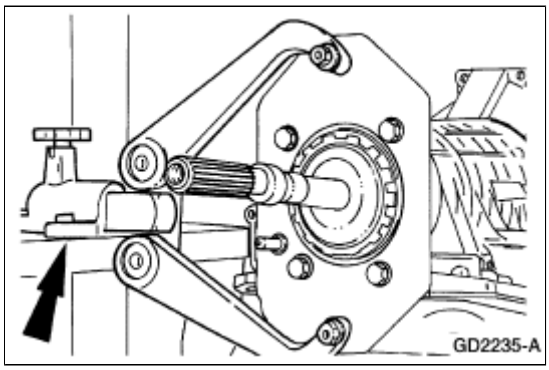
114. Install the transmission fluid pan and transmission fluid pan gasket.
    - Loosely install the screws.



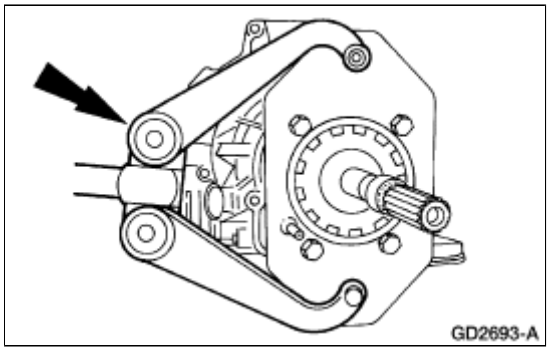
115. Tighten the screws.



116. Remove the transmission from the Holding Fixture and place on a flat surface.

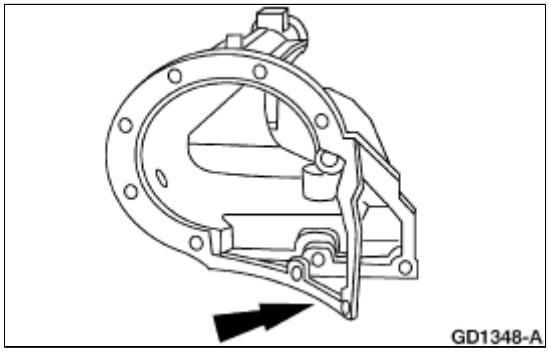


117. Remove the fixture arm of the Holding Fixture from the A4LD Holding Fixture Adapter.



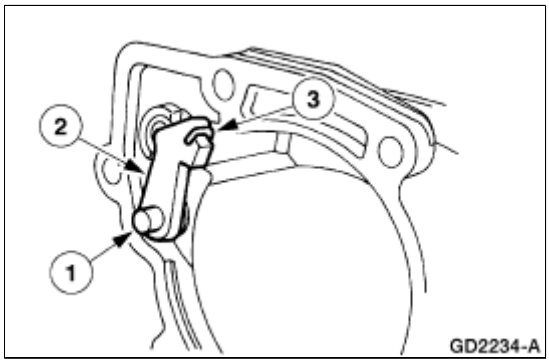
118. **NOTE:** Use petroleum jelly to hold the gasket in place.

Install a new extension housing gasket.



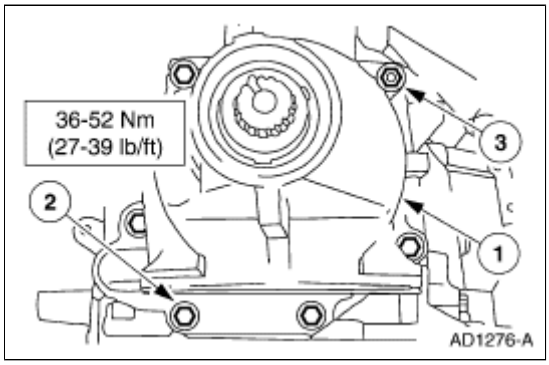
119. **NOTE:** The guide cup is press-fit into the extension housing and is not serviced separately.

Install the parking pawl assembly.
1. Install the parking pawl shaft into the extension housing.
2. Install the parking pawl.
3. Install the parking pawl return spring.



120. **CAUTION: Make sure the parking lever actuating rod is correctly seated into the transmission case parking rod guide cup.**

Install the extension housing.
1. Install the extension housing and gasket.
2. Install the screws.
3. Install the stud(s).

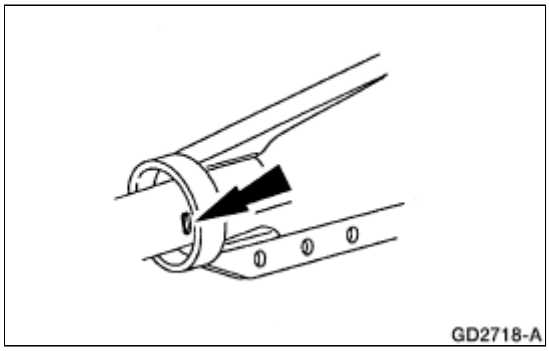


121. **CAUTION: The lube hole in the bushing must be aligned with the lube groove in the extension housing.**

NOTE: Install the extension housing bushing (7A034) only if removed in disassembly.

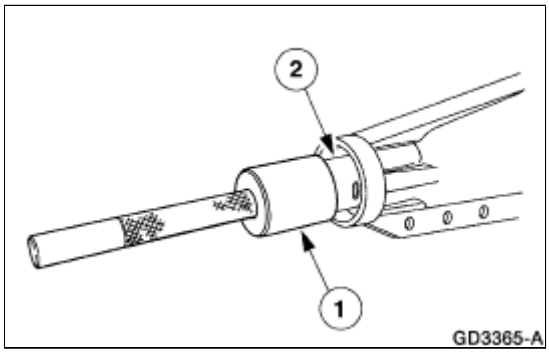
NOTE: Remove any burrs from the extension housing counterbore.

Align lube hole with the lube groove in extension housing. This groove is located at the 3 o'clock position when viewed from the rear.

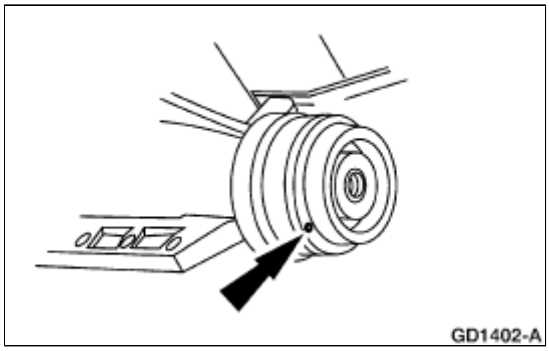


122. **CAUTION: Tool will bottom when bushing is in the proper position.**

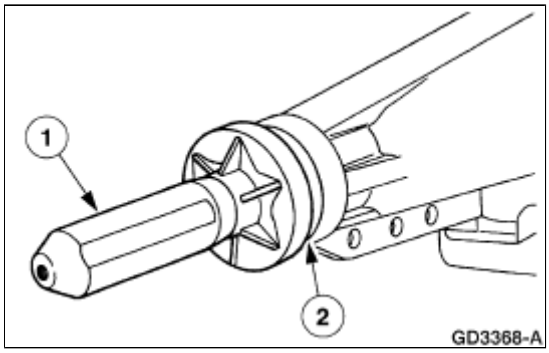
Using the Housing Bushing Replacer, install the extension housing bushing.
1. Position the Housing Bushing Replacer.
2. Install extension housing bushing.



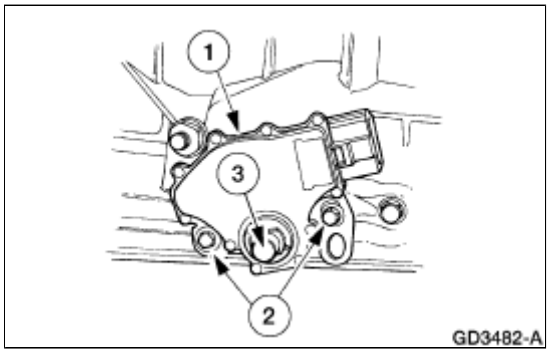
123. Position new extension housing seal with drain hole in the 6 o'clock position.



124. Using Align Extension Housing Seal Replacer, install a new extension housing seal.
    1. Align Extension Housing Seal Replacer.
    2. Install the extension housing seal.



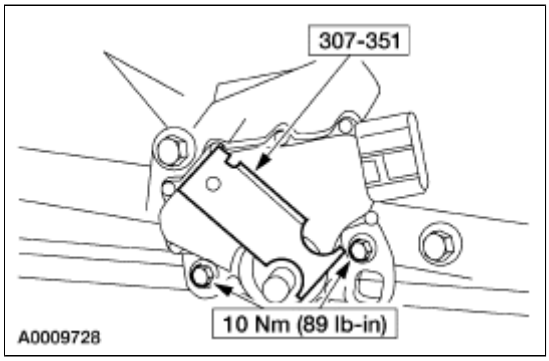
125. Install the digital transmission range (TR) sensor.
    1. Position the digital TR sensor on the transmission.
    2. Loosely install the screws.
    3. Rotate manual lever to neutral position (two detents rearward).



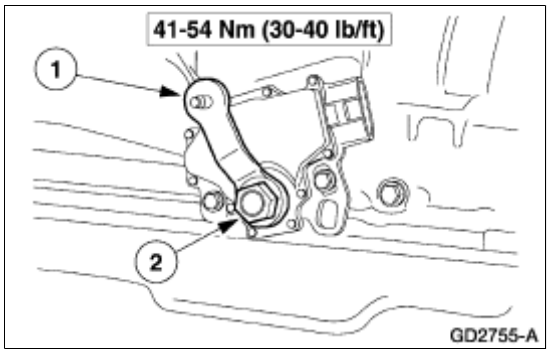
126. **CAUTION: Tightening one screw before tightening the other may cause the sensor to bind or become damaged.**

    NOTE: The manual lever must be in the neutral position.

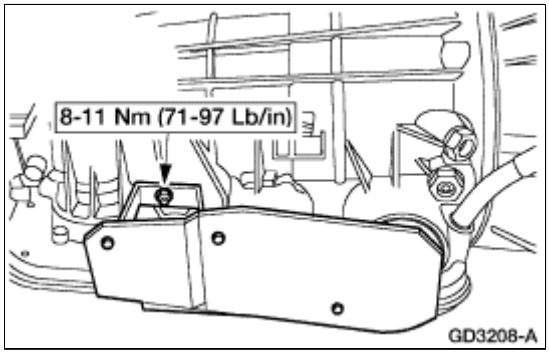
    Using the special tool, align the digital TR sensor and tighten screws in an alternating sequence.



127. Install the manual control lever.
    1. Install the lever.
    2. Install the nut.

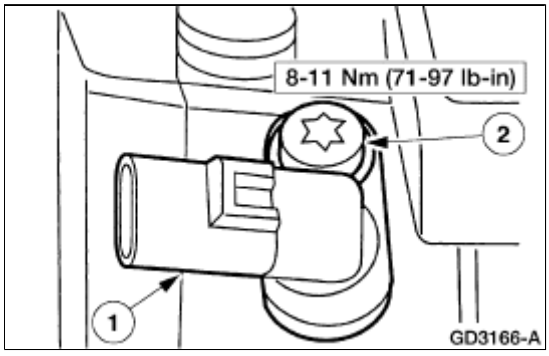


128. Install transmission servo heat shield and nut.



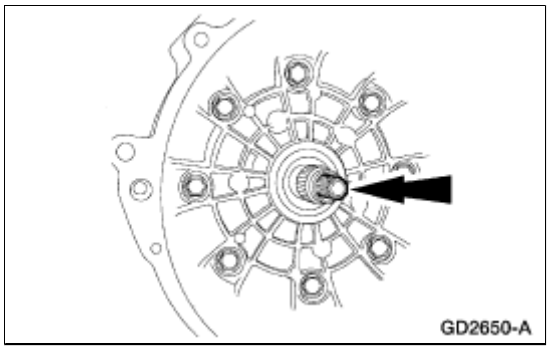
129. **NOTE:** Inspect O-ring for damage. Replace if damaged.

Install the output shaft speed (OSS) sensor.
1. Install the sensor.
2. Install the screw.

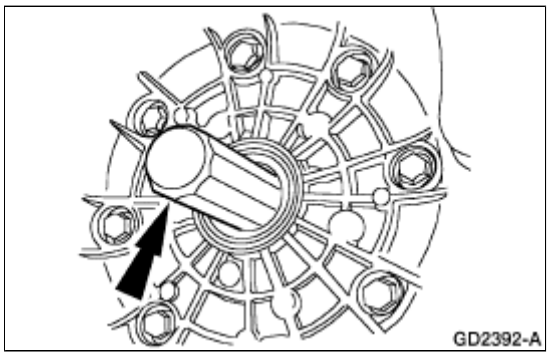


130. **CAUTION: The splines of the input shaft are not the same length on both ends. The shaft end with the shorter splines goes into the fluid pump.**

Install the input shaft.



131. Check that the fluid pump gear seal ring is seated.
    - Insert the Front Pump Seal Sizing Tool into the fluid pump drive gear.

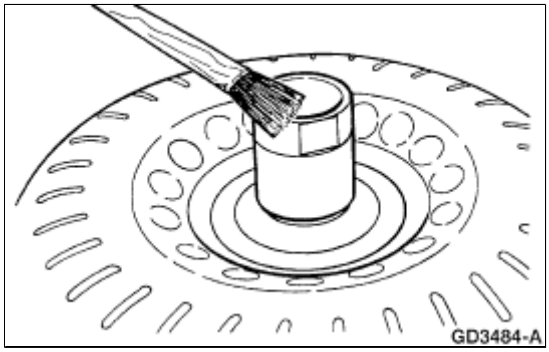


132. **CAUTION: Do not damage the fluid pump gear O-ring when installing torque converter.**

CAUTION: Make sure the converter hub is fully engaged in the front pump support and gear, and rotates freely. Do not damage the hub seal.

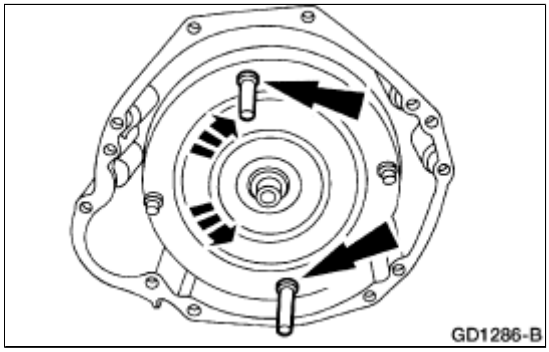
CAUTION: If the torque converter slides out, the hub seal may be damaged.

Lubricate the converter hub with MERCON ® V; Automatic Transmission Fluid XT-5-QM or equivalent Meeting Ford MERCON ® V specification.



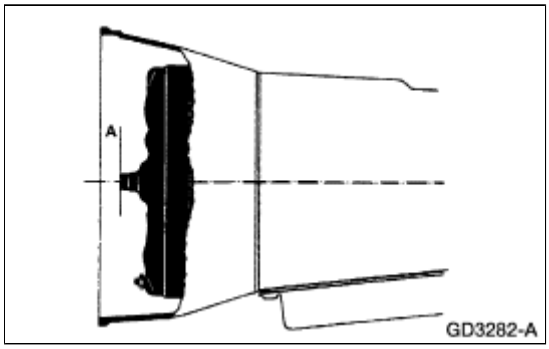
133. **WARNING: The torque converter can fall out if the transmission is tipped. Failure to follow these instructions may result in personal injury.**

Use the Torque Converter Handles to install the torque converter by pushing and rotating.

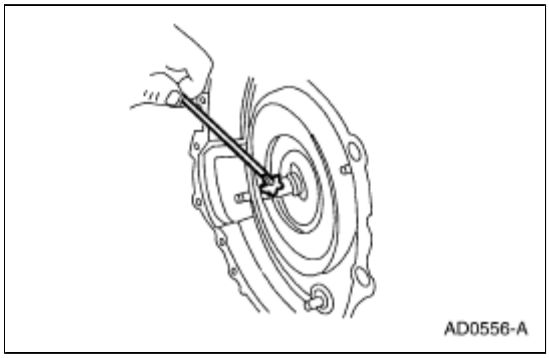


134. **NOTE:** Dimension "A" should be 10.23-14.43 mm (0.43-0.56 in).

Make sure the torque converter is installed to specification.

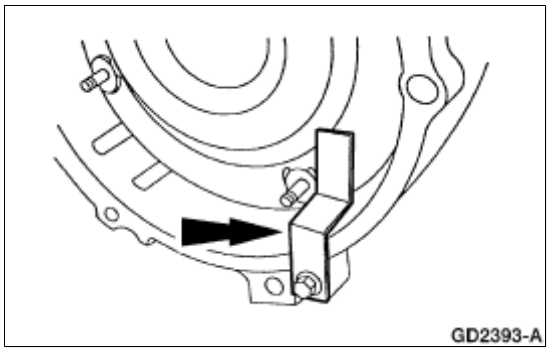


135. Lubricate the torque converter pilot hub with Multi-Purpose Grease D0AZ-19584-A meeting Ford specification ESB-M1C93-B.



136. Before installing transmission, make sure that the transmission cooling system (line and cooler [s]) have been thoroughly flushed. If contamination cannot be removed or proper flow cannot be obtained, replace cooler(s) and/or lines. For additional information, refer to Section 307-02 .

137. Install the Torque Converter Holding Tool on case.


GD2393-A

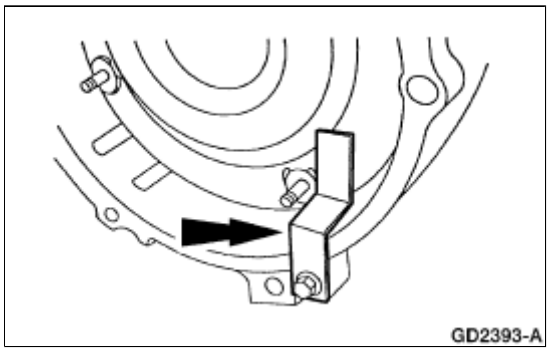
Transmission

1. On 4x4 models install the vent tube assembly.

2. **WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions may result in personal injury.**

   Raise and position the transmission.

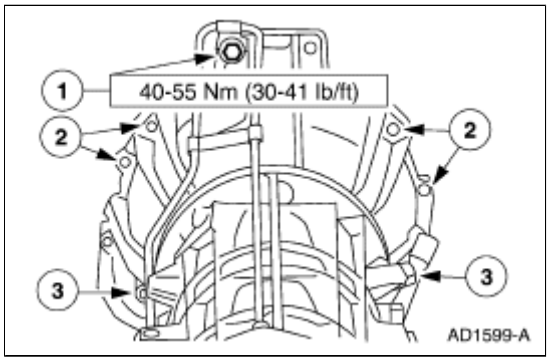
3. Remove the Torque Converter Holding Tool.



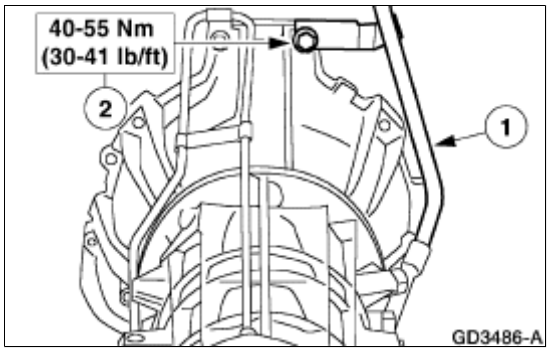
4. **NOTE:** Align the flexplate to converter marks made at removal.

   NOTE: For vehicles equipped with 4.0L SOHC engines, install all eight transmission-to-engine screws. For vehicles equipped with 4.0L EI engines, only install seven transmission-to-engine screws.

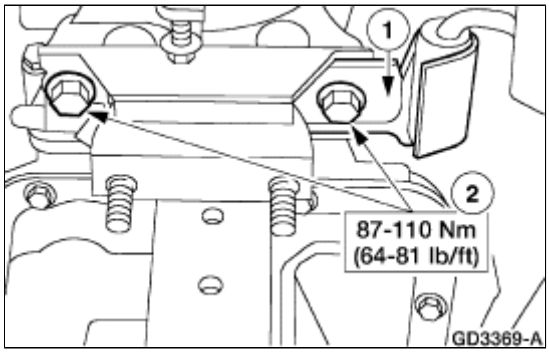
   Install the transmission-to-engine screws.
   1. Install 2 M10 x 40 mm (1.6 in) screws.
   2. Install 4 M10 x 50 mm (2 in) screws.
   3. Install 2 M10 x 75 mm (3 in) screws.



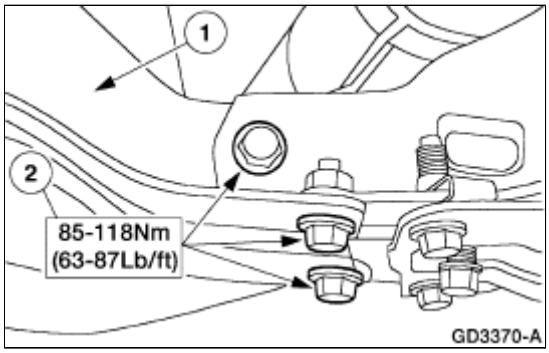
5. For vehicles equipped with a 4.0L EI engine, install the upper filler tube.
   1. Install the upper filler tube.
   2. Install the screw.



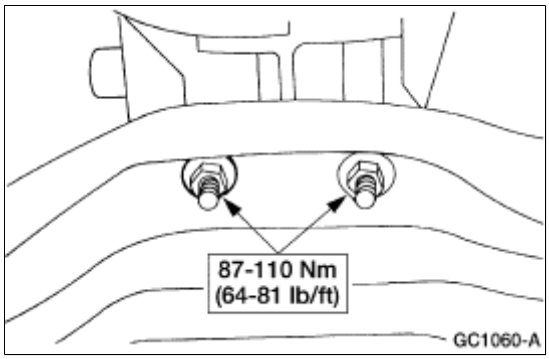
6. Install the transmission mount screws.
    1. Install the exhaust bracket.
    2. Install the screws.



7. Install the crossmember.
    1. Position the crossmember.
    2. Install the six crossmember bolts (three each side).



8. Install the transmission mount into the crossmember and tighten the nuts.

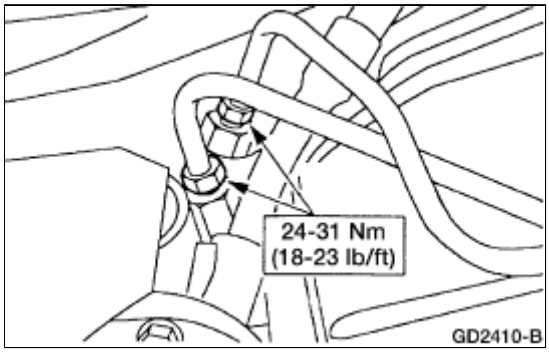


9. Remove the High-Lift Transmission Jack.

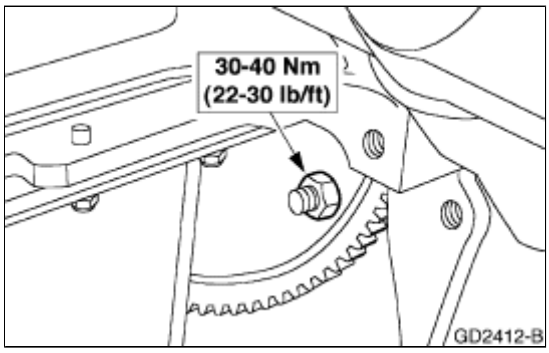
10. If equipped, install the transfer case. For additional information, refer to Section 308-07B .

11. **CAUTION: Use care not to bend or otherwise damage the cooler lines.**

    Hold the case fitting and install the transmission cooler lines.



12. Install the four torque converter-to-flexplate nuts.
    - Rotate the crankshaft as needed to gain access to all the nuts.

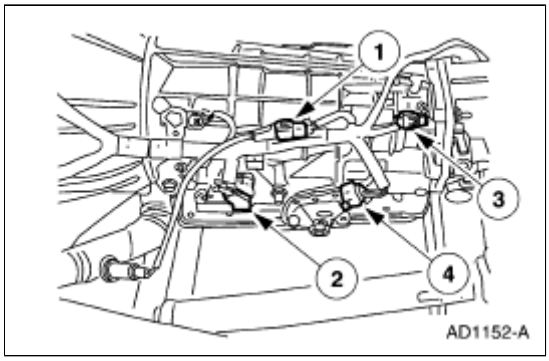


13. Install the starter motor. For additional information, refer to Section 303-06 .

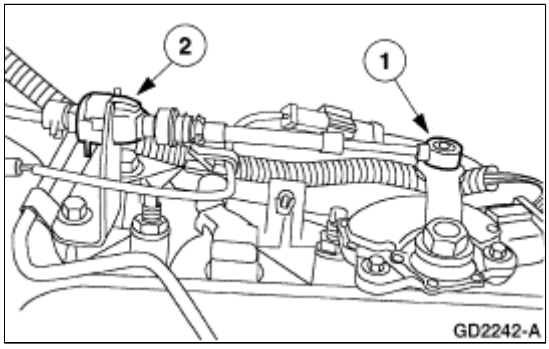
14. Install the catalytic converter assembly and crossover pipe nuts. For additional information, refer to Section 309-00 .

15. Install the transmission wiring harnesses.
    1. Connect the heated oxygen sensor (HO2S) connector.

2. Connect the transmission connector.
3. Connect the output shaft speed (OSS) sensor connector.
4. Connect the digital transmission range (TR) sensor connector.

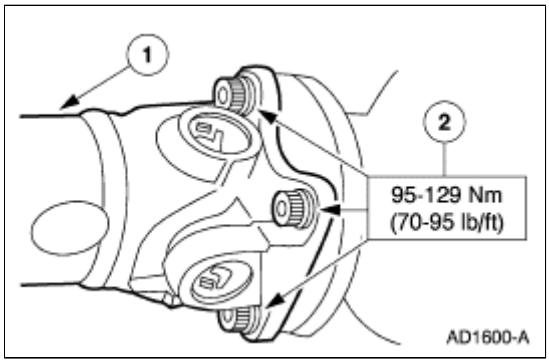


16. Install the shift cable.
    1. Connect the shift cable to the manual control lever.
    2. Connect the shift cable to the bracket.



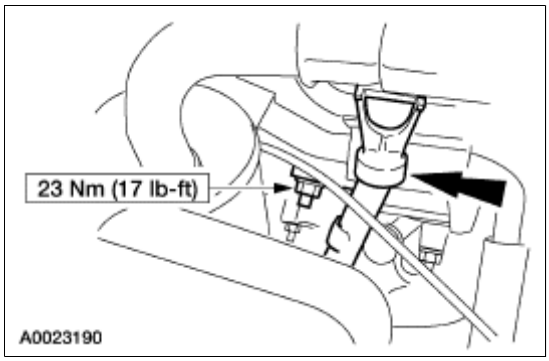
17. **NOTE:** Align the driveshaft yoke and the axle shaft marks made at removal to maintain driveline balance.

    Install the rear driveshaft.
    1. Position the driveshaft.
    2. Install the four driveshaft bolts.



18. Lower the vehicle.

19. For vehicles equipped with a 4.0L SOHC engine, install the transmission fill tube and indicator as an assembly.



20. Connect the battery ground cable.

21. Fill the transmission with fluid and inspect for correct operation.
    - Use MERCON ® V Automatic Transmission Fluid XT-5-QM or equivalent meeting Ford MERCON ® V specification.

22. Verify that the shift cable is correctly adjusted. For additional information, refer to Section 307-05 .

General Specifications

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM—Transmission (4R70W and 5R55E)	MERCON® V or equivalent

Torque Specifications

Description	Nm	lb-ft	lb-in
Transmission Auxiliary Fluid Cooler Bolts	5-7	—	45-62
Transmission Auxiliary Fluid Cooler Hose Clamps	3-4	—	27-35
Radiator Air Deflector Bolts	12-17	—	106-150
Transmission Fluid Cooler Tube Fitting To Radiator	13-22	10-16	—
Transmission Fluid Cooler Tube Fittings At Case(4R70W)	29-35	21-25	—
Transmission Fluid Cooler Tube to Case Fitting (5R55E)	24-31	18-23	—
Transmission Cooler Lines Bracket Bolts	3.1-4.3	—	28-38
Radiator to Radiator Support Bolts	6-8	—	53-71

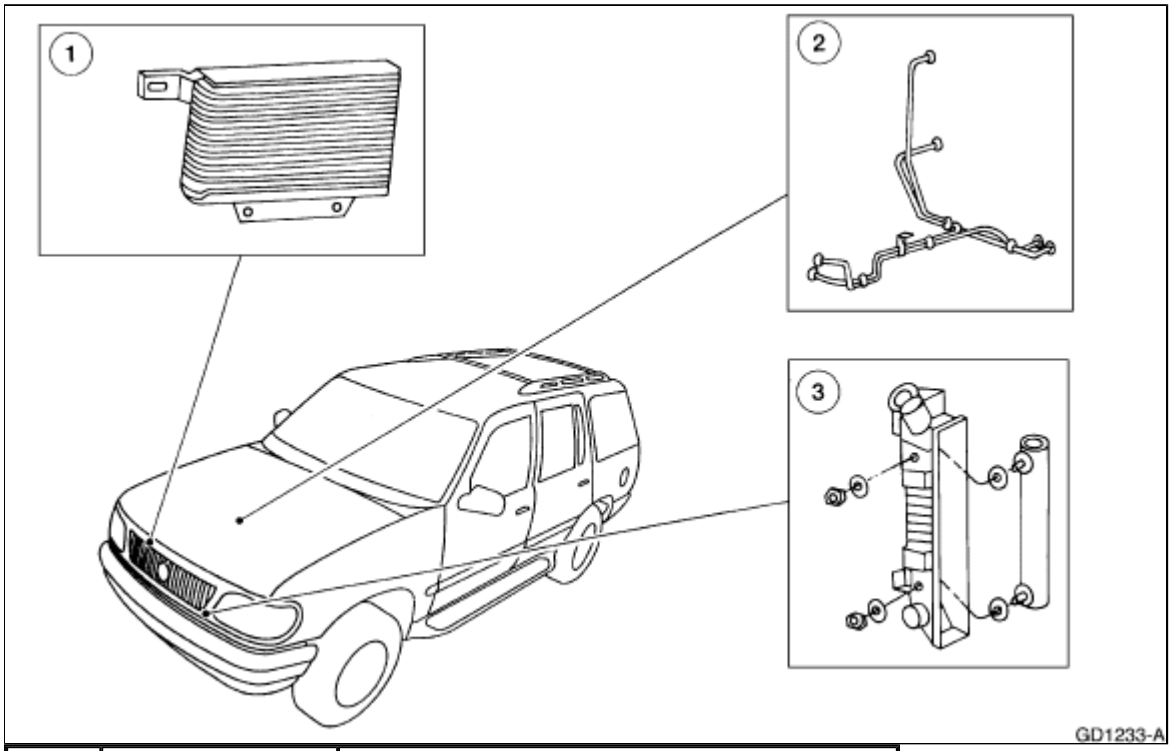
Transmission Cooling

All vehicles with automatic transmissions are equipped with integral transmission fluid coolers (7A095). The integral transmission fluid cooler is contained inside of the radiator outlet tank (8054) and cannot be repaired separately. All (AWD) vehicles are equipped with the transmission auxiliary fluid cooler (7K177) which is mounted in front of the radiator (8005). In operation, transmission fluid travels from the transmission to the integral transmission fluid cooler to the transmission auxiliary fluid cooler then back to the transmission. The integral transmission fluid cooler transfers heat from the transmission fluid to the engine coolant. The transmission auxiliary fluid cooler transfers heat from the transmission fluid to the outside air.

For transmission fluid cooler flow test, refer to Section 307-01A and Section 307-01B .

For transmission fluid cooler backflushing and cleaning, refer to Section 307-01A and Section 307-01B .

Transmission Cooling Components (Mountaineer Shown, Explorer Similar)



Item	Part Number	Description
1	7K177	Transmission auxiliary fluid cooler
2	7C140	Transmission fluid cooler tube
3	7A095	Transmission fluid coolers

Transmission Cooling

Inspection and Verification

WARNING: Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in personal injury and/or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, press down on the radiator cap (with a cloth), turn and remove.

Check for fluid leakage. If fluid leakage is found at any of the transmission fluid cooling components, the component must be replaced.

Symptom Chart

SYMPTOM CHART

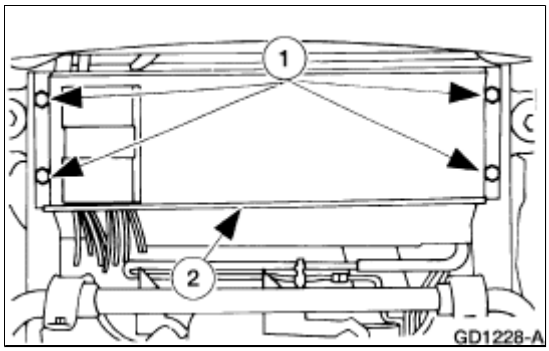
Condition	Possible Sources	Action
• Transmission Overheating	• Damaged radiator.	• REPAIR or install a new radiator. For additional information, REFER to Section 303-03 .
	• System leaks.	• INSPECT for leaks. REPAIR as required.
	• System leaks.	• INSPECT transmission fluid cooler and tubes for leaks. REPAIR as required.
	• Incorrect fluid level.	• ADJUST to proper level.
	• Fluid condition.	• INSPECT according to instructions under Fluid Condition Check. For additional information, REFER to Section 303-03 .
	• Damaged, blocked, reversed, leaking or restricted cooler lines or cooler tubes.	• INSPECT cooler lines and tubes. REPAIR or flush as necessary.
	• Engine concerns causing transmission to overheat.	• INSPECT engine cooling system. For additional information, REFER to Section 303-03 .
	• Excessive towing loads.	• CHECK gross vehicle weight.
	• Incorrect idle or performance.	• REFER to Powertrain Control/Emissions Diagnosis

		(PC/ED) manual.

Auxiliary Transmission Fluid Cooler

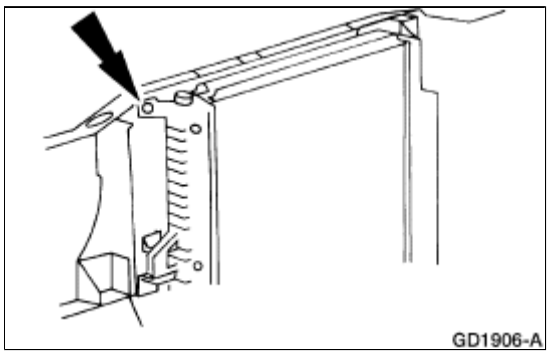
Removal

1. Shut off the air suspension if equipped.
2. Disconnect the battery cables.
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .
4. Remove the radiator air deflector (8327).
    1. Remove the bolts.
    2. Remove the radiator air deflector.

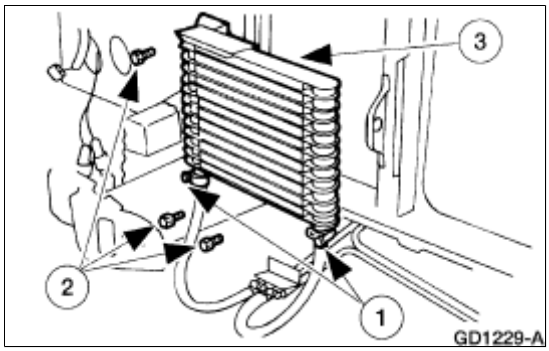


5. Place a drain pan under the transmission auxiliary fluid cooler (7K177).
6. **NOTE:** On 5.0L, the radiator (8005) must be loosened to provide access for removing the upper transmission fluid cooler screw.

    Loosen the two upper radiator hold down screws.

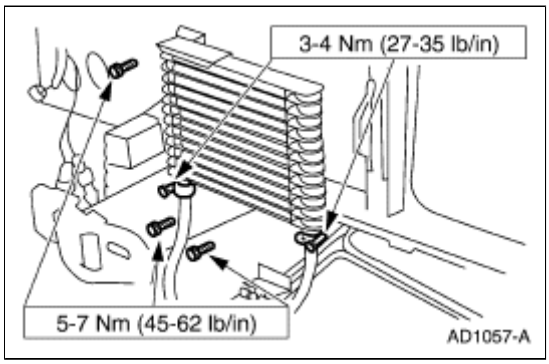


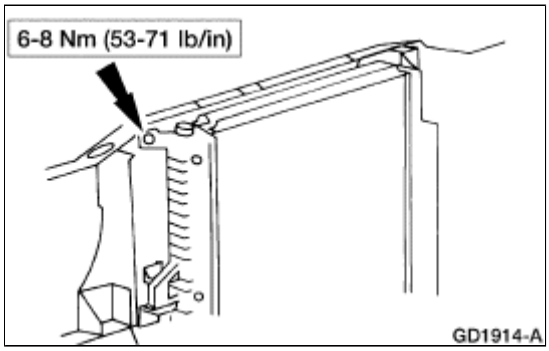
7. Remove the transmission auxiliary fluid cooler.
    1. Disconnect the hoses.
    2. Remove the bolts.
    3. Remove the transmission auxiliary fluid cooler.

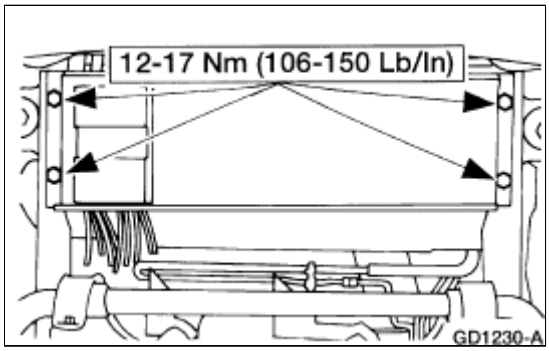


Installation

1. Follow the removal procedure in reverse order.







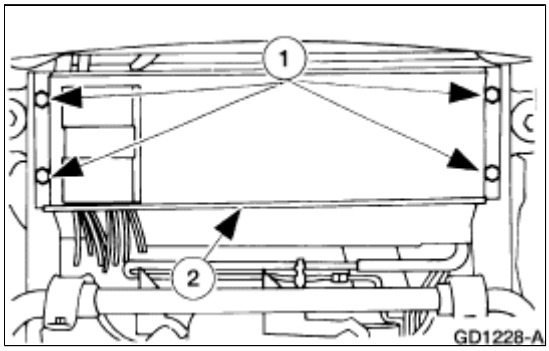
Transmission Fluid Cooler Tubes —4R70W Transmission

Removal

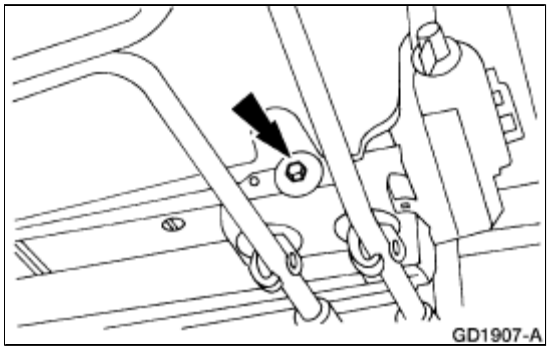
1. **WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

   Raise and support the vehicle. Refer to Section 100-02 .

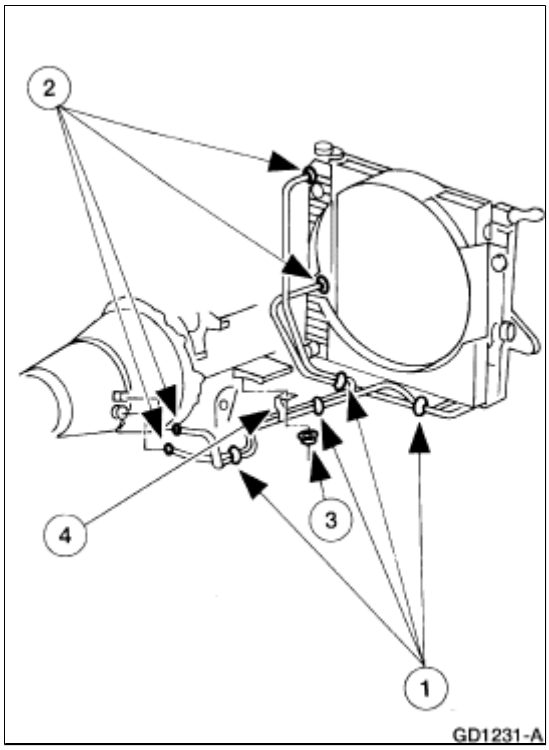
2. Remove the radiator air deflector (8327).
   1. Remove the bolts.
   2. Remove the radiator air deflector.



3. Remove the nut, bolt, and transmission cooler line bracket.



4. Remove the transmission fluid cooler tubes (7C140).
   1. Remove the clips.
   2. Disconnect the fittings.
      - Use a backup wrench to hold the case fitting secure.
   3. Remove the nut.
   4. Remove the transmission fluid cooler tubes.



Installation

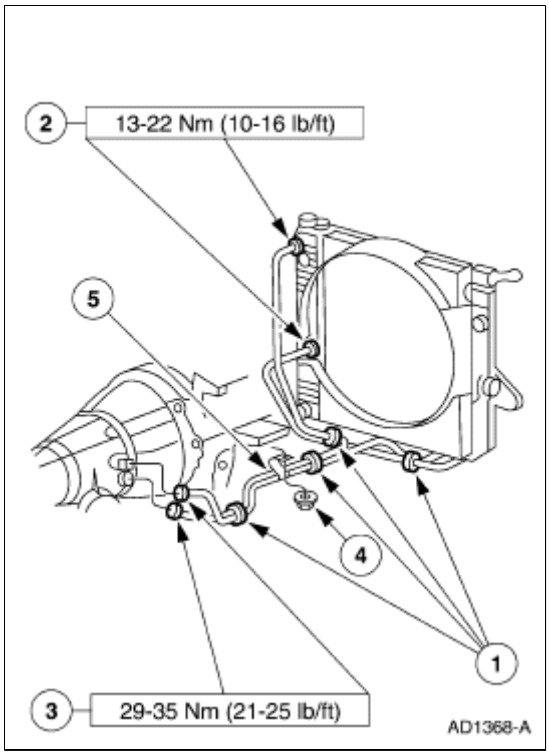
1. **NOTE:** When a transmission fluid cooler tube is replaced, each replacement tube must be fabricated from the same size tube as the original.

   Shape a new transmission fluid cooler tube.
   - Use the prior tube as a guide.
   - Install the appropriate fittings.
   - Use a double flare on the ends of the tubes.

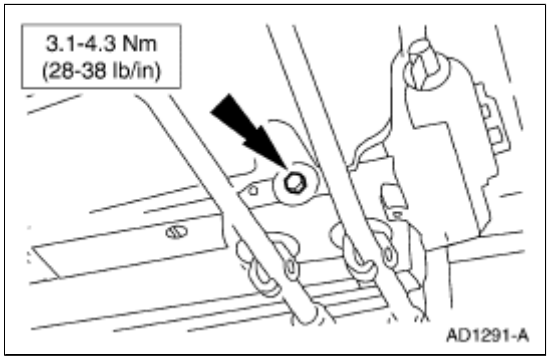
CAUTION: To prevent damage, make sure all plugs are removed from port openings before installing tubes.

CAUTION: To prevent cross threading, all tube nuts must be hand started before being torqued to specification.

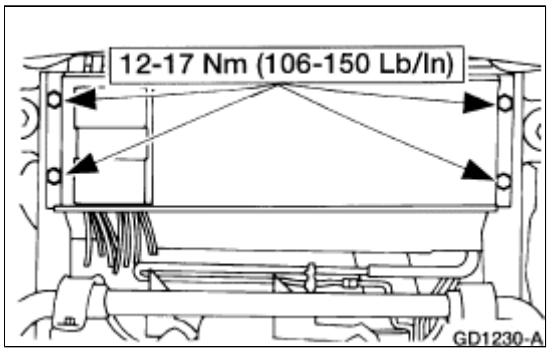
2. Install the transmission fluid cooler tubes.
   1. Install the clips.
   2. Connect the tube fittings to the radiator.
   3. Connect the tube fitting to the transmission.
      - Use a backup wrench to hold the case fitting secure.
   4. Install the tube bracket nut.
   5. Install the transmission fluid cooler tubes.



3. Install the transmission cooler line bracket and nut and bolt.



4. Install the radiator air deflector.
    - Install the bolts.



5. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Lower the vehicle.

6. Fill transmission fluid to the proper level using the correct fluid and inspect for leaks.

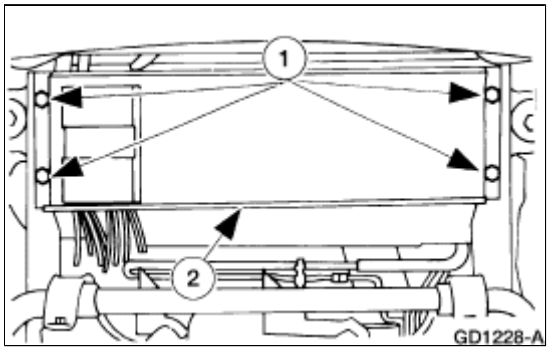
Transmission Fluid Cooler Tubes —5R55E Transmission

Removal

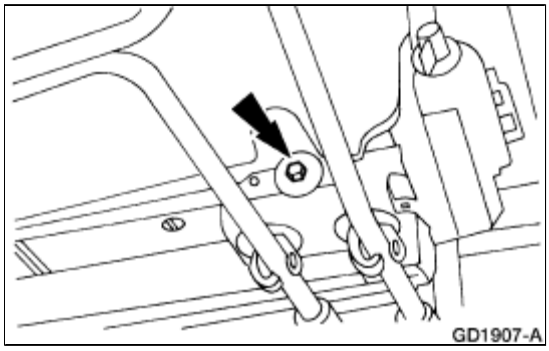
1. **WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

   Raise and support the vehicle; refer to Section 100-02 .

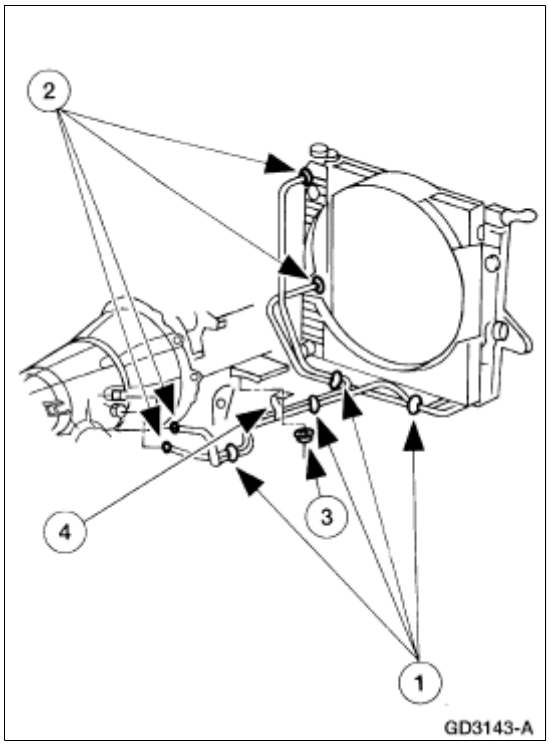
2. Remove the radiator air deflector (8327).
   1. Remove the bolts.
   2. Remove the radiator air deflector.



3. Remove the nut, bolt and transmission cooler line bracket.



4. Remove the transmission fluid cooler tubes (7C140).
   1. Remove the clips.
   2. Disconnect the fittings.
      - Use a backup wrench to hold the case fitting secure.
   3. Remove the nut.
   4. Remove the transmission fluid cooler tubes.



Installation

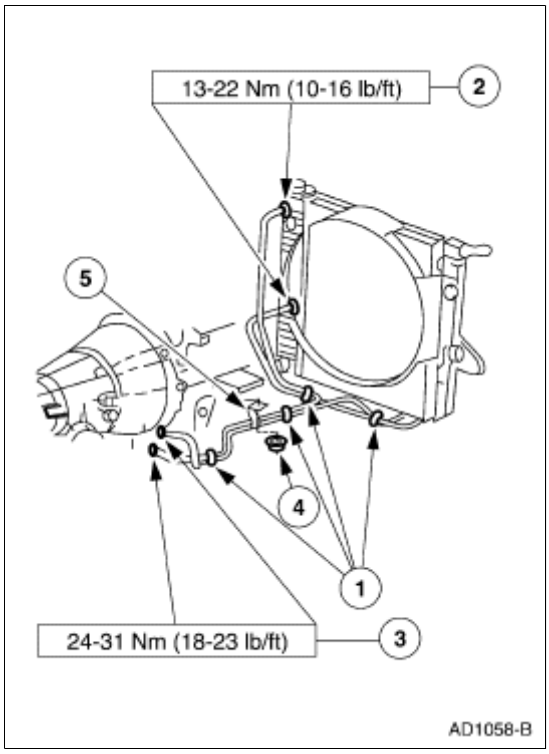
1. **NOTE:** When a transmission fluid cooler tube is replaced, each replacement tube must be fabricated from the same size tube as the original.

   Shape a new transmission fluid cooler tube.
   - Use the prior tube as a guide.
   - Install the appropriate fittings.

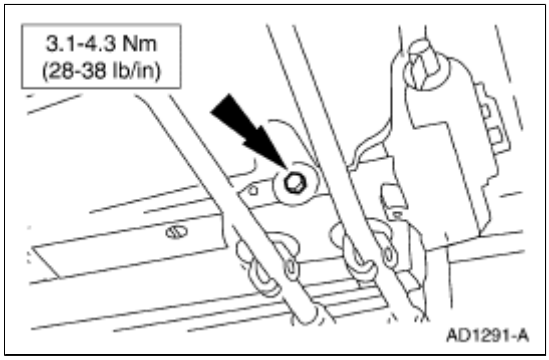
2. **CAUTION: To prevent damage, make sure all plugs are removed from port openings before installing tubes.**

   CAUTION: To prevent cross threading, all tube nuts must be hand started before being torqued to specification.

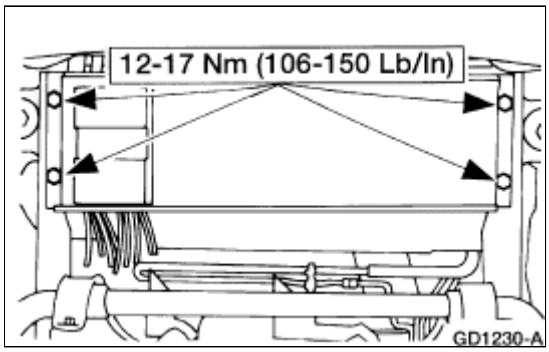
   Install the transmission fluid cooler tubes.
   1. Install the clips.
   2. Connect the tube fittings to the radiator.
   3. Connect the tube fittings to the transmission.
      - Use a backup wrench to hold the case fitting secure.
   4. Install the tube bracket nut.
   5. Install the transmission fluid cooler tubes.



3. Install the nut, bolt, and transmission cooler line bracket.



4. Install the radiator air deflector.
    - Install the bolts.



5. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Lower the vehicle.

6. Fill transmission fluid to the proper level using the correct fluid and inspect for leaks.

Torque Specifications

Description	Nm	lb-ft	lb-in
Transmission shift cable bracket bolts	34-46	25-34	—
Floor shifter base to floor cover	12-16	8-12	—

External Controls

The transmission shift cable transfers the transmission operating mode from the shift control selector lever to the transmission. The indicated position of the shift control selector lever is transferred to the transmission through the transmission column shift selector tube (7212), then to the shift cable and bracket (7E395), and down to the manual control lever (7A256) on the transmission.

Shift Interlock System

The shift interlock system prevents the shifting from PARK unless the brake pedal (2455) is depressed. The shift interlock system consists of a shift lock actuator (3Z719) mounted at the base of the steering column tube (3514). If the ignition switch (11572) is in the RUN position, the shift lock actuator is continually on unless the brake pedal is depressed.

Transmission Control Switch (TCS)

The transmission control switch (TCS) is a momentary contact switch located on the end of the shift control selector lever. Pushing the transmission control switch (TCS) will either disengage or engage the overdrive function of the transmission. If the overdrive ((D)) is disengaged, the message O/D OFF will illuminate on the instrument panel.

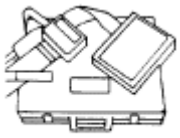
External Controls

Refer to Wiring Diagrams Cell 37 , Shift Lock for schematic and connector information.

Refer to Wiring Diagrams Cell 30 , Transmission Controls for schematic and connector information.

Refer to Wiring Diagrams Cell 29 , Transmission Controls for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
 ST1391-A	104-Pin Breakout Box 418-049 (014-00950) or equivalent

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage, incorrect component installation, and component misalignment. Verify that all circuit-related systems are functioning correctly. Refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Damaged shift lock actuator • Damaged brake pedal position switch • Damaged steering column • Damaged transmission control switch • Damaged instrument cluster • Damaged shift cable and bracket	• Failed fuse(s) • Damaged wiring harness • Loose or corroded connections

3. If the fault is not visually evident, proceed to the Symptom Chart.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Shift Interlock System Does Not Release/Lock Properly	• Circuit(s). • Fuse(s). • Shift lock actuator. • Brake pedal position (BPP) switch.	• GO to Pinpoint Test A .
• Shift Control Out of Proper Gear Relationship	• Transmission shift cable and bracket. • Retainer bracket. • Shift control linkage.	• GO to Pinpoint Test B .
• Transmission Range Indicator Does Not Correspond to the Gear	• Transmission shift cable bracket.	• TIGHTEN bolts holding transmission shift cable bracket.
	• Transmission control indicator linkage.	• ADJUST PRNDL at steering housing.
	• Transmission shift cable loose from the transmission retainer bracket.	• TIGHTEN transmission shift cable bolts.
	• Shift linkage.	• VERIFY transmission shift cable adjustment. REFER to Adjustments in this section. ADJUST transmission shift cable if necessary. VERIFY digital transmission range (DTR) sensor or transmission range (TR) sensor for proper adjustment. REFER to Section 307-01A (5R55E) or Section 307-01B (4R70W).
	• Clip securing the transmission shift cable to the shift control selector lever.	• INSTALL clip properly.
	• Internal transmission concern.	• REFER to Section 307-01A (5R55E) or Section 307-01B (4R70W).
• Transmission Range Indicator Lamp Does Not Illuminate	• Bulb. • Circuit(s).	• REFER to Section 413-00 .
• Transmission Control Switch (TCS) Is Not Operating Properly	• Fuse. • TCS not cycled during self test. • Powertrain control module.	• GO to Pinpoint Test C .

	• Circuit(s).	
• Transmission Control Indicator Lamp (TCIL) Does Not Illuminate	• Bulb. • Circuit(s). • Powertrain control module.	• GO to Pinpoint Test D .
• Transmission Control Indicator Lamp (TCIL) Stays Illuminated	• Circuit(s). • Powertrain control module.	• GO to Pinpoint Test E .
• Rattle, Noise, Buzz, or Other Noise	• Selector lever knob. • Shift control selector lever. • Shift interlock spring.	• REPLACE selector lever knob. • TIGHTEN housing bolts. • ATTACH shift interlock spring properly.
• Water Enters Inside the Vehicle	• Cable assembly grommet. • Torn cable assembly grommet.	• SECURE grommet to dash panel. • INSTALL new transmission shift cable.
• Excessive Shift Effort	• Transmission shift cable. • Cable bracket.	• REPLACE transmission shift cable. • ADJUST cable. TIGHTEN cable bracket screws.
• Transmission Range Selector Lever Will Not Shift From Range	• Transmission shift cable. • Lock tab. • Broken transmission shift cable.	• REINSTALL transmission shift cable. • REPAIR/REPLACE lock tab. • REPLACE transmission shift cable.

Pinpoint Tests

PINPOINT TEST A: THE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 TEST FUSE 10 (7.5A)	
1	

2

Fuse 10 (7.5A)

2 Measure the resistance of fuse 10.

- **Is the resistance 5 ohms or less?**

→ **Yes**
GO to A2 .

→ **No**
GO to A3 .

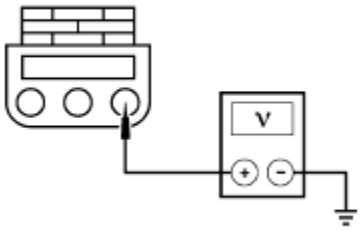
A2 CHECK THE POWER SUPPLY TO THE SHIFT LOCK ACTUATOR—CIRCUIT 1003 (GY/YE)

1

2

Shift Lock Actuator C289

3



A0037583

3 Measure the voltage between the shift lock actuator C289 pin 3, circuit 1003 (GY/YE), harness side and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A5 .

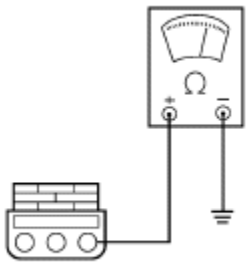
→ **No**
GO to A4 .

A3 TEST CIRCUIT 1003 (GY/YE) FOR SHORT TO GROUND

1

Shift Lock Actuator C289

2



AD1006-A

2 Measure the resistance at C289 pin 3, circuit 1003 (GY/YE).

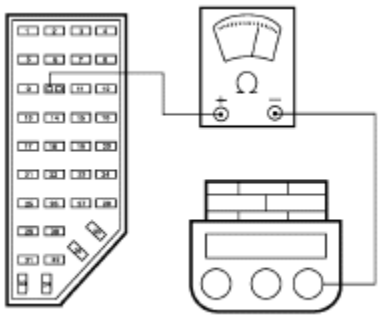
- **Is the resistance 10 K ohms or less?**

→ **Yes**
REPAIR circuit 1003 (GY/YE) for short to ground. TEST the system for normal operation.

→ **No**
INSTALL a new shift lock actuator. TEST the system for normal operation.

A4 TEST CIRCUIT 1003 (GY/YE) FOR OPEN

1



AD1081-A

1 Measure the resistance of circuit 1003 (GY/YE) between the output side of fuse 10 (7.5A) and the shift lock actuator C289 pin 3.

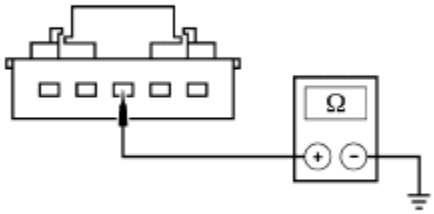
- **Is the resistance 5 ohms or less?**

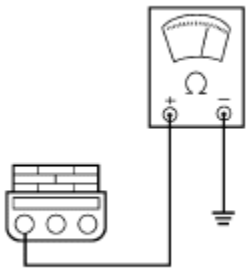
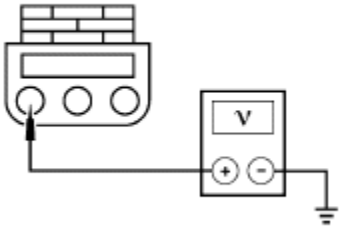
→ **Yes**
GO to A5 .

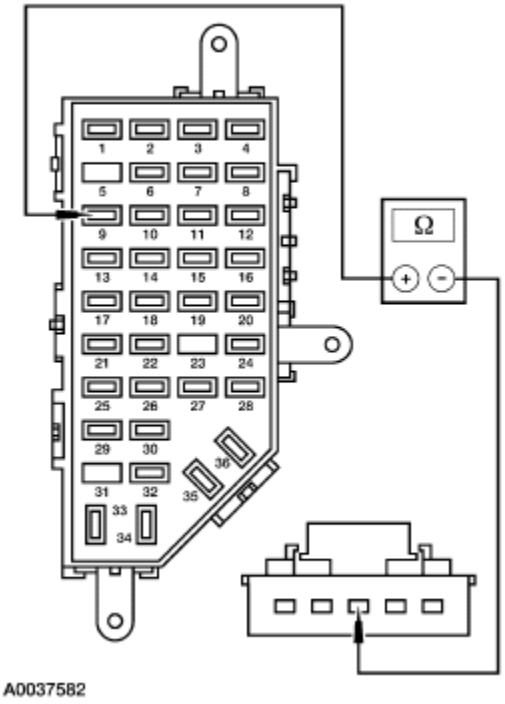
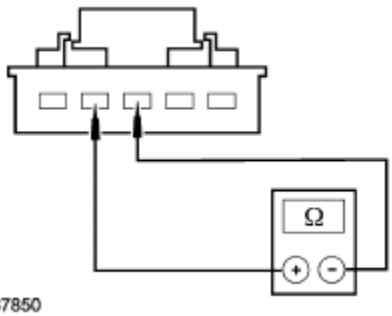
→ **No**
REPAIR circuit 1003 (GY/YE) for open. TEST the system for normal operation.

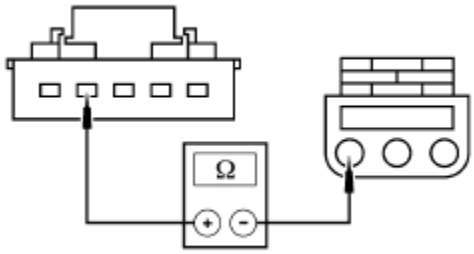
A5 CHECK FUSE 9 (7.5A)

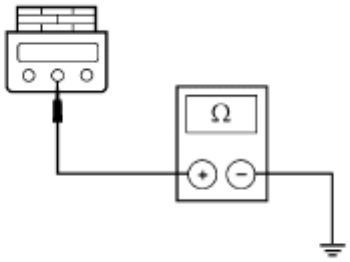
1

 2 Fuse 9 (7.5A)	2 Measure the resistance of fuse 9 (7.5A). • **Is the resistance 5 ohms or less?** → **Yes** GO to A8 . → **No** GO to A6 .
A6 TEST CIRCUIT 276 (BN) FOR SHORT TO GROUND.	
1 Brake Pedal Position (BPP) Switch C224 2  A0037586	2 Measure the resistance of circuit 276 (BN) between C224 pin 3 and ground. • **Is the resistance 10 K ohms or less?** → **Yes** REPAIR circuit 276 (BN) for short to ground. TEST the system for normal operation. → **No** GO to A7 .
A7 TEST CIRCUIT 810 (RD/LG) FOR SHORT TO GROUND	
1 	

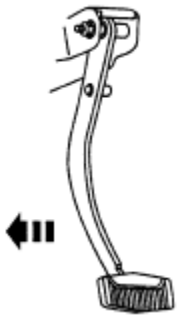
Shift Lock Actuator C289 2  AD1004-A	2 Depress the brake pedal and measure the resistance between C289 pin 1 and ground. • **Is the resistance 10 K ohms or less?** → **Yes** REPAIR circuit 810 (RD/LG) for short to ground. TEST the system for normal operation. → **No** INSTALL a new shift lock actuator. TEST the system for normal operation.
A8 CHECK FOR B+ ON CIRCUIT 810 (RD/LG)	
1 Shift Lock Actuator C289 2  A0037584	2 Depress the brake pedal and measure voltage at C289 pin 1. • **Is the voltage 10 volts or greater?** → **Yes** GO to A12 . → **No** GO to A9 .
A9 TEST CIRCUIT 276 (BN) FOR OPEN	

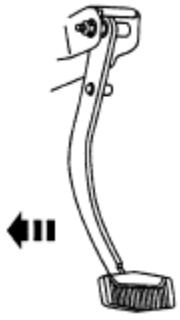
1 Brake Pedal Position (BPP) Switch C224 2  A0037582	2 Measure the resistance between the output side of fuse 9 (7.5A) and the brake pedal position switch pin 3, circuit 276 (BN). • **Is the resistance 5 ohms or less?** → **Yes** GO to A10 . → **No** REPAIR circuit 276 (BN) for open. TEST the system for normal operation.
A10 TEST BRAKE PEDAL POSITION SWITCH	
1  A0037850	1 Measure the resistance of the brake pedal position switch, while open (OFF) and closed (ON), between pin 2 and pin 3 of C224.

	• **Is the resistance of the switch greater than 10 K ohms while OFF and 5 ohms or less while ON?** → **Yes** GO to A11 . → **No** INSTALL a new switch. TEST the system for normal operation.
A11 TEST CIRCUIT 810 (RD/LG) FOR OPEN	
1 Brake Pedal Position (BPP) Switch C224 2 Shift Lock Actuator C289 3  A0037587	3 Measure the resistance between C224 pin 2 and C289 pin 1. • **Is the resistance 5 ohms or less?** → **Yes** INSTALL a new shift lock actuator. TEST the system for normal operation → **No** REPAIR circuit 810 (RD/LG) for open. TEST the system for normal operation.
A12 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1	1 Measure the resistance between the shift lock actuator C289 pin 2, circuit 57 (BK), harness side and ground.

 GD2181-A	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new shift lock actuator. REFER to Brake Shift Interlock Actuator in this section. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). RECONNECT all components. TEST the system for normal operation.

PINPOINT TEST B: SHIFT CONTROL IS OUT OF PROPER GEAR RELATIONSHIP

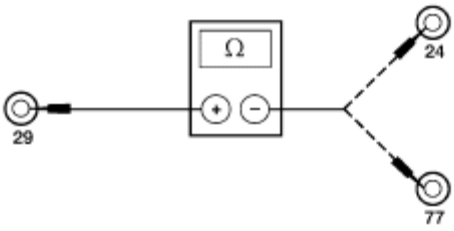
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK SHIFT CONTROL LINKAGE	
1 2  L10513-A	2 Apply the brake pedal (2455). 3 Gain access to the shift control linkage. 4 Actuate the transmission range selector lever in all ranges. 5 Observe all linkages during operation.

	• **Is the linkage damaged?** → **Yes** REPLACE the shift control linkage. TEST the system for normal operation. → **No** GO to B2 .
B2 CHECK TRANSMISSION SHIFT CABLE	
	1 Check transmission shift cable and bracket installation and tightness. • **Is the transmission shift cable properly installed and adjusted?** → **Yes** VERIFY the transmission shift cable adjustment. REFER to Adjustments in this section. ADJUST the transmission shift cable if necessary. VERIFY the digital transmission range (DTR) sensor for proper adjustment. REFER to Section 307-01A (5R55E) or Section 307-01B (4R70W). ADJUST DTR sensor if necessary. GO to B3 . → **No** REPAIR as necessary. TEST the system for normal operation.
B3 CHECK LINKAGE/CABLE FOR PROPER GEAR RELATIONSHIP	
1  L10513-A	1 Apply the brake pedal. 2 Actuate the transmission range selector lever in all ranges. • **Does the indicator match the gear selection?** → **Yes** System OK. TEST the system for normal operation.

	→ **No** REFER to Shift Indicator Cable Adjustment in this section. TEST the system for normal operation.

PINPOINT TEST C: TRANSMISSION CONTROL SWITCH (TCS) IS NOT OPERATING PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK I/P FUSE 26	
1 2 I/P Fuse 26 (10A)	• **Is the resistance less than 5 ohms?** → **Yes** REINSTALL the fuse. GO to C3 . → **No** REPLACE the failed fuse. TEST the system for normal operation. If the fuse fails again, GO to C2 .
C2 CHECK CIRCUIT 224 (T/W) FOR SHORT TO GROUND	
1 Powertrain Control Module (PCM) 2 104-Pin Breakout Box 3	1 Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Repair as necessary. 2 Leave PCM disconnected. 3 Measure the resistance between test pin 29 and test pins 24 and 77 at the 104-Pin Breakout Box.



D17786-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
CHECK circuit 298 (P/O) and related components for short to ground. TEST the system for normal operation.

→ **No**
REPAIR circuit 224 (T/W). TEST the system for normal operation.

C3 CHECK TRANSMISSION CONTROL SWITCH (TCS) CIRCUIT FOR VOLTAGE

1

Powertrain Control Module (PCM)

1 Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Repair as necessary.

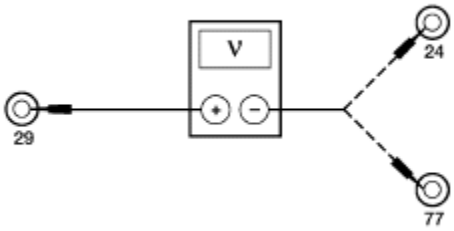
2

104-Pin Breakout Box

2 Leave PCM disconnected.

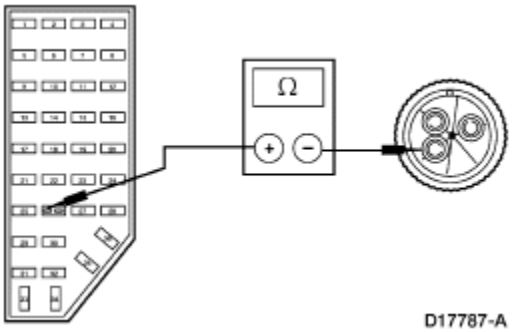
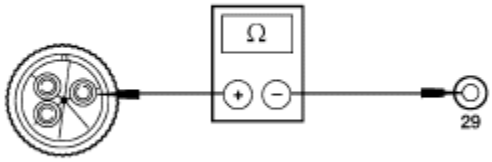
3

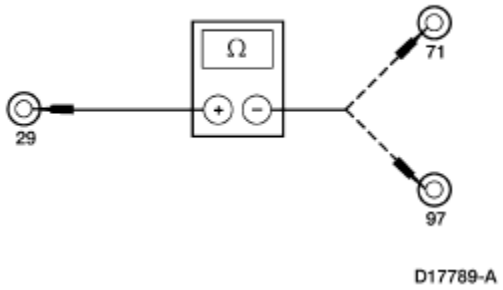
4



D17791-A

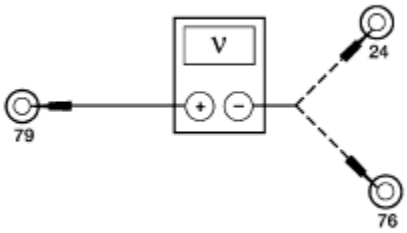
4 Measure the voltage between test pin 29 and test pins 24 and 77 at the 104-Pin Breakout Box while cycling the TCS several times.

	• **Does the voltage cycle?** → **Yes** REPLACE the powertrain control module (PCM) (12A650). REMOVE the 104-Pin Breakout Box. TEST the system for normal operation. → **No** GO to C4 .
C4 CHECK CIRCUIT 298 (P/O) AND CIRCUIT 224 (T/W) FOR OPEN	
1 	
2 I/P Fuse 26 (10A)	
3 Transmission Control Switch (TCS)	3 Inspect both ends for damaged or pushed out pins, moisture, corrosion, loose wires, etc. Repair as necessary.
4  D17787-A	4 Measure the resistance between the I/P fuse 26 (10A) connector pin 1 and the power side of the TCS vehicle harness connector circuit 298 (P/O).
5  29 D17788-A	5 Measure the resistance between test pin 29 at the 104-Pin Breakout Box and signal side of the transmission control switch vehicle harness connector circuit 224 (T/W).

	• **Is the resistance less than 5 ohms for both circuits?** → **Yes** GO to C5 . → **No** REPAIR open circuit. REMOVE 104-Pin Breakout Box. RECONNECT all components. TEST the system for normal operation.
C5 CHECK CIRCUIT 224 (T/W) FOR SHORT TO POWER	
1  D17789-A	1 Measure the resistance between test pin 29 and test pins 71 and 97 at the 104-Pin Breakout Box. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the transmission control switch. REMOVE the 104-Pin Breakout Box. RECONNECT all components. TEST the system for normal operation. → **No** REPAIR circuit 224 (T/W). REMOVE the 104-Pin Breakout Box. RECONNECT all components. TEST the system for normal operation.

PINPOINT TEST D: TRANSMISSION CONTROL INDICATOR LAMP (TCIL) DOES NOT ILLUMINATE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK TRANSMISSION CONTROL INDICATOR LAMP (TCIL) CIRCUIT FOR VOLTAGE	
1 2	2 Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Repair as

 Powertrain Control Module (PCM) 3 104-Pin Breakout Box 4 5  GD2604-A	necessary. 3 Leave the powertrain control module disconnected. 5 Measure the voltage between test pin 79 and test pins 24 and 76 at 104-Pin Breakout Box. • **Is the voltage reading greater than 2 volts?** → **Yes** REPLACE the PCM. REMOVE the 104-Pin Breakout Box. CYCLE the transmission control switch (TCS) to check the operation of the TCIL. TEST the system for normal operation. → **No** CHECK the indicator bulb and the fuse. If OK, REPAIR wiring between the ignition switch and test pin 79 at the PCM harness connector. TEST the system for normal operation.

PINPOINT TEST E: TRANSMISSION CONTROL INDICATOR LAMP (TCIL) STAYS ILLUMINATED

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CYCLE TRANSMISSION CONTROL SWITCH (TCS)	
1	

2 Cycle the transmission control switch (TCS).

- **Does the transmission control indicator lamp (TCIL) illuminate and then go off?**

→ **Yes**
OK at this time. Concern may be intermittent.

→ **No**
GO to E2 .

E2 CHECK CIRCUIT 911 (W/LG) FOR SHORT TO GROUND

1

2

Powertrain Control Module (PCM)

3

2 Inspect both ends for damage or pushed out pins, moisture, corrosion, loose wires, etc. Repair as necessary.

- **Does the TCIL remain on?**

→ **Yes**
REPAIR circuit 911 (W/LG). REMOVE 104-Pin Breakout Box. RECONNECT all components. TEST the system for normal operation.

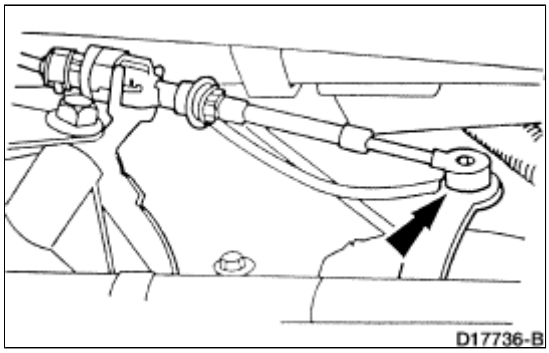
→ **No**
REPLACE the PCM. TEST the system for normal operation.

Cable/Bracket Adjustment

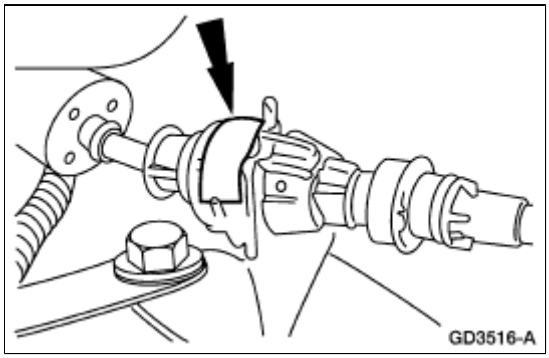
1. Place the gearshift lever (7210) in the (D) position and hang a 3.6 kg (8 lb) weight on the gearshift lever.

2. Raise and support the vehicle; refer to Section 100-02 .

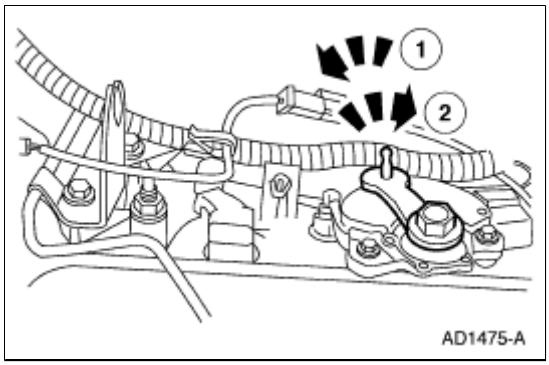
3. Disconnect the transmission shift cable from the manual control lever (7A256).



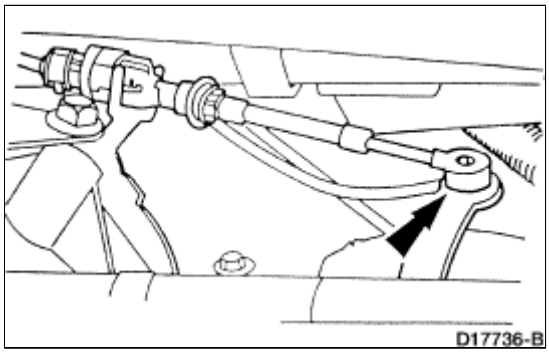
4. Pull out the transmission shift cable adjustment lock tab on the shift cable body.



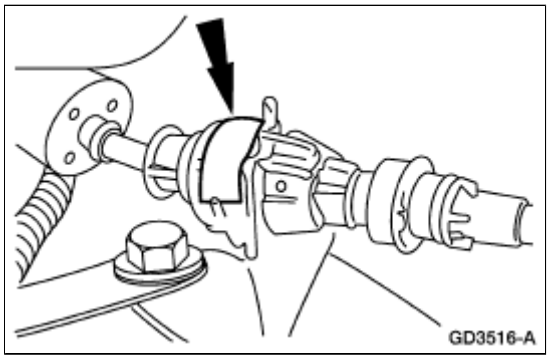
5. Place the manual control lever in the (D) position.
    1. Place the manual control lever in the first gear position. Rotate the manual control lever forward until travel stops.
    2. Move the manual control lever back two detents to the (D) position.



6. Connect the transmission shift cable to the manual control lever.



7. Push in the transmission shift cable adjustment lock tab on the shift cable body.



8. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.

9. Remove the 3.6 kg (8 lb) weight.

10. **CAUTION: Do not adjust the transmission shift cable in any position other than (D).**

    Verify that the vehicle will start in P or N and that backup lamps illuminate in R. If not, repeat Steps 1 through 7 and perform a digital transmission range sensor alignment. Refer to Section 307-01A (5R55E) or Section 307-01B (4R70W).

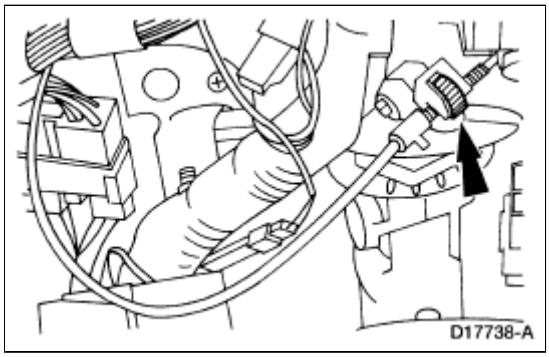
Cable Adjustment —Shift Indicator

1. Remove the upper instrument panel steering column cover (04459); refer to Section 501-12 .

2. Place the gearshift lever in the (D) position.
   - Rotate the gearshift lever clockwise until it bottoms out (first gear), then rotate two detents counterclockwise ((D) position).

3. Hang a 3.6 kg (8 lb) weight on the gearshift lever.

4. Center the pointer in the middle of the (D) position.
   - Rotate the thumbwheel located on the bottom of the steering column to adjust the pointer.



5. Remove the 3.6 kg (8 lb) weight.

6. Carefully move the gearshift lever from detent to detent and compare with the transmission settings.
   - Readjust if necessary.

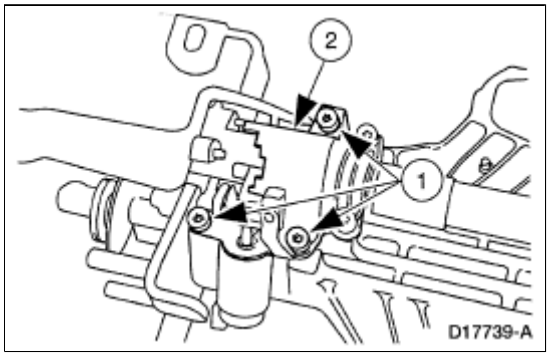
7. Install the upper instrument panel steering column cover; refer to Section 501-12 .

Brake Shift Interlock Actuator

Removal

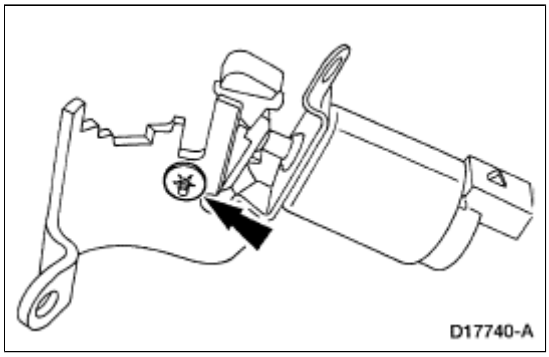
1. Remove the steering column assembly. For additional information, refer to Section 211-04 .

2. Remove the insert plate and shift lock actuator (3Z719).
    1. Remove the bolts.
    2. Remove the insert plate and shift lock actuator.



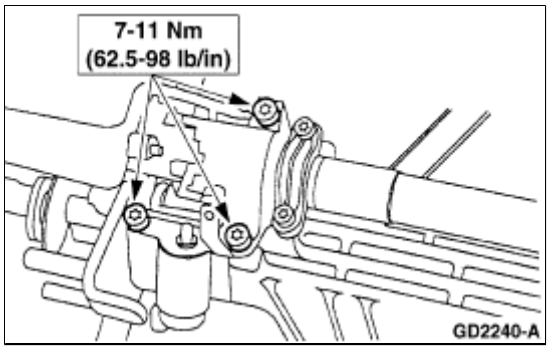
3. **NOTE:** The shift lock actuator clip is an assembly aid for the assembly plant and does not need to be replaced.

    Remove the insert plate from the shift lock actuator.
    - Remove and discard the shift lock actuator clip.



Installation

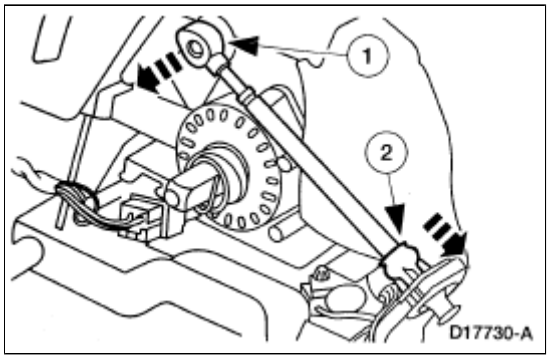
1. Follow the removal procedure in reverse order.


7-11 Nm
(62.5-98 lb/in)
GD2240-A

Cable/Bracket —4.0L

Removal

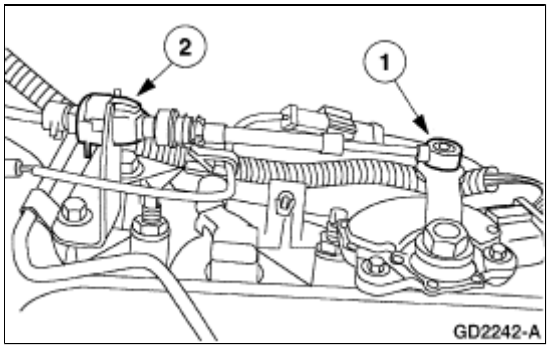
1. Disconnect the transmission shift cable from the steering column.
    1. Disconnect the shift cable from the transmission column shift selector tube (7212).
    2. Disconnect the shift cable from the steering column bracket.



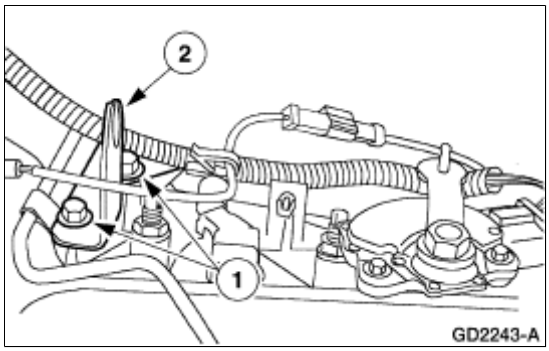
2. Push the rubber grommet and transmission shift cable through the bulkhead.

3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Remove the transmission shift cable from the automatic transmission.
    1. Disconnect the shift cable from the manual control lever (7A256).
    2. Depress lock tabs to release shift cable and disconnect the shift cable from the shift cable bracket.



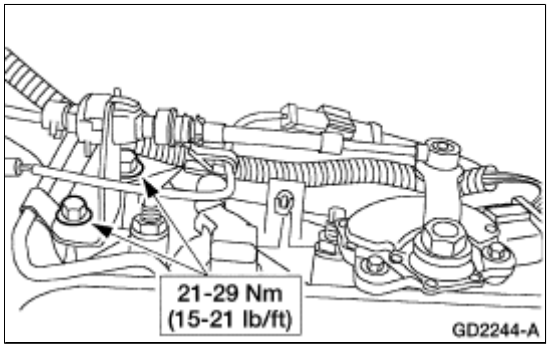
5. Remove the transmission shift cable bracket from the automatic transmission.
    1. Remove the bolt.
    2. Remove the transmission shift cable bracket.



Installation

1. **NOTE:** The manual lever must be in the O/D position.

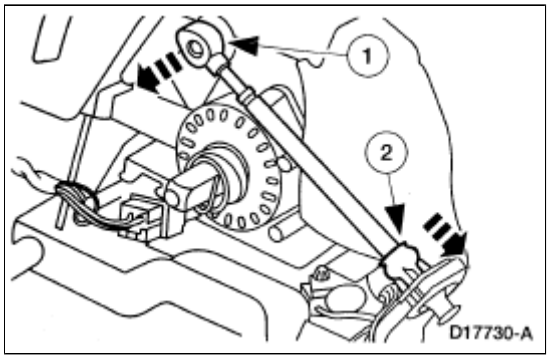
   Follow the removal procedure in reverse order.
   - Adjust the transmission shift cable. For additional information, refer to Cable/Bracket Adjustment in this section.



Cable/Bracket —5.0L

Removal

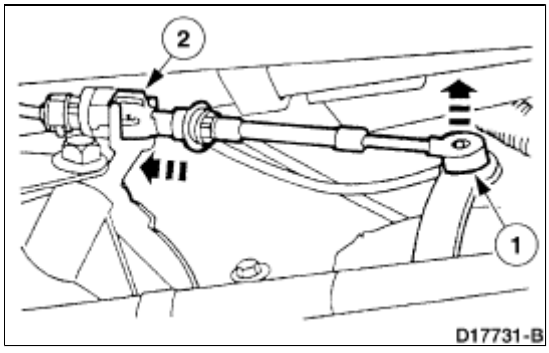
1. Disconnect the transmission shift cable from the steering column.
    1. Disconnect the shift cable from the transmission column shift selector tube (7212).
    2. Disconnect the shift cable from the steering column bracket.



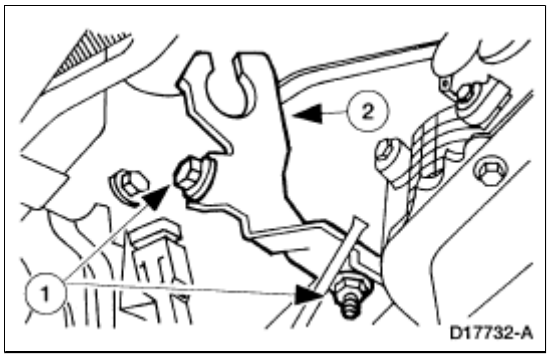
2. Push the rubber grommet and shift cable through the bulkhead.

3. Raise and support the vehicle; refer to Section 100-02 .

4. Remove the transmission shift cable from the transmission.
    1. Disconnect the shift cable from the manual control lever (7A256).
    2. Depress the lock tabs to release the shift cable and disconnect the shift cable from the shift cable bracket.

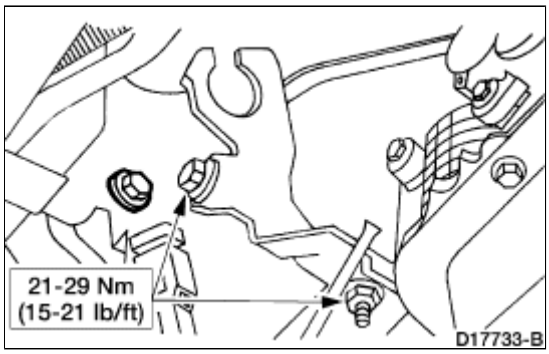


5. Remove the transmission shift cable bracket from the automatic transmission.
    1. Remove the bolts.
    2. Remove the transmission shift cable bracket.



Installation

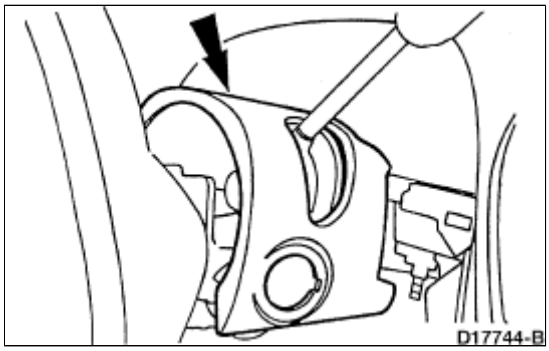
1. Follow the removal procedure in reverse order.
    - Adjust the transmission shift cable; refer to Shift Indicator Cable Adjustment in this section.



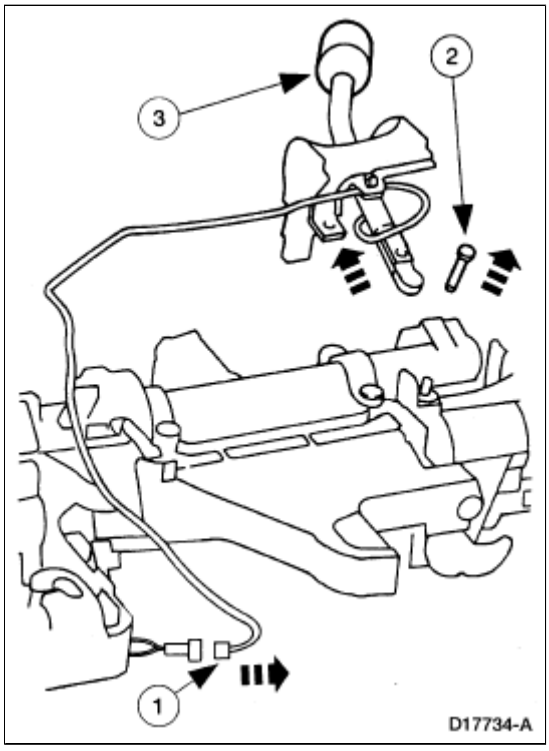
Selector Lever

Removal

1. Remove the ignition switch lock cylinder. For additional information, refer to Section 211-04 .
2. Remove the upper steering column shroud (3530).



3. Remove the gearshift lever (7210).
    1. Disconnect the shift control selector lever harness connector.
    2. Remove and discard the gearshift lever pin (7G357).
    3. Remove the gearshift lever.



Installation

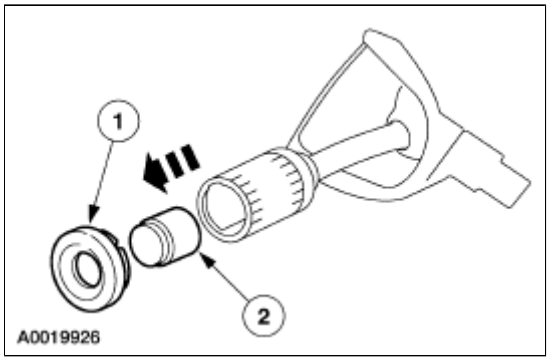
1. **NOTE:** The gearshift lever pin must be replaced whenever removed.

   Follow the removal procedure in reverse order.

Transmission Control (TC) Switch

Removal

1. Remove the transmission control switch (TCS).
    1. Remove the TCS cover.
    2. Remove the TCS.



Installation

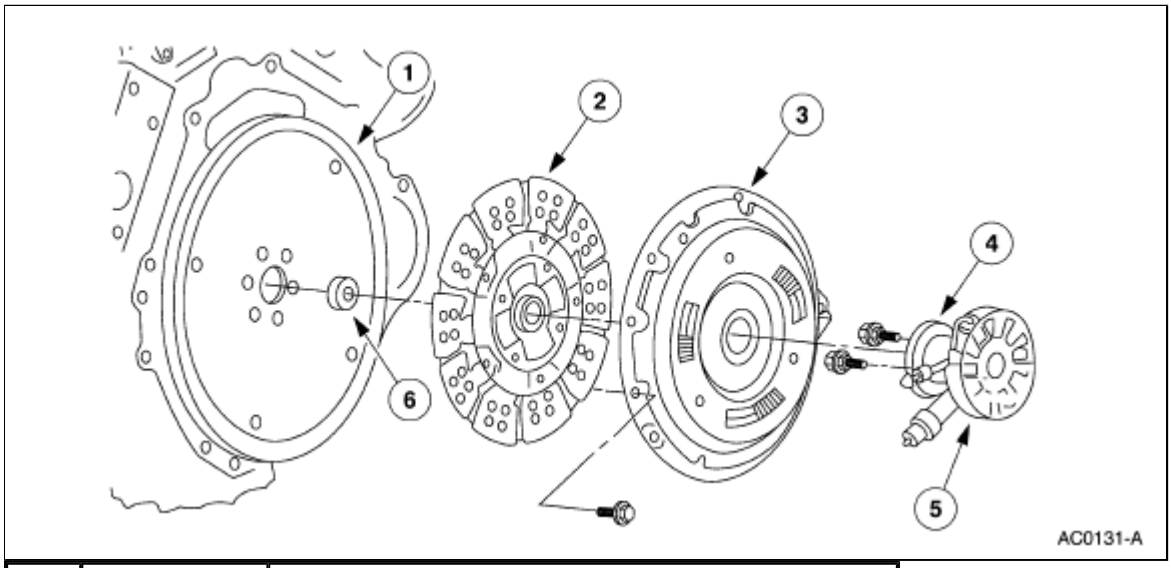
1. Follow the removal procedure in reverse order.

General Specifications

Item	Specification
Diaphragm Spring	Belleville
Total Plate Pressure Kg (lbs)	1020 (2248) 143 (315)
Clutch Disc	
O.S. Diameter (approx) mm (in)	258 (10.2)
I.S. Diameter (approx) mm (in)	185 (7.3)
Facing Area Sq. cm (sq. in)	508 (787)
Compressed Thickness mm (in)	7.8 (0.307)
Lining Material	Woven non-asbestos
Flywheel Runout mm (in)	0.13 (0.005)
No. Torsion Springs	4

Manual Transmission and Clutch

The primary function of the clutch system is to couple and decouple engine power to the transmission upon driver command. For additional information, refer to Section 308-01 .



Item	Part Number	Description
1	6375	Flywheel
2	7550	Clutch Disc
3	7563	Clutch Pressure Plate
4	—	Clutch Release Hub and Bearing (Part of 7A508)
5	7A508	Clutch Slave Cylinder
6	7118	Transmission Input Shaft Pilot Bearing

- The clutch is a single-plate, dry friction clutch disc (7550) with a self-adjusting, diaphram-style spring clutch plate. The clutch disc has a splined hub which attaches the clutch disc to the input shaft (7017).
- The clutch operating mechanism consists of a clutch slave cylinder (7A508) with an integral release bearing.
- A input shaft which supports the end of the bearing (7120). The bearing does not require lubrication unless the clutch system is repaired.
- The clutch system engages and disengages the manual transmission from the engine. The clutch system is disengaged when the clutch pedal (7519) is depressed and engaged when the clutch pedal is released. When the clutch pedal is depressed, it pushes the clutch master cylinder plunger, which hydraulically actuates the clutch slave cylinder. The clutch slave cylinder actuates the clutch pressure plate diaphragm spring, releasing pressure on the clutch disc. This release eliminates the engagement between the transmission and the engine.

Manual Transmission and Clutch

Inspection and Verification

The vehicle should be road tested, if possible, to verify the customer concern. Some clutch conditions may be attributed to a misadjusted clutch pedal height, linkage, or shift mechanism. These should be checked and corrected prior to attempting major disassembly procedures. Check to see that the transaxle is filled to the proper level with the specified lubricant; refer to Section 308-03 for the procedure.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Clutch Slippage	• Clutch pedal (7519) sticking. • Clutch pressure plate diaphragm spring damaged or weakened. • Clutch pressure plate (7563) damaged. • Clutch disc facing damaged or worn excessively. • Clutch disc facing surface hardened or oil coated. • Clutch release hub and bearing binding. • Flywheel glazed or damaged. • Clutch slave cylinder (7A508) damaged or leaking. • Clutch master cylinder damaged or leaking. • Clutch hydraulic reservoir leaking or damaged or low hydraulic fluid.	• GO to Pinpoint Test A .
• Clutch Chatter or Shudder	• Loose or worn engine mount. • Oil on clutch disc facing. • Clutch pressure plate damaged or excessive runout. • Clutch disc facing surface hardened or damaged. • Flywheel surface glazed or damaged. • Input shaft (7017) eccentric not perpendicular. • Transmission not square with engine mounting surface.	• GO to Pinpoint Test B .
• Clutch Drag	• Insufficient clutch system fluid. • Leakage of clutch system fluid. • Excessive runout or damaged clutch disc (7550). • Clutch disc splines rusted or worn.	• GO to Pinpoint Test C .

• Clutch Pedal Pulsation	• Clutch disc damaged or worn. • Excessive flywheel runout.	• GO to Pinpoint Test D .
• Clutch Related Vibrations	• Engine component grounding against frame. • Engine mounts loose or damaged. • Loose flywheel bolts. • Excessive flywheel runout. • Imbalanced clutch pressure plate. • Accessory drive belt loose or damaged.	• GO to Pinpoint Test E .
• Hard Shifting	• Insufficient clutch system fluid. • Damaged or worn gear shifter fork. • Damaged clutch slave cylinder. • Transmission concern.	• GO to Pinpoint Test F .
• Excessive Noise	• Clutch slave cylinder worn or damaged. • Pilot bearing worn or damaged. • Excessive crankshaft end play.	• GO to Pinpoint Test G .

Pinpoint Tests

PINPOINT TEST A: CLUTCH SLIPPAGE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CLUTCH PEDAL RELEASE TEST	
2 	1 Block the wheels and apply the parking brake. 3 Depress and slowly release clutch pedal. • **Does clutch pedal release without binding?** → **Yes** GO to A2 . → **No** INSPECT clutch pedal ; REFER to Section 308-02 .
A2 PERFORM STALL TEST	
2 	1 Block the wheels and apply the parking brake. 3 Place transmission in fourth gear.

	4 Increase engine to 2000 rpm and slowly release the clutch pedal fully. • **Does the engine stall within five seconds?** → **Yes** The clutch is not slipping. VERIFY customer concern. → **No** VERIFY customer concern. RETURN to the Symptom Chart if necessary.

PINPOINT TEST B: CLUTCH CHATTER OR SHUDDER

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK ENGINE OR TRANSMISSION MOUNTS	
	1 Inspect all engine and transmission mounts for looseness or damage. Refer to Section 303-01A , Section 303-01B , Section 303-01C and Section 308-03 if necessary. • **Are any of the engine or transmission mounts loose or damaged?** → **Yes** TIGHTEN or REPLACE the engine or transmission mounts. TEST the system for normal operation. → **No** GO to B2 .
B2 INSPECT CLUTCH PRESSURE PLATE	
	1 Remove the clutch pressure plate ; refer to Section 308-01 . 2 Inspect the clutch pressure plate for damage and runout. • **Are any signs of damage present on the clutch pressure plate ?** → **Yes** REPLACE the clutch pressure plate ; refer to Section 308-01 . TEST the system for normal operation. → **No** GO to B3 .
B3 CHECK CLUTCH DISC	
	1 Perform the clutch disc inspection; refer to Disc Check in this section. • **Is the clutch disc OK?** → **Yes** GO to B4 .

	→ **No** REPLACE the clutch disc ; refer to Section 308-01 . TEST the system for normal operation.
B4 INSPECT FLYWHEEL	
	1 Inspect the flywheel (6375) for damage and runout. • **Is the flywheel OK?** → **Yes** GO to B5 . → **No** TIGHTEN, RESURFACE or REPLACE the flywheel as necessary; refer Section 308-01 . TEST the system for normal operation.
B5 INSPECT INPUT SHAFT	
	1 Inspect the input shaft (7015) for signs of wear or damage. • **Are any signs of wear or damage present on the input shaft ?** → **Yes** REPLACE input shaft ; refer to Section 308-03 . → **No** VERIFY customer concern. RETURN to the Symptom Chart if necessary.

PINPOINT TEST C: CLUTCH DRAG

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK FLUID LEVEL	
1	2 Inspect the fluid level in the clutch master cylinder reservoir. • **Is the fluid level within the MAX and MIN level marks?** → **Yes** GO to C2 . → **No** ADD brake fluid and CHECK for leaks.
C2 CHECK CLUTCH PRESSURE PLATE	
	1 Remove the clutch pressure plate ; refer to Section 308-01 . 2 Inspect the clutch pressure plate for wear or runout.

	• **Are there any signs of excessive wear or runout to the clutch pressure plate ?** → **Yes** REPLACE the clutch pressure plate ; REFER to Section 308-01 . → **No** GO to C3 .
C3 CHECK CLUTCH DISC	
	1 Perform the clutch disc inspection procedure in this section. • **Is the clutch disc OK?** → **Yes** VERIFY customer concern. RETURN to the Symptom Chart if necessary. → **No** REPLACE the clutch disc ; REFER to Section 308-01 .

PINPOINT TEST D: CLUTCH PEDAL PULSATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK CLUTCH PEDAL PULSATION	
1 	2 With the transmission in NEUTRAL, slowly press the clutch pedal. • **Does the clutch pedal pulsate while being pressed?** → **Yes** GO to D2 . → **No** VERIFY customer concern. RETURN to Symptom Chart if necessary.
D2 INSPECT CLUTCH PRESSURE PLATE	
	1 Remove the clutch pressure plate ; REFER to Section 308-01 . 2 Inspect the clutch pressure plate for damage. • **Are there any signs of damage on the clutch pressure plate ?** → **Yes** REPLACE the clutch pressure plate ; REFER to Section 308-01 .

	→ **No** GO to D3 .
D3 INSPECT CLUTCH DISC	
	1 Perform the clutch disc inspection; refer to Disc Check in this section. • **Is the clutch disc OK?** → **Yes** GO to D4 . → **No** REPLACE the clutch disc ; REFER to Section 308-01 .
D4 INSPECT FLYWHEEL	
	1 Inspect the flywheel for damage and runout. • **Is the flywheel OK?** → **Yes** VERIFY customer concern. RETURN to the Symptom Chart if necessary. → **No** TIGHTEN, RESURFACE or REPLACE the flywheel as necessary; REFER to Section 308-01 . TEST the system for normal operation.

PINPOINT TEST E: CLUTCH RELATED VIBRATIONS

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK FOR ENGINE COMPONENT GROUNDING	
	1 Raise the vehicle on a hoist; refer to Section 100-02 . 2 Check the engine and transmission mounts for grounding. 3 Check for exhaust manifolds or other engine components grounding on the body or frame. • **Is there evidence of grounding on the body or frame?** → **Yes** REPAIR components as necessary. TEST the system for normal operation. → **No** GO to E2 .
E2 CHECK FOR ACCESSORY DRIVE VIBRATIONS	
2	1 Remove the accessory drive belt.

- **Does the vibration stop when the accessory drive belt is removed from the engine?**

→ **Yes**
REFER to Section 303-05 to diagnose the accessory drive belt components.

→ **No**
STOP the engine and REINSTALL the drive belt. GO to E3 .

E3 CHECK FOR RELEASE BEARING NOISE

1

2 Depress and hold the clutch pedal.

- **Is a whirring, grating, or grinding noise present only when pedal is pushed?**

→ **Yes**
REPLACE the clutch release hub and bearing; REFER to Section 308-02 .

→ **No**
GO to E4 .

E4 INSPECT FLYWHEEL

1

1 Remove the transmission; refer to Section 308-03 .

2 Inspect the flywheel ; REFER to Flywheel Check in this section.

- **Is the flywheel OK?**

→ **Yes**
GO to E5 .

→ **No**
TIGHTEN, RESURFACE, or REPLACE the flywheel ; REFER to Section 308-01 .
TEST the system for normal operation.

E5 CHECK FOR PRESSURE PLATE IMBALANCE

1 **CAUTION: Failure to support the engine properly could result in damage to the vehicle.**

	Support the engine securely. 2 Operate the engine with the transmission removed. • **Is the vibration still present?** → **Yes** REFER to Section 303-00 to diagnose the engine vibration concern. → **No** REPLACE the clutch pressure plate and clutch disc ; REFER to Section 308-01 . TEST the system for normal operation.

PINPOINT TEST F: HARD SHIFTING

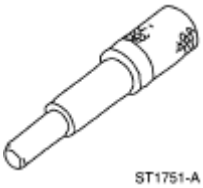
CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK FLUID LEVEL	
1	2 Inspect the fluid level in the clutch master cylinder reservoir. • **Is the fluid level within the MAX and MIN level marks?** → **Yes** GO to F2 . → **No** ADD brake fluid and CHECK for leaks.
F2 CHECK TRANSMISSION SHIFTING	
1	2 Shift the transmission. • **Does transmission shift smoothly?** → **Yes** VERIFY the customer concern. RETURN to the Symptom Chart if necessary. → **No** REFER to Section 308-03 to diagnose hard shifting concern.

PINPOINT TEST G: EXCESSIVE NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 TRANSMISSION NEUTRAL GEAR ROLLOVER TEST	
	1 Start the engine and let idle with transmission in neutral and clutch engaged (pedal up). If noise is excessive, depress the clutch pedal to stop the transmission input shaft from rotating. • **Does the noise stop when the clutch pedal is depressed?** → **Yes** REFER to Section 308-03 to diagnose the transmission noise concern. → **No** GO to G2.
G2 CHECK CLUTCH SLAVE CYLINDER	
	1 Remove the transmission; refer to Section 308-03. 2 Inspect the clutch slave cylinder for wear or loss of lubrication; refer to Section 308-02. • **Are there signs of wear or loss of lubrication?** → **Yes** REPLACE the clutch slave cylinder and bearing; REFER to Section 308-02. → **No** GO to G3.
G3 CHECK PILOT BEARING	
	1 Inspect the transmission input shaft pilot bearing (7118) for damage. • **Is the transmission input shaft pilot bearing OK?** → **Yes** GO to G4. → **No** REPLACE the pilot bearing.
G4 CHECK TORSION SPRINGS	
	1 Inspect the torsion springs for fatigue or breakage. • **Are there any signs of fatigue or breakage?** → **Yes** REPLACE the clutch disc. TEST the system for normal operation. → **No** INSPECT the crankshaft end play.

Disc Check

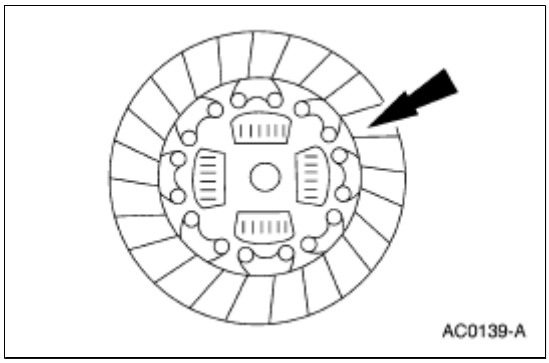
Special Tool(s)

ST1266-A	Dial Indicator/Magnetic Base 100-D002 (D78P-4201-B) or equivalent
 ST1751-A	Clutch Aligner T71P-7137-H
ST1470-A	Pilot Bearing Replacer T85T-7137-A
ST1282-A	Puller T58L-101-B

1. Remove the clutch assembly; refer to Section 308-01 .

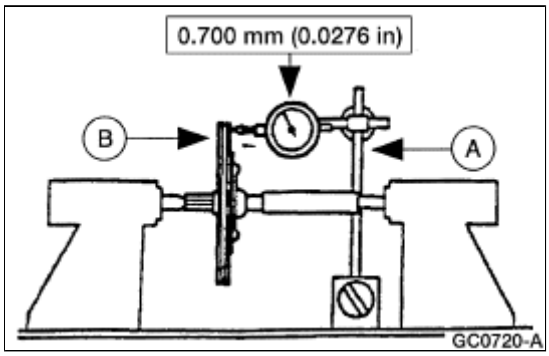
2. **NOTE:** Use emery cloth to remove minor imperfections in the clutch disc lining surface.

   Inspect the clutch disc (7550) for:
   - oil or grease saturation.
   - worn or loose facings.
   - warpage.
   - broken springs.
   - wear or rust on the splines.
   - replace the clutch disc if any of these conditions are present.



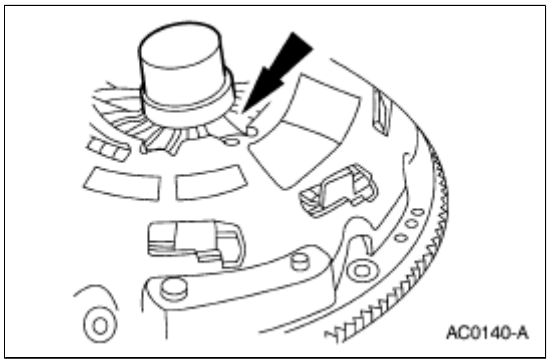
3. **NOTE:** The clutch disc and pressure plate should always be replaced as an assembly.

   Use (A) Dial Indicator/Magnetic Base to inspect the (B) clutch disc runout.
   - Replace the clutch disc if not within specification.



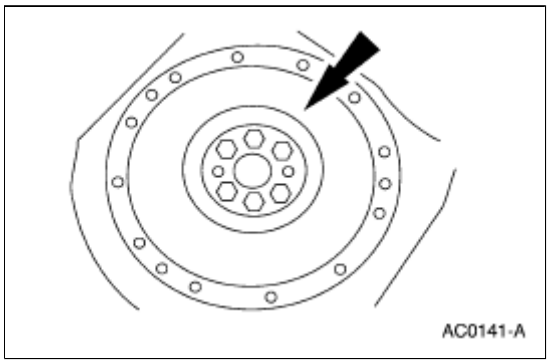
Pressure Plate Check

1. Inspect the clutch pressure plate diaphragm fingers for wear.
    - Replace the clutch pressure plate (7563), if necessary.



Flywheel Check

1. Inspect the flywheel (6375) for:
   - cracks.
   - heat checks or other damage.
   - machine friction surface of flywheel if scored or worn.

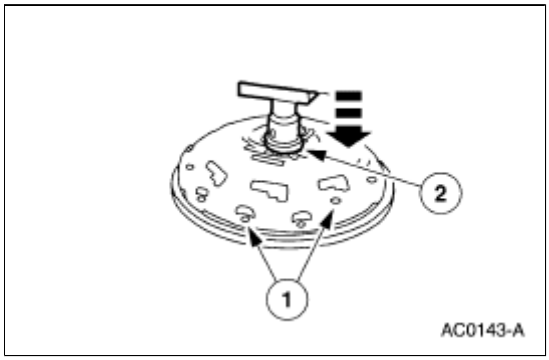


2. After machining
   - Surface runout must not exceed 0.13 mm (0.005 inch) TIR, surface finish must be in the range of 4.0/1.3 micrometer (160/52 microinch).
   - Major diameter of dowel pin (press fit diameter) must not extend above the new surface.
   - The clutch pressure plate retaining bolts must screw into the flywheel under hand torque to within 1.50 mm (0.06) of new surface.
   - Flywheel with dimensions less than the charted dimensions must not be used; install new service flywheel.

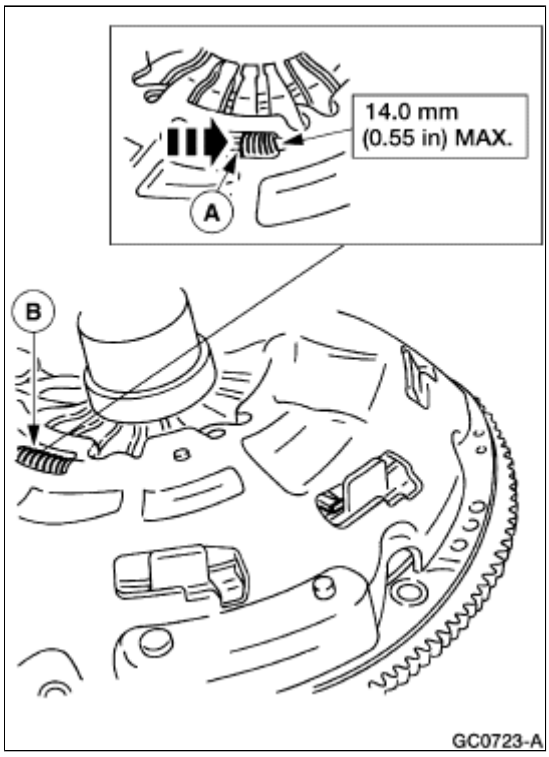
Pressure Plate Adjustment

1. **NOTE:** Self-adjusting clutch pressure plate must be adjusted before installation.

   Compress the clutch diaphragm fingers.
   1. Place the flywheel and the clutch pressure plate in a press.
   2. Use a suitable adapter and a press to depress the clutch diaphragm fingers until the adjusting ring moves freely.



2. Adjust the clutch pressure plate.
   - Rotate the (A) adjusting ring counterclockwise until the (B) tension springs are compressed.
   - Hold the (A) adjusting ring while releasing the pressure on the clutch fingers.

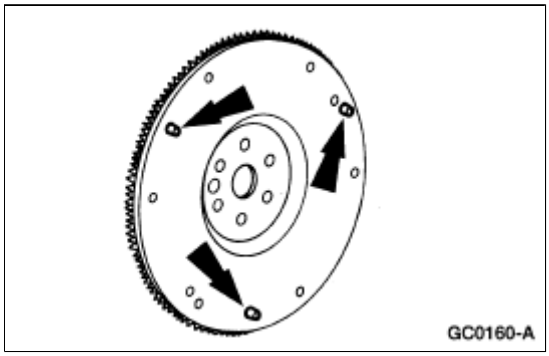


Dowels —Flywheel

Removal

1. **NOTE:** Take care not to damage the flywheel dowel holes or surface areas around the flywheel dowel during removal.

   Remove the flywheel dowels by using a drift pin where the flywheel dowel is installed in an open hole, and locking pliers where the flywheel dowel is installed in a blind hole.



Installation

1. **NOTE:** Care should be taken to drive the flywheel dowel squarely into place until fully seated and to not damage surrounding surface areas.

   Install all flywheel dowels by driving them into place using a brass or plastic mallet.

Dowels —Flywheel Housing to Block

Removal

1. **NOTE:** Take care not to damage the flywheel housing-to-block dowel holes or surface areas around the flywheel housing-to-block dowel hole during removal.

   Remove the flywheel housing-to-block dowels (6397) using a drift pin where the flywhere housing-to-block dowel is installed in an open hole, and locking pliers where the flywheel housing-to-block dowel is installed in a blind hole.

General Specifications

Item	Specification
Lubricants	
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (Type II)
High-Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	ESA-M1C198-A

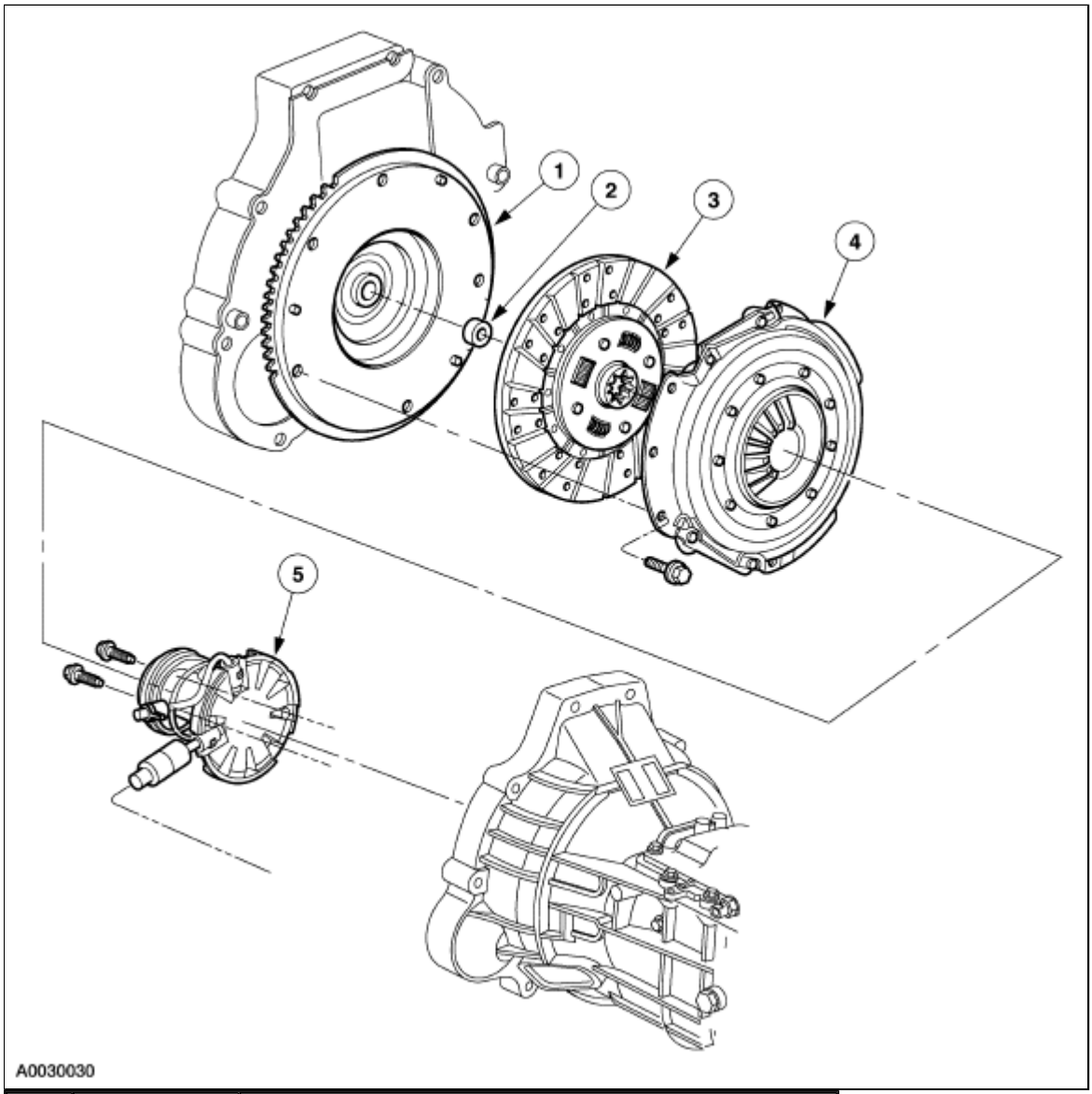
Torque Specifications

Description	Nm	lb-ft
Clutch pressure plate bolts	32	24
Flywheel bolts	102-115	75-85
Clutch slave cylinder bolts	20	15

Clutch

The primary function of the clutch system is to connect and disconnect engine power to the transmission upon driver command.

Clutch System Components



Item	Part Number	Description
1	6375	Flywheel
2	7600	Transmission input shaft pilot bearing
3	7550	Clutch disc
4	7563	Clutch pressure plate

5	7A508	Clutch slave cylinder/clutch release hub and bearing

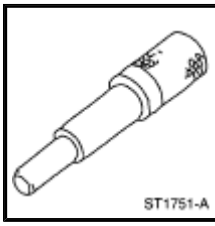
- The clutch is a single-plate, dry friction clutch disc with a self-adjusting, diaphragm-style spring clutch pressure plate.
- The clutch operating mechanism consists of a clutch slave cylinder with an integral release bearing.
- A pilot bearing supports the end of the input shaft. The bearing does not require lubrication unless the clutch system is serviced.

Clutch

Refer to Section 308-00 .

Disc and Pressure Plate

Special Tool(s)

 ST1751-A	Aligner, Clutch Disc 308-006 (T71P-7137-H)

Material

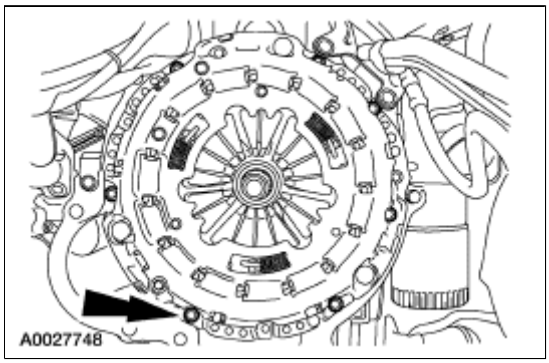
Item	Specification
High-Temperature 4X4 Front Axle Grease E8TZ-19590-A	ESA-M1C198-A

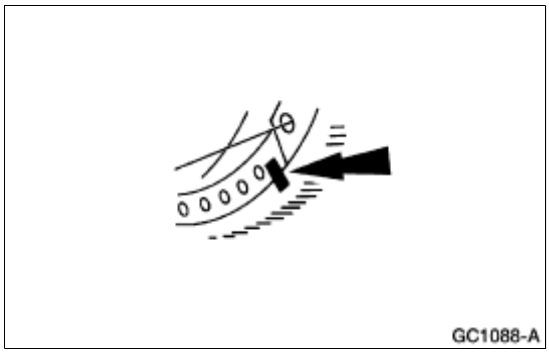
Removal

1. Remove the transmission. For additional information, refer to Section 308-03 .

2. **CAUTION: If the clutch disc and pressure plate are to be reinstalled, bolts must be removed evenly or permanent damage to the diaphragm spring will occur resulting in complete clutch release.**

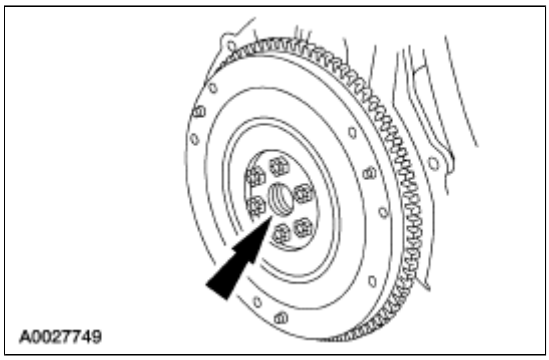
   Remove the bolts, clutch pressure plate and the clutch disc.
   - If the parts are to be reused, index-mark the clutch pressure plate to the flywheel.



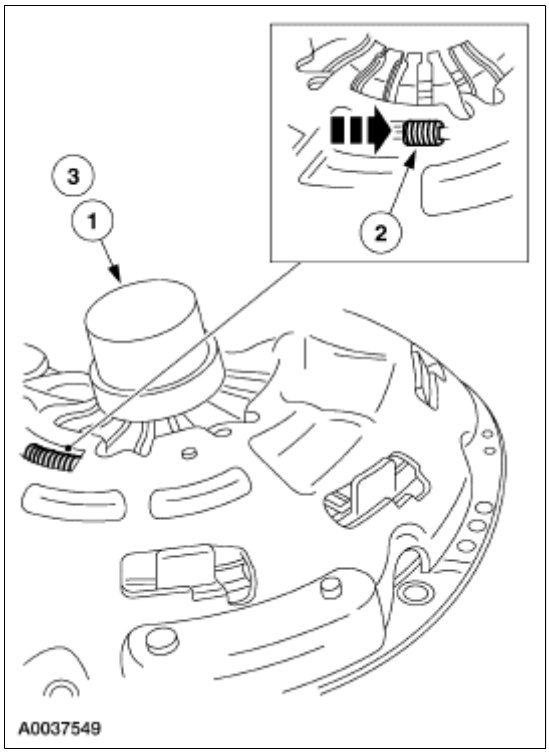


Installation

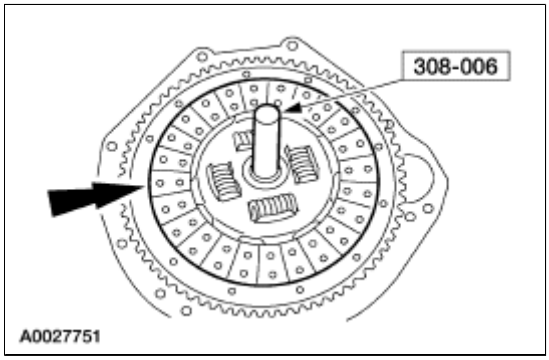
1. Lubricate the transmission input shaft pilot bearing with grease.



2. Adjust the clutch pressure plate.
    1. Using a suitable press, press downward on the fingers until the adjusting ring moves freely.
    2. Rotate the adjusting ring counterclockwise to compress the tension springs. Hold the adjusting ring in this position.
    3. Release the pressure on the fingers. The adjusting ring will stay in the reset position.

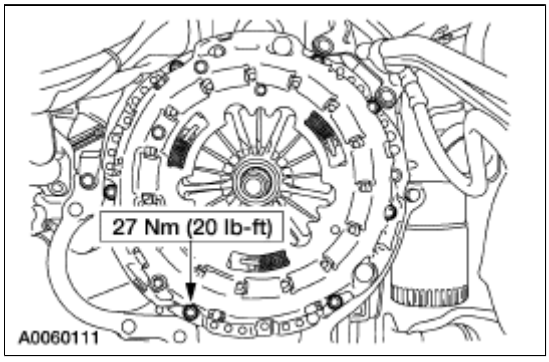


3. Using the special tool, position the clutch disc on the flywheel.



4. **NOTE:** If reusing the clutch pressure plate and flywheel, align the marks made during removal.

   Using the special tool, align the clutch disc and the clutch pressure plate. Install the bolts and tighten in a star pattern sequence.



5. **NOTE:** Before securing the transmission to the engine, connect the hydraulic line to the clutch slave cylinder.

   Install the transmission.
   - For additional information, refer to Section 308-03 .

Flywheel

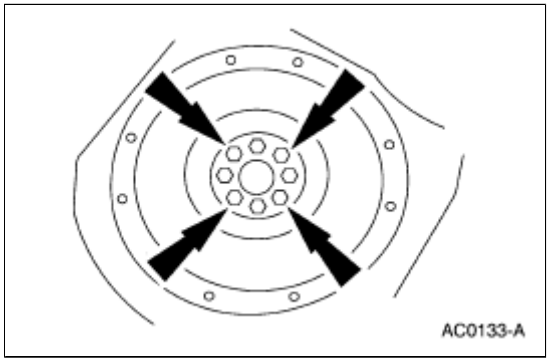
Material

Item	Specification
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)

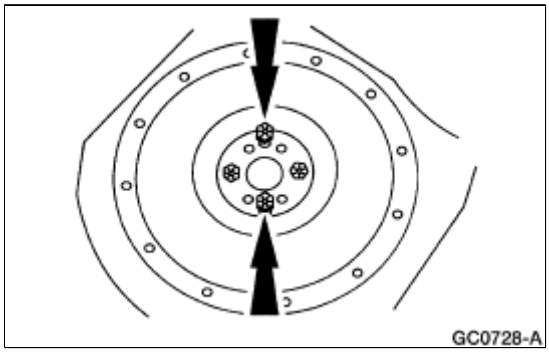
Removal

1. Remove the transmission. For additional information, refer to Section 308-03 .
2. Remove the clutch disc and pressure plate. For additional information, refer to Disc and Pressure Plate in this section.
3. **CAUTION: Two bolts should be loosened but left in to prevent the flywheel (6375) from falling.**

   Remove six of the eight bolts. Loosen the two remaining bolts but leave in place.



4. Press the flywheel off the crankshaft.
   - Install two bolts in the threaded holes in the flywheel and remove flywheel.

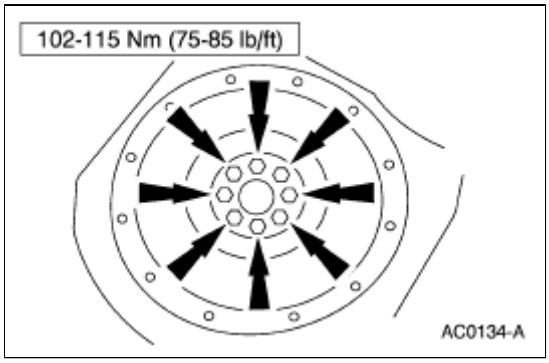


5. Remove the bolts remaining in the crankshaft.

6. Remove the flywheel.

Installation

1. Position the flywheel onto the crankshaft and install the flywheel-to-crankshaft bolts (6379).
   - Apply threadlock and sealer to bolt threads.



2. Install the disc and pressure plate. For additional information, refer to Disc and Pressure Plate in this section.

3. Install the transmission. For additional information, refer to Section 308-03 .

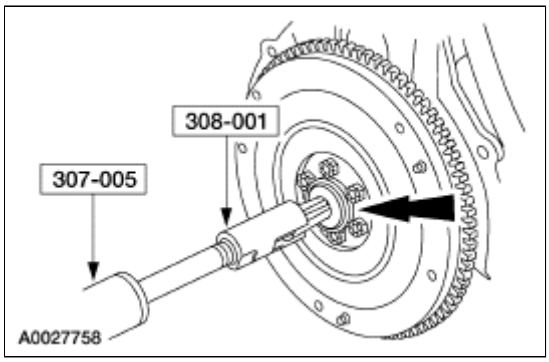
Bearing

Special Tool(s)

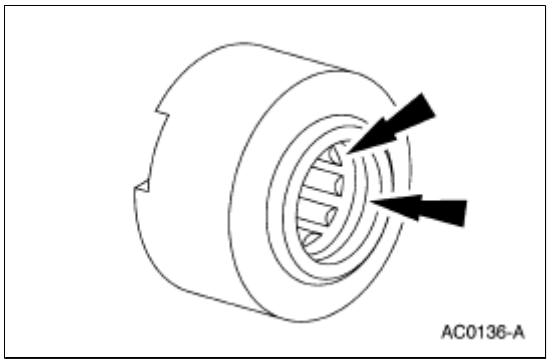
ST1187-A	Slide Hammer 307-005 (T59L-100-B)
ST1470-A	Installer, Pilot Bearing 308-105 (T85T-7137-A)
ST1282-A	Remover, Pilot Bearing 308-001 (T58L-101-B)

Removal

1. Using the special tool, remove the transmission input shaft pilot bearing.



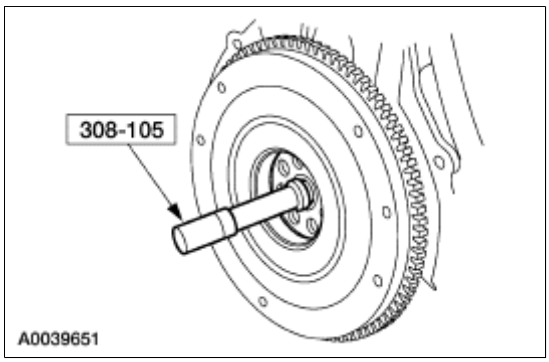
2. Inspect the transmission input shaft pilot bearing for:
   - misalignment and looseness in the flywheel.
   - needle rollers for scoring, worn or broken needle rollers, inadequate grease or discoloration.
   - seal leakage.



Installation

1. **NOTE:** The transmission input shaft pilot bearing can only be installed with the seal facing the transmission. The transmission input shaft pilot bearing is pregreased and does not require additional lubrication. A new transmission input shaft pilot bearing must be installed whenever it is removed.

   Using a soft-face hammer and the special tool, install the transmission input shaft pilot bearing.



Ring Gear

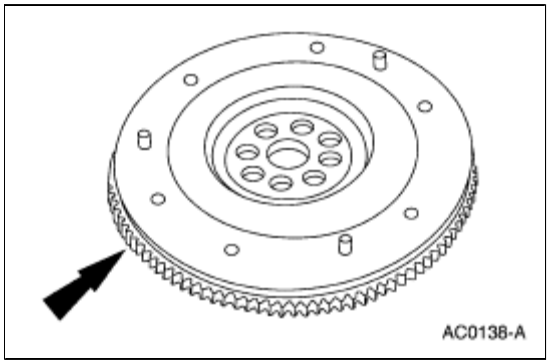
Removal

WARNING: This procedure should be performed only by a properly equipped and experienced acetylene torch operator. To avoid personal injury, use tongs or wear welding gloves and safety goggles when handling the heated flywheel ring gear.

1. Remove the transmission. For additional information, refer to Section 308-03 .
2. Remove the clutch pressure plate and clutch disc. For additional information, refer to Disc and Pressure Plate in this section.
3. Remove the flywheel (6375). For additional information, refer to Flywheel in this section.
4. **CAUTION: Do not heat the flywheel ring gear (6384) beyond 278°C (500°F). Use heat indicating crayons to prevent over heating.**

   CAUTION: Tap the flywheel ring gear evenly to prevent binding.

   Remove the flywheel ring gear from the flywheel.
   - Evenly heat the flywheel ring gear and use a brass drift to drive the flywheel ring gear off the flywheel.



Installation

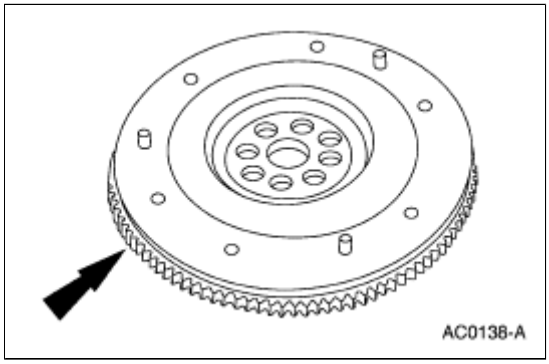
WARNING: This procedure should be performed only by a properly equipped and experienced acetylene torch operator. To avoid personal injury, use tongs or wear welding gloves and safety goggles when handling the heated flywheel ring gear.

1. **CAUTION: Do not heat the flywheel ring gear beyond 278°C (500°F). Use heat indicating crayons to prevent over heating.**

CAUTION: Keep the torch moving to prevent hot spots.

Evenly heat the flywheel ring gear.

2. Install the flywheel ring gear.
   - The bevel on the flywheel ring gear must face the rear of the flywheel.
   - Use a brass drift.



3. Install the flywheel. For additional information, refer to Flywheel in this section.
4. Install the clutch pressure plate and clutch disc.
5. Install the transmission.

General Specifications

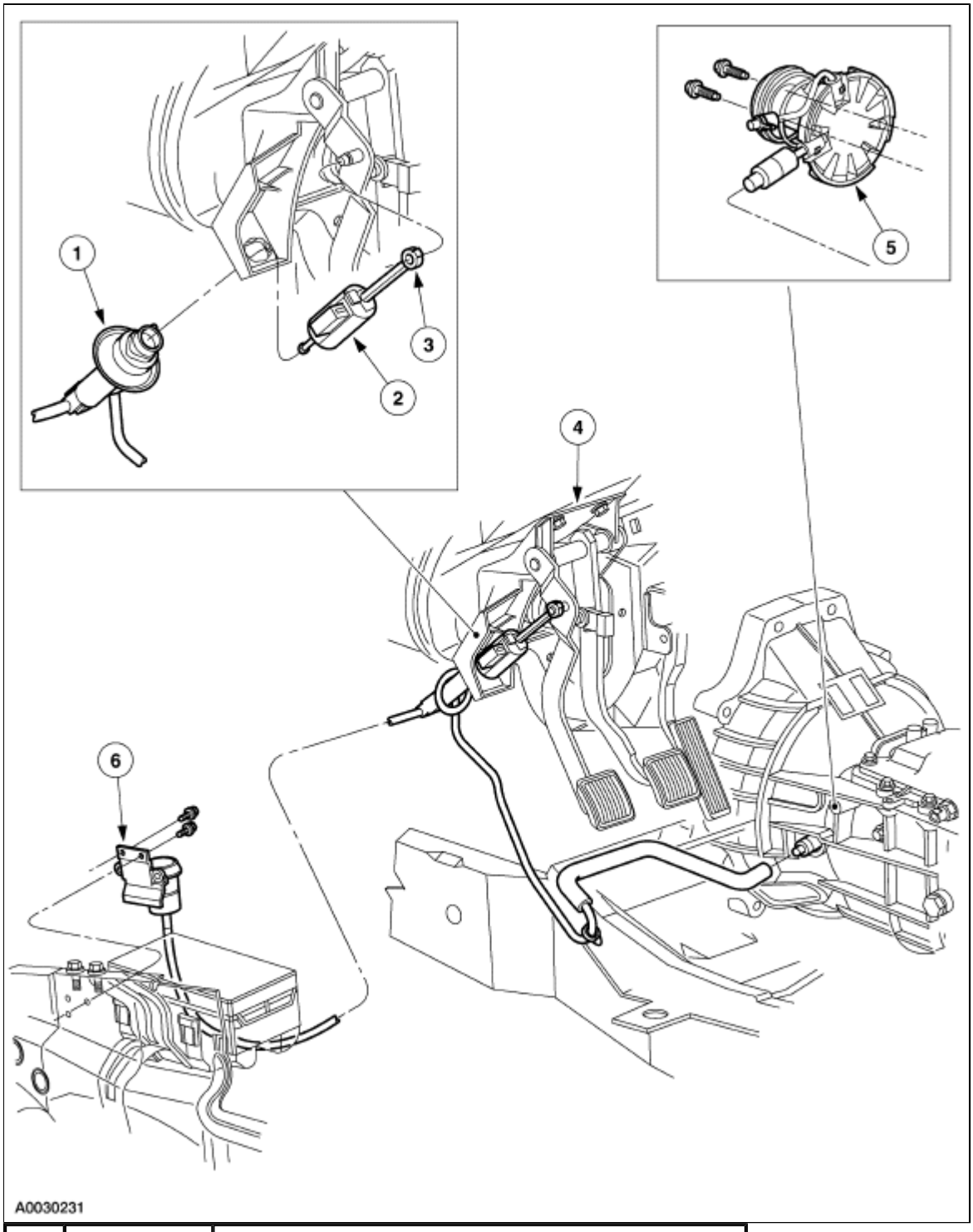
Item	Specification
Clutch System	
Clutch control	Hydraulic
System adjustment	Automatic
Clutch pedal type	Suspended
Fluid and Lubricant	
Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB	ESA-M6C25-A
Premium Long-Life Grease XG-1-C, XG-1-K	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Clutch slave cylinder bolts	20	15	—
Clutch master cylinder reservoir bolts	2.2	—	18

Clutch Controls

Component Location



Item	Part Number	Description
1	7A543	Clutch master cylinder
2	11A152	Clutch pedal position (CPP) switch
3	7A581	Clutch master cylinder push rod bushing
4	2450	Brake and clutch pedal support bracket
5	7A508	Clutch slave cylinder/clutch release hub and bearing
6	7K500	Clutch master cylinder reservoir and tubing

The clutch control system actuates the clutch system. When the clutch pedal is depressed it pushes the clutch master cylinder plunger which transmits hydraulic pressure to the clutch slave cylinder. The clutch slave cylinder engages and compresses the clutch pressure plate diaphragm spring, releasing the pressure on the clutch disc which in turn disengages the transmission from the engine.

- The hydraulic clutch system adjusts automatically to compensate for clutch disc wear.
- The clutch pedal position (CPP) switch is attached to the clutch pedal via the push rod assembly. Depressing the clutch pedal manually closes the switch and allows engine cranking. The switch also deactivates the speed control system and signals the EEC module when the clutch pedal is depressed.

Clutch Controls

Refer to Section 308-00 .

Clutch Pedal

Removal and Installation

NOTE: The clutch pedal is serviced with the brake pedal as an assembly only.

For additional information, refer to Section 206-06 .

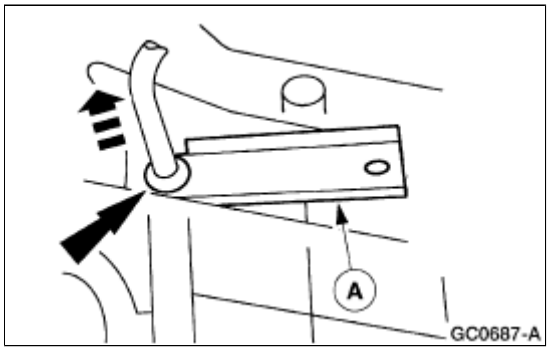
Clutch Master Cylinder/Reservoir

Special Tool(s)

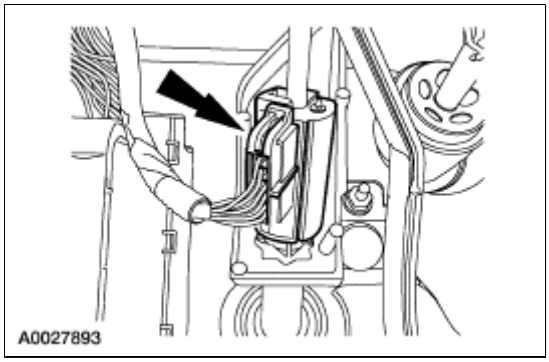
ST1318-A	Remover, Hydraulic Line Connector 308-182 (T88T-70522-A)

Removal and Installation

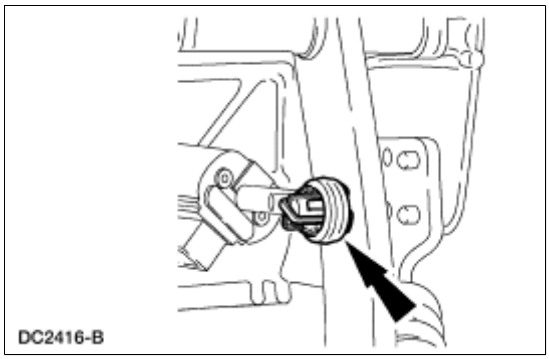
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Using the special tool, disconnect the hydraulic line from the clutch slave cylinder.



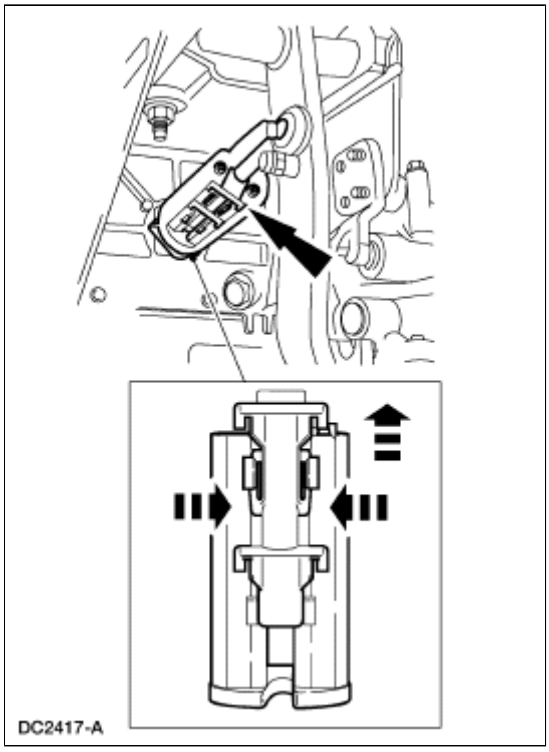
3. Lower the vehicle.
4. Disconnect the clutch pedal position (CPP) switch electrical connector.



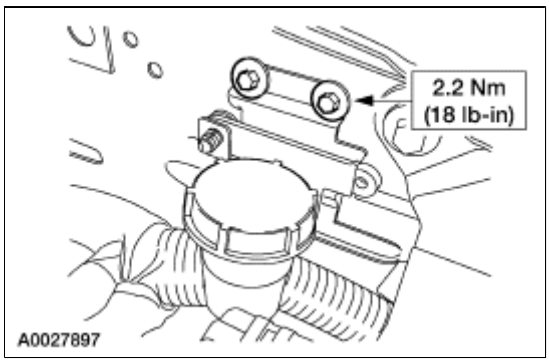
5. Disconnect the clutch master cylinder rod from the clutch pedal arm.
   - Remove and discard the clutch master cylinder push rod bushing.



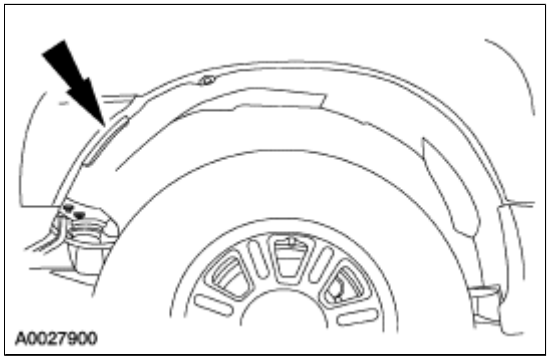
6. Remove the CPP switch.
    - Pinch the lock tabs and pull the clip forward.
    - Rotate and snap the CPP switch from the clutch master cylinder rod.



7. Remove the reservoir.



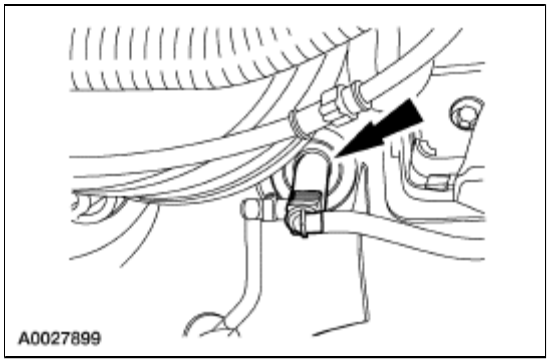
8. Remove the three pushpins, four bolts, four screws and the inner fender splash shield.



9. Unclip the hydraulic line-to-frame retainer.

10. **CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, wash the surface with water immediately.**

    Unlock and remove the clutch master cylinder assembly.
    - Twist the clutch master cylinder clockwise 45 degrees to unlock it from the support bracket.
    - Remove the reservoir, the hydraulic line and the clutch master cylinder as an assembly.
    - Install a new clutch master cylinder push rod bushing.



11. **CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, wash the surface with water immediately.**

    To install, reverse the removal procedure.
    - Bleed the clutch hydraulic system. For additional information, refer to Section 308-00 .
    - Rotate the clutch master cylinder 45 degrees counterclockwise.

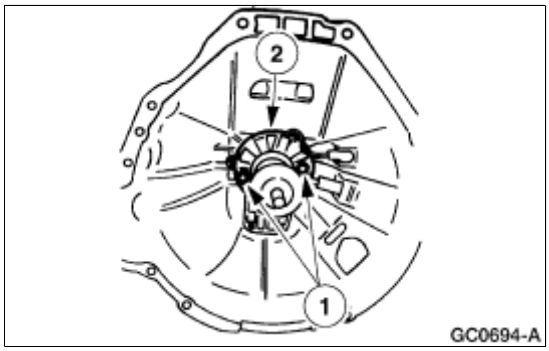
Slave Cylinder

Removal

1. Remove the transmission. For additional information, refer to Section 308-03 .

2. **NOTE:** Inspect the clutch housing for traces of fluid. If brake fluid is visible, install a new clutch slave cylinder.

   Remove the clutch slave cylinder.
   1. Remove the bolts.
   2. Remove the clutch slave cylinder.

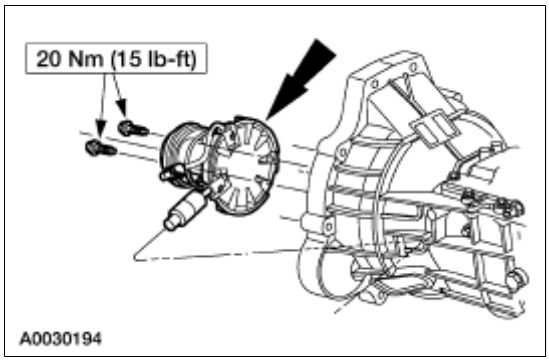


3. Inspect the clutch slave cylinder for the following:
   - Worn or damaged boot.
   - Leaking fluid.
   - Worn or damaged bearing.

4. Inspect the clutch release bearing as follows:
   - Rotate the outer race while applying pressure. If the bearing rotation is rough, install a new clutch slave cylinder.
   - Inspect for wear or damage.

Installation

1. To install, reverse the removal procedure.
   - Position the clutch slave cylinder to the transmission and install the bolts.



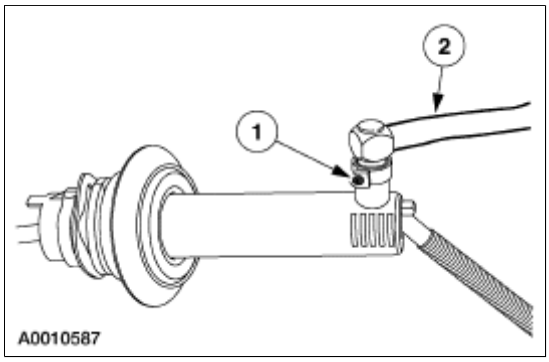
2. Install the transmission. For additional information, refer to Section 308-03 .
3. Depress and release the clutch pedal five full strokes.

Hydraulic Tubes

Removal

1. Remove the clutch master cylinder and the hydraulic line assembly. For additional information, refer to Clutch Master Cylinder/Reservoir in this section.

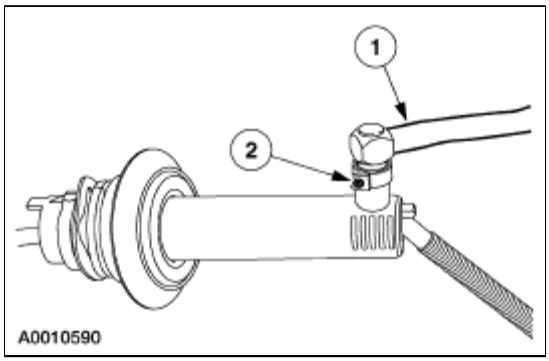
2. Disconnect the hydraulic line from the clutch master cylinder.
    1. Using a 3/32-inch punch and hammer, drive out the roll pin and discard it.
    2. Disconnect the hydraulic line.



Installation

1. **NOTE:** Make sure the O-ring is in the outlet port or on the tube connector.

    Connect and secure the hydraulic tube to the clutch master cylinder.
    1. Install the tube to the clutch master cylinder.
    2. Install a new roll pin.



2. Bleed the clutch hydraulic system. For additional information, refer to Section 308-00 .

General Specifications

Item	Specification
Output shaft maximum runout	0.05 mm (0.002 in)
Shift fork to synchronizer sleeve	0.8 mm (0.031 in)
Synchronizer blocking ring to gear	1.5 mm (0.059 in)
Third/fourth clutch hub end play	0.00-0.05 mm (0.00-0.0019 in)
Reverse idler gear end play	0.1-0.2 mm (0.0039-0.0078 in)
Fifth/reverse hub end play	0.00-0.05 mm (0.00-0.0019 in)
Countershaft reverse gear end play	0.25-0.35 mm (0.0098-0.0138 in)
Lubricant	
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX	MERCON®
Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A

Torque Specifications

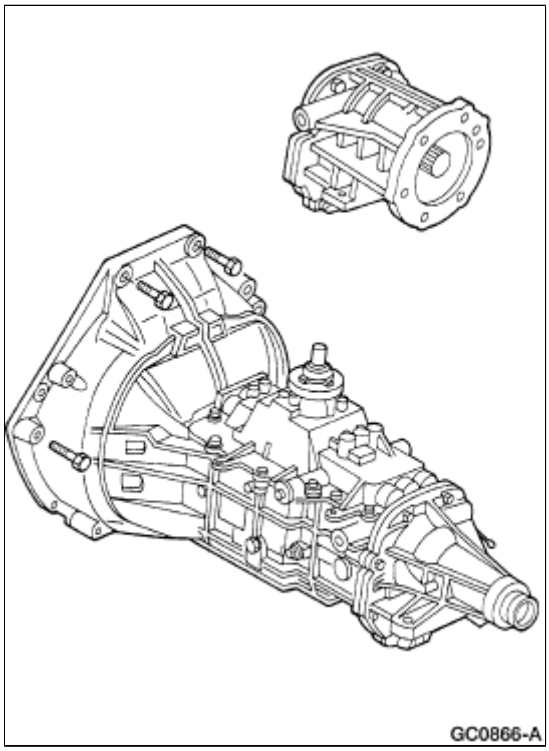
Description	Nm	lb-ft	lb-in
Backup lamp switch	25-35	18-26	—
Case cover bolts	16-22	12-16	—
Case plug	40-58	30-43	—
Counter lever shaft bolt	8-10	6-8	—
Countershaft locknut	128-196	94-144	—
Crossmember bolts	53-72	39-53	—
Crossmember nuts	53-72	39-53	—
Drain plug	40-58	30-43	—
Dust cover bolts	8-11	—	53-70
Extension housing bolts	32-46	24-33	—
Fifth/reverse shift rail bolt	20-30	15-22	—
Fifth/reverse lock plate bolt	8-10	6-8	—
Fill plug	40-58	30-43	—
Fluid passage bolt	8-10	—	72-89
Front bearing retainer bolts	16-22	12-16	—
Gearshift lever bolt	27-40	20-29	—
Gear selector interlock bolts	8-10	—	72-89

Ground wire nut	25-34	18-25	—
Inner gearshift lever boot bolts	10-14	—	89-123
Outer gearshift lever boot screws	5-9	—	45-79
Output shaft locknut	216-274	160-202	—
Rear bearing retainer bolts	18-26	14-19	—
Rear driveshaft bolts	88-119	65-87	—
Reverse idler shaft bolt	79-117	58-86	—
Shift plate bolts	8-10	6-8	—
Transmission bolts	50-68	—	—
Transmission mount bolts	87-110	64-81	—
Transmission mount nuts	87-110	64-81	—
Vehicle speed sensor bolt	11-13	—	98-115

Manual Transmission

The M5OD is a top-shifted, fully synchronized, five speed manual transmission, equipped with an overdrive fifth gear ratio. All gear changes are accomplished with synchronizer sleeves.

M5OD Manual Transmission

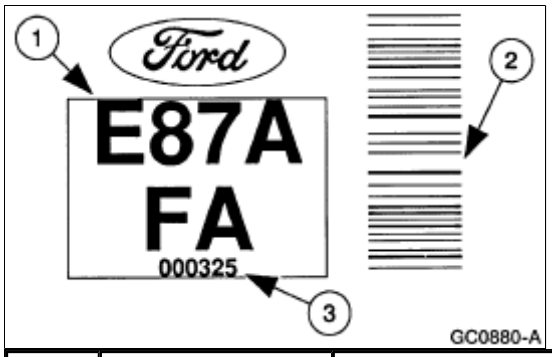


The case (7005), case cover (7222), and extension housing (7A039) are constructed of aluminum alloy. Steel bearing race inserts provide durability in appropriate areas. The extension housing contains a bronze alloy bushing that cannot be replaced. The extension housing must be replaced if the bushing is damaged.

Transmission Identification

The Vehicle Safety Compliance Label (located on the driver door lock pillar) lists applicable transmission identification codes. For additional information on codes, refer to Section 100-01 .

Tag, Service Identification



Item	Part Number	Description
1	—	Ford Motor Company Part Number
2	—	Bar Code
3	—	Serial Number

Manual transmissions are also equipped with service identification tags. The M5OD tag is located on the driver side of the transmission.

Powerflow

Powerflow is accomplished with a series of gears and synchronizers.

In NEUTRAL, there is no powerflow through the transmission.

In first gear, the first/second synchronizer sleeve locks the first gear to the output shaft. The input shaft (7015) drives the countershaft. First gear on the countershaft turns first gear on the output shaft which is driven in reduction at a 3.90:1 ratio.

In second gear, the first/second synchronizer sleeve locks the second gear (2GR) (7102) to the output shaft. The input shaft drives the countershaft. Second gear on the countershaft drives second gear on the output shaft. The output shaft is driven in reduction at a 2.25:1 ratio.

In third gear, the third/fourth synchronizer sleeve locks the third gear (3GR) to the output shaft. The input shaft drives the countershaft. Third gear on the countershaft drives third gear on the output shaft. The output and fifth gear drive shaft (7061) is driven in reduction at a 1.49:1 ratio.

In fourth gear, the third/fourth synchronizer sleeve locks the input shaft to the output and fifth gear drive shaft. The input shaft and output shaft turn at the same speed (1:1 ratio).

In fifth gear, the fifth/reverse synchronizer sleeve locks the fifth gear (5GR) to the countershaft. The input shaft drives the countershaft. Fifth gear on the countershaft drives fifth gear on the output shaft. The output shaft is overdriven at a ratio of 0.80:1.

In REVERSE gear, the fifth/reverse synchronizer sleeve locks the REVERSE gear to the countershaft. The input gear drives the countershaft. The countershaft reverse gear drives the reverse idler gear. The reverse idler gear drives the reverse gear on the output shaft. The output shaft is driven in the opposite direction of the input shaft at a ratio of 3.91:1.

Manual Transmission

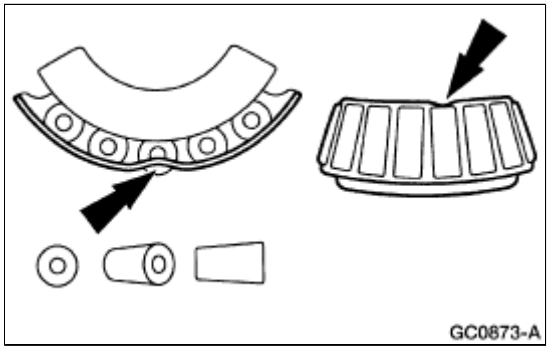
Refer to Section 308-00 .

Bearings

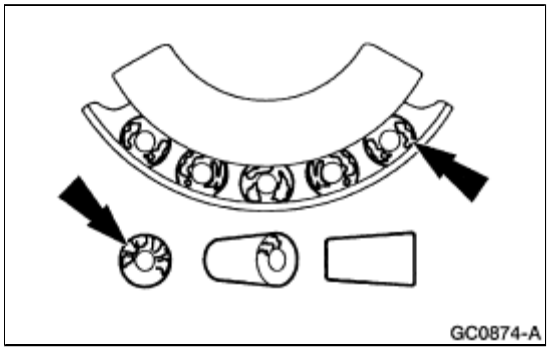
Inspect

1. **NOTE:** If any of the following conditions exist, replace the bearing.

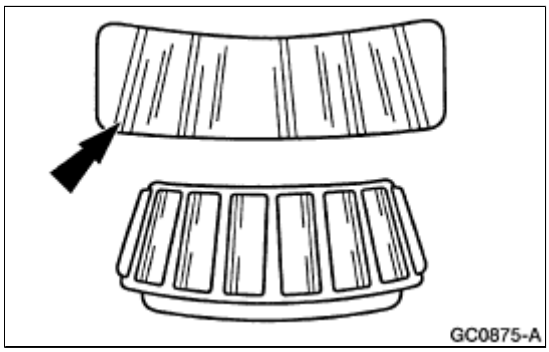
   Inspect the bearing for bent cage.



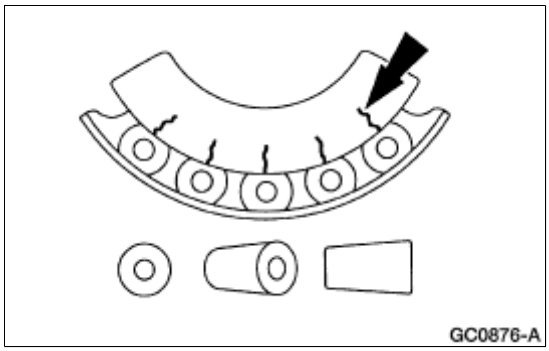
2. Inspect the bearings for galling (metal smears on the roller ends).
   - Galling is caused by overheating, poor lubrication or overload.
   - If galling is found, replace the bearing and inspect the seals.



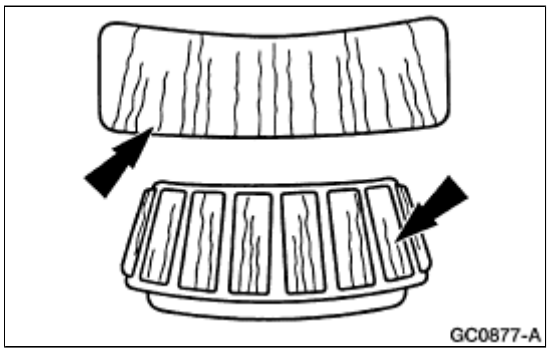
3. Inspect the bearing for brinelling (surface indentations in the raceway).



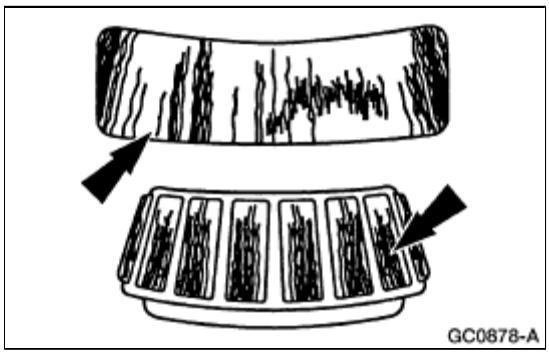
4. Inspect the bearing for cracked inner race.



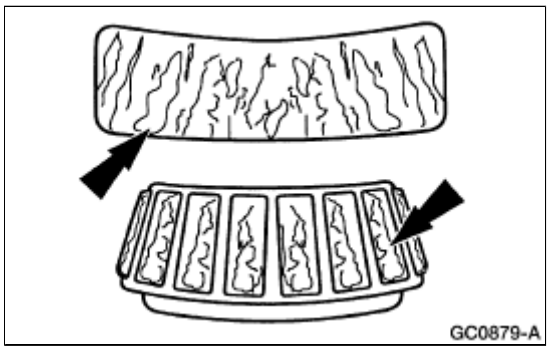
5. Inspect the bearing and raceway for etching.
    - If etching is present, inspect the seals.



6. Inspect the bearing for heat discoloration (dark blue).
    - If heat discoloration is evident, check the bearing and race for loss of temper. Draw a file across the component. If the file cuts the metal, there is a loss of temper.

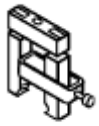


7. Inspect the bearing for fatigue spalling (metal flaking).



Extension Housing

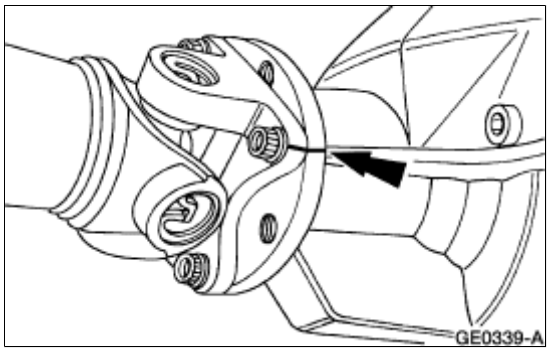
Special Tool(s)

ST1188-A	Extension Housing Seal Replacer 308-002 (T61L-7657-A)
 ST1192-A	Seal Remover 307-048 (T74P-77248-A)
ST1927-A	High Lift Transmission Jack 164-R3508 or equivalent

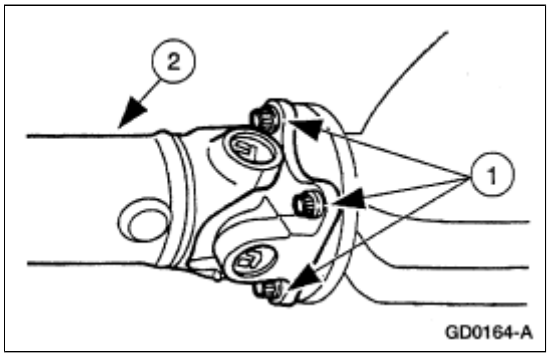
Removal

1. If equipped, turn the air suspension switch off.
2. Disconnect the battery ground cable (14301).
3. Raise and support the vehicle; refer to Section 100-02 .
4. On 4WD vehicles, remove the transfer case; refer to Section 308-07B .
5. Drain the transmission fluid.
6. **NOTE:** To maintain initial driveshaft balance, mark the driveshaft centering socket yoke (4782) and rear axle universal joint flange (4851) so they may be installed in their original positions.

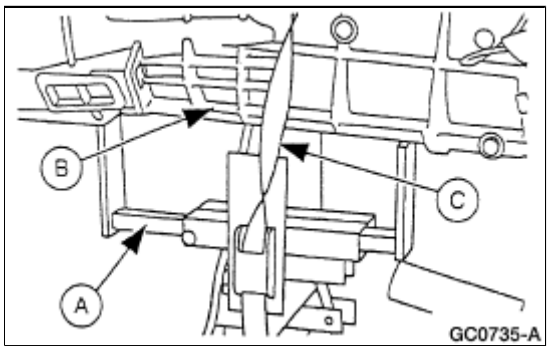
   Mark the driveshaft centering socket yoke and rear axle universal joint flange.



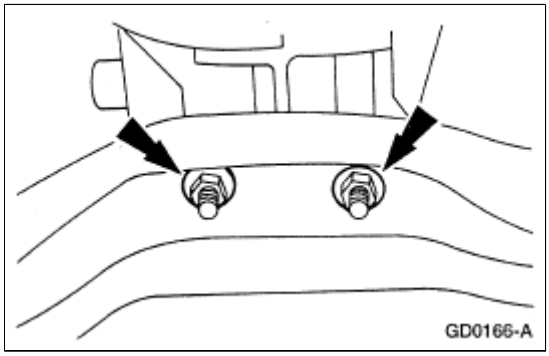
7. Remove and support the rear driveshaft (4A376).
    1. Remove the bolts.
    2. Remove the rear driveshaft.



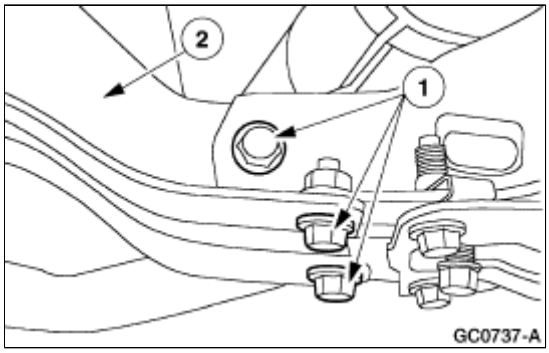
8. Use the (A) Hi-Lift Jack to support the (B) transmission.
    - Secure the (B) transmission with the (C) strap.



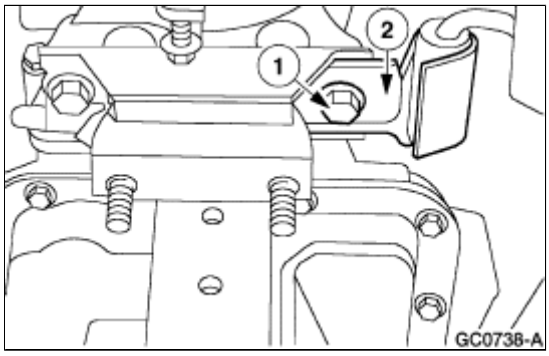
9. Remove the nuts.



10. Remove the crossmember.
    1. Remove the six bolts (three each side).
    2. Remove the crossmember.

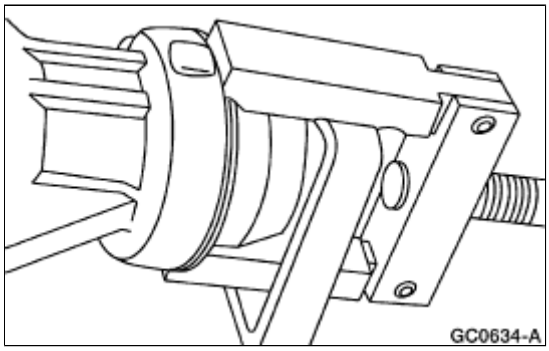


11. Remove the (RH) transmission mount bolt.
    1. Remove the bolt.
    2. Reposition the exhaust mounting bracket.

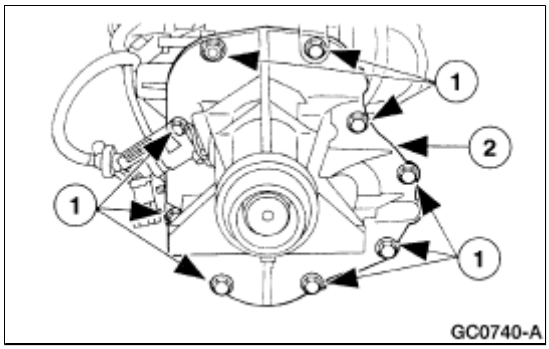


12. Lower the transmission to access extension housing bolts.

13. Use the Seal Remover to remove the extension housing seal.



14. Remove the extension housing (7A039).
    1. Remove the bolts.
    2. Remove the extension housing.

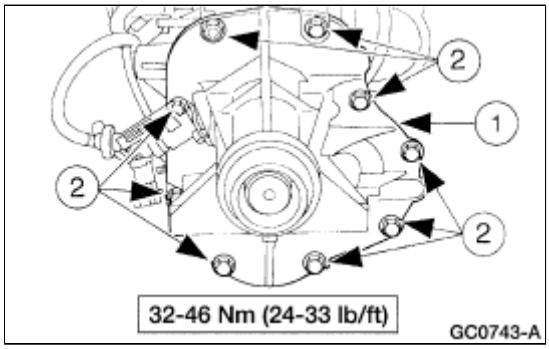


Installation

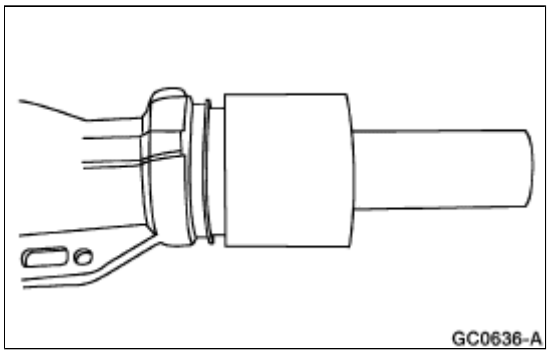
1. **NOTE:** The extension housing must be installed within four minutes after applying silicone.

   Apply a small bead of Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A to the surface of the case (7005).

2. Install the extension housing.
   1. Position the extension housing.
   2. Install the bolts.

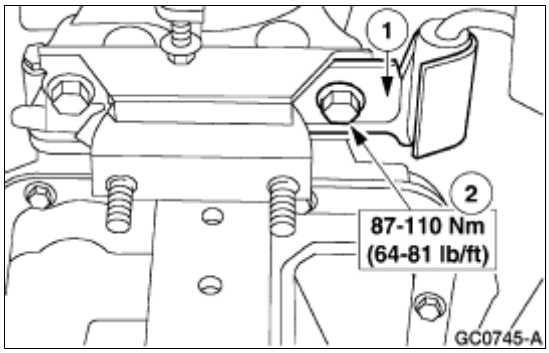


3. Use Extension Housing Seal Replacer to install the extension housing seal.

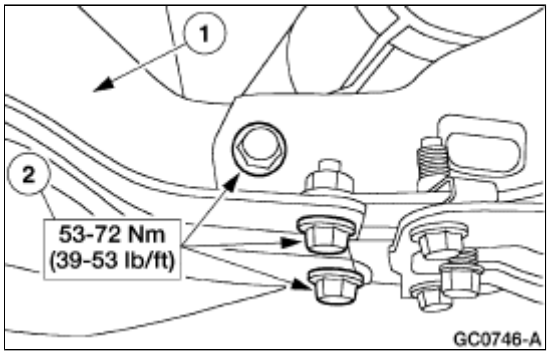


4. Raise and position the transmission.

5. Install the (RH) transmission mount bolt.
   1. Position the exhaust bracket.
   2. Install the bolt.

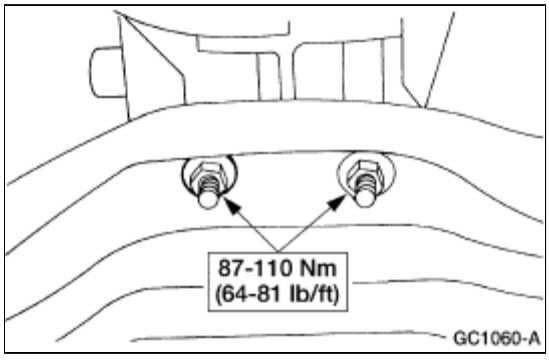


6. Install the crossmember.
    1. Position the crossmember.
    2. Install the six bolts and nuts (three each side).

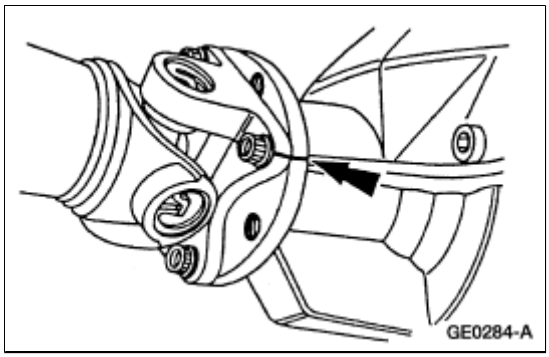


7. Remove the Hi-Lift Jack.

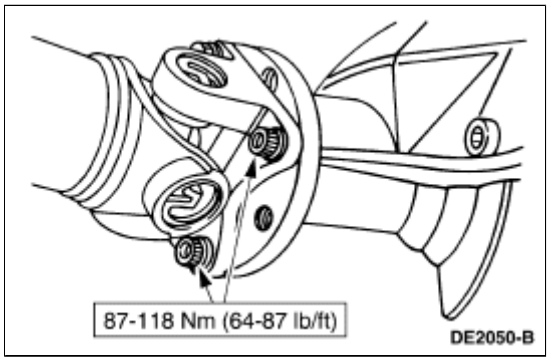
8. Install the nuts.



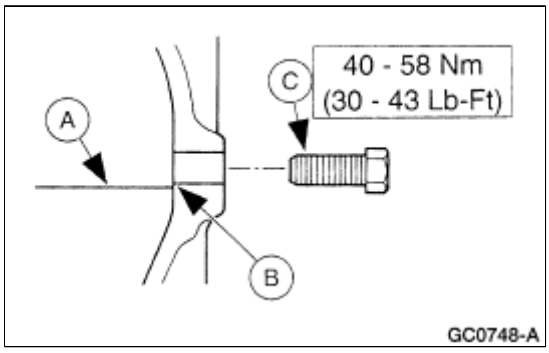
9. Align the marks on the rear driveshaft yoke and on the rear axle pinion flange made during removal. Loosely install the bolts.



10. Tighten the four bolts to specifications.



11. Fill the (A) transmission with MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX or equivalent meeting Ford MERCON® specification until it reaches the bottom of the (B) fill port and install the (C) case plug (7A010).



12. Lower the vehicle.

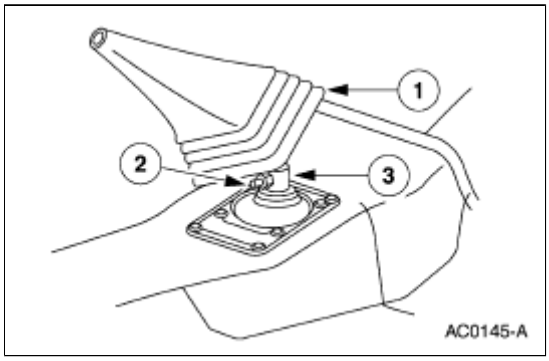
13. Connect the battery ground cable.

14. If equipped with air suspension, reactivate the system by turning on the air suspension switch.

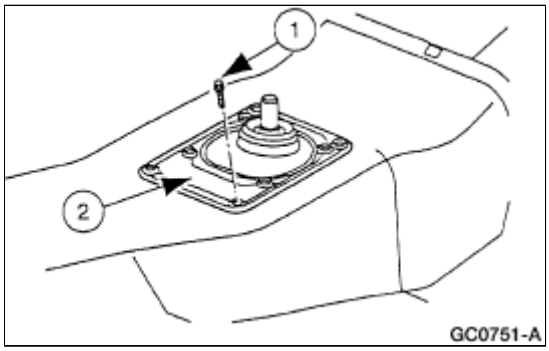
Shift Lever and Boot

Removal

1. Remove the gearshift lever (7210).
    1. Lift the outer gearshift lever boot (7277).
    2. Remove the bolt.
    3. Remove the gearshift lever.

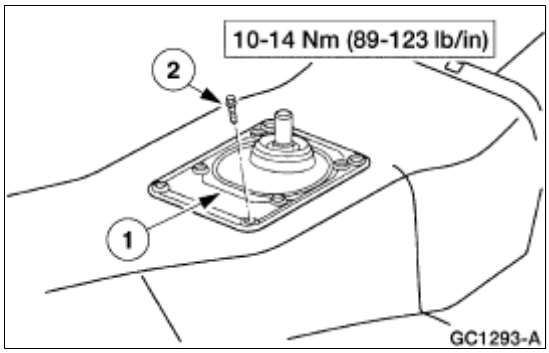


2. Remove the inner gearshift lever boot.
    1. Remove the four screws.
    2. Remove the inner gearshift lever boot.

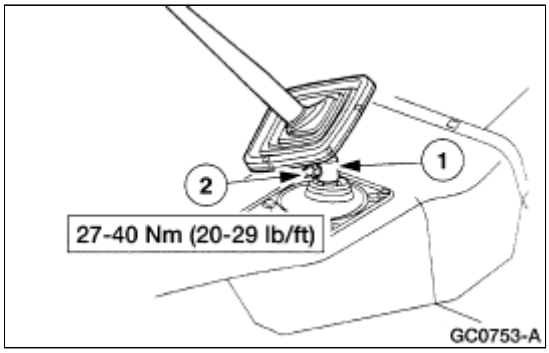


Installation

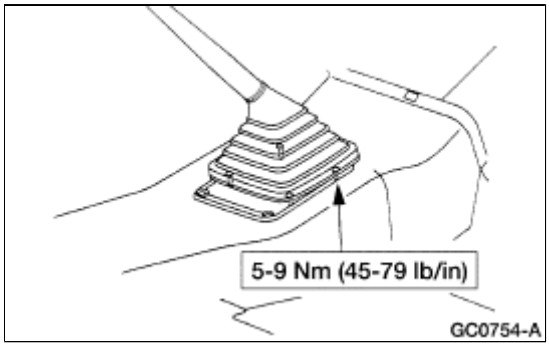
1. Install the inner gearshift lever boot.
    1. Position the inner gearshift lever boot.
    2. Install the screws.



2. Install the gearshift lever.
    1. Position the gearshift lever.
    2. Install the bolt.



3. Install the screws.

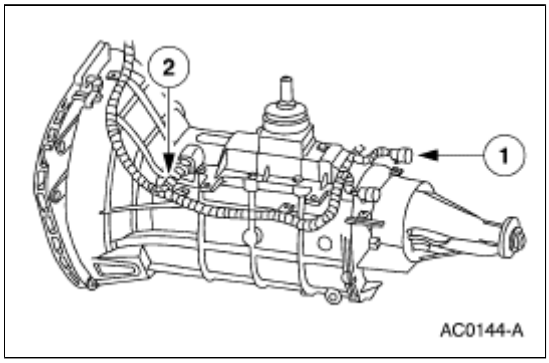


Transmission

Special Tool(s)

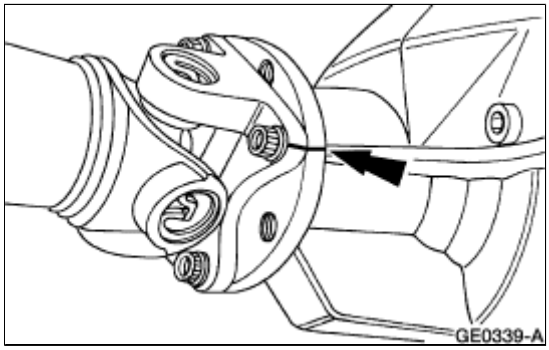
ST1318-A	Clutch Coupling Tool 308-182 (T88T-70522-A)
ST1927-A	Hi-Lift Transmission Jack 164-R3508 or equivalent

1. If equipped, turn the air suspension switch off.
2. Disconnect the battery ground cable (14301).
3. Place the transmission in the NEUTRAL position.
4. Remove the outer gearshift lever boot (7277), gearshift lever (7210) and inner gearshift lever boot; refer to Shift Lever and Boot in this section.
5. Disconnect the transmission wiring harness.
    1. Disconnect the heated oxygen sensor connector.
    2. Disconnect the backup lamp switch connector.

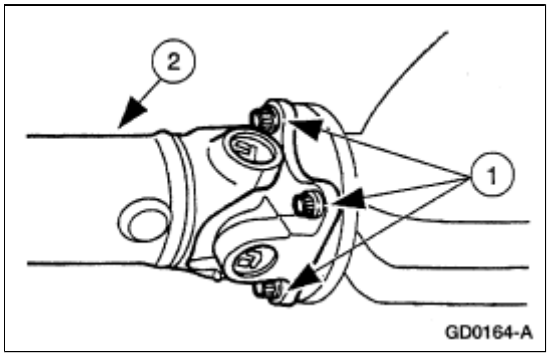


6. Raise and support the vehicle; refer to Section 100-02 .
7. If transmission disassembly is required, drain the transmission fluid.
8. **NOTE:** To maintain initial driveshaft balance, mark the driveshaft centering socket yoke (4782) and rear axle universal joint flange (4851) so they may be installed in their original positions.

Mark the driveshaft centering socket yoke and rear axle universal joint flange.

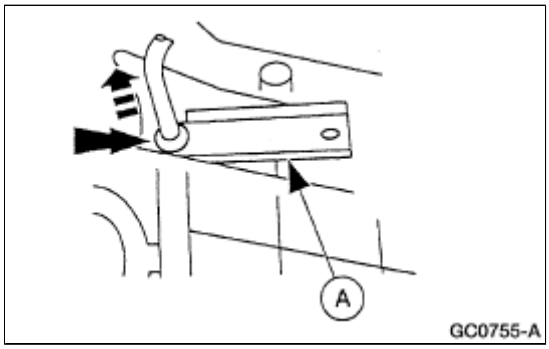


9. Remove the rear driveshaft (4A376).
    1. Remove the four bolts.
    2. Remove the rear driveshaft.



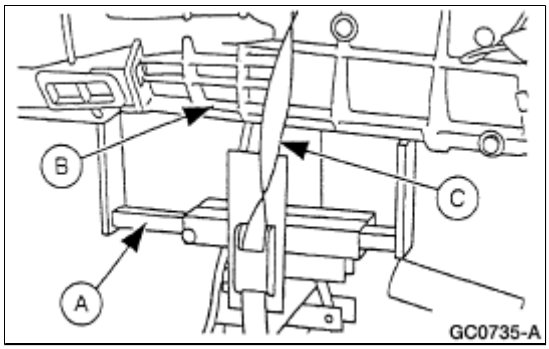
10. On 4-wheel drive vehicles, remove the transfer case; refer to Section 308-07B .

11. Use (A) Clutch Coupling Tool to disconnect the clutch hydraulic line.

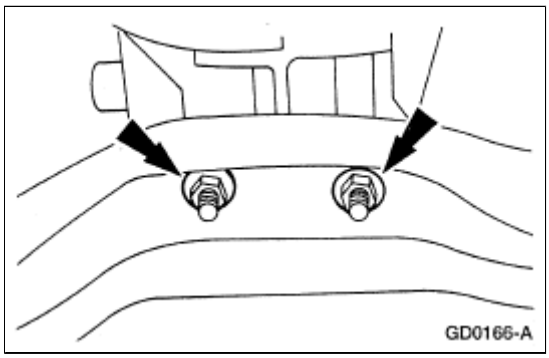


12. Remove the starter motor (11001); refer to Section 303-06 .

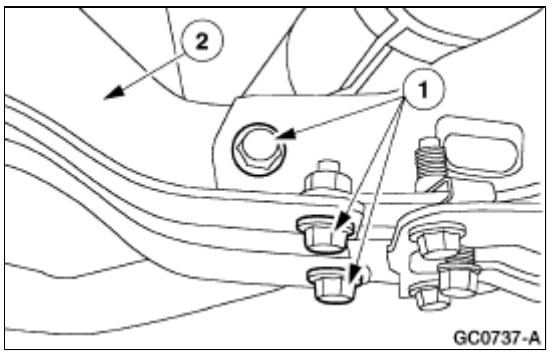
13. Position the (A) Hi-Lift Jack under the transmission (B).
    - Secure with the (C) strap.



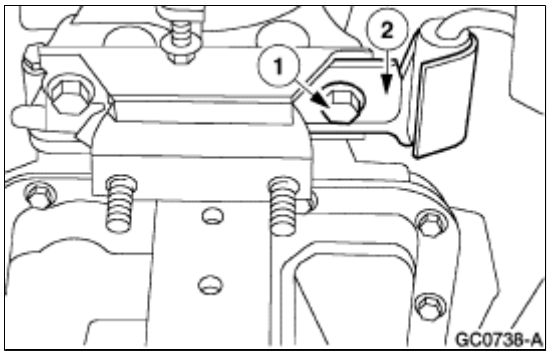
14. Remove the nuts.



15. Remove the rear crossmember.
    1. Remove the six bolts (three each side).
    2. Remove the crossmember.



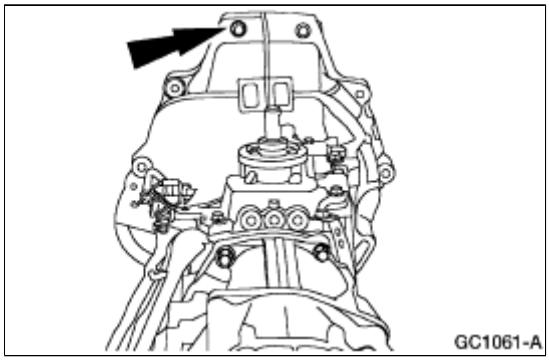
16. Remove the (RH) transmission bolt.
    1. Remove the bolt.
    2. Reposition the exhaust bracket.



17. Remove the exhaust inlet cross-over pipe; refer to Section 309-00 .

18. **NOTE:** Lower the transmission enough to gain access to the bolts. Use a long extension to remove the bolts.

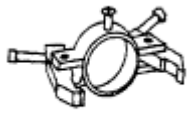
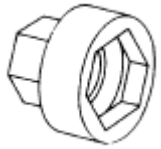
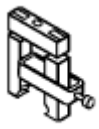
    Remove the nine bolts.



19. Lower the transmission.

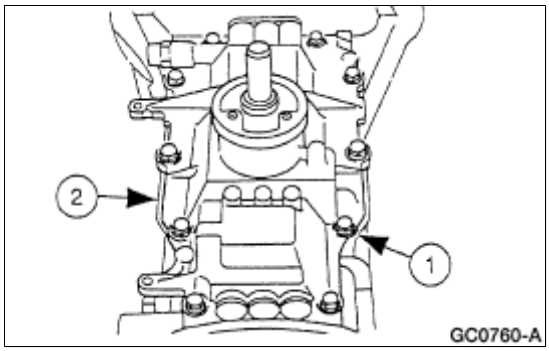
Transmission

Special Tool(s)

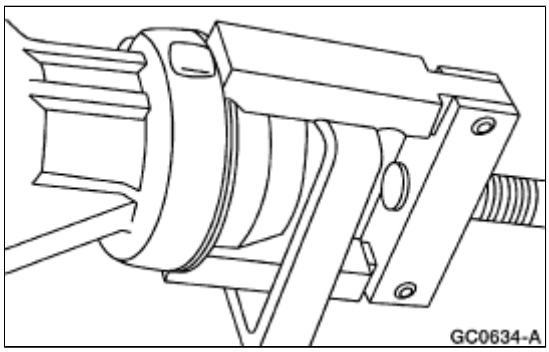
 ST1305-A	Bearing Puller 308-058 (T77J-7025-H)
ST1618-A	Front Cover Removing Bolt Set 308-171 (T88T-7025-D)
 ST1583-A	Mainshaft Locknut Wrench 308-168 (T88T-7025-AR)
ST1303-A	Remover/Replacer Tube 308-024 (T75L-7025-B)
 ST1192-A	Seal Remover 307-048 (T74P-77248-A)
ST1304-A	TOD Forcing Screw 308-092 (T84T-7025-B)

1. Set the transmission on a work bench.

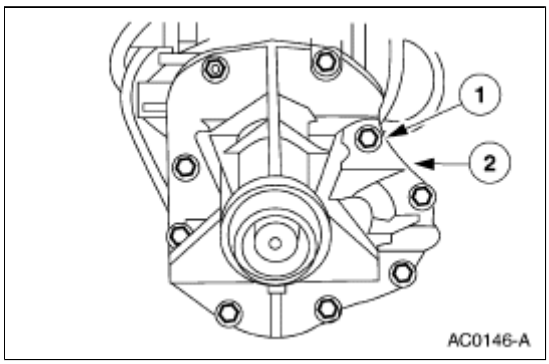
2. Remove the case cover (7222).
    1. Remove the case cover bolts.
    2. Remove the case cover.



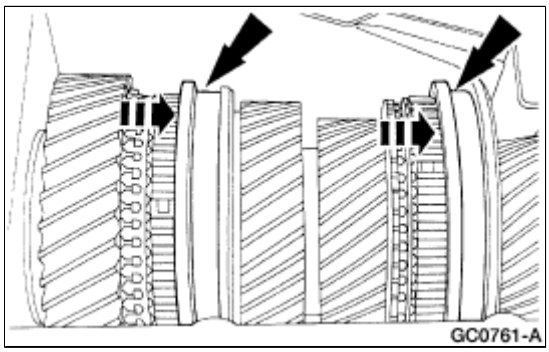
3. Use Seal Remover to remove the extension housing seal.



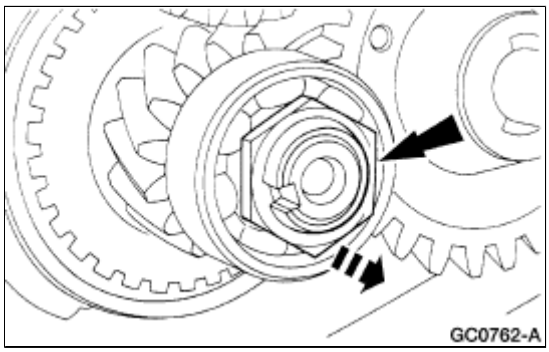
4. Remove the extension housing (7A039).
    1. Remove the bolts.
    2. Remove the extension housing.



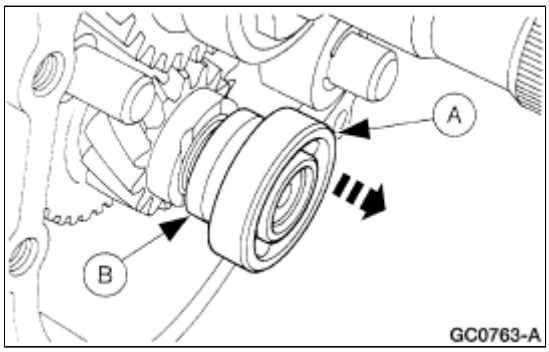
5. Slide the first/second and third/fourth synchronizer sleeves forward to lock the transmission into first and third gears.



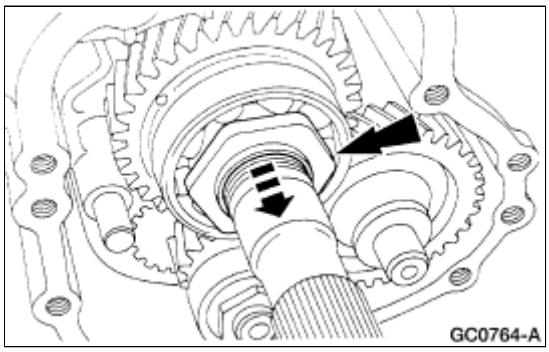
6. Remove and discard the countershaft locknut.



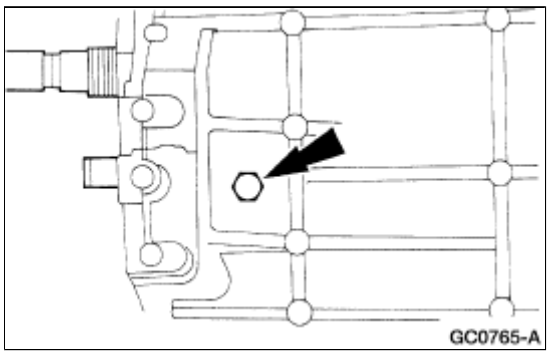
7. Remove the (A) countershaft rear bearing and (B) countershaft rear bearing thrust washer (7L324).



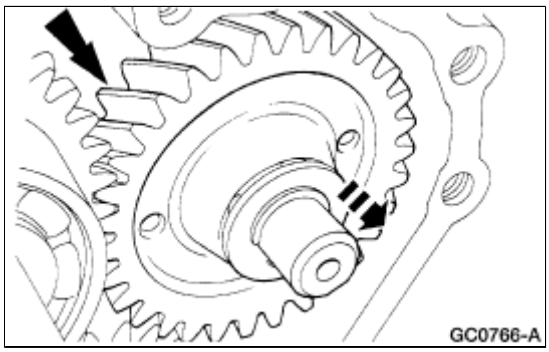
8. Use Mainshaft Locknut Wrench to remove and discard the output shaft rear bearing lock nut (7B364).



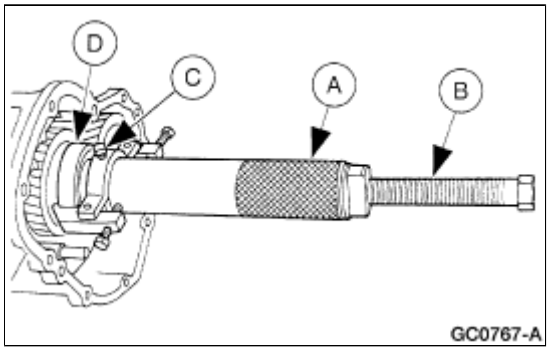
9. Remove the bolt.



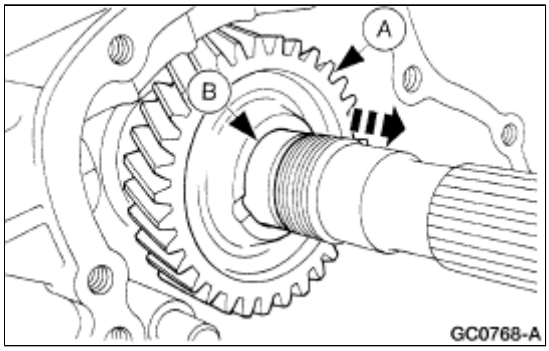
10. Remove the reverse idler gear and bushing (7141).



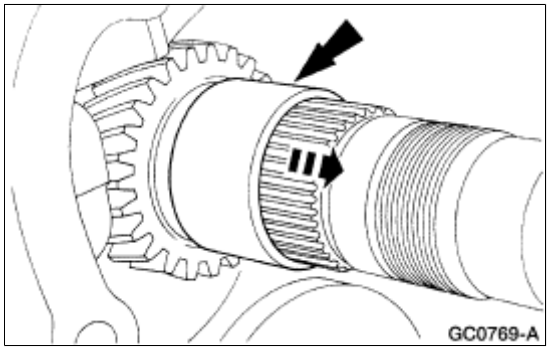
11. Use (A) Remover/Replacer Tube, (B) TOD Forcing Screw and (C) Bearing Puller to remove the (D) output shaft rear bearing (7R205).



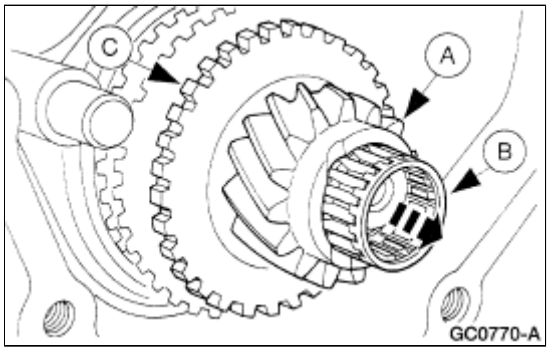
12. Remove the output shaft (7060) (A) reverse gear (7K013) and (B) bushing.



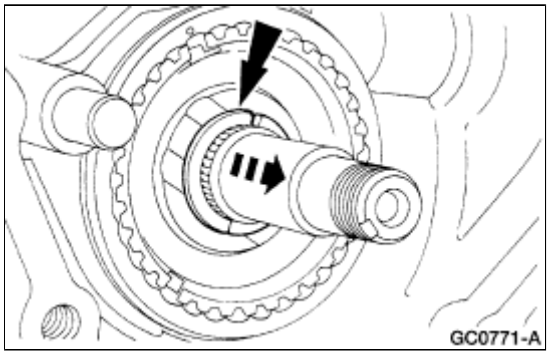
13. Remove the spacer or sleeve (7072).



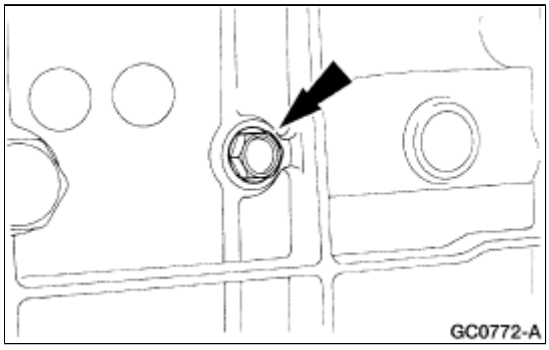
14. Remove the (A) countershaft reverse gear (7N040), the (B) two countershaft reverse gear bearings (7N270), and the (C) reverse synchronizer blocking ring (7107).



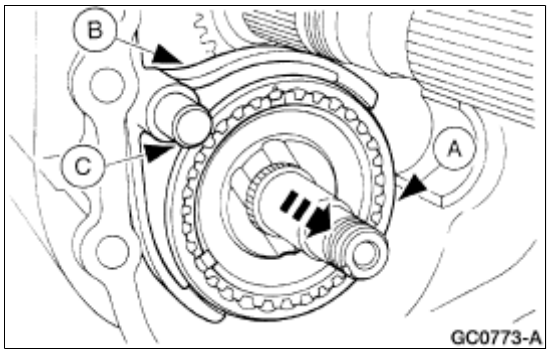
15. Remove the countershaft split washer.



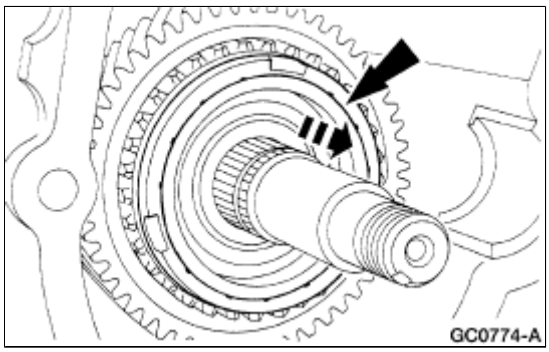
16. Remove the fifth/reverse shift rail bolt.



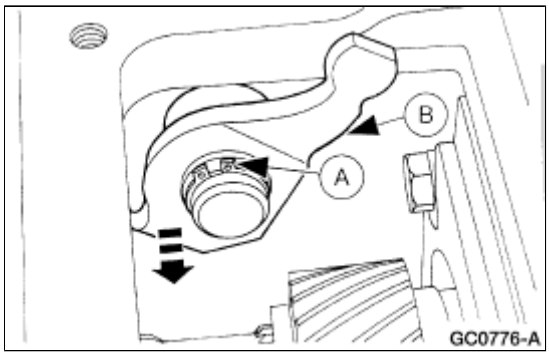
17. Remove the fifth/reverse (A) synchronizer (7124), (B) gear shifter fork (7230), and (C) reverse gear shift rail (7240) as an assembly.



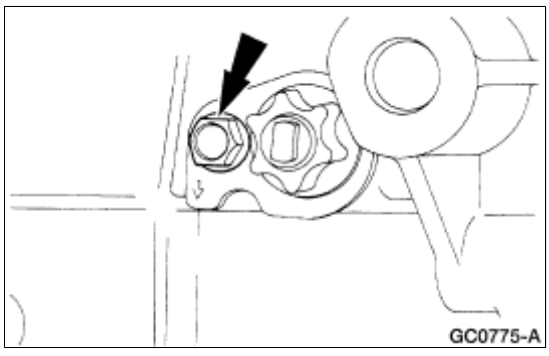
18. Remove the countershaft fifth gear synchronizer blocking ring.



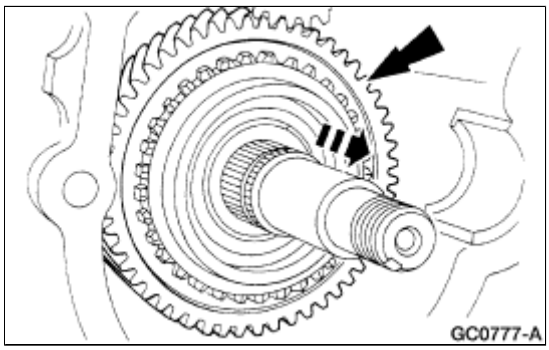
19. Remove the (A) fifth and reverse shift lever retaining ring and the (B) fifth and reverse shift lever (7243).



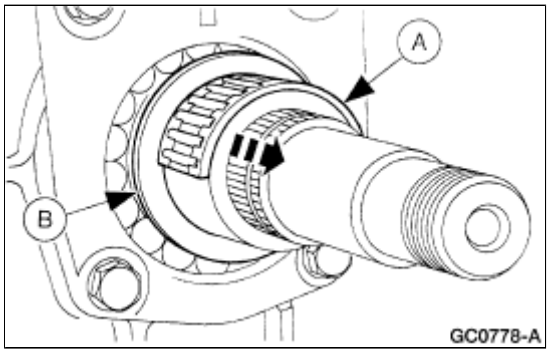
20. Remove the bolt.
Slide shaft out of case.



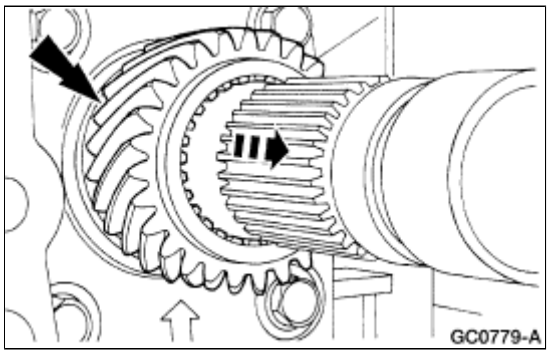
21. Remove the countershaft fifth speed gear.



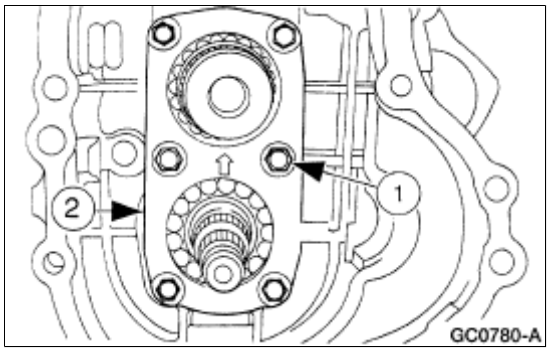
22. Remove the (A) countershaft fifth speed gear split bearing and (B) race.



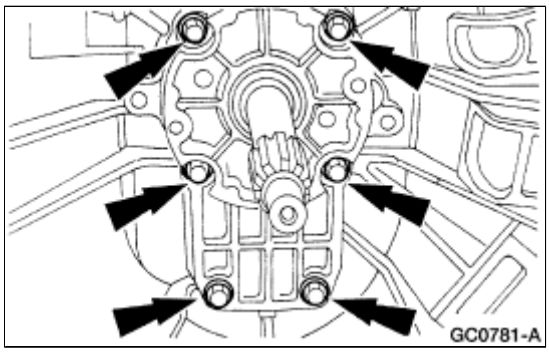
23. Remove the output shaft fifth speed gear.



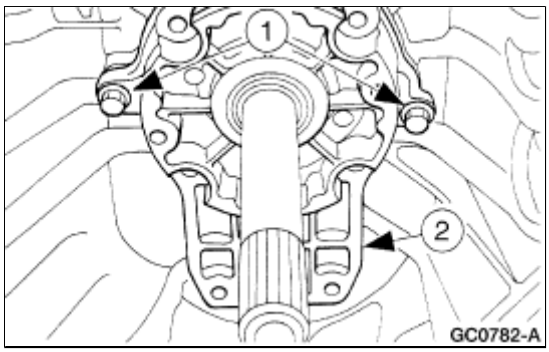
24. Remove the rear bearing retainer.
    1. Remove the retainer bolts.
    2. Remove the bearing retainer (7085).



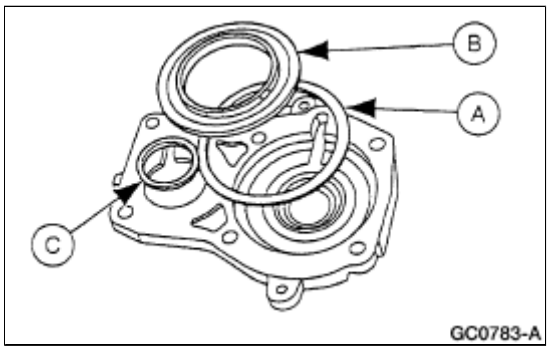
25. Remove the bolts.



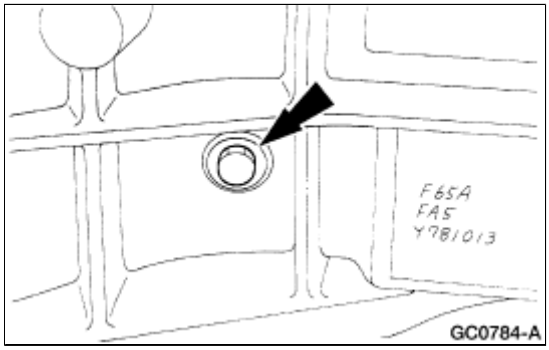
26. Remove the main drive gear bearing retainer (7050).
    1. Install Front Cover Removing Bolt Set into the slave cylinder bolt locations.
    2. Remove the main drive gear bearing retainer.
       - Alternately tighten the bolts until the bearing retainer can be removed by hand.



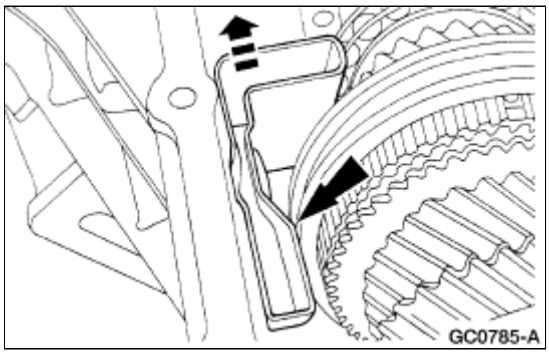
27. Remove the (B) fluid baffle, the (A) input bearing shim, and the (C) countershaft bearing shim.



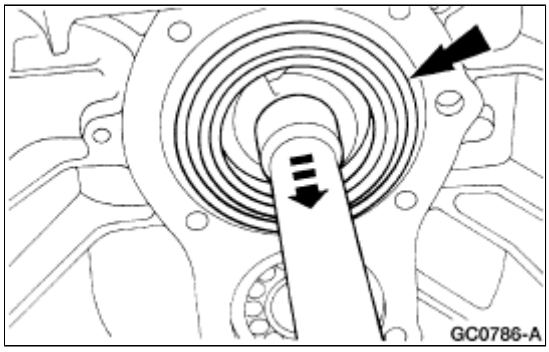
28. Remove the fluid passage bolt.



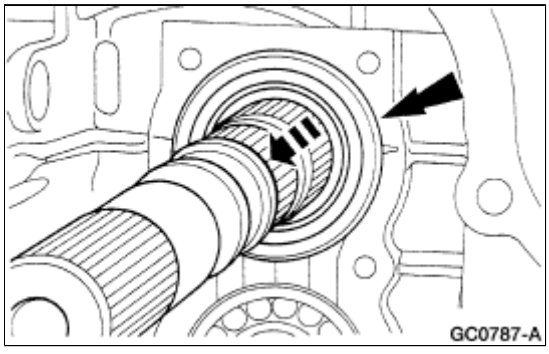
29. Remove the fluid passage.



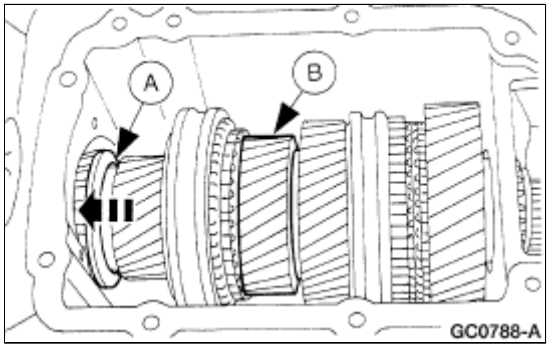
30. Remove the input shaft front bearing race.



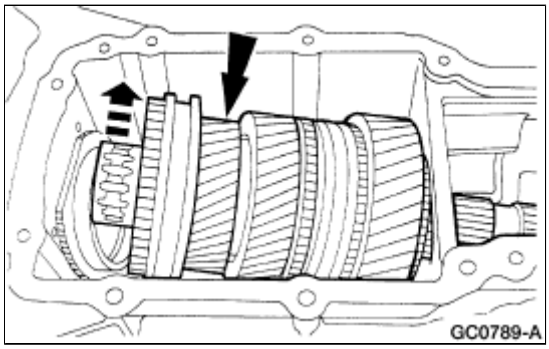
31. Remove the output shaft center bearing race.



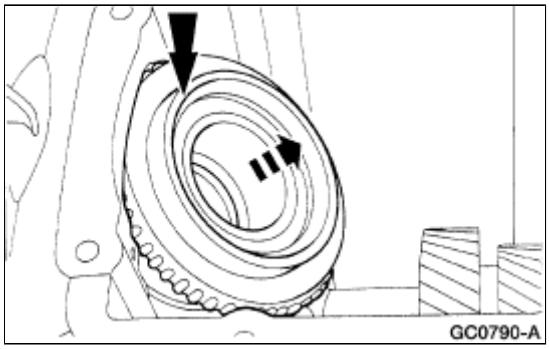
32. Separate the (A) input shaft (7015) and the (B) output shaft.



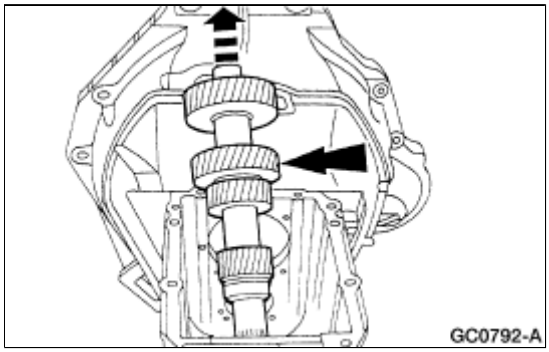
33. Remove the output shaft.



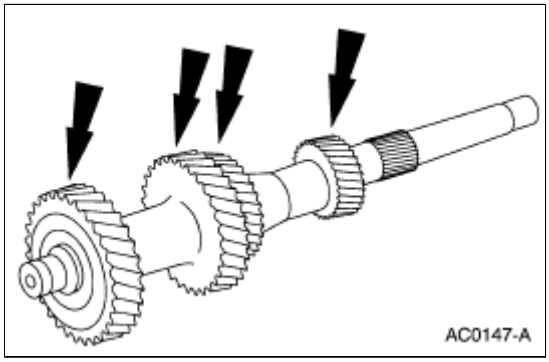
34. Remove the input shaft (7017).



35. Remove the countershaft cluster gear (7113).

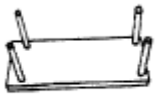


36. Inspect the countershaft cluster gear for damage.



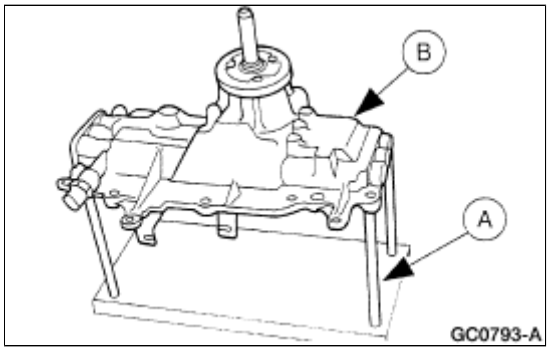
Shift Control Housing

Special Tool(s)

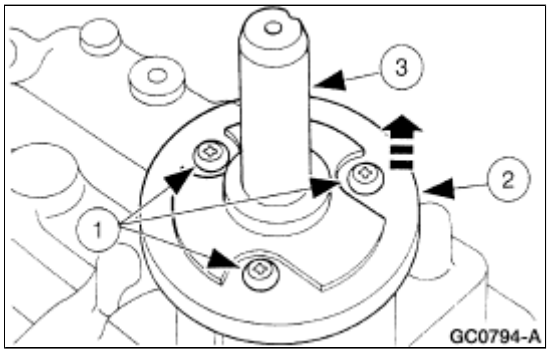
 ST1311-A	Top Cover Holding Fixture 308-170 (T88T-7025-C)

Disassembly

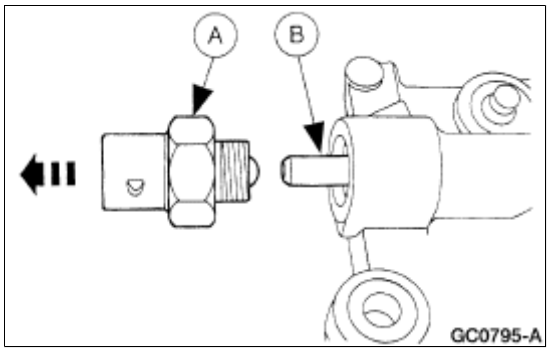
1. Position the (B) case cover (7222) onto (A) Top Cover Holding Fixture.



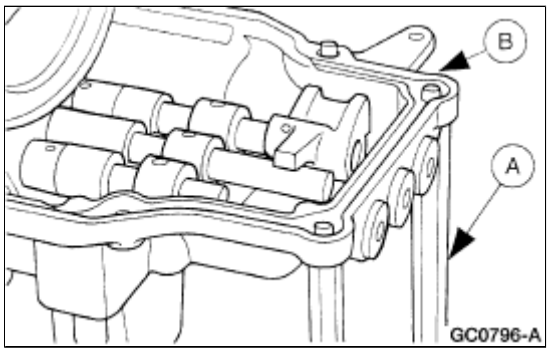
2. Remove the lower gearshift lever (7210).
    1. Remove the screws.
    2. Remove the dust cover.
    3. Remove the lower gearshift lever.



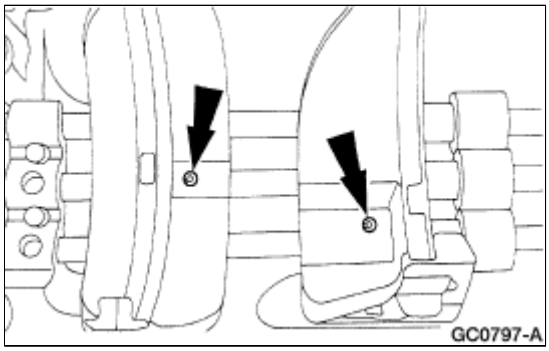
3. Remove the (A) backup lamp switch (15520) and the (B) pin.



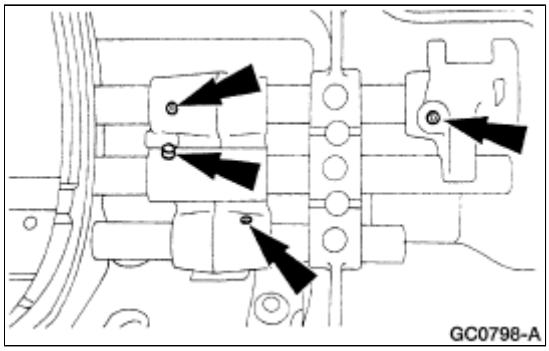
4. Invert the (B) case cover on (A) Top Cover Holding Fixture.



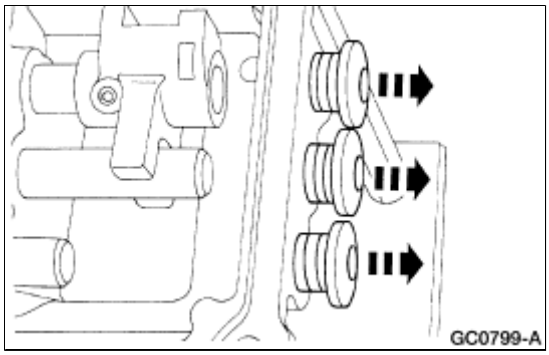
5. Remove and discard the two shift fork spring pins.



6. Remove and discard the four shift gate spring pins.



7. Remove the three rubber service bore plugs.

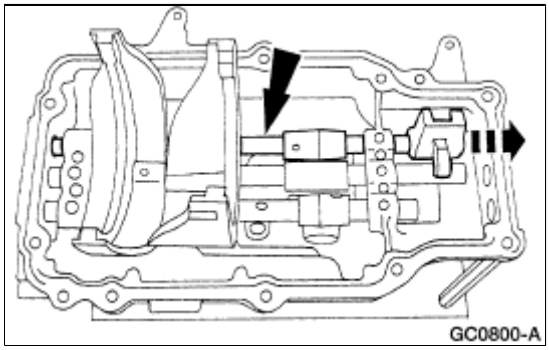


8. **WARNING: Wear safety glasses while performing shift rail removal procedure.**

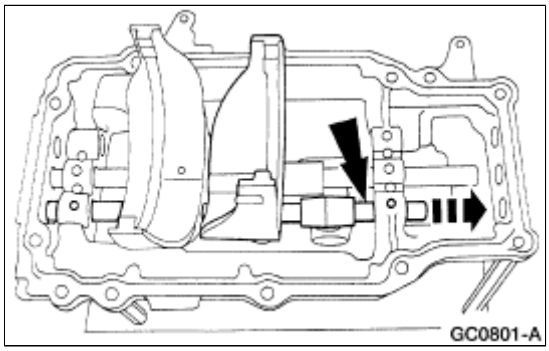
   CAUTION: Perform the following shift rail removal procedure with great care. Cover the lockball and friction device bores and spring seats with a clean cloth held firmly into place during shift rail removal. Failure to cover bores can result in component loss when the ball/friction device and spring forcefully leave their installed positions.

   NOTE: When removing the shift rails, collect and separate the interlock pins to ensure installation into their original locations.

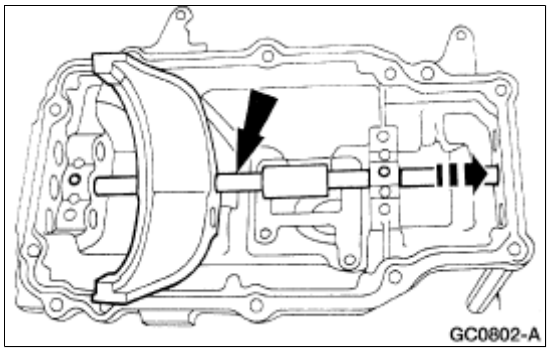
   Use the spring pin bore to remove the fifth/reverse shift rail.



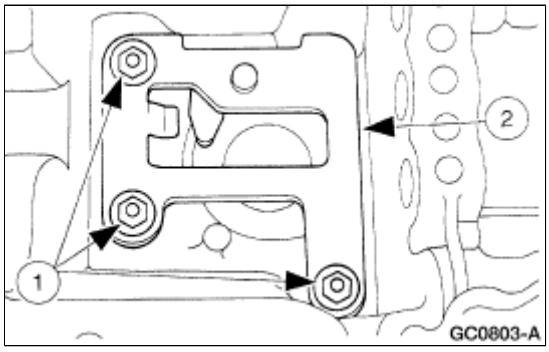
9. Remove the first/second shift rail.
   - Use a suitable punch in the spring pin bore to aid removal.



10. Use the spring pin bore to remove the third/fourth shift rail.

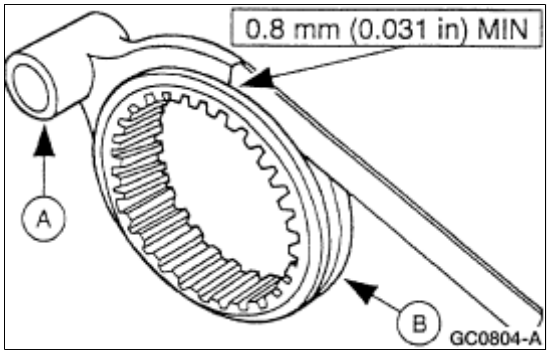


11. Remove the gear selector interlock sleeve (7K201).
    1. Remove the bolts.
    2. Remove the gear selector interlock sleeve.

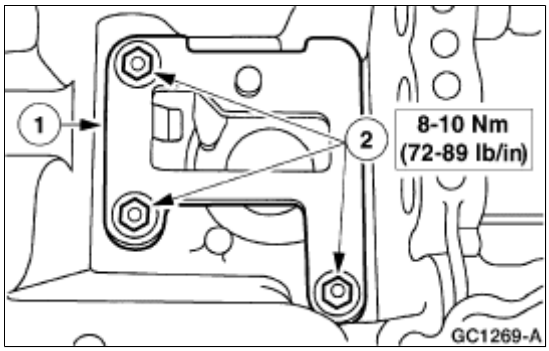


Assembly

1. Check the contact surface of the (A) shift fork and (B) synchronizer sleeve for wear or damage.

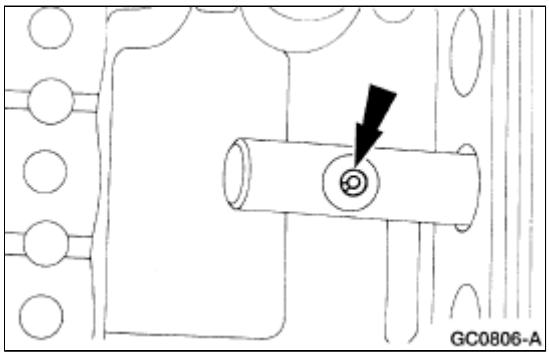


2. Install the gear selector interlock sleeve.
    1. Position the gear selector interlock sleeve.
    2. Install the bolts.

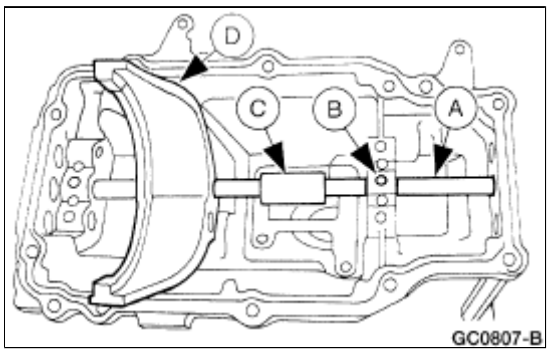


3. **NOTE:** Improper installation of the interlock pins will prevent activation of the backup lamp switch.

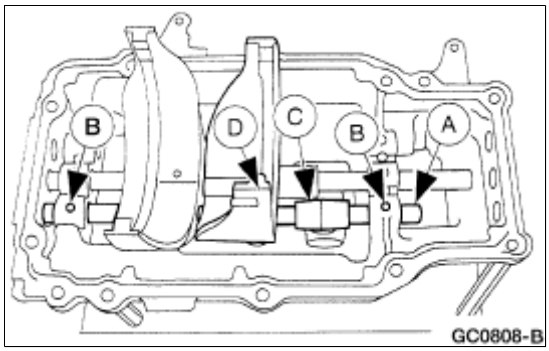
   Install the interlock pins into their original shift rails.



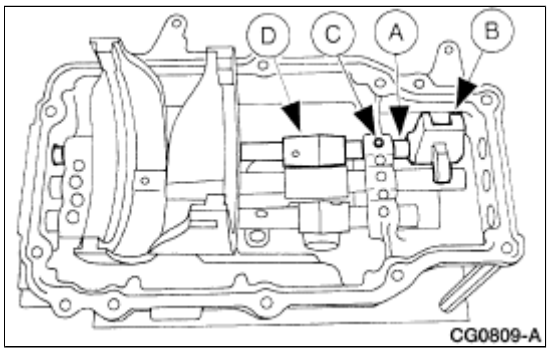
4. Position the (B) detent ball and spring, the (C) shift gate, the (D) shift fork and spring and install the (A) third/fourth shift rail.



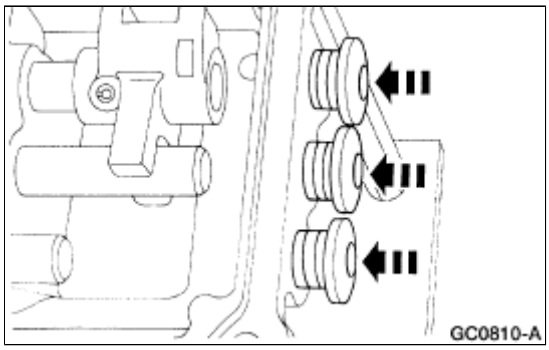
5. Position the (B) detent ball and spring, the (C) shift gate, the (D) shift fork and spring and install the (A) first/second shift rail.



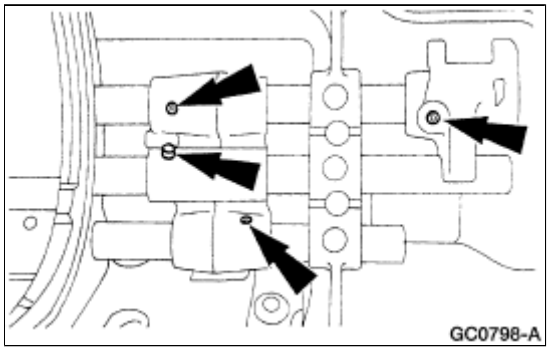
6. Position the (B) fifth/reverse shift control, the (C) detent ball and spring and the (D) shift gate and install the (A) fifth/reverse shift rail.



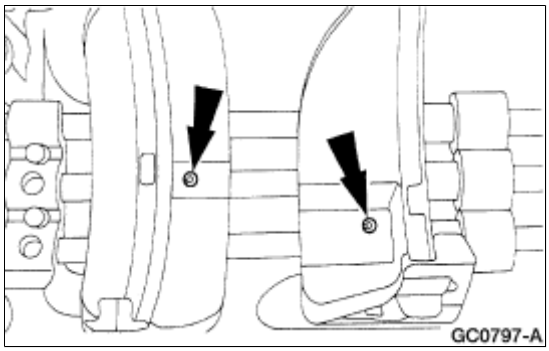
7. Install the three rubber service bore plugs.



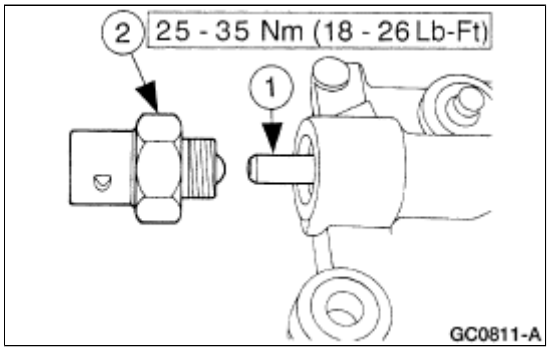
8. Install the pins.



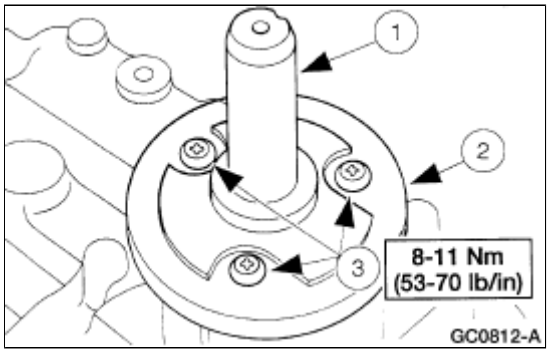
9. Install the two new shift fork spring pins.



10. Install the backup lamp switch.
    1. Install the backup lamp switch pin.
    2. Install the backup lamp switch.



11. Install the lower gearshift lever.
    1. Position the gearshift lever.
    2. Position the dust cover.
    3. Install the bolts.



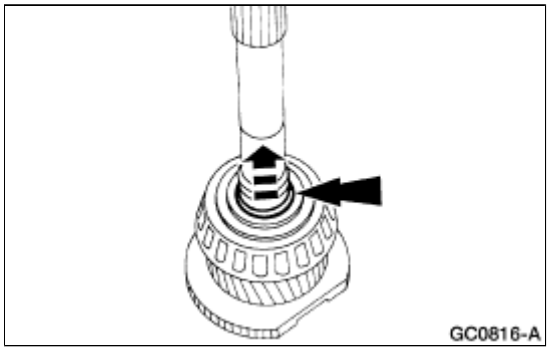
Input Shaft and Bearing

Special Tool(s)

ST1310-A	Pinion Bearing Cone Remover 205-055 (T71P-4621-B)
ST1752-A	1988 Ford Tool Set 308-S167 (T88T-7025-S)

Disassembly

1. Inspect the input shaft bearing.
2. Remove and discard the front bearing oil scoop ring (7046).

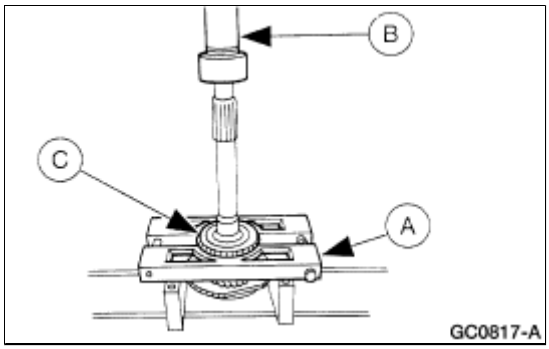

GC0816-A

3. **CAUTION: Use of essential tools may cause damage to the bearings being removed.**

   CAUTION: Hold the input shaft (7015) so it does not fall.

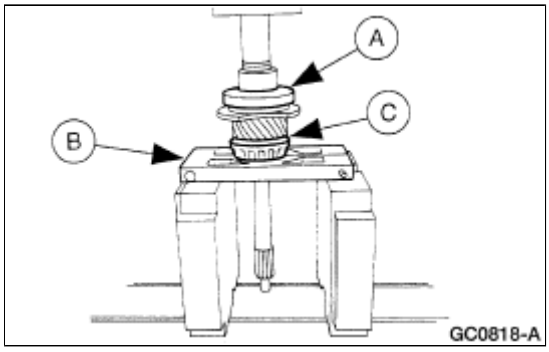
   NOTE: Only remove the bearing if replacement is necessary.

   Use (A) Bearing Cone Remover and an (B) arbor press to remove the (C) bearing.

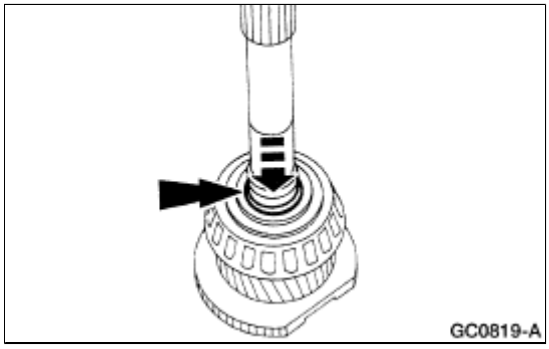


Assembly

1. Use (A) Bearing Cone Replacer, (B) Bearing Cone Remover, and an arbor press to install the (C) bearing.

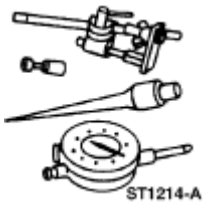


2. Install the front bearing oil scoop ring.
    - A click should be felt as the scoop ring notches align with the input shaft oil holes.



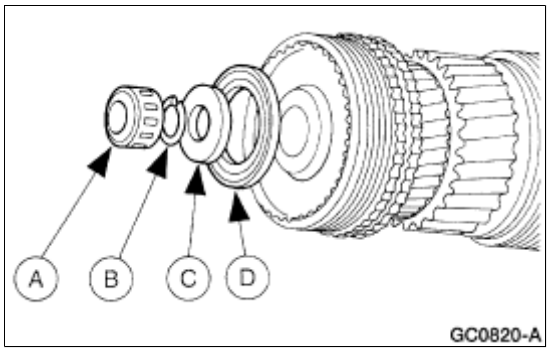
Output Shaft

Special Tool(s)

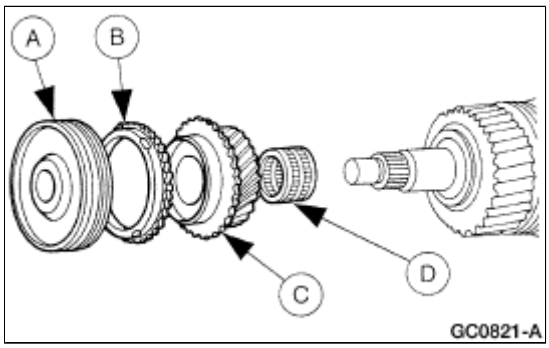
ST1254-A	Axle Bearing/Seal Plate 205-090 (T75L-1165-B)
	Bearing Cone Replacer 308-169 (T88T-7025-B)
ST1308-A	Pinion Bearing Replacer 205-004 (T53T-4621-B)
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent
ST1303-A	Remover/Replacer Tube 308-024 (T75L-7025-B)

Disassembly

1. Remove the (A) transmission input shaft pilot bearing (7118), the (B) bearing outer snap ring (7030), the (C) third and fourth synchronizer spacer (7N112) and the (D) thrust bearing (7C096).

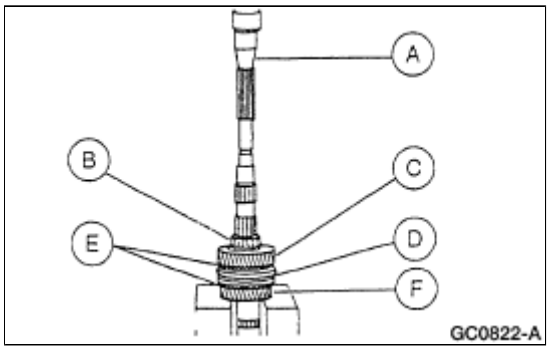


2. Remove the (A) third/fourth synchronizer (7124), the (B) third gear synchronizer blocking ring (7107), the (C) third gear and the (D) gear bearing (7127).



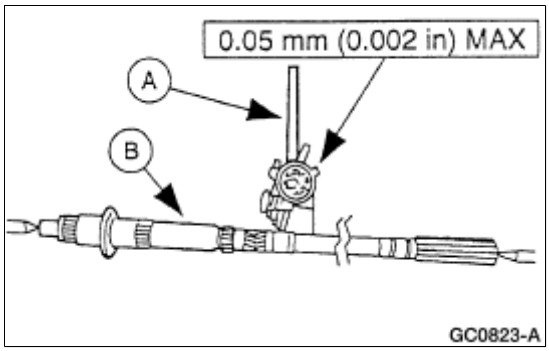
3. **CAUTION: Make sure that the output shaft flange does not contact or ride up onto the press cradle. Improper positioning can result in component damage.**

   Use an (A) arbor press to remove the (B) output shaft center bearing (3C123), the (C) first gear, the (D) first/second synchronizer, the (E) first/second synchronizer blocking rings, and the (F) second gear.

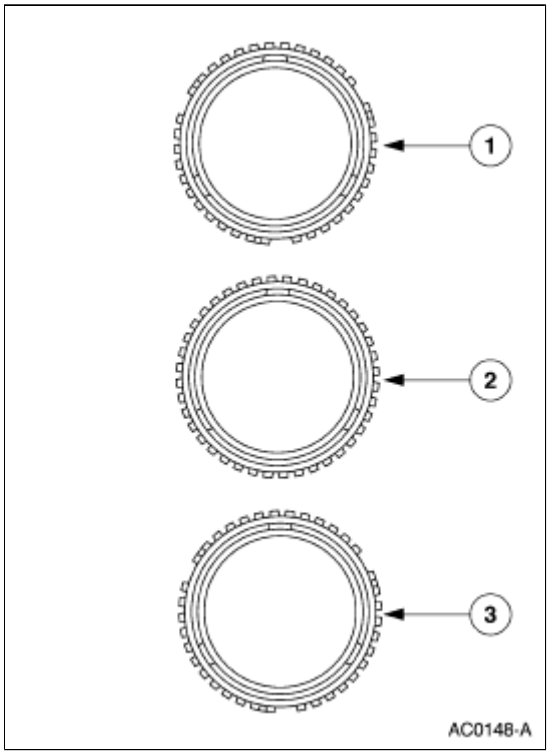


Assembly

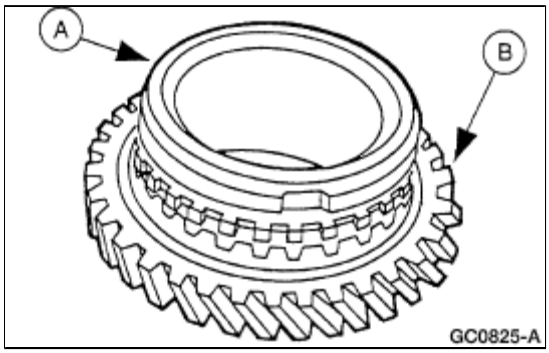
1. Use (A) Dial Indicator with Bracketry to check the (B) output shaft runout.
   - Check runout in several places along the output shaft. If runout exceeds specification, replace the shaft.



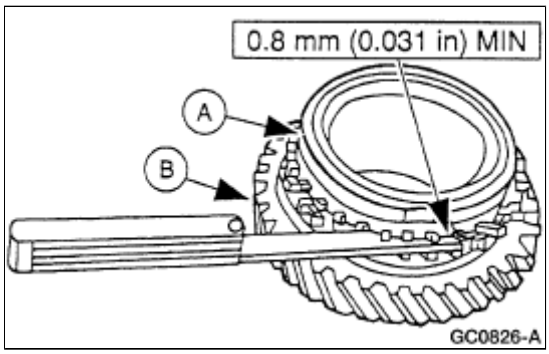
2. Identify the synchronizer blocking ring.
    1. Brass - third gear synchronizer blocking ring.
    2. Brass - first and fourth gear synchronizer blocking ring.
    3. Carbon - second gear synchronizer blocking ring.



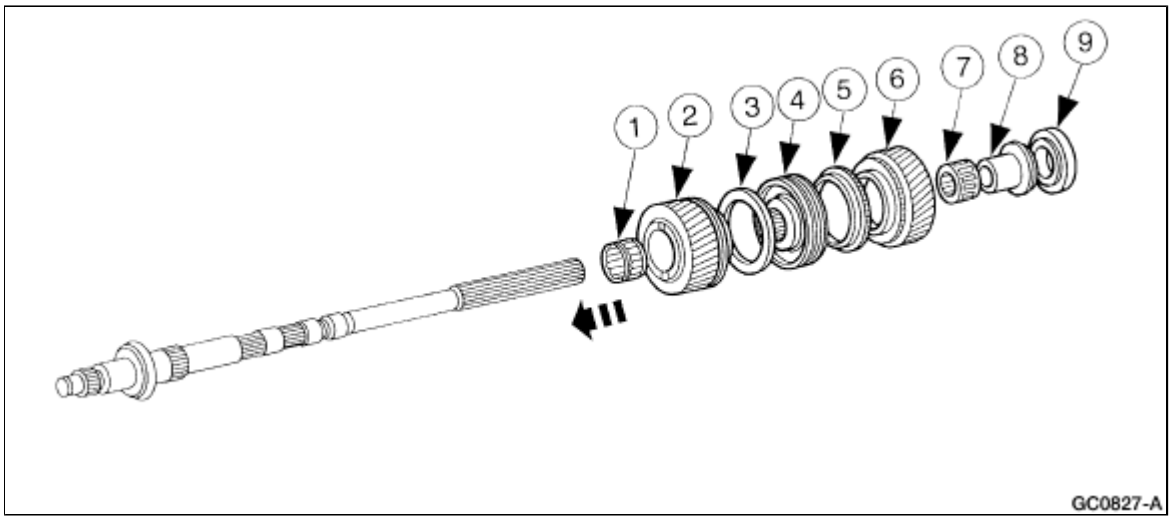
3. Inspect the (A) synchronizer blocking rings for proper contact with the (B) cone surface of the gears.



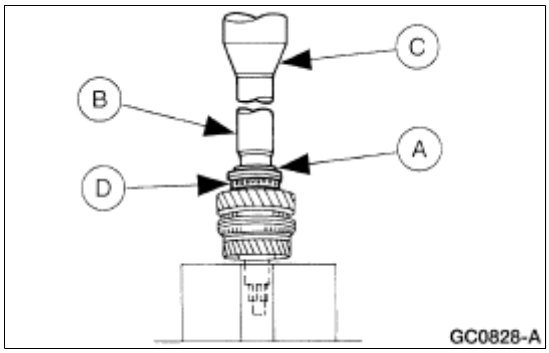
4. Inspect the (A) synchronizer blocking rings for wear on the (B) gear.
    - If clearance is less than specification, replace the ring or gear.



5. Assemble the first and second gear assembly.
    1. Install the second gear needle bearing.
    2. Install the second gear (2GR) (7102).
    3. Install the second synchronizer blocking ring.
    4. Install the first/second synchronizer with the identification hole in the sleeve facing first gear.
    5. Install the first gear synchronizer blocking ring.
    6. Install the first gear (1GR) (7100).
    7. Install the first gear needle bearing.
    8. Install the input bearing spacer.
    9. Position the output shaft center bearing.

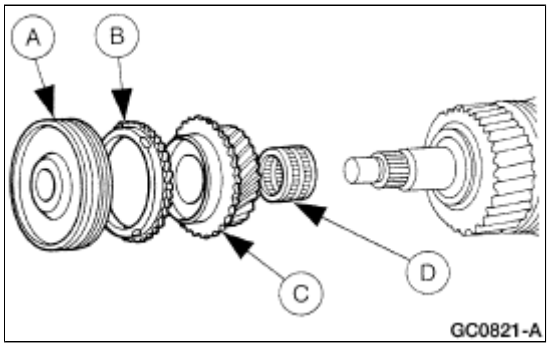


6. Use (A) Bearing Replacer, (B) Remover/Replacer Tube, and an (C) arbor press to press the (D) center bearing into place.

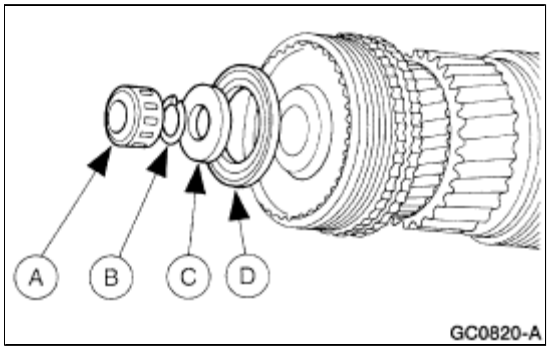


7. **NOTE:** Install the third/fourth synchronizer with the chamfer on the sleeve facing fourth gear.

   Install the (D) third gear bearing, the (C) third gear (3GR) (7B340), the (B) third gear synchronizer blocking ring, and the (A) third/fourth synchronizer.



8. Install the (D) thrust bearing, the (C) third and fourth synchronizer spacer, the (B) bearing outer snap ring, and the (A) transmission input shaft pilot bearing.

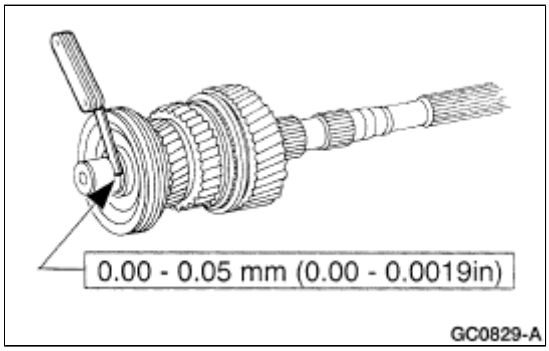


9. Check the third/fourth clutch hub end play.
   - If clearance is not within specification, select the proper bearing outer snap ring.

Bearing Outer Snap Ring Select Chart

Part Number	Thickness
E8TZ-7030-A	1.50 mm (0.0590 in)
E8TZ-7030-B	1.55 mm (0.0610 in)
E8TZ-7030-C	1.60 mm (0.0629 in)

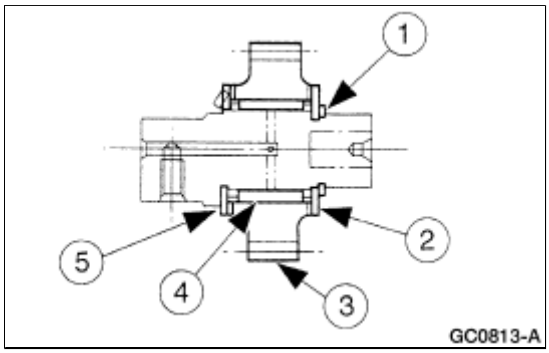
E8TZ-7030-D	1.65 mm (0.0649 in)
E8TZ-7030-E	1.70 mm (0.0669 in)
E8TZ-7030-F	1.75 mm (0.0688 in)
E8TZ-7030-G	1.80 mm (0.0708 in)
E8TZ-7030-H	1.85 mm (0.0728 in)
E8TZ-7030-J	1.90 mm (0.0748 in)
E8TZ-7030-K	1.95 mm (0.0767 in)



Reverse Idler Gear

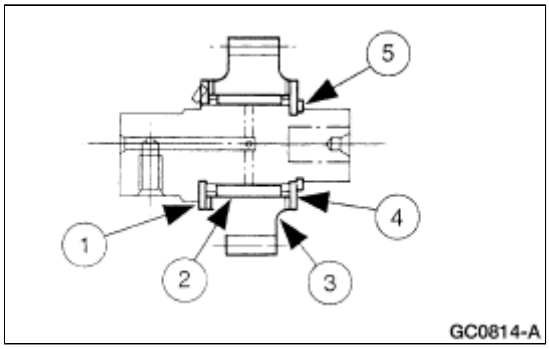
Disassembly

1. Disassemble the reverse idler gear.
    1. Remove the reverse idler gear retaining ring (7156).
    2. Remove the spacer.
    3. Remove the reverse idler gear and bushing (7141).
    4. Remove the reverse idler gear bearing (7E139).
    5. Remove the reverse idler gear thrust washer (7N037).



Assembly

1. Assemble the reverse idler gear.
    1. Install the reverse idler gear thrust washer.
    2. Install the reverse idler gear bearing.
    3. Install the reverse idler gear and bushing.
    4. Install the spacer.
    5. Install the drive belt (8620).



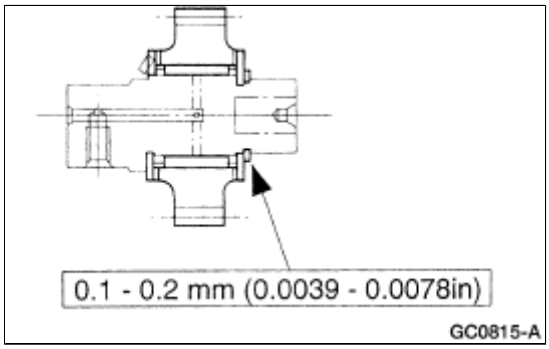
2. Measure the reverse idler gear end play.

Reverse Idler Gear Retaining Rings

Part Number	Thickness
E8TZ-7156-A	1.5 mm (0.0590 in)

E8TZ-7156-G	1.6 mm (0.0629 in)
E8TZ-7156-H	1.7 mm (0.0669 in)
E8TZ-7156-J	1.8 mm (0.0708 in)
E8TZ-7156-K	1.9 mm (0.0748 in)

- If end play is not within specification, install a retaining ring of proper thickness.

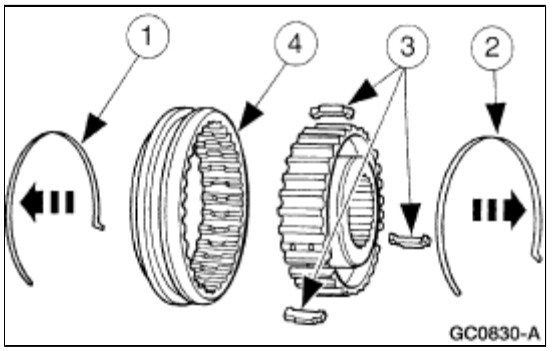


Synchronizers

Disassembly

1. **NOTE:** Mark parts for assembly.

   Disassemble the synchronizer.
   1. Remove one retaining spring.
   2. Flip the synchronizer over and remove the opposite retaining spring.
   3. Remove the three insert keys.
   4. Remove the sleeve.

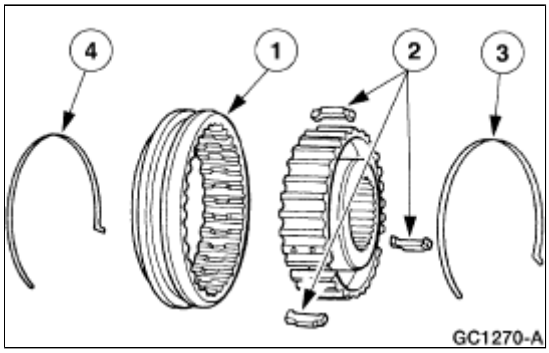


2. Inspect all the synchronizer components for wear and damage.

Assembly

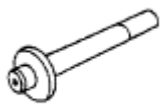
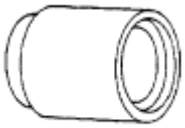
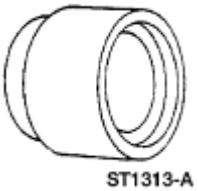
1. **NOTE:** Match the marked parts for assembly.

   Assemble the synchronizer.
   1. Install the sleeve.
   2. Install the insert keys.
   3. Install the retaining spring.
   4. Flip the synchronizer over and install the opposite retaining spring.



Transmission

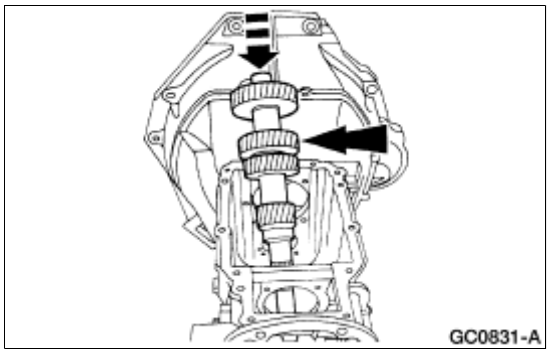
Special Tool(s)

 ST1316-A	Bell Housing Seal Replacer 308-057 (T77J-7025-G)
ST1302-A	Countershaft Locknut Staking Tool 308-056 (T77J-7025-F)
ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A) or equivalent
ST1188-A	Extension Housing Seal Replacer 308-002 (T61L-7657-A)
 ST1312-A	Gear Replacing Spacer 308-173 (T88T-7025-F)
 ST1313-A	Gear Replacing Spacer 308-174 (T88T-7025-G)
ST1583-A	Mainshaft Locknut Wrench 308-168 (T88T-7025-AR)

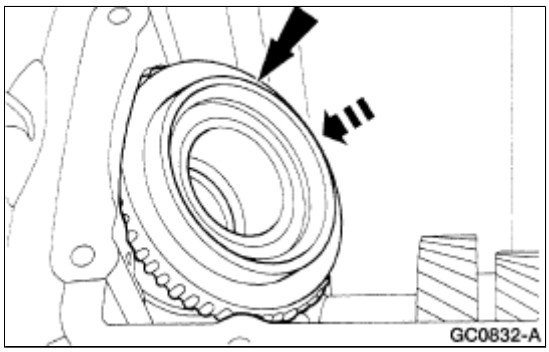
ST1752-A	Mount Transmission Ford Tool Set 308-S167 (T88T-7025-S)
ST1303-A	Remover/Replacer Tube 308-024 (T75L-7025-B)
ST1307-A	Remover/Replacer Tube 308-098 (T85T-7025-A)
ST1317-A	Shaft Adapter - Replacing 308-032 (T75L-7025-L)
ST1314-A	Shaft Collar 308-035 (T75L-7025-P)
ST1314-A	Shaft Collar (4x4 Only) 308-033 (T75L-7025-M)
ST1315-A	Shaft Sleeve Replacer 308-031 (T75L-7025-K)

Assembly

1. Install the countershaft cluster gear (7113).

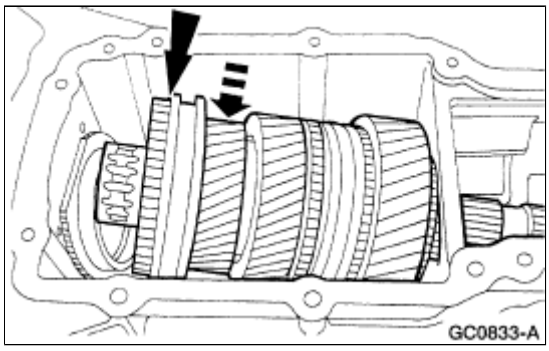


2. Position the input shaft (7015).



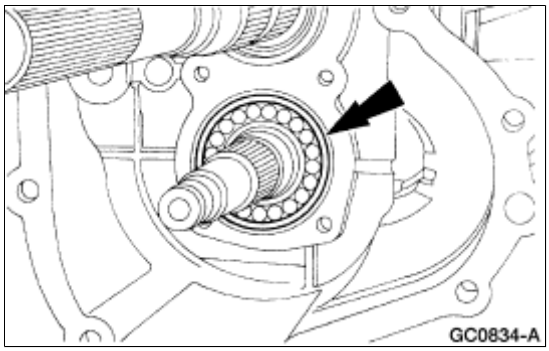
3. **NOTE:** Make sure the fourth gear synchronizer blocking ring is in place.

   Install the output shaft (7060).

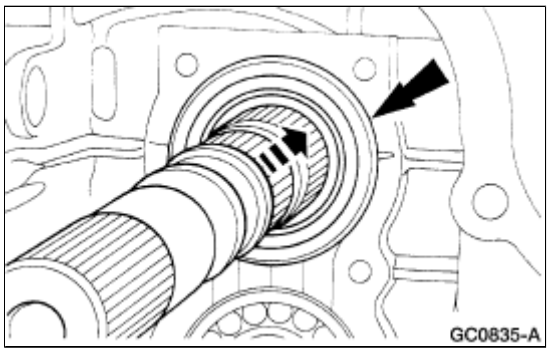


4. Mate the input shaft and output shaft together.

5. Install the countershaft pilot bearing (7121).

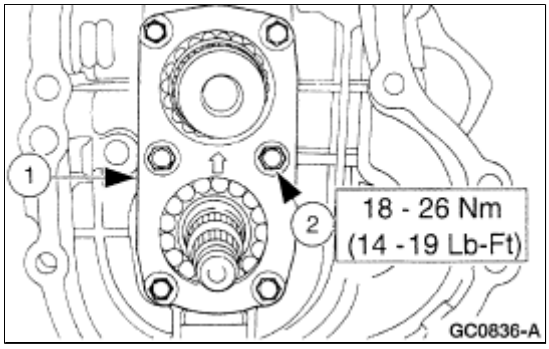


6. Install the output shaft rear bearing (7R205).



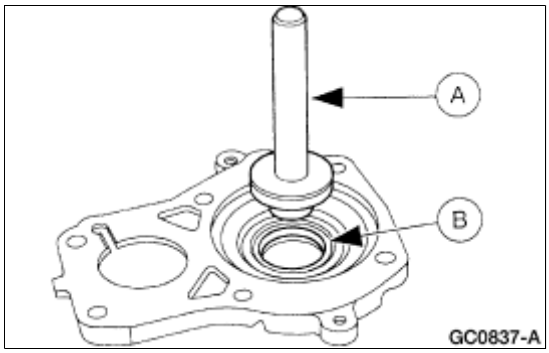
7. **NOTE:** Install the rear bearing retainer (3C610) with the arrow pointing to the top of the case (7005) .

   Install the rear bearing retainer.
   1. Position the rear bearing retainer.
   2. Install the bolts.



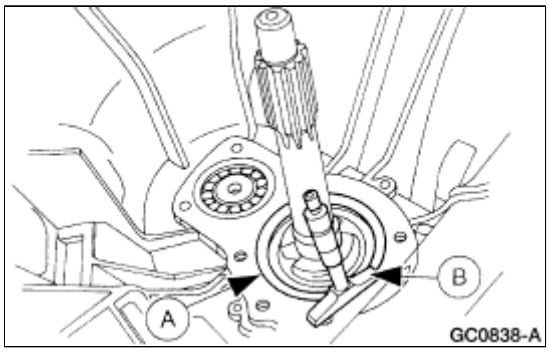
8. **NOTE:** If any related parts (such as the output shaft and bearings) have been replaced, perform the shim thickness selective procedure.

   Use (A) Bell Housing Seal Replacer to install the (B) front cover oil baffle.

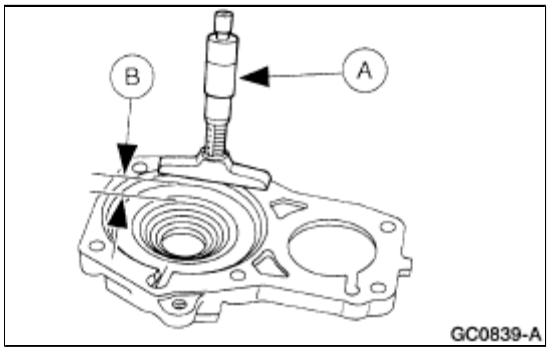


9. Position the transmission with the bell housing facing up.

10. Use (B) Depth Micrometer to measure dimension (A) input shaft bearing race depth.
    - Record dimension (A) on line 2 of the selective shim equation chart.



11. Use (A) Depth Micrometer to measure dimension (B) front bearing retainer depth.
    - Record dimension (B) on line 1 of the selective shim equation chart.



12. Select the proper output shaft shim.

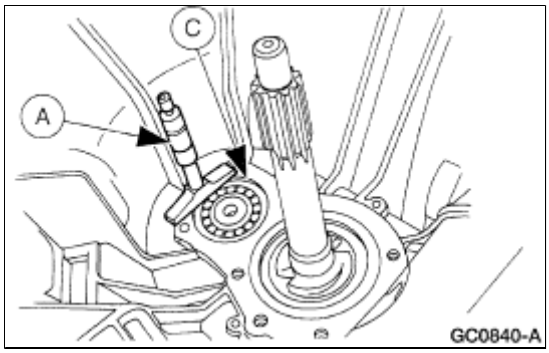
Selective Shim Equation Chart

Step	Measurement mm (in)
Line 1 (Dimension B)	
Line 2 (Dimension A)	
Line 3 (Subtract line 2 from line 1)	

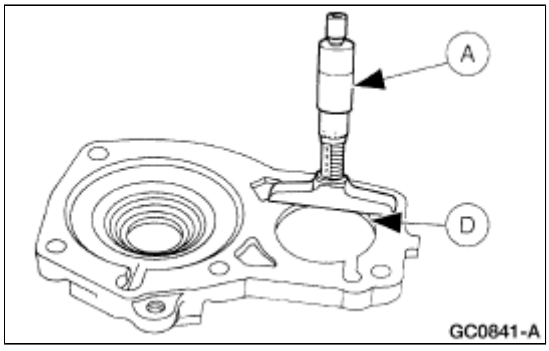
Output Shaft Shim Selective Chart

Total From Line 3 mm (in)	Part Number	Thickness mm (in)
2.75-2.85 (0.108-0.112)	E8TZ-7029-C	2.7 (0.106)
2.85-2.95 (0.112-0.116)	E8TZ-7029-D	2.8 (0.110)
2.95-3.05 (0.116-0.120)	E8TZ-7029-E	2.9 (0.114)
3.05-3.15 (0.120-0.124)	E8TZ-7029-F	3.0 (0.118)
3.15-3.25 (0.124-0.127)	E8TZ-7029-G	3.1 (0.122)
3.25-3.35 (0.127-0.131)	E8TZ-7029-H	3.2 (0.125)
3.35-3.45 (0.131-0.135)	E8TZ-7029-J	3.3 (0.129)
3.45-3.55 (0.135-0.139)	E8TZ-7029-K	3.4 (0.133)
3.55-3.65 (0.139-0.143)	E8TZ-7029-L	3.5 (0.137)
3.65-3.75 (0.143-0.147)	E8TZ-7029-M	3.6 (0.141)
3.75-3.85 (0.147-0.151)	E8TZ-7029-N	3.7 (0.145)
3.85-3.95 (0.151-0.155)	E8TZ-7029-P	3.8 (0.149)
3.95-4.05 (0.155-0.159)	E8TZ-7029-R	3.9 (0.153)
4.05-4.15 (0.159-0.163)	E8TZ-7029-A	4.0 (0.157)
4.15-4.25 (0.163-0.167)	E8TZ-7029-B	4.1 (0.161)

13. Use (A) Depth Micrometer to measure dimension (C) countershaft bearing.
    - Record dimension (C) on line 1 of the countershaft spacer equation chart.



14. Use (A) Depth Micrometer to measure dimension (D) countershaft bearing retainer depth.
    - Record dimension (D) on line 2 of the countershaft spacer equation chart.



15. Select the proper countershaft spacer.

Countershaft Spacer Equation Chart

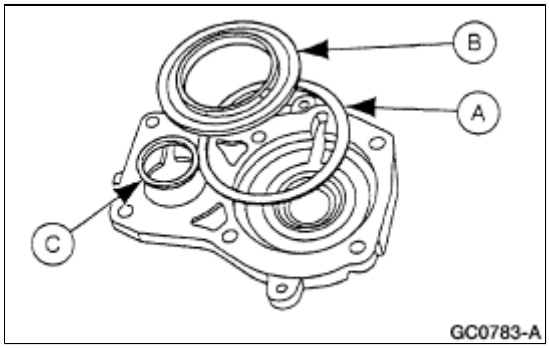
Step	Measurement mm (in)
Line 1 (Dimension C)	
Line 2 (Dimension D)	
Line 3 (subtract line 2 from line 1)	

Countershaft Spacer Selective Chart

Total From Line 3 mm (in)	Part Number	Thickness mm (in)
2.45-2.55 (0.096-0.100)	E8TZ-7C434-A	2.3 (0.090)
2.55-2.65 (0.100-0.104)	E8TZ-7C434-B	2.4 (0.094)
2.65-2.75 (0.104-0.108)	E8TZ-7C434-C	2.5 (0.098)
2.75-2.85 (0.108-0.112)	E8TZ-7C434-D	2.6 (0.102)
2.85-2.95 (0.112-0.116)	E8TZ-7C434-E	2.7 (0.106)
2.95-3.05 (0.116-0.120)	E8TZ-7C434-F	2.8 (0.110)
3.05-3.15 (0.120-0.124)	E8TZ-7C434-G	2.9 (0.114)
3.15-3.25 (0.124-0.128)	E8TZ-7C434-H	3.0 (0.118)
3.25-3.35 (0.127-0.131)	E8TZ-7C434-J	3.1 (0.122)

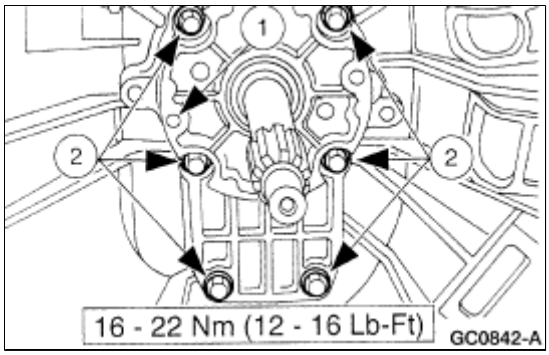
16. **NOTE:** If necessary, apply a light coat of grease to the countershaft spacer, shim and fluid baffle.

Position the (A) bearing shim, the (B) fluid baffle, and the (C) countershaft spacer onto the front bearing retainer.

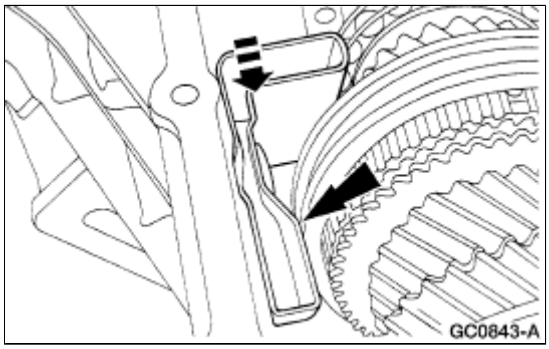


17. **NOTE:** To prevent damage to the fluid seal lip during assembly, tape the input shaft splines.

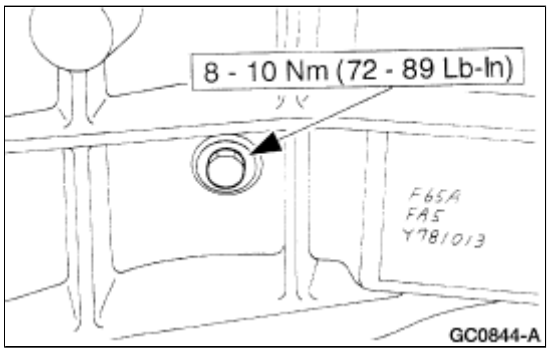
Install the front bearing retainer.
1. Position the front bearing retainer.
2. Install the bolts.



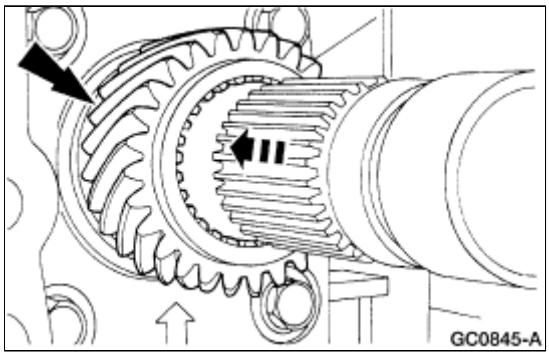
18. Position the fluid passage.



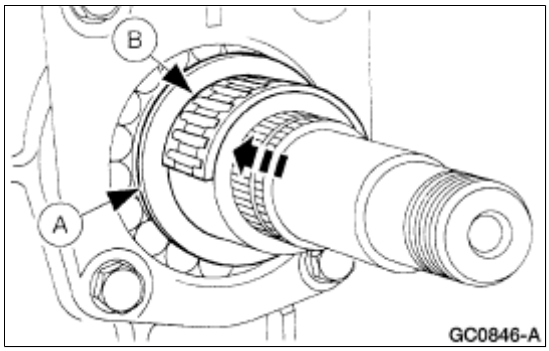
19. Install the fluid passage bolt.



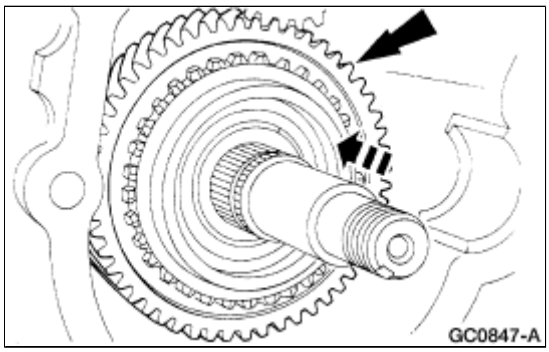
20. Install the output shaft fourth gear (4GR) (7112).



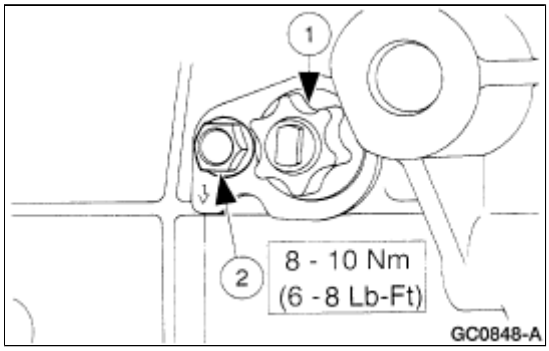
21. Install the (A) race and the (B) fifth speed gear split bearing on the countershaft.



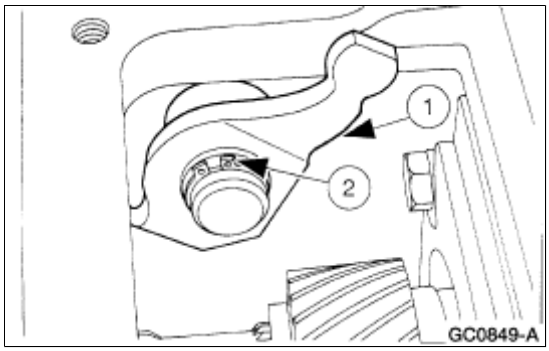
22. Install the countershaft fifth speed gear (7K316).



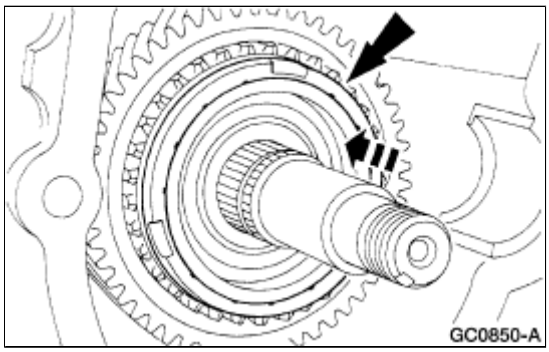
23. Install the counter lever shaft assembly.
    1. Position the counter lever shaft and plate.
    2. Install the counter lever shaft bolt.



24. Install the 5th reverse shift lever.
    1. Position the 5th reverse shift lever.
    2. Install the 5th reverse shift retaining ring.

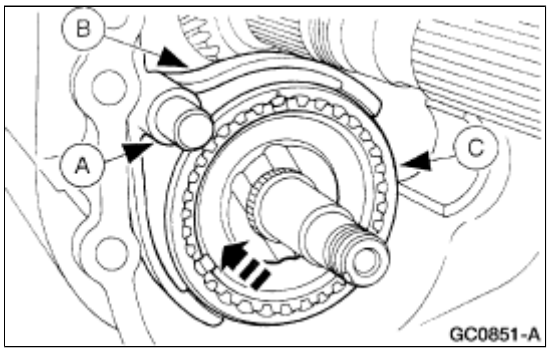


25. Install the countershaft fifth gear synchronizer blocking ring (7107).

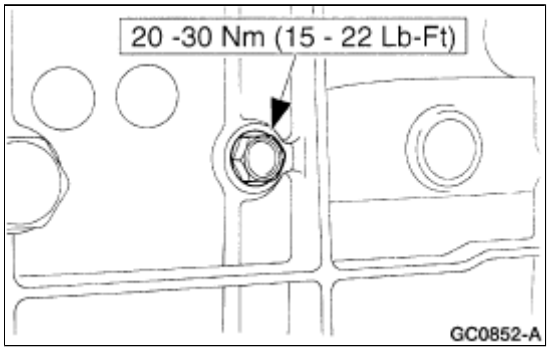


26. **NOTE:** The reference mark on the synchronizer sleeve must face toward the reverse gear.

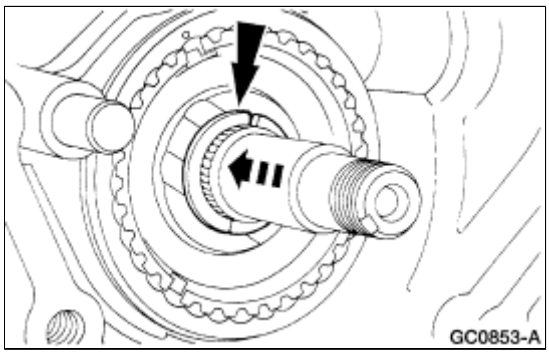
    Install the (A) fifth/reverse shift rail, the (B) shift fork, and the (C) synchronizer.



27. Install the fifth/reverse shift rail bolt.



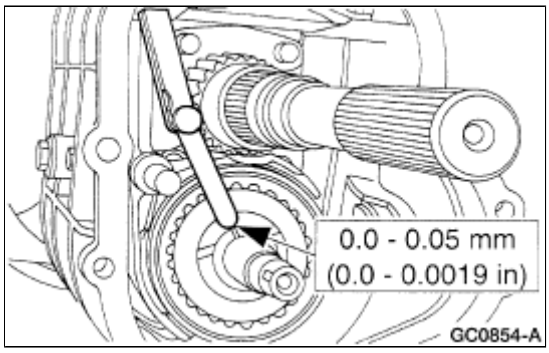
28. Install the synchronizer split washer (7R482).



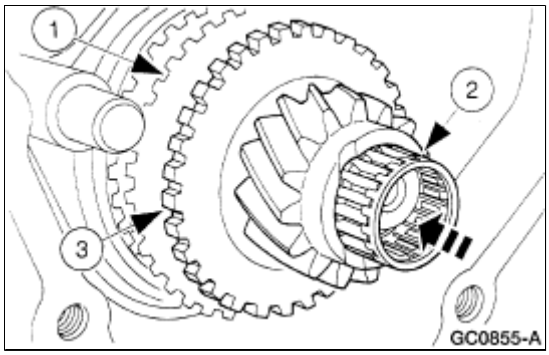
29. Check clutch hub end play.
    - If clutch hub end play is not within specification, select and install the correct split washer.

Spilt Washer Select Chart

Part Number	Thickness mm (in)
E8TZ-7R482-A	3.0 (0.118)
E8TZ-7R482-B	3.1 (0.122)
E8TZ-7R482-C	3.2 (0.125)
E8TZ-7R482-D	3.3 (0.129)
E8TZ-7R482-E	3.4 (0.133)
E8TZ-7R482-F	3.05 (0.120)
E8TZ-7R482-G	3.15 (0.124)
E8TZ-7R482-H	3.25 (0.127)
E8TZ-7R482-J	3.35 (0.131)
E8TZ-7R482-K	3.45 (0.135)
E8TZ-7R482-L	3.50 (0.137)



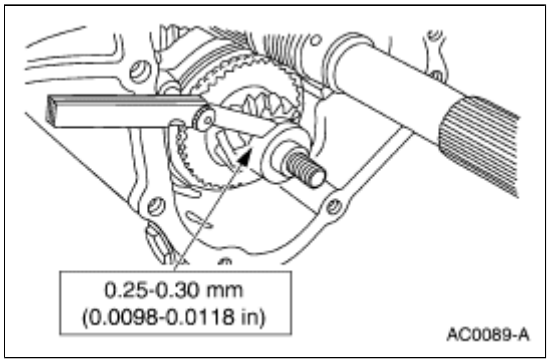
30. Install the countershaft reverse gear (7N040).
    1. Install the countershaft reverse gear.
    2. Install the two countershaft reverse gear bearings (7N270).
    3. Install the reverse synchronizer blocking ring.



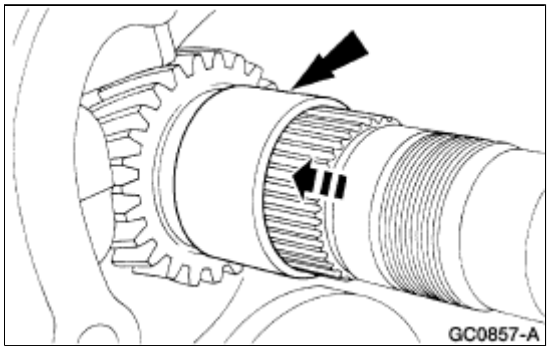
31. Measure the countershaft reverse gear end play.
    - Install the thrust washer and hold it against the shoulder on the countershaft while checking the end play.
    - Determine the correct thrust washer to obtain the correct end play.

Thrust Washer Select Chart

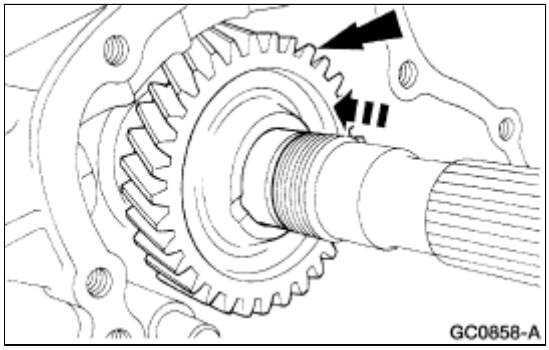
Part Number	Thickness mm (in)
E8TZ-7C340-A	7.45 (0.293)
E8TZ-7C340-B	7.65 (0.301)
E8TZ-7C340-C	7.85 (0.309)
E8TZ-7C340-D	7.35 (0.289)
E8TZ-7C340-E	7.55 (0.297)
E8TZ-7C340-F	7.75 (0.305)



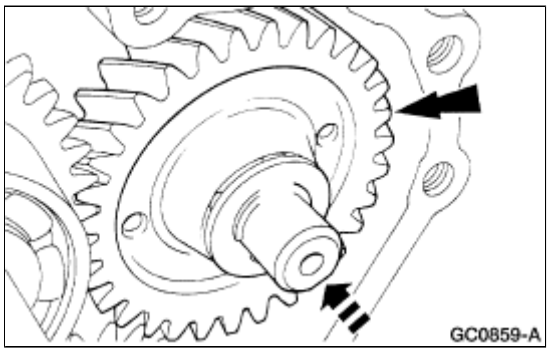
32. Install the output shaft spacer.



33. Install the output shaft reverse gear.

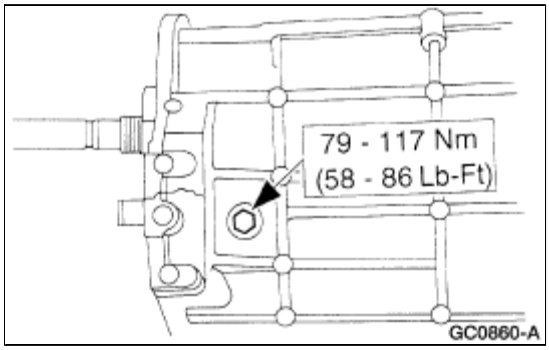


34. Install the reverse idler gear and bushing (7141).

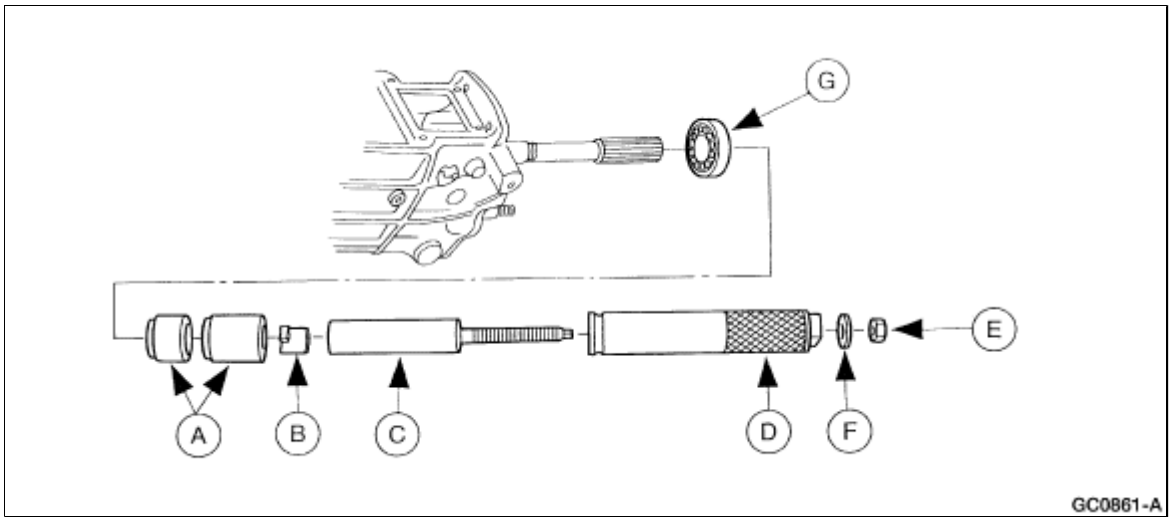


35. **NOTE:** Reverse idler shaft bolt must be installed within four minutes after applying silicone.

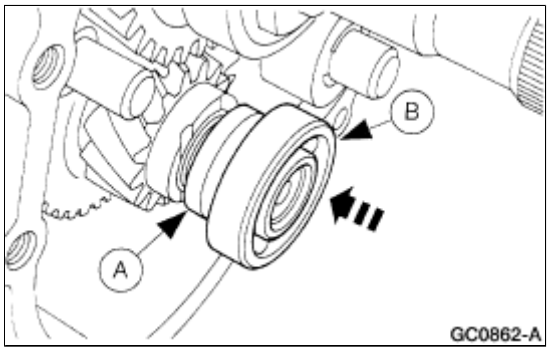
    Apply Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A to reverse idler shaft bolt threads and install the reverse idler shaft bolt.



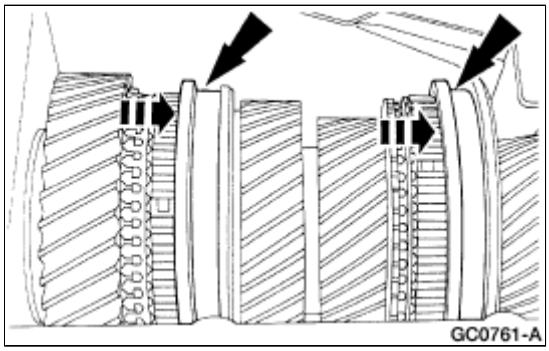
36. Use (A) Gear Replacing Spacer, (B) Shaft Collar, (C) Shaft Sleeve Replacer, (D) Remover/Replacer Tube, (E) nut and (F) washer to install the (G) output shaft rear bearing.



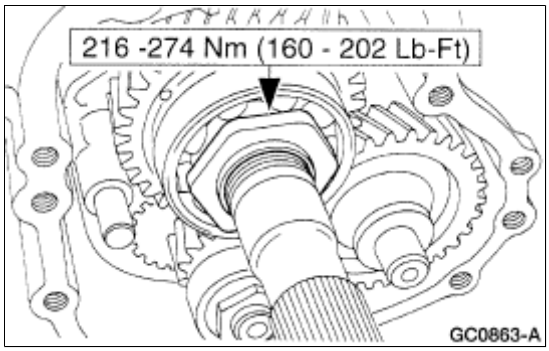
37. Install the (A) thrust washer and (B) countershaft rear bearing (7D283).



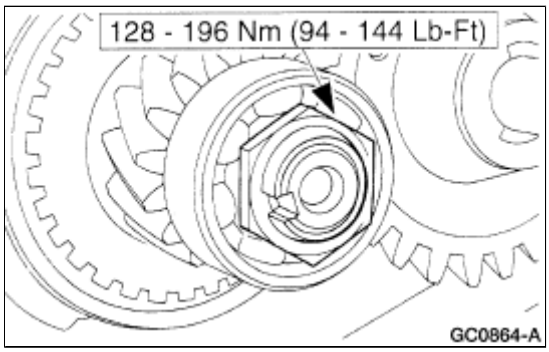
38. Lock the transmission into first and third gear.



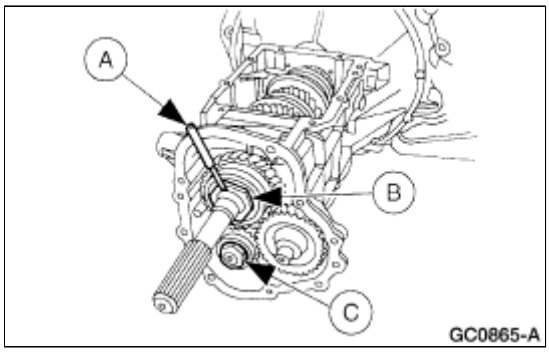
39. Use Mainshaft Locknut Wrench to install a new output shaft rear bearing lock nut (7B364).



40. Install a new countershaft locknut.



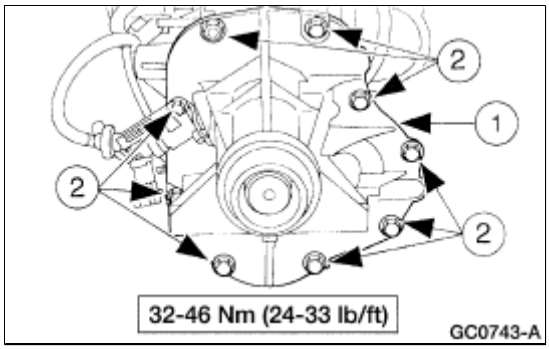
41. Use (A) Countershaft Locknut Staking Tool to stake the (B) output shaft rear bearing lock nut and the (C) countershaft locknut.



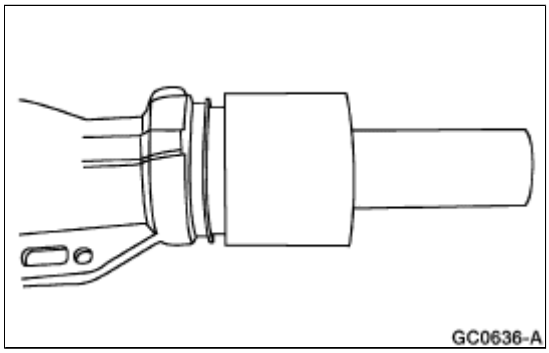
42. **NOTE:** Extension housing must be installed within four minutes after applying silicone.

    Apply a small bead of Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A to the extension housing mating surface.

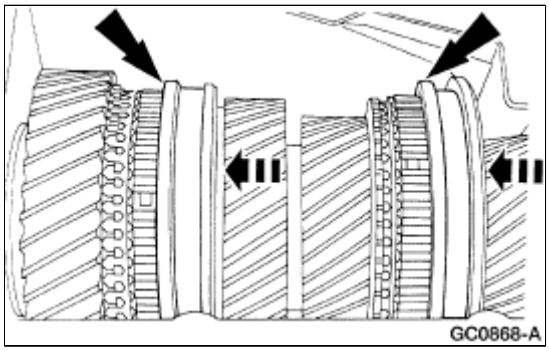
43. Install the extension housing (7A039).
    1. Position the extension housing.
    2. Install the bolts.



44. Use Extension Housing Seal Replacer to install the extension housing seal.



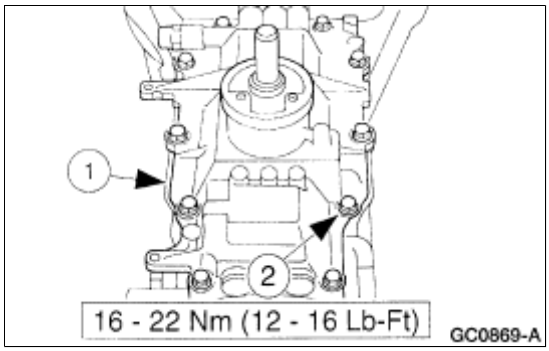
45. Place the synchronizer sleeves in neutral.



46. **NOTE:** Case cover must be installed within four minutes after applying silicone.

    Apply a small bead of Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A to the case cover mating surface.

47. Install the case cover (7222).
    1. Position the case cover.
    2. Install the bolts.

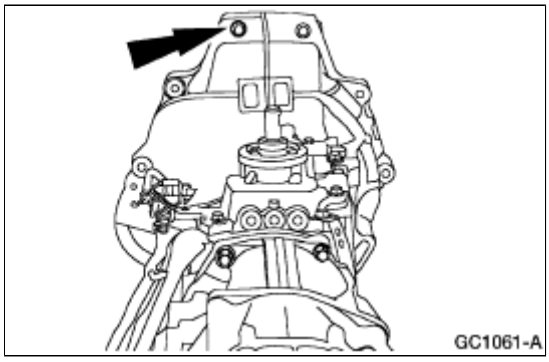

1
2
16 - 22 Nm (12 - 16 Lb-Ft)
GC0869-A

Transmission

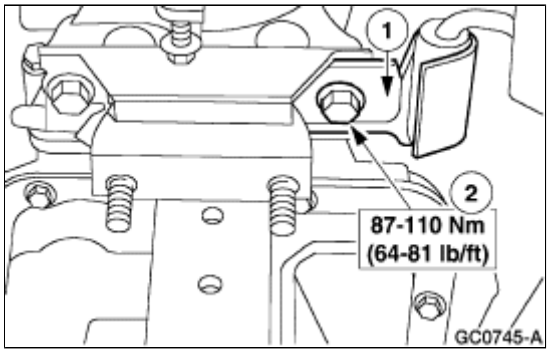
Special Tool(s)

ST1927-A	Hi-Lift Transmission Jack 164-R3508 or equivalent

1. Position the transmission onto a Hi-Lift Jack.
2. Raise and position the transmission.
3. Install the nine transmission to engine bolts.

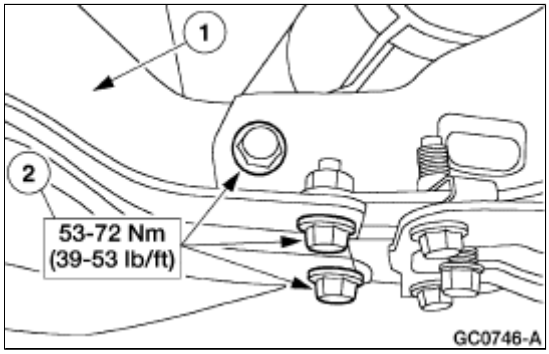


4. Install the exhaust inlet crossover pipe; refer to Section 309-00 .
5. Install the (RH) transmission mount bolt.
    1. Position the exhaust bracket.
    2. Install the bolt.

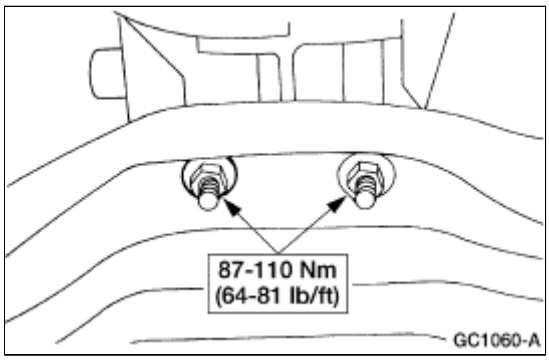


6. Install the rear crossmember.
    1. Position the crossmember.

2. Install the six bolts (three each side).



7. Install the nuts.



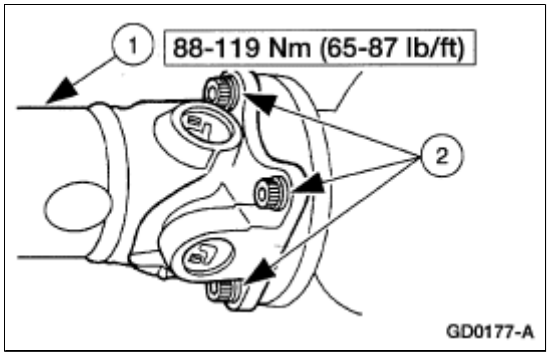
8. Remove the Hi-Lift Jack.

9. Install the starter motor (11001); refer to Section 303-06 .

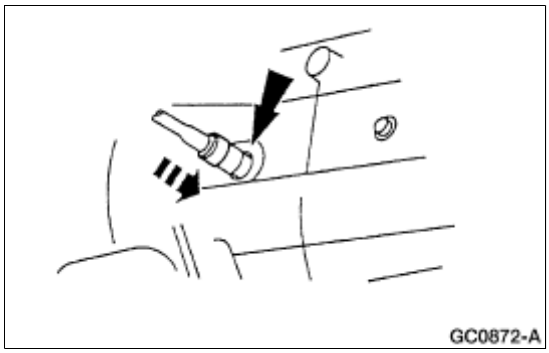
10. On 4-wheel drive vehicles, install the transfer case; refer to Section 308-07B .

11. **NOTE:** To maintain initial driveshaft balance, align marks on the rear driveshaft yoke and axle flange made during removal.

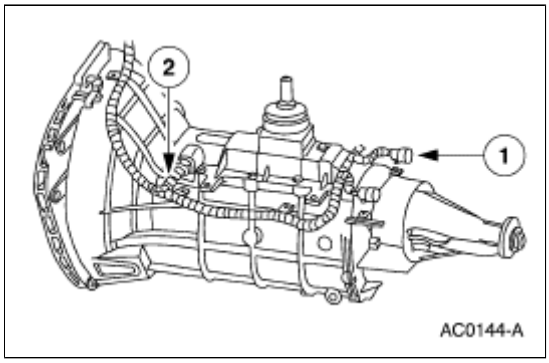
    Install the rear driveshaft.
    1. Position the rear driveshaft.
    2. Install the four bolts.



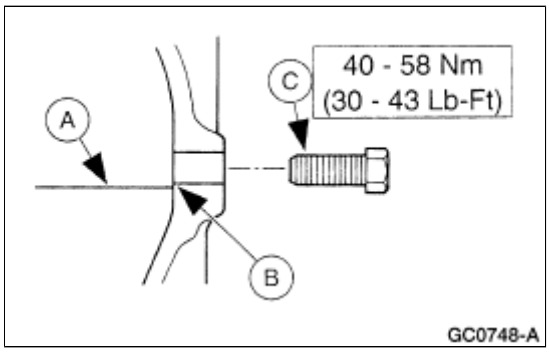
12. Connect the hydraulic clutch line.



13. Reconnect the transmission wiring harness.
    1. Connect the heated oxygen sensor (HO2S) connector.
    2. Connect the backup lamp switch connector.



14. Fill the transmission with (A) transmission fluid until it reaches the bottom of the (B) fill port and install the (C) case plug (7A010).
    - Use MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX or equivalent MERCON® automatic transmission fluid.



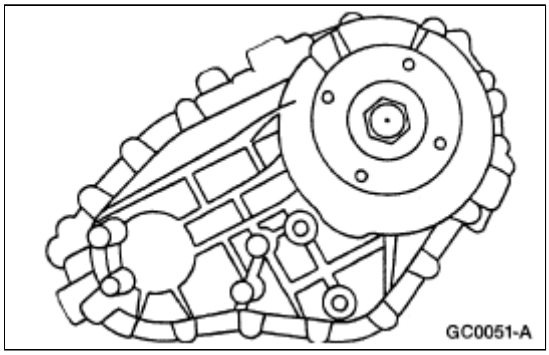
15. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Lower the vehicle.

16. Install the gear shift lever; refer to Shift Lever and Boot in this section.

17. Connect the battery ground cable (14301).

Transfer Case —All-Wheel Drive (AWD)

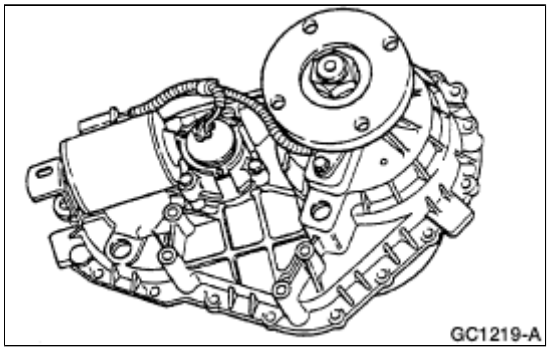


The all-wheel drive transfer case is a two-piece aluminum, chain driven, viscous clutch type unit. This produces a system in which all-wheel drive is always activated. The all-wheel drive transfer case is automatic and has no external controls.

The viscous clutch is a torque distribution device. It is non-repairable. The internal construction of the viscous clutch consists of alternating plates that are connected to the front and rear outputs of the transfer case. The viscous clutch is filled with a high viscosity fluid which flows through slots in the plates. The resistance to shear causes the plates to transmit torque at the needed ratio. The ratio that torque is transmitted at is approximately 35% front and 65% rear.

Torque is transmitted through the input shaft to the planet carrier assembly. Torque flow continues through the gear ring to the rear output shaft. Torque also flows from the planet carrier assembly to the sun gear shaft, which is splined to the drive sprocket. The drive gear is connected to the driven sprocket by the drive chain. Torque continues through the driven sprocket to the front output shaft flange. The viscous clutch provides the connection between the gear ring and the sun gear shaft.

Transfer Case —Automatic Four Wheel Drive (A4WD)



The A4WD system is an electronic shift 4x4 system that allows the operator to choose between three different 4x4 modes. The operator can switch between A4WD and 4WD HIGH modes at any speed. To engage or disengage LOW range, the vehicle speed must be less than 5 km/h, the brake depressed, and the transmission must be in NEUTRAL.

The front/rear driveshaft speed sensors (Hall effect) are mounted to the transfer case and detect the speed of the front and rear driveshafts. This input is used by the generic electronic module (GEM) primarily to control A4WD operation.

The throttle position output signal is provided to the GEM from the powertrain control module (PCM). This signal is used by the GEM in controlling the A4WD clutch.

The shift motor sense plate, an integral part of the electric shift motor, informs the GEM to the position of the transfer case.

The digital TR sensors are located on the LH side of the transmission; these sensors inform the GEM when the transmission is in the neutral position.

The electric shift motor is mounted externally at the rear of the transfer case. It drives a rotary cam which moves the mode fork and range fork within the transfer case between the HIGH range (A4WD, 4HIGH) and LOW range positions.

The 4x4 shift motor uses a module containing two relays which, under the control of the GEM, shifts the transfer case shift motor between HIGH range (A4WD, 4HIGH), and 4LOW modes.

The solid state clutch relay is used to activate the A4WD clutch within the transfer case.

System Function

Hall effect sensor monitors input and output shaft speed.

In the A4WD (C-Trac) system, the GEM varies the torque sent to the front driveline by controlling the transfer case clutch. At rest and under cruising conditions, the GEM activates the transfer case clutch a minimum duty cycle (percentage of time the clutch is turned on), which allows for the slight difference between the front and rear driveshafts which normally occurs when negotiating a corner on dry pavement. Under any of the following conditions, the GEM will increase the duty cycle in order to prevent or control slip:

- Slip is detected (by using the Hall Effect Sensors)
- Heavy acceleration (throttle position).

Feature inputs:

- Brake ON/OFF switch.
- 4WD mode switch.
- Digital transmission range sensor.
- Clutch switch (manual transmission vehicles only).
- Vehicle speed signal (transmitted from the ABS module).
- Front/rear driveshaft speed sensors.
- Throttle position information from the PCM.
- Contact plate position inputs A, B, C, D.

Feature outputs:

- Solid state clutch relay (pulse width modulated signal: grounded when relay is on, battery potential when relay is off).
- A4WD indicator (ground when activated, open circuit when deactivated).
- 4x4 shift motor relay outputs.

Shifts between A4WD and 4x4 HIGH can be made at any speed. Listed below are the inputs and outputs needed by the GEM to execute a change between any of these modes.

Feature inputs:

- Front/rear driveshaft speed sensor.
- Vehicle speed signal.
- Throttle position information.
- 4WD mode switch.

Feature outputs:

- Solid state clutch relay (pulse width modulated signal; grounded when relay is on, battery potential when relay is off).
- 4x4 HIGH cluster indicator (ground when activated, open circuit when deactivated).

When shifting into or out of LOW range, the GEM requires that the vehicle speed is less than 5 km/h (3 mph), the brake is applied, and the transmission is in NEUTRAL.

Feature inputs:

- Throttle position information.
- 4WD mode switch.
- Contact plate position inputs A, B, C, D.
- Vehicle speed signal (transmitted from ABS module).
- Brake ON/OFF switch input (battery voltage when brake is depressed, open circuit when not activated).
- Digital transmission range sensor (ground when transmission is in NEUTRAL, open circuit otherwise).
- Start/clutch depressed input (manual transmission only).

Feature outputs:

- 4x4 shift motor relay outputs.
- 4LOW cluster indicators (ground when activated, open circuit when deactivated).
- Solid state clutch relay (pulse width modulated signal; grounded when relay is on, battery potential when relay is off).

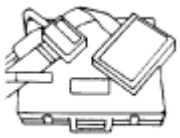
Transfer Case

Refer to Wiring Diagrams Cell 34 , Electric Shift Control for schematic and connector information.

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell 62 , Instrument Cluster for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter 418-F082 (105-R00051) or equivalent
 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950) or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Inspection and Verification — AWD

NOTE: If the area of concern is indicated to be other than the transfer case, refer to the specific section or sections of the appropriate shop manual.

1. **NOTE:** Owner driving habits as well as road and weather conditions should be noted.

   Road test the vehicle to verify the concern, noting the road speed, engine speed, and speed range where the vehicle problem is evident.

2. Raise the vehicle on the hoist and position suitable safety floor stands under the vehicle.

3. Run the vehicle at the road speed where the concern exists. Verify concern area:
   - Engine.
   - Transmission.
   - Front/rear driveline components.
   - Front/rear drive axles.

- Front/rear brake systems.
- Front/rear wheels and/or tires.
- Transfer case.

4. Refer to the appropriate owner guide for operating data, if the concern is verified to be driveline or torsional windup, before repairing the transfer case.

5. Check tires and vehicle load if the problem is clearly driveline windup and not broken parts.

6. If the concern is not visually evident, refer to Symptom Chart — AWD.

Symptom Chart — AWD

Symptom Chart

Condition	Possible Sources	Action
• Transfer Case Makes Noise	• Tire inflation pressure. • Tire and wheel size.	• ENSURE that all tires and wheels are the same size and that inflation pressures are correct.
	• Tire tread wear.	• CHECK tire tread wear to see if there is more than 0.15 mm (0.06 in) difference in tread wear between front and rear. INTERCHANGE one front wheel and one rear wheel.
	• Internal components.	• OPERATE vehicle in all transmission gears. If there in noise in transmission in Neutral gear or in some gears and not in others, REMOVE and REPAIR transmission. REFER to Section 307-01A . If there is noise in all gears, DISASSEMBLE transfer case. REFER to Section 308-07C . CHECK input gear and intermediate and front output shaft gear for damage. REPLACE as required. REFER to Section 307-01A .
	• Lubricant level.	• FILL with MERCON V® Multi-Purpose Automatic Transmission Fluid XT-5QM or equivalent MERCON approved fluid.
• Wheel/Tire Bounce, Vehicle Skip	• Internal components.	• OPERATE vehicle in all transmission gears. If there in noise in transmission in Neutral gear, or in some gears and not in others, REMOVE and REPAIR transmission. REFER to Section 307-01A . If there is noise in all gears, DISASSEMBLE transfer case. REFER to Section 308-07C . CHECK input gear and intermediate and front output shaft gear for damage. REPLACE as required. REFER to Section 307-01A .
	• Tire tread wear.	• MAKE SURE that all tires and wheels are the same size and that inflation pressures are correct.
• Leaking (ATF) From Vent	• Transfer case.	• DRAIN lubricant to proper level.

	• Vent tube.	• REPAIR or REPLACE the vent tube. REFER to Section 308-07C .
• Leaking (ATF) From Transfer Case Housing	• Transfer case housing bolts.	• TIGHTEN bolts to specification. REFER to Section 308-07C .
	• Sealant.	• REBUILD with Black Non-Acid Cure Silicone Rubber E7TZ-19562-A or equivalent.
	• Lubricant.	• DRAIN lubricant and FILL with MERCON V® Multi-Purpose Automatic Transmission Fluid XT-5QM or equivalent MERCON approved fluid.
	• Transfer case gasket.	• REPLACE transfer case gasket. REFER to Section 308-07C .
• Leaking (ATF) Output Shaft Seals	• Vent is plugged.	• REPAIR plugged vent. REFER to Section 308-07C .
	• Output shaft seals.	• REPLACE leaking output shaft seal. REFER to Section 308-07C .

Inspection and Verification — A4WD

1. Verify the customer concern by operating the A4WD.

2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connector(s) • Lamp(s) • Circuitry

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is properly installed.
   2. check battery voltage.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for generic electronic module (GEM), go to Pinpoint Test D.

- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the GEM.

6. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart — A4WD to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Deck Lid Switch Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 .
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .

B1352	Ignition Key-In — Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 .
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 .
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window LF One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window LF One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window LF Down Circuit Failure	GEM	REFER to Section 501-11 .
B1405	Power Window LF Down Short Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window LF Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay Coil Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .

B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delay Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	GO to Pinpoint Test B .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	GO to Pinpoint Test B .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Wiper Rear Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into

			the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size and axle ratio. TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
B2105	Throttle Position Input Out of Range Low	GEM	GO to Pinpoint Test A .
B2106	Throttle Position Input Out of Range High	GEM	GO to Pinpoint Test A .
P0500	Vehicle Speed Signal Circuit Failure	GEM	GO to Pinpoint Test B .
P1763	Transmission Neutral In Tow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral In Tow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	GO to Pinpoint Test C .
P1806	4WD High Indicator Short to Battery	GEM	GO to Pinpoint Test C .
P1808	4WD Low Indicator Circuit Failure	GEM	GO to Pinpoint Test C .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	GO to Pinpoint Test C .
P1812	4WD Mode Select Circuit Failure	GEM	GO to Symptom Chart.
P1815	4WD Mode Select Short Circuit to Ground	GEM	GO to Symptom Chart.
P1820	Transfer Case CW Shift Relay Coil Circuit Open or Short to Ground	GEM	GO to Pinpoint Test B .
P1822	Transfer Case CW Shift Relay Coil Short to Battery	GEM	GO to Pinpoint Test B .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	GO to Pinpoint Test A .
P1826	4WD Electric Clutch Relay Short to Battery	GEM	GO to Pinpoint Test A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	GO to Pinpoint Test B .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	GO to Pinpoint Test B .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	GO to Symptom Chart.
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	GO to Symptom Chart.
P1838	Transfer Case Shift Motor Circuit Failure	GEM	GO to Pinpoint Test B .

P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	GO to Pinpoint Test B .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	GO to Pinpoint Test B .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure (GEM Only)	GEM	GO to Pinpoint Test B .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure (GEM Only)	GEM	GO to Pinpoint Test B .
P1866	Transfer Case Maintenance Required (GEM Only) (4-wheel drive operation can be restored by clearing the DTC and cycling the ignition.)	GEM	GO to Pinpoint Test B .
P1867	Transfer Case Contact Plate General Circuit Failure (GEM Only)	GEM	GO to Pinpoint Test B .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	GO to Symptom Chart.
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery (GEM Only)	GEM	GO to Symptom Chart.
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	GO to Pinpoint Test B .

GEM/CTM Parameter Identification (PID) Index

NOTE: Depending on the level of scan tool software, the VSS_GEM PID could show units in MPH, but the actual value is in KPH. If the PID is off by a factor of 1.6, the PID is giving speed in KPH. This concern is normal.

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 MPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Left Front Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_Door, R_Door, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Right Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G

VBATGEM	Battery Voltage	0.0 VDC - 16.0 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, OFFO-G, ON-B-
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
TPI	Throttle Position Input (TPI) Status	0-250 Counts
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	0-38%
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 MPH
TRA_FSP	Front Shaft Speed (GEM Only)	0-255 MPH
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	LF Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments (0-63.75 AMPS)
D_PWPK	LF Power Window Regulator Electric Drive Peak	0.25 amp increments (0-63.75 AMPS)

	Current (GEM Only)	
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	PLATE PWR	ON, OFF

4-WHEEL ELECTRONIC SHIFT (GEM only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM only)	UP RELAY	ON, OFF
REAR WIPER (GEM only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

Symptom Chart — A4WD

Symptom Chart

Condition	Possible Sources	Action
• The Vehicle Does Not Operate Properly in AUTO and 4WD HIGH Modes	• Circuitry. • Mode switch. • Speed sensors. • Transfer case electric clutch. • Transfer case mechanism. • GEM. • PCM. • DTC B2105. • DTC B2106. • DTC P1812. • DTC P1815. • DTC P1824. • DTC P1826. • DTC P1836. • DTC P1837. • DTC P1874. • DTC P1875. • DTC P0500.	• GO to Pinpoint Test A .
• The Vehicle Does Not Shift Between A4WD/4WD HIGH and 4WD LOW Modes Properly but Operates Properly in Auto Mode	• Circuitry. • Mode switch. • Contact plate sensors A, B, C and/or D. • Transfer case shift motor. • Transfer case shift relay. • Transfer case mechanism. • GEM. • Digital TR sensor. • Neutral safety switch. • Speed sensors. • Brake pedal position (BPP) switch.	• GO to Pinpoint Test B .

	• 4WABS control module. • DTC B1483. • DTC B1485. • DTC P1812. • DTC P1815. • DTC P1820. • DTC P1822. • DTC P1828. • DTC P1830. • DTC P1836. • DTC P1837. • DTC P1838. • DTC P1846. • DTC P1850. • DTC P1854. • DTC P1858. • DTC P1866. • DTC P1867. • DTC P1874. • DTC P1875. • DTC P1891 • DTC P0500.	
• The 4x4 or 4x4 LOW Range Indicator Does Not Operate Properly	• Circuitry. • Lamp. • Instrument Cluster. • GEM. • DTC P1804. • DTC P1806. • DTC P1808. • DTC P1810.	• GO to Pinpoint Test C .
• No Communication With the Module — Generic Electronic Module	• Circuitry. • Fuses. • GEM. • GEM connectors.	• GO to Pinpoint Test D .

Pinpoint Tests

CAUTION: Before removing and installing the GEM or its connectors, disconnect the battery. Failure to follow this caution will result in GEM storing many erroneous DTCs and it may exhibit erratic operation after installation.

CAUTION: Be careful when probing the fuse junction panel, power distribution box or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

CAUTION: Electronic modules are sensitive to electrostatic charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when performing the pinpoint tests, and intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: Complete the entire pinpoint test related to the symptom before replacing the GEM.

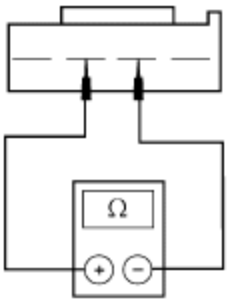
PINPOINT TEST A: THE VEHICLE DOES NOT OPERATE PROPERLY IN AUTO AND 4WD HIGH MODES

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch pedal when turning the ignition switch to START. Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to A2 . → **No** REFER to Section 417-02 .
A2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES	
1 2 Clear Continuous DTCs 3	1 Retrieve and document continuous DTCs.

 GEM On-Demand Self-Test	• **Are any DTCs recorded?** → **Yes** If DTC B1398 is retrieved with P1824, REFER to Section 501-11 . REPAIR DTC B1398 first, then TEST the system for normal operation. If DTC B1371, B1302, B1398, B1814, or B1818, REFER to the GEM/CTM Diagnostic Trouble Code (DTC) Index to diagnose first. If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. If DTC B2105, GO to A41 . If DTC B2106, GO to A41 . If DTC P1812, GO to A5 . If DTC P1815, GO to A5 . If DTC P1824, GO to A19 . If DTC P1826, GO to A19 . If DTC P1836, GO to A31 . If DTC P1837, GO to A31 . If DTC P1874, GO to A31 . If DTC P1875, GO to A31 . If DTC P0500, GO to A31 . → **No** GO to A3 .
A3 CHECK THE 4X4 HIGH LAMP INDICATOR — TRIGGER THE GEM ACTIVE COMMAND HIGH LAMP	
1 	1 Trigger the GEM active command HIGH LAMP ON then OFF. • **Does the 4x4 HIGH indicator illuminate then go off?**

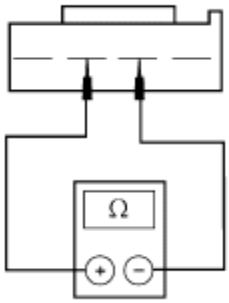
	→ **Yes** GO to A4 . → **No** GO to Pinpoint Test C .
A4 CHECK THE 4X4 LOW LAMP INDICATOR — TRIGGER THE GEM ACTIVE COMMAND LOW LAMP	
1 	1 Trigger the GEM active command LOW LAMP ON then OFF. • **Does the 4x4 LOW indicator illuminate then go off?** → **Yes** GO to A5 . → **No** GO to Pinpoint Test C .
A5 CHECK THE 4WD MODE SWITCH IN THE AUTO POSITION — MONITOR THE GEM PID 4WD_SW	
1 2 GC1174-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the AUTO position. • **Does the GEM PID 4WD_SW indicate AUTO?** → **Yes** GO to A6 . → **No** GO to A8 .
A6 CHECK THE 4WD MODE SWITCH IN THE 4WD HIGH POSITION — MONITOR THE GEM PID 4WD_SW	

1 2 GC1175-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the 4WD HIGH position. • **Does the GEM PID 4WD_SW indicate 4WD HIGH?** → **Yes** GO to A7 . → **No** GO to A8 .
A7 CHECK THE 4WD MODE SWITCH IN THE 4WD LOW POSITION — MONITOR THE GEM PID 4WD_SW	
1 2 GC1176-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the 4WD LOW position. • **Does the GEM PID 4WD_SW indicate 4WD LOW?** → **Yes** GO to A17 . → **No**

	GO to A8 .
A8 CHECK THE 4WD MODE SWITCH IN THE AUTO POSITION	
1 2 4WD Mode Switch C279 3 GC1174-A 4  GC1123-A	3 Place the 4WD mode switch in the AUTO position. 4 Measure the resistance between 4WD mode switch terminals 2 and 3. • **Is the resistance between 3700 and 4100 ohms?** → **Yes** GO to A9 . → **No** REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.
A9 CHECK THE 4WD MODE SWITCH IN THE 4WD HIGH POSITION	
1	1 Place the 4WD mode switch in the 4WD HIGH position.

GC1175-A

2



GC1123-A

2 Measure the resistance between 4WD mode switch terminals 2 and 3.

- **Is the resistance between 1050 and 1150 ohms?**

→ **Yes**
GO to A10 .

→ **No**
REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.

A10 CHECK THE 4WD MODE SWITCH IN THE 4WD LOW POSITION

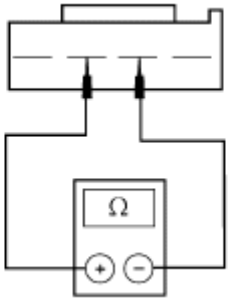
1

GC1176-A

1 Place the 4WD mode switch in the 4WD LOW position.

2

2 Measure the resistance between 4WD mode switch terminals 2 and 3.



GC1123-A

- **Is the resistance between 340 and 380 ohms?**

→ **Yes**
GO to A11 .

→ **No**
REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.

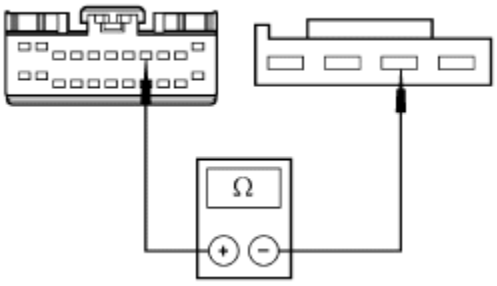
A11 CHECK CIRCUIT 465 (W/LB) FOR OPEN

1

2

GEM C282

3



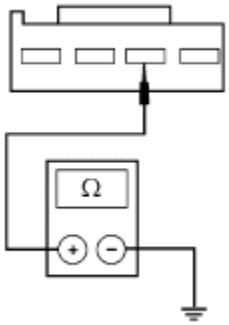
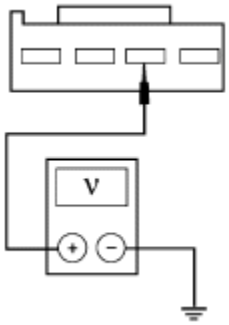
GC1556-A

3 Measure the resistance between 4WD mode switch C279-3, circuit 465 (W/LB), and GEM C282-8, circuit 465 (W/LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to A12 .

→ **No**
REPAIR circuit 465 (W/LB). CLEAR the DTCs.

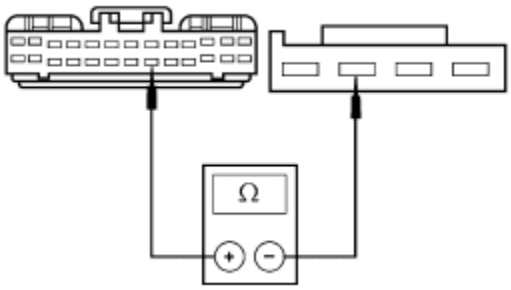
	TEST the system for normal operation.
A12 CHECK CIRCUIT 465 (W/LB) FOR SHORT TO GROUND	
1  GC1098-A	1 Measure the resistance between 4WD mode switch C279-3, circuit 465 (W/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to A13 . → **No** REPAIR circuit 465 (W/LB). CLEAR the DTCs. TEST system for normal operation.
A13 CHECK CIRCUIT 465 (W/LB) FOR SHORT TO POWER	
1 2  GC1099-A	2 Measure the voltage between 4WD mode switch C279-3, circuit 465 (W/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 465 (W/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A14 .
A14 CHECK CIRCUIT 359 (GY/R) FOR OPEN	

1

2

GEM C280

3



GC1632-A

3 Measure the resistance between 4WD mode switch C279-2, circuit 359 (GY/R), and GEM C280-21, circuit 359 (GY/R).

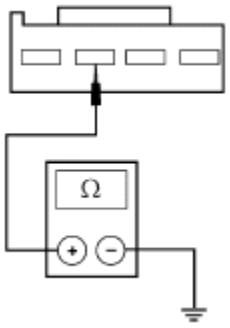
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to A15 .

→ **No**
REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.

A15 CHECK CIRCUIT 359 (GY/R) FOR SHORT TO GROUND

1



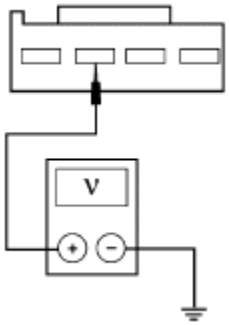
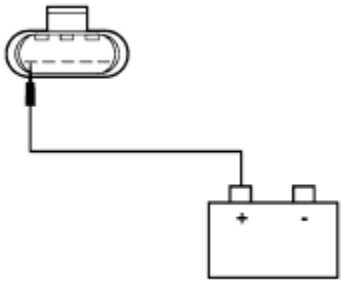
GC1102-A

1 Measure the resistance between 4WD mode switch C279-2, circuit 359 (GY/R), and ground.

- **Is the resistance greater than 10,000 ohms?**

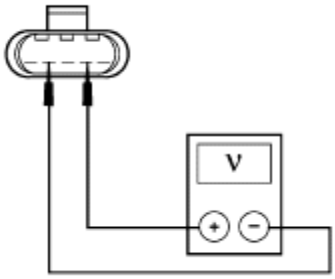
→ **Yes**
GO to A16 .

→ **No**

	REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST system for normal operation.
A16 CHECK CIRCUIT 359 (GY/R) FOR SHORT TO POWER	
1 2  GC1101-A	2 Measure the voltage between 4WD mode switch C279-2, circuit 359 (GY/R), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
A17 CHECK THE SOLID STATE CLUTCH RELAY	
1 Solid State Clutch Relay C274 2  GC1874-A 3	2 Connect a jumper wire between battery positive terminal and solid state clutch relay terminal 1. 3 Connect a jumper wire between solid state clutch relay terminal 2 and ground.

GC1559-A

4



GC1560-A

4 Measure the voltage between solid state clutch relay terminals 4 and 2.

- **Is the voltage 0 volts?**

→ **Yes**
GO to A18 .

→ **No**
REPLACE the solid state clutch relay. CLEAR the DTCs. TEST the system for normal operation.

A18 CHECK THE SOLID STATE CLUTCH RELAY SWITCH MODE

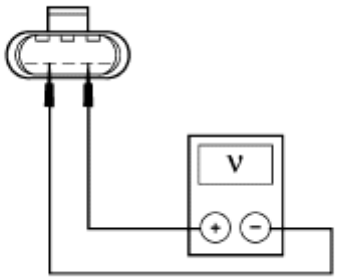
1

GC1561-A

2

1 Connect a jumper wire between solid state clutch relay terminal 3 and ground.

2 Measure the voltage between solid state clutch relay terminals 2 and 4.



- **Is the voltage greater than 10 volts?**

→ **Yes**
RECONNECT the solid state clutch relay, GO to A19 .

→ **No**
REPLACE the solid state clutch relay. CLEAR the DTCs. TEST the system for normal operation.

A19 CHECK THE SOLID STATE CLUTCH RELAY COIL CIRCUIT — MONITOR THE GEM PID 4WDCLST

1

2

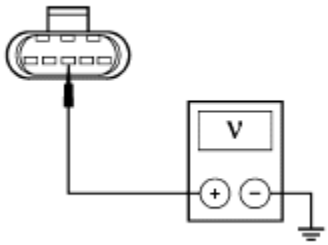
3

1 Place the 4WD mode switch in the 4WD HIGH position.

3 Monitor the GEM PID 4WDCLST.

- **Does the GEM PID 4WDCLST indicate ON---, OFF---?**

→ **Yes**
GO to A24 .

	→ **No** If the GEM PID 4WDCLST indicates ON-B-, GO to A20 . If the GEM PID 4WDCLST indicates OFFO-G, GO to A21 .
A20 CHECK CIRCUIT 275 (Y) FOR SHORT TO POWER	
1 2 Solid State Clutch Relay C274 3 GEM C282 4 5  GC1562-A	5 Measure the voltage between solid state clutch relay C274-3, circuit 275 (Y), and ground.
	• **Is any voltage indicated?** → **Yes** REPAIR circuit 275 (Y). CLEAR the DTCs. TEST the system for normal operation. → **No** RECONNECT system. RETRIEVE DTCs. TEST the system for normal operation. If the system is still inoperative, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

A21 CHECK CIRCUIT 400 (LB/BK) FOR VOLTAGE

1

2

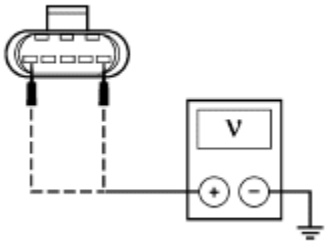
Solid State Clutch Relay C274

3

4

4 Trigger the GEM active command ACCY RLY to ON.

5



GC1563-A

5 Measure the voltage between solid state clutch relay C274-1, circuit 400 (LB/BK), and ground; and between solid state clutch relay C274-5, circuit 400 (LB/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A22 .

→ **No**
REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

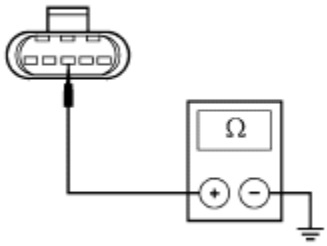
A22 CHECK CIRCUIT 275 (Y) FOR SHORT TO GROUND

1

2

GEM C282

3



GC1564-A

3 Measure the resistance between solid state clutch relay C274-3, circuit 275 (Y), and ground.

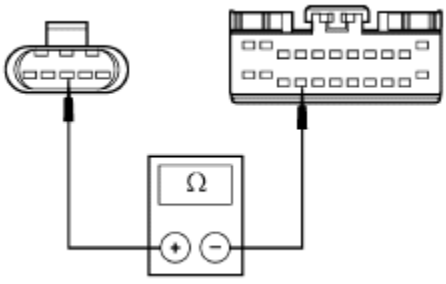
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to A23 .

→ **No**
REPAIR circuit 275 (Y). CLEAR the DTCs. TEST the system for normal operation.

A23 CHECK CIRCUIT 275 (Y) FOR OPEN

1



GC1565-A

1 Measure the resistance between solid state clutch relay C274-3, circuit 275 (Y), and GEM C282-15, circuit 275 (Y).

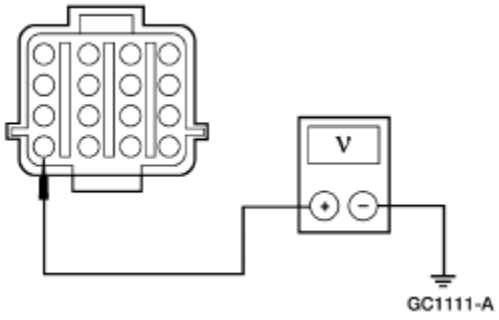
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 275 (Y). CLEAR the DTCs. TEST the system for normal operation.

A24 CHECK THE ELECTRIC CLUTCH — ENERGIZED

1 2 4 GC1175-A 5 	3 Raise and support the vehicle; refer to Section 100-02 . 4 Place the 4WD mode switch in the 4WD HIGH position. 5 Trigger the GEM active command ACCY RLY to ON. 6 Rotate the front drive shaft. • **Does the front drive shaft lock to the rear?** → **Yes** GO to A25 . → **No** GO to A26 .
A25 CHECK THE ELECTRIC CLUTCH — NOT ENERGIZED	
1 	1 Trigger the GEM active command ACCY RLY to OFF. 2 Rotate the front drive shaft. • **Does the front drive shaft lock to the rear?** → **Yes**

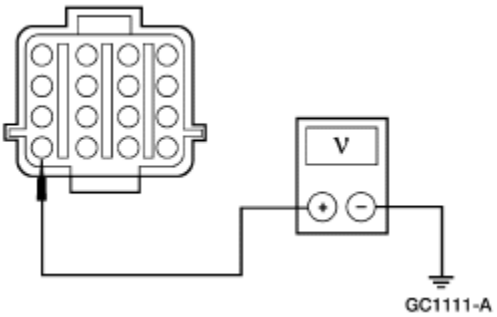
	GO to A27 . → **No** GO to A31 .
A26 CHECK THE VOLTAGE TO THE ELECTRIC CLUTCH — GEM ACTIVE COMMAND ACCY RLY ON	
1 2 Transfer Case Assembly C201 3 4 5  GC1111-A	4 Trigger the GEM active command ACCY RLY to ON. 5 Measure the voltage between transfer case assembly C201-16, circuit 779 (BR), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the electric clutch. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A29 .
A27 CHECK THE VOLTAGE TO THE ELECTRIC CLUTCH — GEM ACTIVE COMMAND ACCY RLY OFF	
1	

2

Transfer Case Assembly C201

3

4



4 Measure the voltage between transfer case assembly C201-16, circuit 779 (BR), and ground.

- **Is the voltage zero volts?**

→ **Yes**
REPLACE the electric clutch. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to A28 .

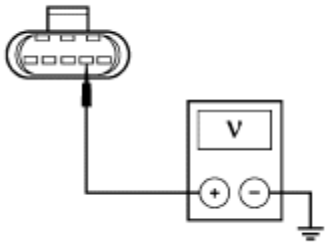
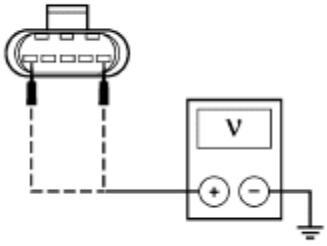
A28 CHECK CIRCUIT 779 (BR) FOR SHORT TO POWER

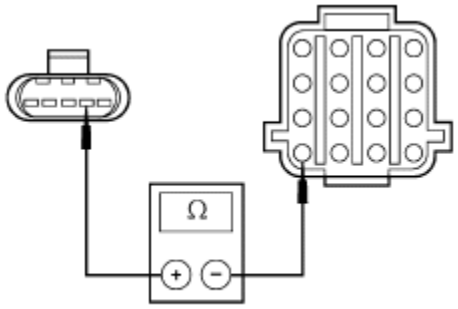
1

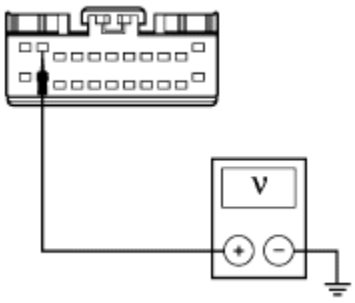
2

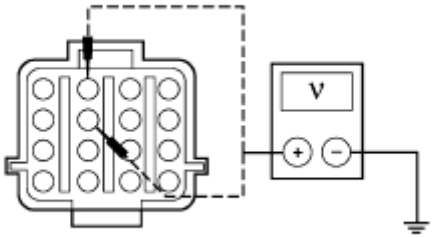
Solid State Clutch Relay C274

3

4  GC1566-A	4 Measure the voltage between solid state clutch relay C274-2, circuit 779 (BR), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 779 (BR). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the solid state clutch relay. CLEAR the DTCs. TEST the system for normal operation.
A29 CHECK THE VOLTAGE TO THE SOLID STATE CLUTCH RELAY — CIRCUIT 400 (LB/BK)	
1 2 Solid State Clutch Relay C274 3 4  GC1563-A	3 Trigger the GEM active command ACCY RLY to ON. 4 Measure the voltage between solid state clutch relay C274-1 and C274-5, circuit 400 (LB/BK), and ground. • **Is the voltage greater than 10 volts?**

	→ **Yes** GO to A30 . → **No** REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.
A30 CHECK CIRCUIT 779 (BR) FOR OPEN	
1  GC1592-A	1 Measure the resistance between transfer case assembly C201-16, circuit 779 (BR), and solid state clutch relay C274-2, circuit 779 (BR). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 779 (BR). CLEAR the DTCs. TEST the system for normal operation.
A31 CHECK THE FRONT AND REAR DRIVE SHAFT SPEED SENSORS	
1 	1 Monitor the GEM PIDs TRA_FSP and TRA_RSP while driving the vehicle 0 to 88.5 km/h (55 mph). • **Do the PID values agree with the speedometer?** → **Yes** GO to A39 . → **No** GO to A32 .
A32 CHECK CIRCUIT 539 (PK/LB) FOR SHORT TO POWER	
1 	

2 GEM C282 3 4  GC1567-A	4 Measure the voltage between GEM C282-2, circuit 539 (PK/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 539 (PK/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** RECONNECT GEM C282. GO to A33 .
A33 CHECK THE VOLTAGE TO THE FRONT AND REAR SHAFT SPEED SENSORS — CIRCUIT 774 (LG)	
1 2 Transfer Case Assembly C201 3 4	4 Measure the voltage between transfer case assembly C201-3, circuit 774 (LG), C201-7, circuit 774 (LG), and ground.



GC1115-A

- **Is the voltage greater than 10 volts?**

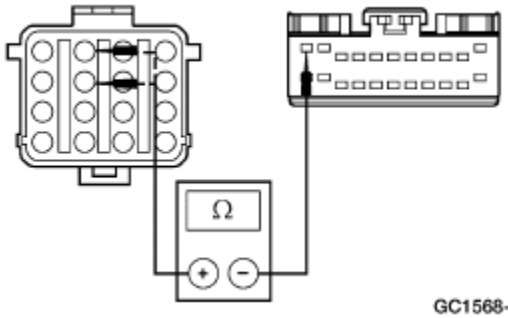
→ **Yes**
GO to A36 .

→ **No**
GO to A34 .

A34 CHECK CIRCUIT 774 (LG) FOR OPEN

1

2



GC1568-A

2 Measure the resistance between transfer case assembly C201-3, circuit 774 (LG), C201-7, circuit 774 (LG), and GEM C282-1, circuit 774 (LG).

- **Is the resistance less than 5 ohms?**

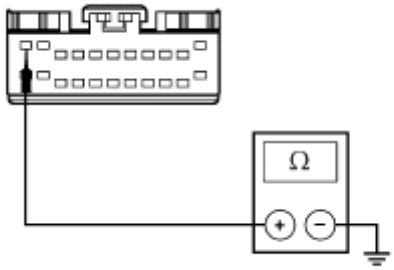
→ **Yes**
GO to A35 .

→ **No**
REPAIR circuit 774 (LG). CLEAR the DTCs. TEST the system for normal operation.

A35 CHECK CIRCUIT 774 (LG) FOR SHORT TO GROUND

1

1 Measure the resistance between GEM C282-1, circuit 774 (LG), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

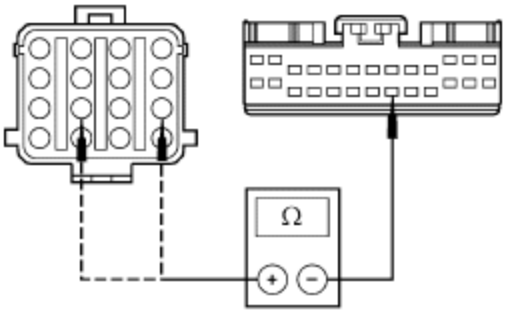
→ **No**
REPAIR circuit 774 (LG). CLEAR the DTCs. TEST the system for normal operation.

A36 CHECK CIRCUIT 359 (GY/R) FOR OPEN

1

GEM C280

2



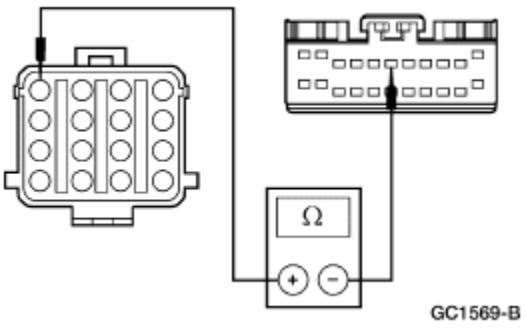
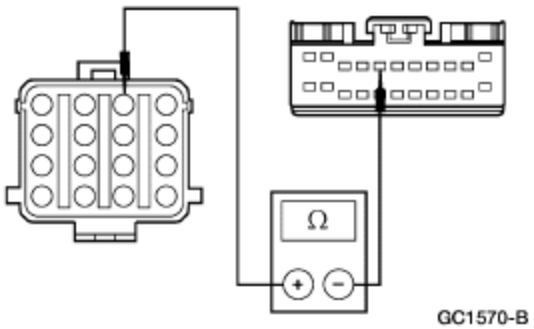
2 Measure the resistance between transfer case assembly C201-6, circuit 359 (GY/R), C201-8, circuit 359 (GY/R), and GEM C280-21, circuit 359 (GY/R).

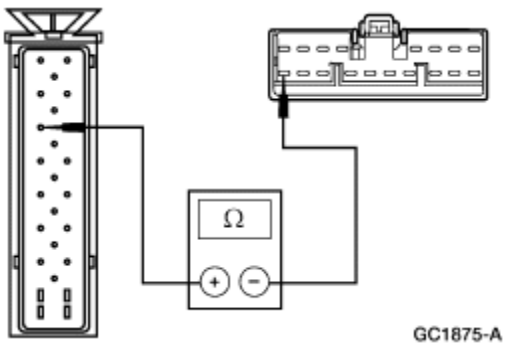
- **Is the resistance less than 5 ohms?**

→ **Yes**
If DTC P1836 was retrieved in **A2** , GO to A37 .

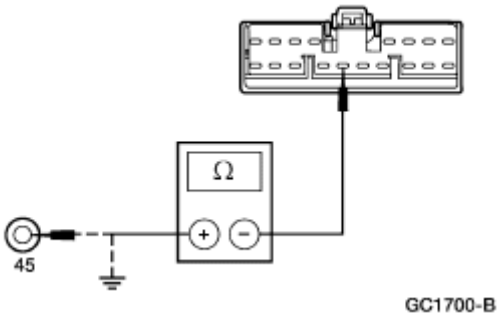
If DTC P1837 was retrieved in **A2** , GO to A38 .

If DTCs P1836 and P1837 were not retrieved, REPLACE the GEM; REFER to Section 419-

	10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.
A37 CHECK THE FRONT SHAFT SPEED SENSOR CIRCUIT 236 (BK/LG) FOR OPEN	
1  	1 Measure the resistance between transfer case assembly C201-4, circuit 236 (BK/LG), and GEM C282-6, circuit 236 (BK/LG). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the front shaft speed sensor. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 236 (BK/LG). CLEAR the DTCs. TEST the system for normal operation.
A38 CHECK THE REAR SHAFT SPEED SENSOR CIRCUIT 772 (LB) FOR OPEN	
1  	1 Measure the resistance between transfer case assembly C201-2, circuit 772 (LB), and GEM C282-5, circuit 772 (LB). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the rear shaft speed sensor. CLEAR the DTCs. TEST the system for normal operation. → **No**

	REPAIR circuit 236 (BK/LG). CLEAR the DTCs. TEST the system for normal operation.
A39 CHECK THE VEHICLE SPEED SIGNAL — MONITOR THE GEM PID VSS_GEM	
1 	1 Monitor the GEM PID VSS_GEM while driving the vehicle 0 to 88.5 kph (55 mph). • **Does the GEM PID VSS_GEM agree with the speedometer?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A40 .
A40 CHECK CIRCUIT 679 (GY/BK) FOR OPEN	
1 2 4WABS Control Module C186 3 GEM C283 4  	4 Measure the resistance between GEM C283-9, circuit 679 (GY/BK), and 4WABS control module C186-19, circuit 679 (GY/BK). • **Is the resistance less than 5 ohms?** → **Yes**

	REFER to Section 206-09 . → **No** REPAIR circuit 679 (GY/BK). CLEAR the DTCs. TEST the system for normal operation.
A41 CHECK THE THROTTLE POSITION INPUT—MONITOR THE GEM PID TPI	
1 2 	2 Monitor the GEM PID TPI while pressing and releasing the accelerator. • **Does the GEM PID TPI decrease when the accelerator is pressed and increase when the accelerator is released?** → **Yes** DISCONNECT GEM C283 and PCM C202 and INSPECT circuit 357 (Y/W) for signs of corrosion or damage. If OK, RECONNECT the connectors, CLEAR the DTCs. TEST the system for normal operation. If the DTCs reappear, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A42 .
A42 CHECK CIRCUIT 357 (Y/W) FOR OPEN AND SHORT TO GROUND	
1 2 PCM C202 3 GEM C283 5	4 Connect the EEC-V 104-Pin Breakout Box.



5 Measure the resistance between EEC-V 104-Pin Breakout Box pin 45, circuit 357 (Y/W), and GEM C283-13, circuit 357 (Y/W); and between GEM C357, circuit 357 (Y/W), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the GEM connector and ground?**

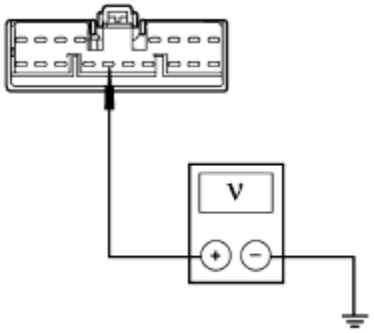
→ **Yes**
GO to A43 .

→ **No**
REPAIR circuit 357 (Y/W). CLEAR the DTCs. TEST the system for normal operation.

A43 CHECK CIRCUIT 357 (Y/W) FOR SHORT TO POWER

1

2



2 Measure the voltage between GEM C283-13, circuit 357 (Y/W), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 357 (Y/W). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REFER to Section 3A in the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.

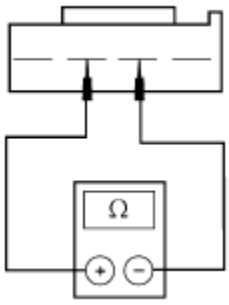
PINPOINT TEST B: THE VEHICLE DOES NOT SHIFT BETWEEN A4WD/4WD HIGH AND 4WD LOW MODES PROPERLY BUT OPERATES PROPERLY IN AUTO MODE

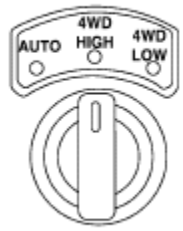
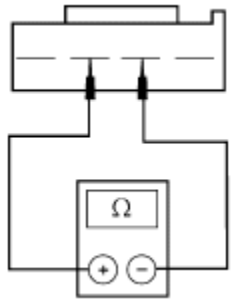
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1 2 Scan Tool 3	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch pedal when turning the ignition switch to START. Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to B2 . → **No** REFER to Section 417-02 , Pinpoint Test D .
B2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Clear Continuous DTCs 3 GEM On-Demand Self-Test	1 Retrieve and document continuous DTCs.

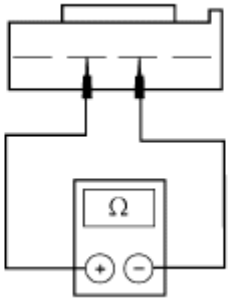
	• **Are any DTCs recorded?** → **Yes** If DTC B1371, B1302, B1398, B1814, or B1818, REFER to the GEM/CTM Diagnostic Trouble Code (DTC) Index to diagnose first. If DTC P0500, GO to B73 . If DTC P1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. If DTC B1483, GO to B17 . If DTC B1485, GO to B17 . If DTC P1812, GO to B3 . If DTC P1815, GO to B3 . If DTC P1820, GO to B55 . If DTC P1822, GO to B55 . If DTC P1828, GO to B55 . If DTC P1830, GO to B55 . If DTC P1836, GO to B31 . If DTC P1837, GO to B31 . If DTC P1838, GO to B55 . If DTC P1846, GO to B40 . If DTC P1850, GO to B40 . If DTC P1854, GO to B40 . If DTC P1858, GO to B40 . If DTC P1866, GO to B40 . If DTC P1867, GO to B40 . If DTC P1874, GO to B31 . If DTC P1875, GO to B31 . If DTC P1891, GO to B31 . → **No** GO to B3 .
B3 CHECK THE 4X4 HIGH LAMP INDICATOR — TRIGGER THE GEM ACTIVE COMMAND HIGH LAMP	

1 	1 Trigger the GEM active command HIGH LAMP ON then OFF. • **Does the 4x4 HIGH indicator illuminate then go off?** → **Yes** GO to B4 . → **No** GO to Pinpoint Test C .
B4 CHECK THE 4X4 LOW LAMP INDICATOR — TRIGGER THE GEM ACTIVE COMMAND LOW LAMP	
1 	1 Trigger the GEM active command LOW LAMP ON then OFF. • **Does the 4x4 LOW indicator illuminate then go off?** → **Yes** GO to B5 . → **No** GO to Pinpoint Test C .
B5 CHECK THE 4WD MODE SWITCH IN THE AUTO POSITION — MONITOR THE GEM PID 4WD_SW	
1 2 GC1174-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the AUTO position. • **Does the GEM PID 4WD_SW indicate AUTO?**

	→ **Yes** GO to B6 . → **No** GO to B8 .
B6 CHECK THE 4WD MODE SWITCH IN THE 4WD HIGH POSITION — MONITOR THE GEM PID 4WD_SW	
1 2 GC1175-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the 4WD HIGH position. • **Does the GEM PID 4WD_SW indicate 4WD HIGH?** → **Yes** GO to B7 . → **No** GO to B8 .
B7 CHECK THE 4WD MODE SWITCH IN THE 4WD LOW POSITION — MONITOR THE GEM PID 4WD_SW	
1 2 GC1176-A	1 Monitor the GEM PID 4WD_SW. 2 Place the 4WD mode switch in the 4WD LOW position.

	• **Does the GEM PID 4WD_SW indicate 4WD LOW?** → **Yes** GO to B17 . → **No** GO to B8 .
B8 CHECK THE 4WD MODE SWITCH IN THE AUTO POSITION	
1 2 4WD Mode Switch C279 3 GC1174-A 4  GC1123-A	3 Place the 4WD mode switch in the AUTO position. 4 Measure the resistance between 4WD mode switch terminals 2 and 3. • **Is the resistance between 3700 and 4100 ohms?** → **Yes** GO to B9 . → **No**

	REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.
B9 CHECK THE 4WD MODE SWITCH IN THE 4WD HIGH POSITION	
1  GC1175-A	1 Place the 4WD mode switch in the 4WD HIGH position.
2  GC1123-A	2 Measure the resistance between 4WD mode switch terminals 2 and 3. • **Is the resistance between 1050 and 1150 ohms?** → **Yes** GO to B10 . → **No** REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.
B10 CHECK THE 4WD MODE SWITCH IN THE 4WD LOW POSITION	
1 GC1176-A	1 Place the 4WD mode switch in the 4WD LOW position.
2	2 Measure the resistance between 4WD mode switch terminals 2 and 3.



GC1123-A

- **Is the resistance between 340 and 380 ohms?**

→ **Yes**
GO to B11 .

→ **No**
REPLACE the 4WD mode switch. CLEAR the DTCs. TEST the system for normal operation.

B11 CHECK CIRCUIT 465 (W/LB) FOR OPEN

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GEM C282

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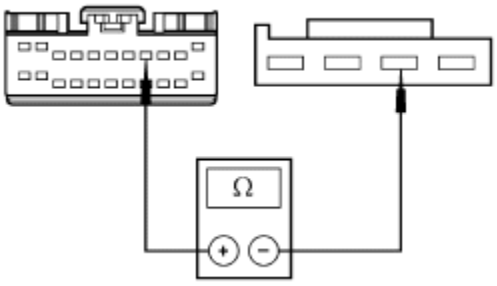


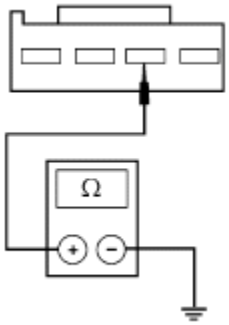
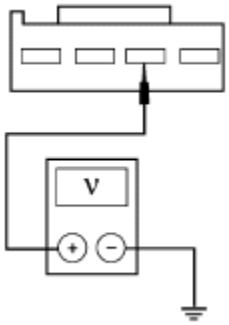
GC1556-A

3 Measure the resistance between 4WD mode switch C279-3, circuit 465 (W/LB), and GEM C282-8, circuit 465 (W/LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B12 .

→ **No**
REPAIR circuit 465 (W/LB). CLEAR the DTCs.

	TEST the system for normal operation.
B12 CHECK CIRCUIT 465 (W/LB) FOR SHORT TO GROUND	
1  GC1098-A	1 Measure the resistance between 4WD mode switch C279-3, circuit 465 (W/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B13 . → **No** REPAIR circuit 465 (W/LB). CLEAR the DTCs. TEST system for normal operation.
B13 CHECK CIRCUIT 465 (W/LB) FOR SHORT TO POWER	
1 2  GC1099-A	2 Measure the voltage between 4WD mode switch C279-3, circuit 465 (W/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 465 (W/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B14 .
B14 CHECK CIRCUIT 359 (GY/R) FOR OPEN	

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GEM C280

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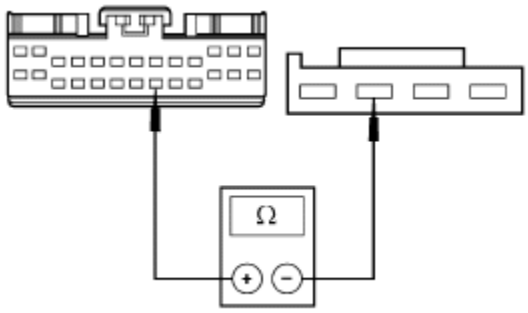


GC1783-B

3 Measure the resistance between 4WD mode switch C279-2, circuit 359 (GY/R), and GEM C280-21, circuit 359 (GY/R).

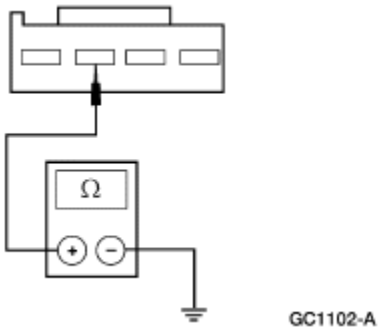
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B15 .

→ **No**
REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.

B15 CHECK CIRCUIT 359 (GY/R) FOR SHORT TO GROUND

1



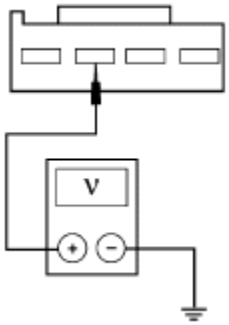
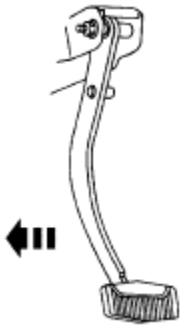
GC1102-A

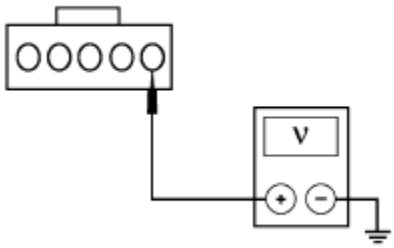
1 Measure the resistance between 4WD mode switch C279-2, circuit 359 (GY/R), and ground.

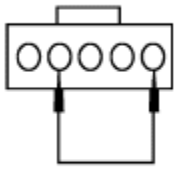
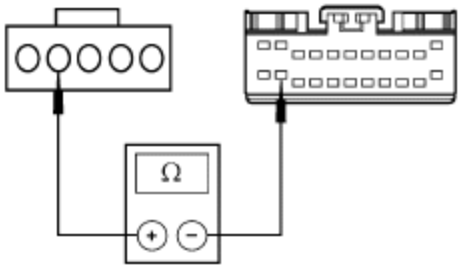
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to B16 .

→ **No**

	REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST system for normal operation.
B16 CHECK CIRCUIT 359 (GY/R) FOR SHORT TO POWER	
1 2  GC1101-A	2 Measure the voltage between 4WD mode switch C279-2, circuit 359 (GY/R), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
B17 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH — MONITOR THE GEM PID BOO_GEM	
1 2  GC1124-A	1 Monitor the GEM PID BOO_GEM. 2 Depress the brake pedal. • **Does the GEM PID BOO_GEM indicate ON?**

	→ **Yes** GO to B22 . → **No** GO to B18 .
B18 CHECK FUSE JUNCTION PANEL FUSE 13 (20A)	
1 2 Fuse 13 (20A)	• **Is the fuse OK?** → **Yes** GO to B19 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground, REPAIR as necessary.
B19 CHECK THE VOLTAGE TO THE PEDAL POSITION (BPP) SWITCH — CIRCUIT 10 (LG/R)	
1 BPP Switch C224 2  GC1571-A	2 Measure the voltage between BPP switch C224-5, circuit 10 (LG/R), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B20 .

	→ **No** REPAIR circuit 10 (LG/R). CLEAR the DTCs. TEST the system for normal operation.
B20 CHECK THE BPP SWITCH — MONITOR THE GEM PID BOO_GEM	
1 2  GC1572-A	1 Monitor the GEM PID BOO_GEM. 2 Connect a jumper wire between BPP switch C224-5, circuit 10 (LG/R), and C224-2, circuit 810 (R/LG). • **Does the GEM PID BOO_GEM indicate ON?** → **Yes** REPLACE the BPP switch; REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B21 .
B21 CHECK CIRCUIT 810 (R/LG) FOR OPEN	
1 GEM C282 2  GC1573-A	2 Measure the resistance between GEM C282-13, circuit 810 (R/LG), and BPP switch C224-2, circuit 810 (R/LG).

	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 810 (R/LG). CLEAR the DTCs. TEST the system for normal operation.
B22 CHECK THE CLUTCH INTERLOCK — MONITOR THE GEM PID CLTCHSW	
1 	
2 	2 Monitor the GEM PID CLTCHSW.
3 	3 For A/T equipped vehicles, place the PRNDL in the park position.
	4 Verify the GEM PID CLTCHSW indicates ENGAGED.
5 	5 For vehicles equipped with M/T, depress the clutch.
6 	6 Verify the GEM PID CLTCHSW indicates ENGAGED.
	• **Does the GEM PID CLTCHSW indicate ENGAGED when in neutral (A/T) or the clutch is depressed (M/T) and indicate NOT_ENGAGED when in any position other than PARK or NEUTRAL (A/T) or clutch not depressed (M/T)?** → **Yes** If A/T, GO to B26 . If M/T, GO to B29 . → **No** GO to B23 .

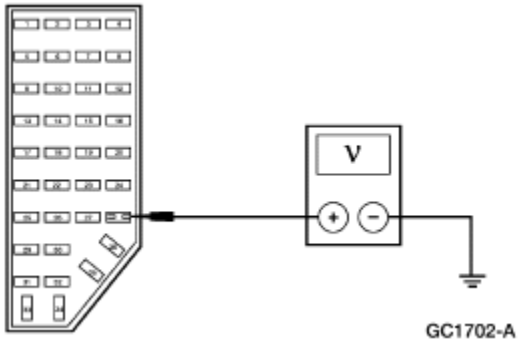
B23 CHECK FOR VOLTAGE AT FUSE JUNCTION PANEL FUSE 28 (7.5A)

1

Fuse 28 (7.5A)

2

3



3 Measure the voltage between fuse junction panel fuse 28 (7.5A), pin 2, and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B24 .

→ **No**
DIAGNOSE the starting system; REFER to Section 303-06 .

If OK, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

B24 CHECK CIRCUIT 1000 (R/LG) FOR OPEN AND SHORT TO GROUND

1

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GEM C283

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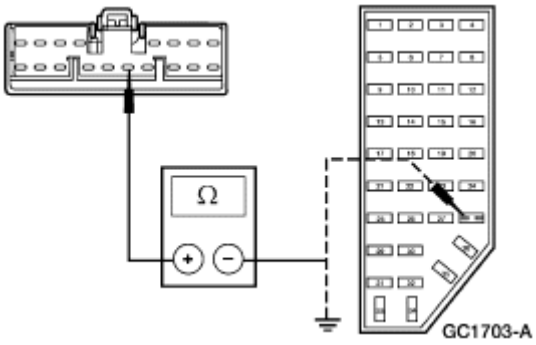
3 Measure the resistance between GEM C283-14, circuit 1000 (R/LG), and fuse junction panel fuse 28 (7.5A), pin 1; and between GEM C283-14, circuit 1000 (R/LG), and



ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the GEM connector and ground?**

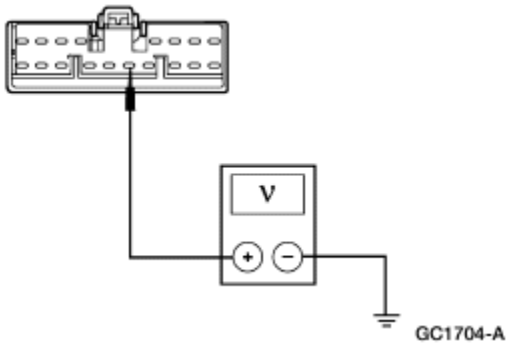
→ **Yes**
GO to B25 .

→ **No**
REPAIR circuit 1000 (R/LG). CLEAR the DTCs. TEST the system for normal operation.

B25 CHECK CIRCUIT 1000 (R/LG) FOR SHORT TO POWER

1

2



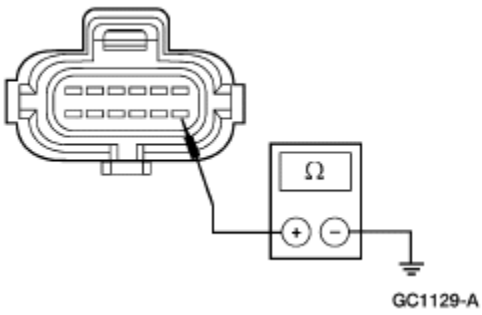
2 Measure the voltage between GEM C283-14, circuit 1000 (R/LG), and ground.

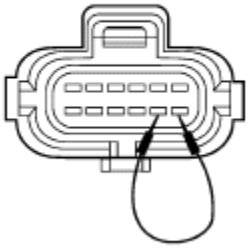
- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 1000 (R/LG). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

B26 CHECK THE TRANSMISSION RANGE SENSOR — MONITOR THE GEM PID NTRL_SW

1 2 3 4 	1 Monitor the GEM PID NTRL_SW. 3 Verify the GEM PID NTRL_SW indicates NTRL. 4 Verify the GEM PID NTRL_SW indicates notNTRL when the transmission is in any position other than NEUTRAL. • **Does the GEM PID NTRL_SW indicate correctly?** → **Yes** GO to B31 . → **No** GO to B27 .
B27 CHECK THE GROUND TO THE DIGITAL TR SENSOR — CIRCUIT 57 (BK)	
1 Digital TR Sensor C112 2  GC1129-A	2 Measure the resistance between digital TR sensor C112-7, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to B28 .

	→ **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
B28 CHECK THE DIGITAL TR SENSOR — MONITOR THE GEM PID NTRL_SW	
1 	1 Monitor the GEM PID NTRL_SW.
2  GC1130-A	2 Connect a jumper wire between digital TR sensor C112-7, circuit 57 (BK) and C112-8, circuit 463 (R/W).
3 	
4 	4 Verify the GEM PID NTRL_SW indicates NTRL.
	5 Remove the jumper wire.
6 	6 Monitor the GEM PID NTRL_SW.
	7 Verify the GEM PID NTRL_SW indicates notNTRL. • **Does the GEM PID NTRL_SW indicate correctly?** → **Yes** REPLACE the digital TR sensor; REFER to Section 307-01A (4R70W) or Section 307-01B (5R55E). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B29 .

B29 CHECK CIRCUIT 463 (R/W) FOR OPEN

1

2

GEM C282

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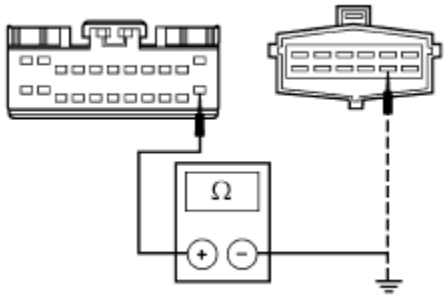


3 Measure the resistance between GEM C282-22, circuit 463 (R/W), and digital TR sensor C112-8, circuit 463 (R/W) (A/T); or between GEM C282-22, circuit 463 (R/W), and ground (M/T).

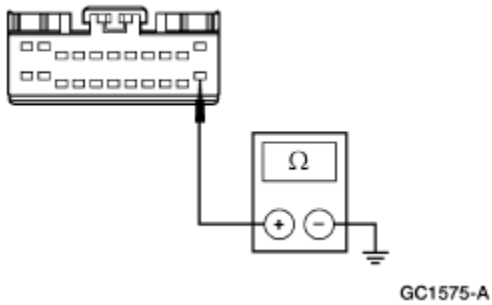
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B30 .

→ **No**
REPAIR circuit 463 (R/W). CLEAR the DTCs. TEST the system for normal operation.

B30 CHECK CIRCUIT 463 (R/W) FOR SHORT TO GROUND

1

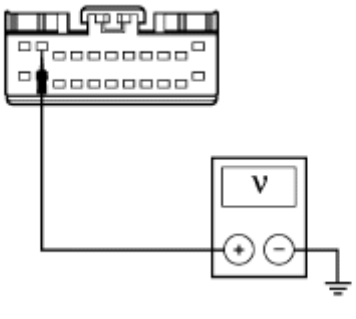


1 Measure the resistance between GEM C282-22, circuit 463 (R/W), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for

	normal operation. → **No** REPAIR circuit 463 (R/W). CLEAR the DTCs. TEST the system for normal operation.
B31 CHECK THE FRONT AND REAR SHAFT SPEED SENSORS — MONITOR THE GEM PIDS TRA_FSP AND TRA_RSP	
1 2 GC1175-A	1 Monitor the GEM PIDs TRA_FSP and TRA_RSP 2 Place the 4WD mode switch in the 4WD HIGH position. 3 Drive the vehicle 0 to 88.5 km/h (55mph). • **Do the PID values agree with the speedometer?** → **Yes** GO to B39 . → **No** GO to B32 .
B32 CHECK CIRCUIT 539 (PK/LB) FOR SHORT TO POWER	
1 2 GEM C282 3 4	4 Measure the voltage between GEM C282-2,



circuit 539 (PK/LB), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 539 (PK/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
RECONNECT GEM C282, GO to B33 .

B33 CHECK THE VOLTAGE TO THE FRONT AND REAR SHAFT SPEED SENSORS — CIRCUIT 774 (LG)

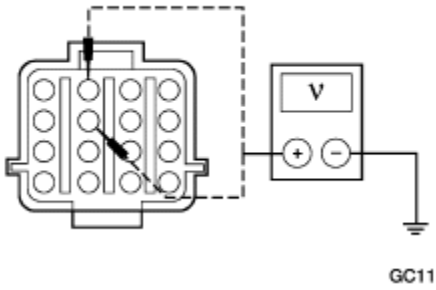
1

2

Transfer Case Assembly C201

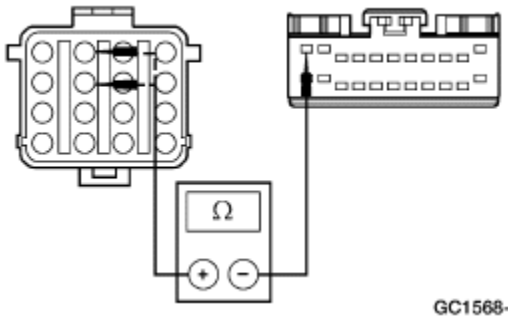
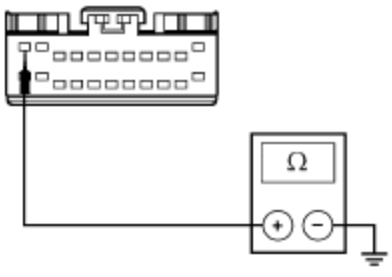
3

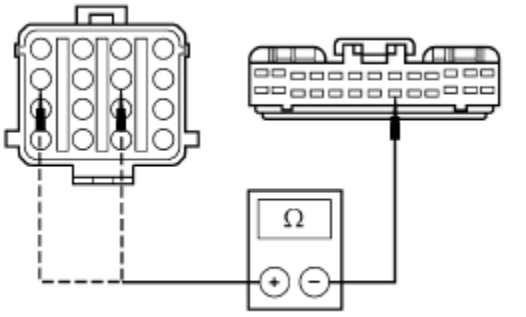
4

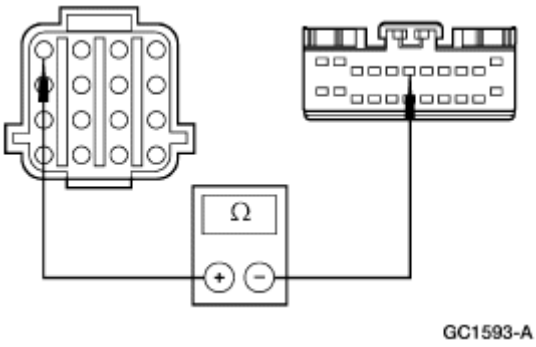


4 Measure the voltage between transfer case assembly C201-3, circuit 774 (LG), C201-7, circuit 774 (LG), and ground.

- **Is the voltage greater than 10 volts?**

	→ **Yes** GO to B36 . → **No** GO to B34 .
B34 CHECK CIRCUIT 774 (LG) FOR OPEN	
1 2 GEM C282 3  GC1568-A	3 Measure the resistance between transfer case assembly C201-3, circuit 774 (LG), C201-7, circuit 774 (LG), and GEM C282-1, circuit 774 (LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to B35 . → **No** REPAIR circuit 774 (LG). CLEAR the DTCs. TEST the system for normal operation.
B35 CHECK CIRCUIT 774 (LG) FOR SHORT TO GROUND	
1  GC1576-A	1 Measure the resistance between GEM C282-1, circuit 774 (LG) and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 774 (LG). CLEAR the DTCs. TEST the system for normal operation.
B36 CHECK CIRCUIT 359 (GY/R) FOR OPEN	
1 GEM C280 2  GC1577-C	2 Measure the resistance between transfer case assembly C201-6, circuit 359 (GY/R), C201-8, circuit 359 (GY/R), and GEM C280-21, circuit 359 (GY/R). • **Is the resistance less than 5 ohms?** → **Yes** If DTC P1836 was retrieved in **B2** , GO to B37 . If DTC P1837 was retrieved in **B2** , GO to B38 . If DTC P1836 and P1837 were not retrieved, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.
B37 CHECK THE FRONT SHAFT SPEED SENSOR CIRCUIT 236 (BK/LG) FOR OPEN	
1	1 Measure the resistance between transfer case assembly C201-4, circuit 236 (BK/LG), and GEM C282-6, circuit 236 (BK/LG).



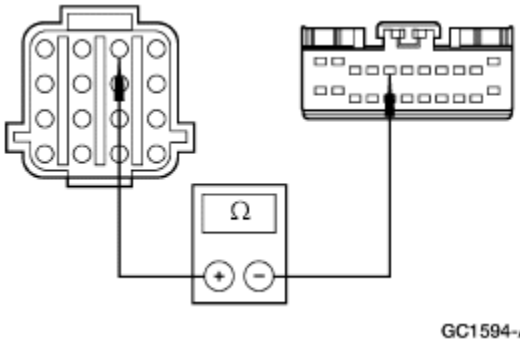
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the front output shaft sensor; REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 236 (BK/LG). CLEAR the DTCs. TEST the system for normal operation.

B38 CHECK THE REAR SHAFT SPEED SENSOR CIRCUIT 772 (LB) FOR OPEN

1



1 Measure the resistance between transfer case assembly C201-2, circuit 772 (LB), and GEM C282-5, circuit 772 (LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the rear output shaft sensor; REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 236 (BK/LG). CLEAR the DTCs. TEST the system for normal operation.

B39 CHECK THE VEHICLE SPEED SIGNAL — MONITOR THE GEM PID VSS_GEM

1

1 Monitor the GEM PID VSS_GEM while driving the vehicle 0 to 88.5 km/h (55 mph).

	• **Does the GEM PID VSS_GEM agree with the speedometer?** → **Yes** GO to B40 . → **No** GO to B73 .
B40 CHECK THE CONTACT PLATE SWITCHES	
1 2 3 GC1175-A 4 GC1176-A	1 Monitor the GEM PIDs PLATE_A, PLATE_B, PLATE_C, and PLATE_D. 3 Depress the brake pedal and shift the transmission into neutral or depress the clutch, while placing the 4WD mode switch in the 4WD HIGH position and record the PIDs. 4 Depress the brake pedal and shift the transmission into neutral or depress the clutch, while placing the 4WD mode switch in the 4WD LOW position and record the PIDs. 5 Compare the PIDs with the following tables: **Scan Tool Software 11.0 and Prior Versions** **AUTO/4WD HIGH** PLATE_A: CLOSED PLATE_B: CLOSED PLATE_C: OPEN **4WD LOW** PLATE_A: CLOSED PLATE_B: OPEN PLATE_C: CLOSED

PLATE_D	CLOSED	OPEN

Scan Tool Software 12.0 and Higher Versions

	AUTO/4WD HIGH	4WD LOW
PLATE_A	CLOSED	OPEN
PLATE_B	OPEN	CLOSED
PLATE_C	CLOSED	OPEN
PLATE_D	CLOSED	CLOSED

- **Do the PIDs agree with the table?**

→ **Yes**
REPAIR the transfer case; REFER to Section 308-07B . CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.

→ **No**
GO to B41 .

B41 CHECK CIRCUIT 771 (P/Y) TO THE CONTACT PLATE SWITCH A — MONITOR THE GEM PID PLATE_A

1

2

Transfer Case Assembly C201

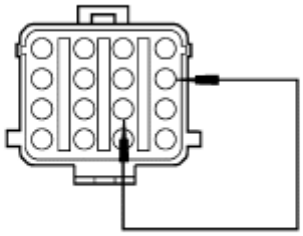
3

4

4 Monitor the GEM PID PLATE_A. Verify the GEM PID PLATE_A indicates OPEN.

5

5 Connect a jumper wire between transfer case assembly C201-10, circuit 762 (Y/W), and C201-5, circuit 771 (P/Y).



GC1578-B

6

6 Verify the GEM PID PLATE_A indicates CLOSED.

- **Does the GEM PID PLATE_A agree with the expected results?**

→ **Yes**
GO to B46 .

→ **No**
GO to B42 .

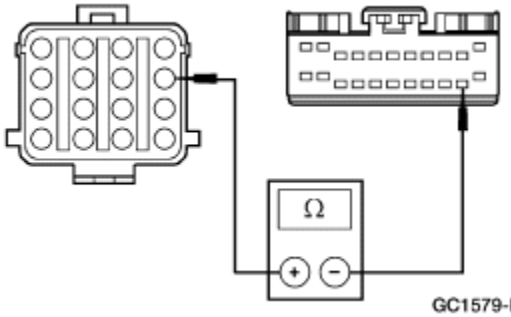
B42 CHECK CIRCUIT 771 (P/Y) FOR OPEN

1

2

GEM C282

3

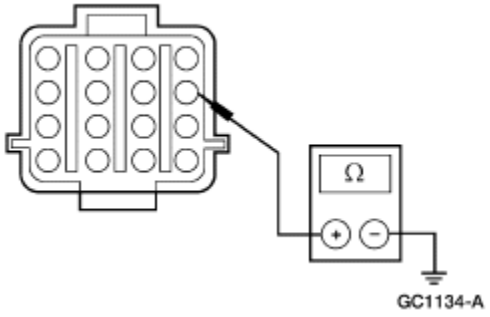
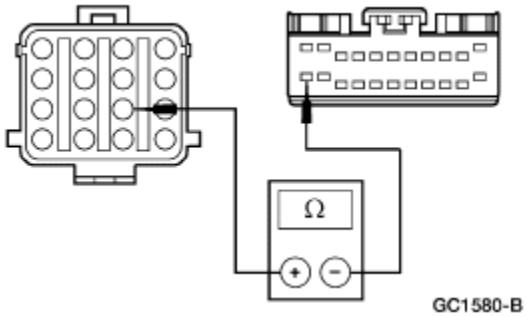


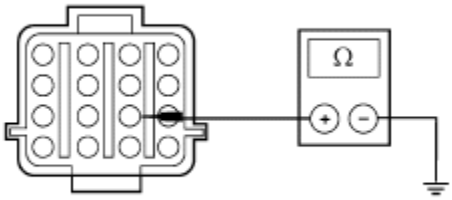
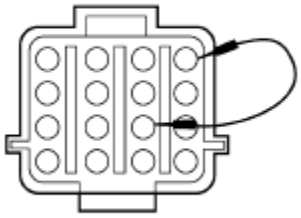
GC1579-B

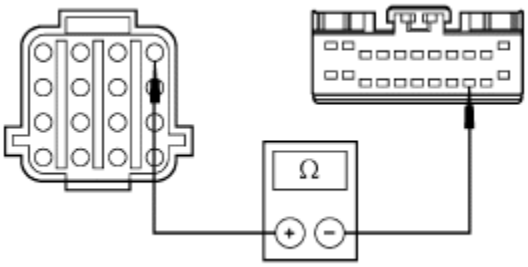
3 Measure the resistance between transfer case assembly C201-5, circuit 771 (P/Y), and GEM C282-21, circuit 771 (P/Y).

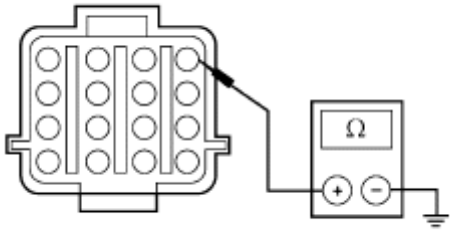
- **Is the resistance less than 5 ohms?**

→ **Yes**

	GO to B43 . → **No** REPAIR circuit 771 (P/Y). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation. If concern still exists, GO to B44 .
B43 CHECK CIRCUIT 771 (P/Y) FOR SHORT TO GROUND	
1  	1 Measure the resistance between transfer case assembly C201-5, circuit 771 (P/Y), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B44 . → **No** REPAIR circuit 771 (P/Y). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.
B44 CHECK CIRCUIT 762 (Y/W) FOR OPEN	
1  	1 Measure the resistance between transfer case assembly C201-10, circuit 762 (Y/W), and GEM C282-12, circuit 762 (Y/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to B45 . → **No** REPAIR circuit 762 (Y/W). CLEAR the DTCs

	and CYCLE the ignition. TEST the system for normal operation.
B45 CHECK CIRCUIT 762 (Y/W) FOR SHORT TO GROUND	
1  GC1136-A	1 Measure the resistance between transfer case assembly C201-10, circuit 762 (Y/W), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 762 (Y/W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.
B46 CHECK THE CIRCUIT 770 (W) TO THE CONTACT PLATE SWITCH B — MONITOR THE GEM PID PLATE_B	
1 	
2 	2 Monitor the GEM PID PLATE_B. Verify the GEM PID PLATE_B indicates OPEN.
3  GC1141-A	3 Connect a jumper wire between transfer case assembly C201-10, circuit 762 (Y/W), and C201-1, circuit 770 (W).
4	4 Verify the GEM PID PLATE_B indicates

	CLOSED. • **Does the GEM PID PLATE_B agree with the expected results?** → **Yes** GO to B49 . → **No** GO to B47 .
B47 CHECK CIRCUIT 770 (W) FOR OPEN	
1 2 GEM C282 3  GC1581-A	3 Measure the resistance between transfer case assembly C201-1, circuit 770 (W), and GEM C282-20, circuit 770 (W). • **Is the resistance less than 5 ohms?** → **Yes** GO to B48 . → **No** REPAIR circuit 770 (W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation. If concern still exists, RECONNECT GEM C282, GO to B49 .
B48 CHECK CIRCUIT 770 (W) FOR SHORT TO GROUND	
1	1 Measure the resistance between transfer case assembly C201-1, circuit 770 (W), and ground.



GC1143-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 770 (W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.

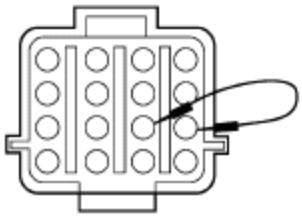
B49 CHECK THE CIRCUIT 764 (BR/W) TO THE CONTACT PLATE SWITCH C — MONITOR THE GEM PID PLATE _C

1

2

2 Monitor the GEM PID PLATE_C. Verify the GEM PID PLATE_C indicates OPEN.

3

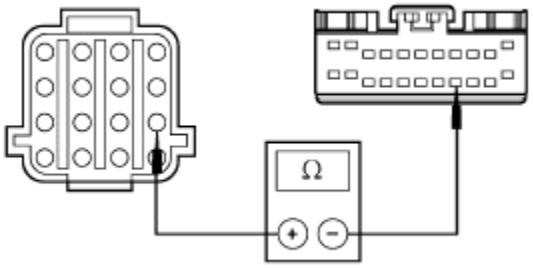


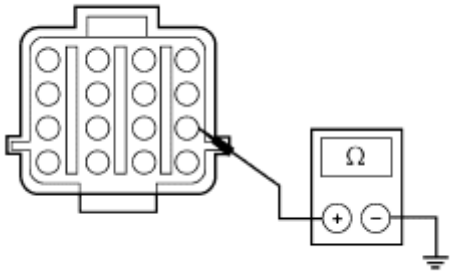
GC1144-A

3 Connect a jumper wire between transfer case assembly C201-10, circuit 762 (Y/W), and C201-9, circuit 764 (BR/W).

4

4 Verify the GEM PID PLATE_C indicates CLOSED.

	• **Does the GEM PID PLATE_C agree with the expected results?** → **Yes** GO to B52 . → **No** GO to B50 .
B50 CHECK CIRCUIT 764 (BR/W) FOR OPEN	
1 2 GEM C282 3  GC1582-A	3 Measure the resistance between transfer case assembly C201-9, circuit 764 (BR/W), and GEM C282-19, circuit 764 (BR/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to B51 . → **No** REPAIR circuit 764 (BR/W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation. If the concern still exists, RECONNECT GEM C282, GO to B52 .
B51 CHECK CIRCUIT 764 (BR/W) FOR SHORT TO GROUND	
1	1 Measure the resistance between transfer case assembly C201-9, circuit 764 (BR/W), and ground.



GC1146-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 764 (BR/W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.

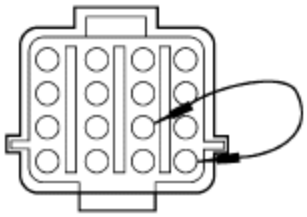
B52 CHECK THE CIRCUIT 763 (O/W) TO THE CONTACT PLATE SWITCH D — MONITOR THE GEM PID PLATE_D

1

2

2 Monitor the GEM PID PLATE_D. Verify the GEM PID PLATE_D indicates OPEN.

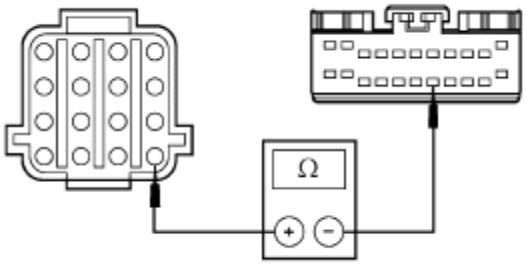
3

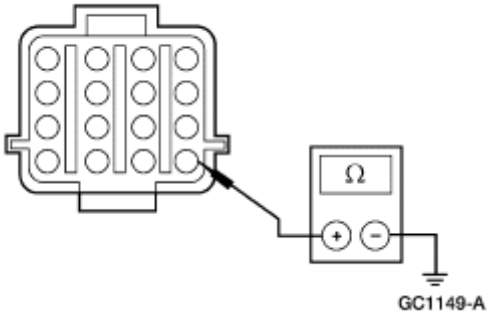

GC1147-A

3 Connect a jumper wire between transfer case assembly C201-10, circuit 762 (Y/W), and C201-13, circuit 763 (O/W).

4

4 Verify the GEM PID PLATE_D indicates CLOSED.

	• **Does the GEM PID PLATE_D agree with the expected results?** → **Yes** REPLACE the transfer case electric shift motor; REFER to Section 308-07B . CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation. → **No** GO to B53 .
B53 CHECK CIRCUIT 763 (O/W) FOR OPEN	
1 2 GEM C282 3  GC1882-A	3 Measure the resistance between transfer case assembly C201-13, circuit 763 (O/W), and GEM C282-18, circuit 763 (O/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to B54 . → **No** REPAIR circuit 763 (O/W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.
B54 CHECK CIRCUIT 763 (O/W) FOR SHORT TO GROUND	
1	1 Measure the resistance between transfer case assembly C201-13, circuit 763 (O/W), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.

→ **No**
REPAIR circuit 763 (O/W). CLEAR the DTCs and CYCLE the ignition. TEST the system for normal operation.

B55 CHECK THE TRANSFER CASE SHIFT RELAYS — MONITOR THE GEM PIDS MTR_CCW AND MTR_CW

1

2

2 Monitor the GEM PIDs MTR_CCW and MTR_CW while triggering the GEM active command CW/CCW ON and OFF.

- **DO the GEM PIDs MTR_CCW and MTR_CW indicate ON---, OFF---?**

→ **Yes**
GO to B64 .

→ **No**
If the PIDs displayed ON-B-, GO to B61 .

If the PIDs displayed OFFO-G, GO to B56 .

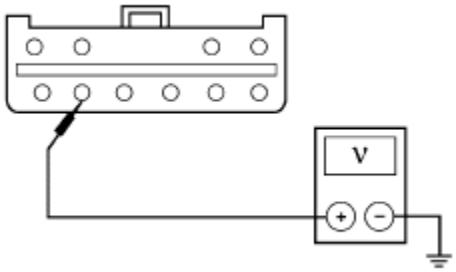
B56 CHECK THE VOLTAGE TO THE TRANSFER CASE SHIFT RELAY COIL — CIRCUIT 705 (LG/O)

1

2

Transfer Case Shift Relay C278

3



GC1150-A

3 Measure the voltage between transfer case shift relay C278-5, circuit 705 (LG/O), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B57 .

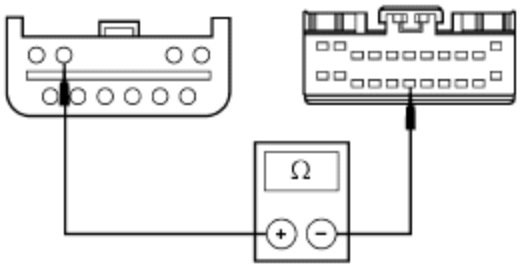
→ **No**
REPAIR circuit 705 (LG/O). CLEAR the DTCs. TEST the system for normal operation.

B57 CHECK CIRCUIT 513 (BR/PK) FOR OPEN

1

GEM C282

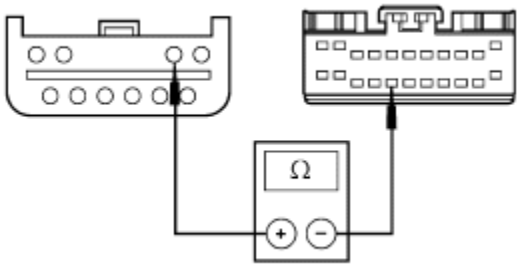
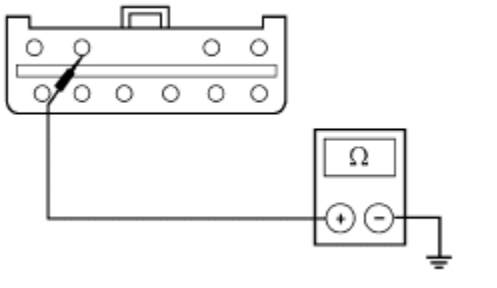
2

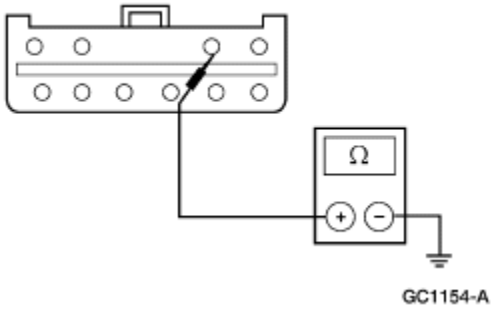


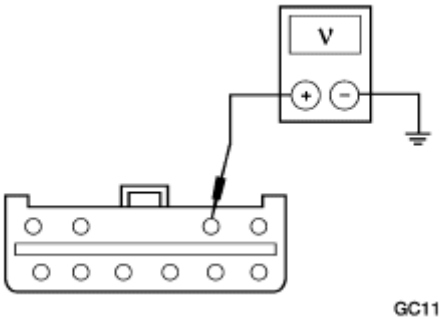
GC1584-A

2 Measure the resistance between transfer case shift relay C278-9, circuit 513 (BR/PK), and GEM C282-17, circuit 513 (BR/PK).

- **Is the resistance less than 5 ohms?**

	→ **Yes** GO to B58 . → **No** REPAIR circuit 513 (BR/PK). CLEAR the DTCs. TEST the system for normal operation.
B58 CHECK CIRCUIT 339 (GY) FOR OPEN	
1  GC1585-A	1 Measure the resistance between transfer case shift relay C278-8, circuit 339 (GY), and GEM C282-16, circuit 339 (GY). • **Is the resistance less than 5 ohms?** → **Yes** GO to B59 . → **No** REPAIR circuit 339 (GY). CLEAR the DTCs. TEST the system for normal operation.
B59 CHECK CIRCUIT 513 (BR/PK) FOR SHORT TO GROUND	
1  GC1153-A	1 Measure the resistance between transfer case shift relay C278-9, circuit 513 (BR/PK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B60 . → **No** REPAIR circuit 513 (BR/PK). CLEAR the DTCs. TEST the system for normal operation.
B60 CHECK CIRCUIT 339 (GY) FOR SHORT TO GROUND	

1  GC1154-A	1 Measure the resistance between transfer case shift relay C278-8, circuit 339 (GY), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B63 . → **No** REPAIR circuit 339 (GY). CLEAR the DTCs. TEST the system for normal operation.
B61 CHECK CIRCUIT 339 (GY) FOR SHORT TO POWER	
1 2 GEM C282 3 Transfer Case Shift Relay C278 4 5	5 Measure the voltage between transfer case shift relay C278-8, circuit 339 (GY), and ground.



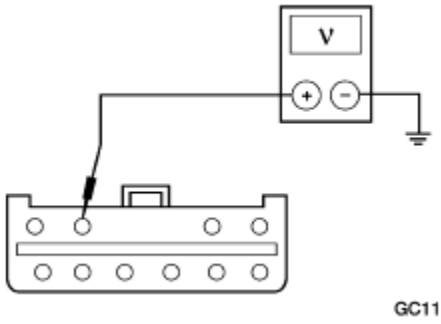
- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 339 (GY). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to B62 .

B62 CHECK CIRCUIT 513 (BR/PK) FOR SHORT TO POWER

1



1 Measure the voltage between transfer case shift relay C278-9, circuit 513 (BR/PK), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 513 (BR/PK). CLEAR the DTCs. TEST the system for normal operation.

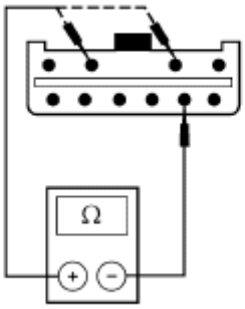
→ **No**
GO to B63 .

B63 CHECK THE TRANSFER CASE SHIFT RELAY COILS

1

2

2 Measure the resistance between transfer case shift relay terminals 8, 9 and terminal 5.



GC1157-A

- **Are the resistances between 60 and 100 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the transfer case shift motor relay. CLEAR the DTCs. TEST the system for normal operation.

B64 CHECK THE VOLTAGE TO THE TRANSFER CASE SHIFT MOTOR — GEM ACTIVE COMMAND CW/CCW ON

1

2

Transfer Case Assembly C201

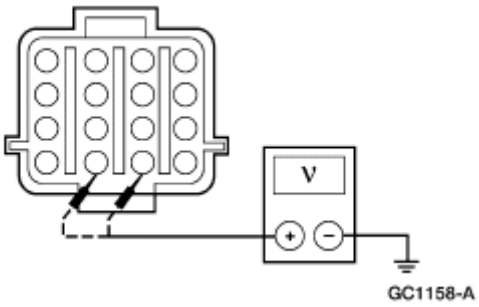
3

4

4 Trigger the GEM active command CW/CCW to ON.

5

5 Measure the voltage between transfer case assembly C201-14, circuit 778 (O), C201-15, circuit 777 (Y), and ground.



- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to B66 .

→ **No**
GO to B65 .

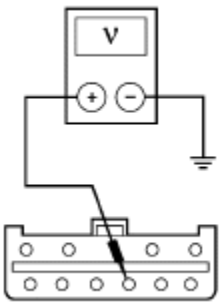
B65 CHECK THE VOLTAGE TO THE TRANSFER CASE SHIFT RELAY — SWITCH SIDE

1

2

Transfer Case Shift Relays C278

3



3 Measure the voltage between transfer case shift relay C278-3, circuit 704 (DG/LG), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B70 .

→ **No**
REPAIR circuit 704 (DG/LG). CLEAR the DTCs. TEST the system for normal operation.

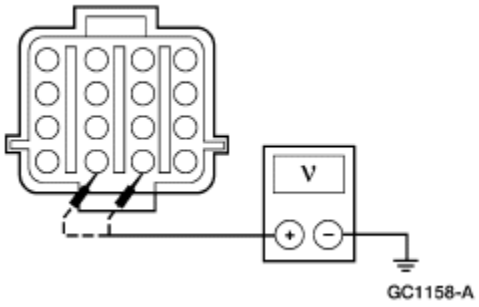
B66 CHECK THE VOLTAGE TO THE TRANSFER CASE SHIFT MOTOR — GEM ACTIVE COMMAND CW/CCW OFF

1

2

2 Trigger the GEM active command CW/CCW to OFF.

3



3 Measure the voltage between transfer case assembly C201-14, circuit 778 (O), C201-15, circuit 777 (Y), and ground.

- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to B67 .

→ **No**
GO to B69 .

B67 CHECK CIRCUITS 777 (Y) FOR SHORT TO POWER

1

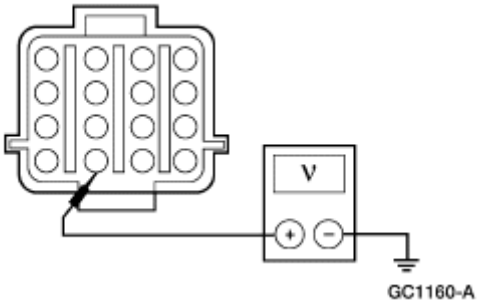
2

Transfer Case Shift Relay C278

3

4

4 Measure the voltage between transfer case assembly C201-15, circuit 777 (Y), and ground.



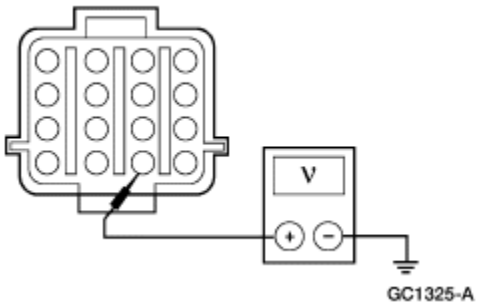
- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 777 (Y). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to B68 .

B68 CHECK CIRCUITS 778 (O) FOR SHORT TO POWER

1



1 Measure the voltage between transfer case assembly C201-14, circuit 778 (O), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 778 (O). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the transfer case shift relay. CLEAR the DTCs. TEST the system for normal operation.

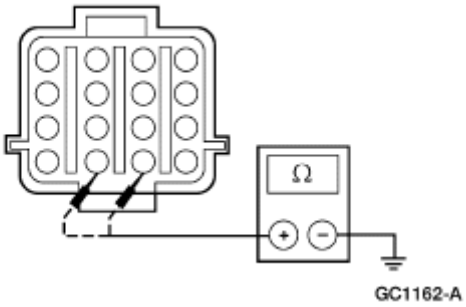
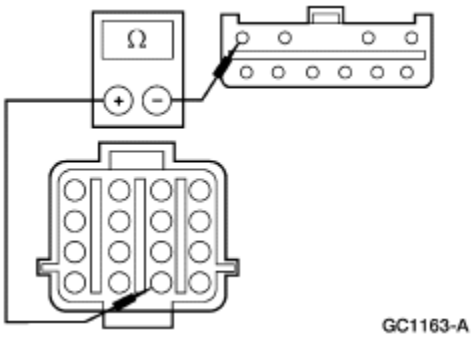
B69 CHECK CIRCUITS 777 (Y) AND 778 (O) FOR AN OPEN THROUGH THE TRANSFER CASE RELAY

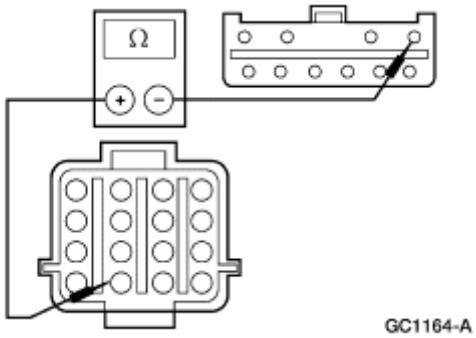
1

2

1 Trigger the GEM active command CW/CCW to OFF.

2 Measure the resistance between transfer case

	assembly C201-14, circuit 778 (O), C201-15, circuit 777 (Y), and ground. • **Are the resistances less than 5 ohms?** → **Yes** RECONNECT the transfer case assembly C201, GO to B40 . → **No** GO to B72 .
B70 CHECK CIRCUITS 778 (O) FOR OPEN	
1 	1 Measure the resistance between transfer case assembly C201-14, circuit 778 (O), and transfer case shift relay C278-10, circuit 778 (O). • **Is the resistances less than 5 ohms?** → **Yes** GO to B71 . → **No** REPAIR circuit 778 (O). CLEAR the DTCs. TEST the system for normal operation.
B71 CHECK CIRCUIT 777 (Y) FOR OPEN	
1	1 Measure the resistance between transfer case shift relay C278-7, circuit 777 (Y), and transfer case assembly C201-15, circuit 777 (Y).



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the transfer case shift relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 777 (Y). CLEAR the DTCs. TEST the system for normal operation.

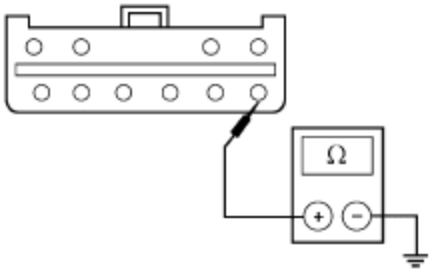
B72 CHECK THE GROUND TO THE TRANSFER CASE SHIFT RELAY — CIRCUIT 57 (BK)

1

2

Transfer Case Shift Relay C278

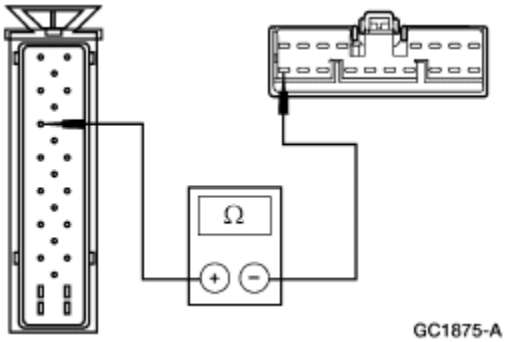
3



3 Measure the resistance between transfer case shift relay C278-1, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the transfer case shift relay. CLEAR the DTCs. TEST the system for normal operation.

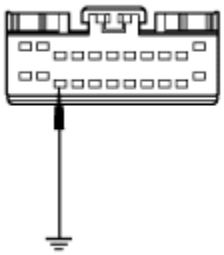
	→ **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
B73 CHECK CIRCUIT 679 (GY/BK) FOR OPEN	
1 2 4WABS Control Module C186 3 GEM C282 4  	4 Measure the resistance between 4WABS control module C186-19, circuit 679 (GY/BK), and GEM C283-9, circuit 679 (GY/BK). • **Is the resistance less than 5 ohms?** → **Yes** DIAGNOSE the 4WABS system; REFER to Section 206-09 . → **No** REPAIR circuit 679 (GY/BK). CLEAR the DTCs. TEST the system for normal operation.

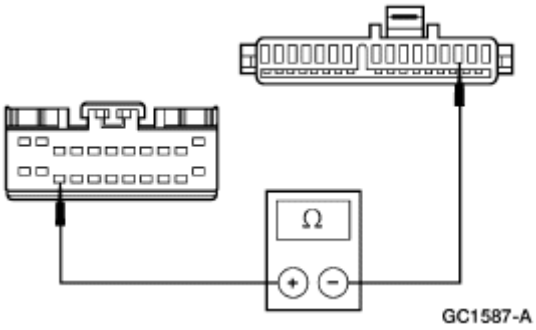
PINPOINT TEST C: THE 4X4 HIGH AND/OR 4X4 LOW INDICATOR(S) DO/DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1	

 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch pedal when turning the ignition switch to START. Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to C2 . → **No** REFER to Section 417-02 .
C2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM On-Demand Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1342, REPLACE GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	If DTC P1804, GO to C3. If DTC P1806, GO to C3. If DTC P1808, GO to C3. If DTC P1810, GO to C3. → **No** GO to C3.
C3 VERIFY THE INOPERATIVE INDICATOR LAMP	
	1 Verify the inoperative indicator lamp. • **Is the 4x4 HIGH indicator inoperative?** → **Yes** GO to C4. → **No** If the 4x4 LOW indicator is inoperative, GO to C9. If both the 4x4 HIGH and 4x4 LOW indicators are inoperative; REFER to Section 413-01.
C4 CHECK THE 4X4 HIGH INDICATOR — MONITOR THE GEM PID 4WDHIGH	
1 2 	2 Monitor the GEM PID 4WDHIGH while triggering the GEM active command HIGH LAMP to ON then OFF. The 4X4 HIGH indicator should illuminate, then go off. • **Does the indicator operate correctly?** → **Yes** Indicator is operating correctly, GO to Pinpoint Test A. → **No** If the GEM PID 4WDHIGH displays ON-B-, GO to C7. If the GEM PID 4WDHIGH displays OFFO-G, GO to C5.
C5 CHECK THE GEM	
1	

 2 GEM C282 3  GC1586-A 4 	3 Connect a jumper wire between GEM C282-14, circuit 783 (GY), and ground. • **Does the 4x4 HIGH indicator illuminate?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C6 .
C6 CHECK CIRCUIT 783 (GY) FOR OPEN	
1 2 Instrument Cluster C286 3	3 Measure the resistance between GEM C282-14, circuit 783 (GY), and instrument cluster C286-3, circuit 783 (GY).



- **Is resistance less than 5 ohms?**

→ **Yes**
REPLACE the instrument cluster printed circuit; REFER to Section 413-01 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 783 (GY). CLEAR the DTCs. TEST the system for normal operation.

C7 CHECK THE INSTRUMENT CLUSTER FOR SHORT TO POWER — MONITOR THE GEM PID 4WDHIGH

1

2

Instrument Cluster C286

3

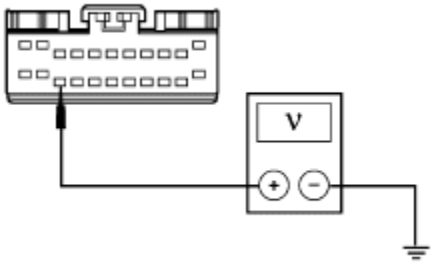
4

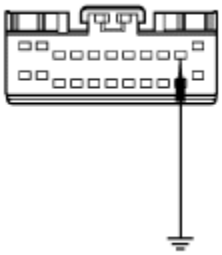
4 Monitor the GEM PID 4WDHIGH while triggering the GEM active command HIGH LAMP to ON then OFF.

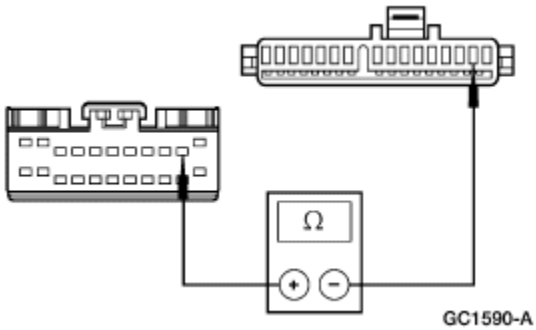
- **Does the GEM PID 4WDHIGH display ON-B-?**

→ **Yes**
GO to C8 .

→ **No**

	REPLACE the instrument cluster printed circuit; REFER to Section 413-01 . CLEAR the DTCs. TEST the system for normal operation.
C8 CHECK CIRCUIT 783 (GY) FOR SHORT TO POWER	
1 2 GEM C282 3  GC1588-A	3 Measure the voltage between GEM C282-14, circuit 783 (GY), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 783 (GY). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
C9 CHECK THE 4X4 LOW INDICATOR — MONITOR THE GEM PID 4WDLOW	
1 2 	2 Monitor the GEM PID 4WDLOW while triggering the GEM active command LOW LAMP to ON then OFF. The 4x4 LOW indicator should illuminate, then go off. • **Does the indicator operate correctly?** → **Yes**

	Indicator is operating correctly, GO to Pinpoint Test A . → **No** If the GEM PID 4WDLOW displays ON-B-, GO to C12 . If the GEM PID 4WDLOW displays OFFO-G, GO to C10 .
C10 CHECK THE GEM	
1 2 GEM C282 3  GC1589-A 4 	3 Connect a jumper wire between GEM C282-10, circuit 784 (LB/BK), and ground. • **Does the 4X4 LOW indicator illuminate?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C11 .
C11 CHECK CIRCUIT 784 (LB/BK) FOR OPEN	
1	

1 2 Instrument Cluster C286 3  GC1590-A	3 Measure the resistance between GEM C282-10, circuit 784 (LB/BK), and instrument cluster C286-2, circuit 784 (LB/BK). • **Is resistance less than 5 ohms?** → **Yes** REPLACE the instrument cluster printed circuit; REFER to Section 413-01 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 784 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.
C12 CHECK THE INSTRUMENT CLUSTER FOR SHORT TO POWER — MONITOR THE GEM PID 4WDLOW	
1 2 Instrument Cluster C286 3 4	4 Monitor the GEM PID 4WDLOW while triggering the GEM active command LOW LAMP to ON, then OFF.

- **Does the GEM PID 4WDLOW display ON-B-?**

→ **Yes**
GO to C13 .

→ **No**
REPLACE the instrument cluster printed circuit; REFER to Section 413-01 . CLEAR the DTCs. TEST the system for normal operation.

C13 CHECK CIRCUIT 784 (LB/BK) FOR SHORT TO POWER

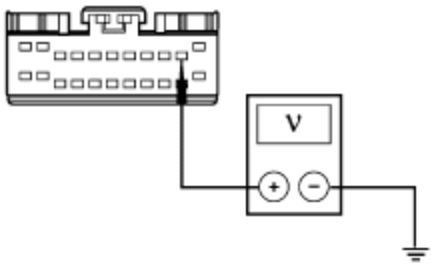
1

2

GEM C282

3

4



GC1591-A

4 Measure the voltage between GEM C282-10, circuit 784 (LB/BK) and ground.

- **Is any voltage indicated?**

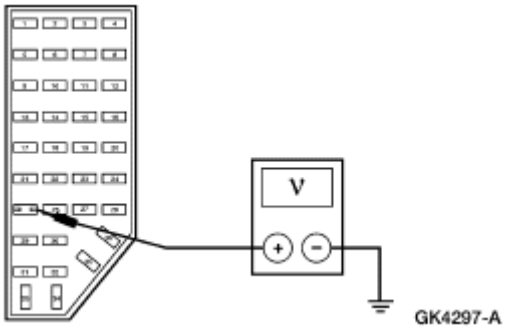
→ **Yes**
REPAIR circuit 784 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for

	normal operation.

PINPOINT TEST D: NO COMMUNICATION WITH MODULE — GENERIC ELECTRONIC MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK POWER DISTRIBUTION BOX MAXI-FUSE 1 (60A)	
1 Fuse 1 (60A)	• **Is the fuse OK?** → **Yes** GO to D2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
D2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to D3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.
D3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE	
1	1 Measure the voltage between fuse junction panel fuse 25 (7.5A) pin 2, circuit 1052 (T/BK), and ground.



- **Is voltage greater than 10 volts?**

→ **Yes**
GO to D4 .

→ **No**
REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.

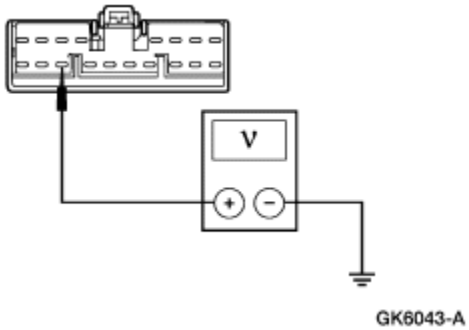
D4 CHECK THE VOLTAGE TO THE GEM — CIRCUIT 1001 (W/Y)

1

2

GEM C283

3



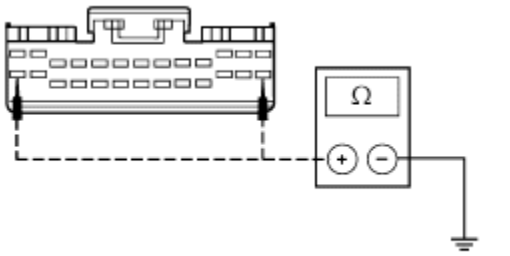
3 Measure the voltage between GEM C283-11, circuit 1001 (W/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to D5 .

→ **No**
REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.

D5 CHECK CIRCUIT 570 (BK/W) FOR OPEN

1 GEM C280 2  GC1770-A	2 Measure the resistance between GEM C280-14, circuit 570 (BK/W), and ground; and between GEM C280-26 circuit 570 (BK/W), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

General Specifications

Item	Specification	Capacity
Motorcraft MERCON® Automatic Transmission Fluid XT-2-DDX or -QDX	—	1.42 Liters (3.0 Pints)
Motorcraft Black Non-Acid Cure Silicone Rubber E7TZ-19562-A	ESL-M4G273-A	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Breather barb	8-14	6-10	—
Transfer case bolts	25	18	—
Damper bolts	41	30	—
Drain plug	15	11	—
Transfer case to transmission bolts	41	30	—
Fill plug	15	11	—
Rear output flange nut	355	262	—
Transfer case shift motor bolts	10	—	89
Clutch coil assembly nuts	10	—	89
Output shaft speed sensor bolt	5	—	44
Skid plate bolts	24	18	—

Transfer Case

Motor, Electric Shift

The externally mounted transfer case shift motor (7G360), located at the rear of the transfer case (7A195), turns the shift cam assembly. As the shift cam assembly turns, it positions the reduction shift fork (7289) for desired transfer case operation. An integral position sensor in the shift motor provides motor position information to the generic electronic module (GEM).

Switch, Rotary 4x4 Mode

The rotary 4x4 mode switch, mounted on the instrument panel, allows the operator to select the 4WD Auto, 4WD High, and 4WD Low transfer case operating modes. The indicator light, above the rotary switch dial, will illuminate when the 4WD High or 4WD Low position has engaged.

Switch, Brake Pedal Position (BPP)

The brake pedal position (BPP) switch is located on the brake pedal. The switch signals the GEM when the operator activates the brake pedal.

Switch, Clutch Pedal Position (CPP)

The clutch pedal position (CPP) switch is located on the clutch pedal bracket. On vehicles equipped with a manual transmission (7003) and an electronic shift transfer case, the clutch pedal must be fully depressed and vehicle stopped in order to make a range shift from HIGH to LOW, or from LOW to HIGH.

Sensor, Digital Transmission Range (DTR)

The DTR sensor is located on the outside of the transmission near the transmission shift cable attachment. The DTR sensor completes the start circuit in PARK and NEUTRAL, the back-up lamp circuit in REVERSE and the neutral sense circuit (4WD) in NEUTRAL. The DTR sensor also sends a digital output signal to the powertrain control module (PCM) (12A650) indicating the manual lever position (P, R, N, D, 2, 1).

Sensor, Throttle Position (TP)

The TP sensor is located on the throttle body. The sensor provides throttle position information to the PCM. The PCM converts the throttle position signal to a pulse width modulated (PWM) signal, and sends it to the GEM to control and adjust the transfer case clutch duty cycle.

Sensor, Front and Rear Output Shaft Speed (OSS)

The externally mounted OSS sensors are located at the rear of the transfer case. The sensors provide the GEM with front and rear driveshaft speeds to control and adjust the transfer case clutch duty cycle.

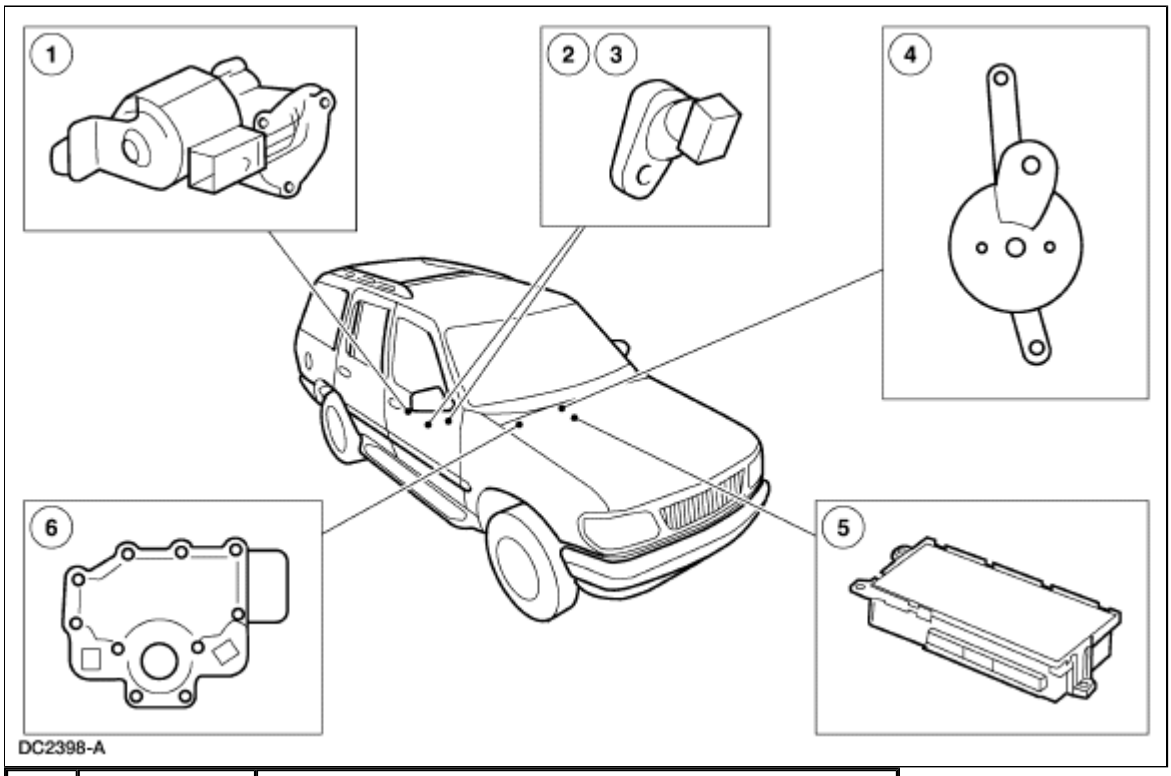
Sensor, Vehicle Speed Sensor (VSS)

The Anti-Lock Brake System (ABS) provides the GEM with vehicle speed information to control and adjust the transfer case clutch duty cycle.

Generic Electrical Module (GEM)

The GEM controls the operation of the transfer case in response to inputs from the electric shift motor, 4x4 mode switch, CPP switch, BPP switch, DTR sensor, throttle position output from the PCM, front and rear OSS sensors, and the VSS.

Electronic Shift Control System Components



Item	Part Number	Description
1	7G360	Transfer case shift motor
2	7F293	Front output shaft speed sensor
3	7F293	Rear output shaft speed sensor
4	—	Shift range selector switch
5	14B205	Generic electronic module (GEM) (electric shift only)
6	—	Digital transmission range (DTR) sensor

Mechanical Operation

The Borg-Warner 44-05 transfer case is available in the Explorer (A4WD) vehicle. The transfer case transfers power from the transmission to the rear axle, and also to the front axle when electronically activated.

In the Auto mode, torque from the transmission is transferred to the input shaft (7017) which, in turn, drives

the rear output shaft (7061) that drives the rear axle assembly (4006). The electromechanical ball ramp clutch assembly drives the drive sprocket (7177) after the GEM activates the clutch coil. The drive sprocket turns the drive chain (7A029) that rotates the front output shaft and the front driveshaft (4602). In the 4x4 High mode, the operation is the same as in the Auto mode, except that the GEM consistently activates the electromechanical ball ramp clutch assembly.

The high-low shift occurs when the reduction shift fork moves the high-low collar (7100) to lock the planetary gear set to the output shaft. Then, torque, transmitted through the sun gear, from the input shaft, turns the front planetary gear set assembly (7A398). The front planetary gear set assembly, which is now engaged, provides transfer case speed reduction.

Transfer Case Functions

There are three transfer case modes, Auto, 4WD Low, and 4WD High. Neutral is only available as a dealer installed option.

Control-Trac Function

The Control-Trac transfer case uses an electromechanical clutch assembly to control torque to the front wheels. In the Auto mode, while at rest and under cruising conditions, the GEM activates the transfer case clutch at a minimum level. This allows for the slight difference between the front and rear driveshafts which occurs normally when negotiating a corner on dry pavement. Under any of the following conditions, the GEM will increase the torque sent through the clutch to the front wheels in order to prevent or control slip.

- Slip is detected (by monitoring the front and rear OSS sensors in the transfer case)
- Throttle position (by using the throttle position signal from the EEC)

Range Function

NOTE: At zero throttle, the duty cycle remains low. At very light to heavy acceleration, the duty cycle jumps to the maximum.

In the 4WD Low Range, with throttle input, the transfer case electromechanical clutch locks the front and rear driveshafts for maximum 4WD traction. The transfer case shift motor rotates the shift cam to move the reduction shift fork to the 4WD low range position. This low range shift, accomplished through a planetary gear set, changes the torque to the driveshaft from 1:1 to 2.48:1 ratio.

In the 4WD High Range, with throttle input, the GEM signals the transfer case electromechanical clutch to lock the front and the rear driveshafts for maximum 4WD traction. Never use the 4WD High range when driving on dry or merely wet pavement. Use the 4WD High range only for driving off-road or in severe winter weather.

Transfer Case

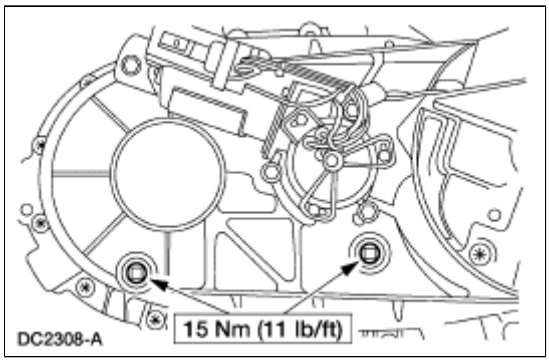
Refer to Section 308-07A .

Transfer Case Draining and Filling

1. **CAUTION: Transfer case failure can result if the correct fill procedures are not followed.**

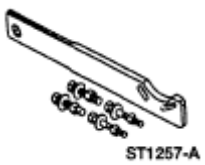
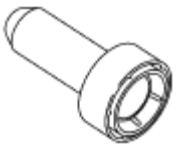
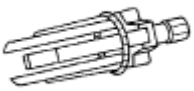
   NOTE: The fluid level must be just below the fill plug.

   Remove the fill plug and check the fluid level.
   - If the fluid is below the proper level, fill the transfer case with Motorcraft MERCON® Automatic Transmission Fluid XT-2-QDX or -DDX or MERCON® equivalent.



Seal —Rear

Special Tool(s)

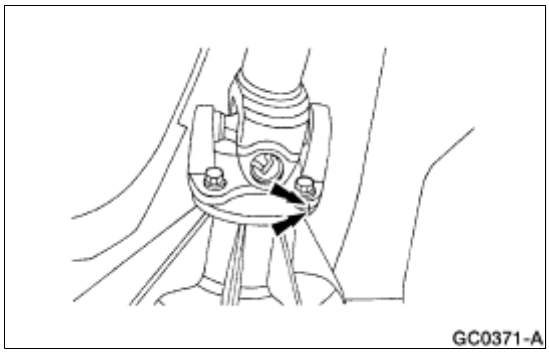
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST2305-A	Input Shaft Seal Installer 308-186 (T90T-7127-B)
 ST1213-A	Puller 307-001 (TOOL-1175-AC) or Equivalent

Removal

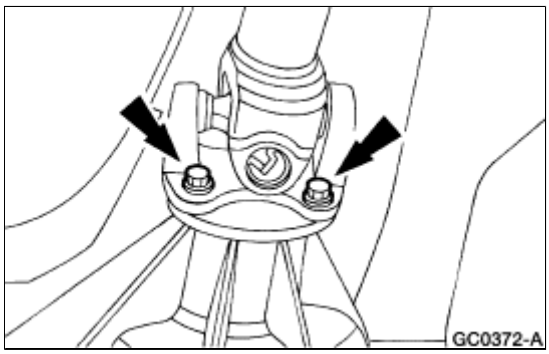
WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs which can result in shifting of the vehicle during these operations.

1. With the transmission in neutral, raise and support the vehicle. For additional information, refer to Section 100-02 .

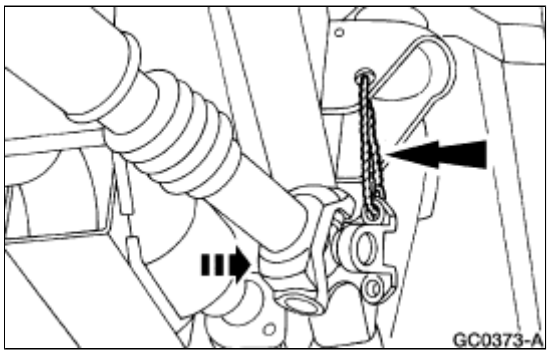
2. Index-mark the rear output flange (7B214) and the driveshaft yoke.



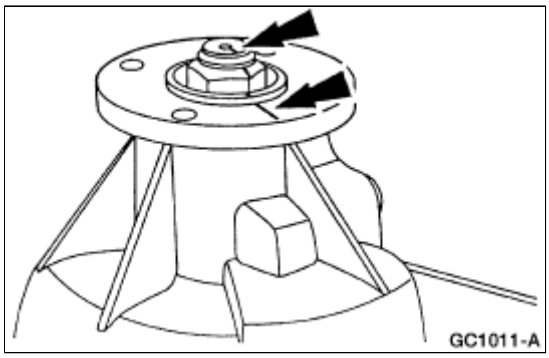
3. Remove the four bolts.



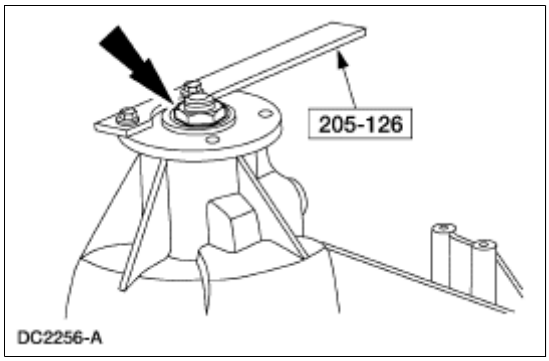
4. Separate the driveshaft from the output flange, and position the driveshaft aside.



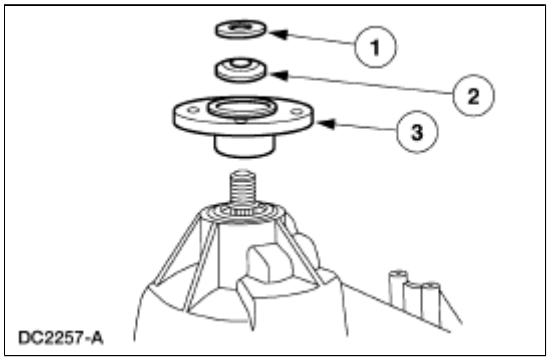
5. Index-mark the rear output flange to the rear output shaft (7061).



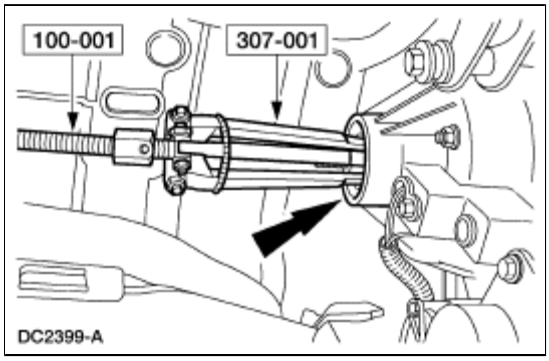
6. Use the special tool to hold the rear output flange while removing the nut.



7. Remove the rear output flange.
    1. Remove the output shaft yoke washer (7B368).
    2. Remove the oil seal (7052).
    3. Remove the rear output flange.

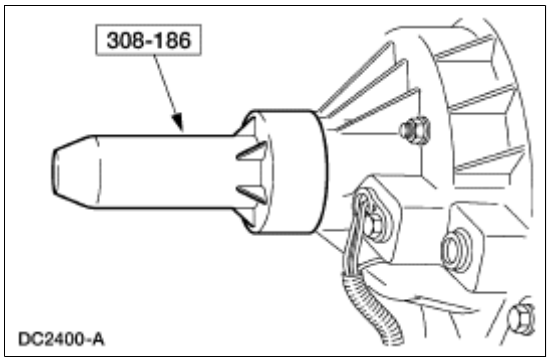


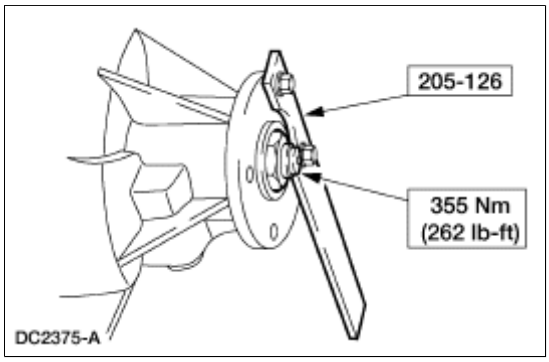
8. Using the special tools, remove the oil seal.



Installation

1. To install, reverse the removal procedure.
    - Use the special tool to install the oil seal.
    - Refer to Section 205-01 for driveshaft fastener tightening specifications.
    - Check, and if necessary, fill the transfer case to the specified level with the specified fluid. For additional information, refer to Transfer Case Draining and Filling in the General Procedures portion of this section.

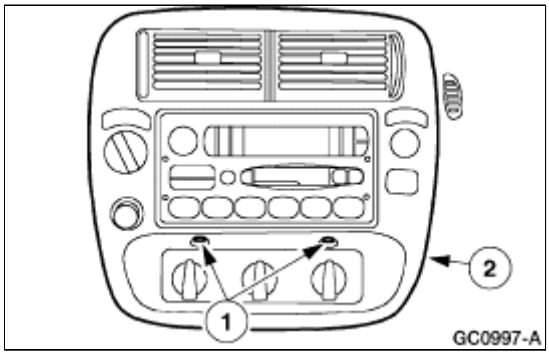

308-186
DC2400-A


205-126
355 Nm
(262 lb-ft)
DC2375-A

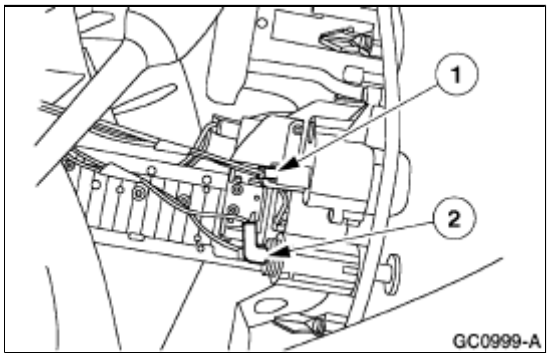
Shift Switch

Removal

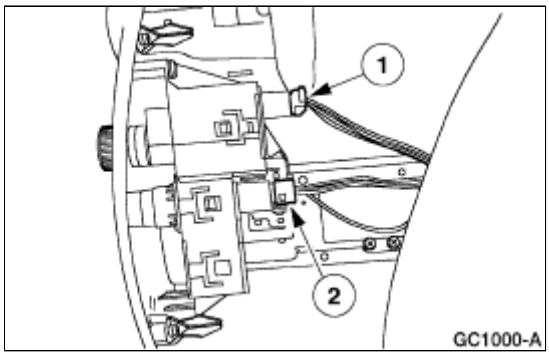
1. Remove and reposition the center instrument panel finish panel (044D70).
    1. Remove the screws.
    2. Remove and reposition the instrument panel finish panel.



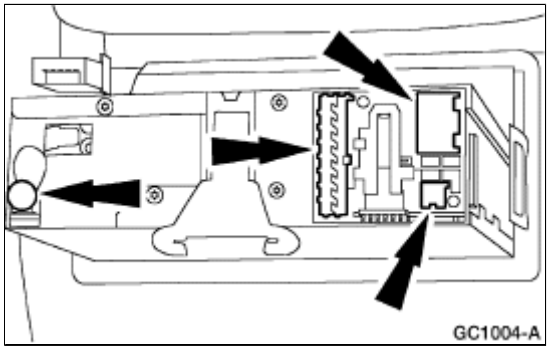
2. Disconnect the electrical connectors.
    1. Disconnect the shift range selector switch electrical connector.
    2. Disconnect the cigar lighter electrical connectors.



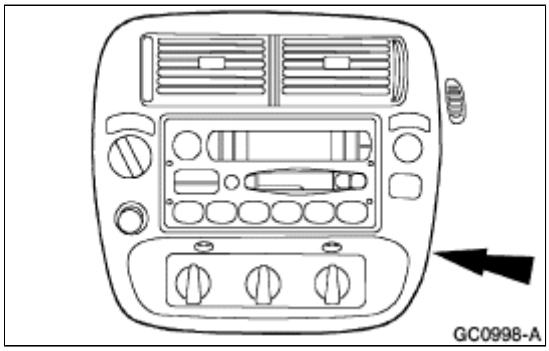
3. Disconnect the electrical connectors.
    1. Disconnect the rear heated back light switch electrical connector.
    2. Disconnect the rear wiper switch electrical connector (if so equipped).



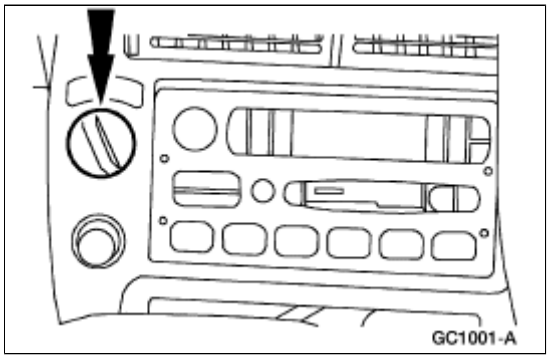
4. Disconnect the radio electrical connector.



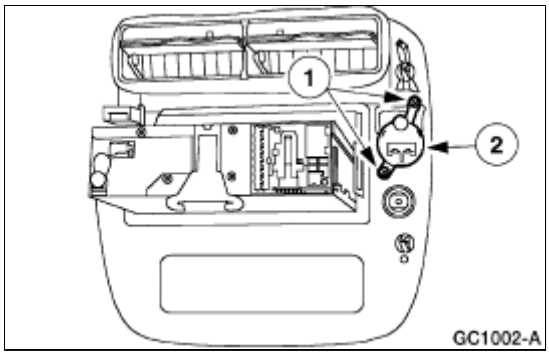
5. Remove the instrument panel finish panel.



6. Remove the shift range selector switch knob.



7. Remove the shift range selector.
    1. Remove the screws.
    2. Remove the switch.



Installation

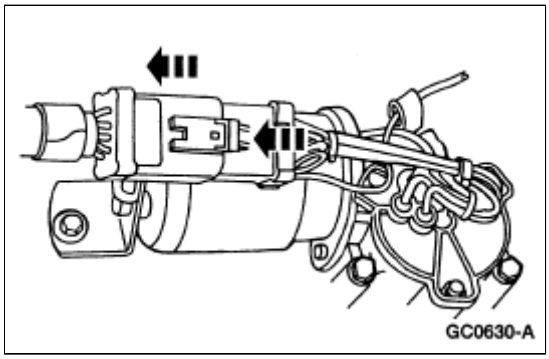
1. Follow the removal procedure in reverse order.

Transfer Case Shift Motor

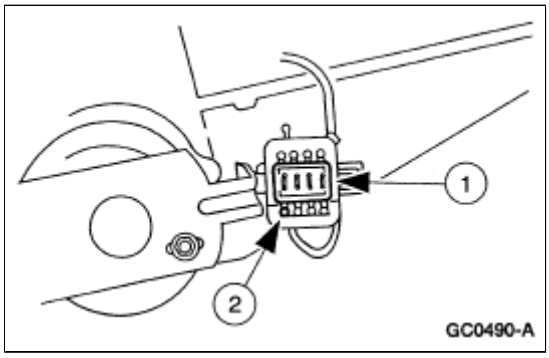
Removal

WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the electrical connector.

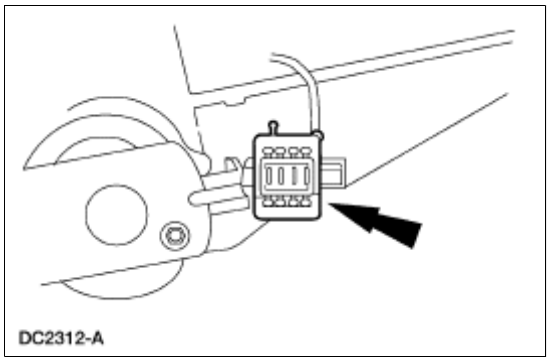


3. Remove the coil wire from the electrical connector.
    1. Remove the connector interlock.
    2. Remove the coil wire pin.
    - Use the proper electrical connector pin remover.

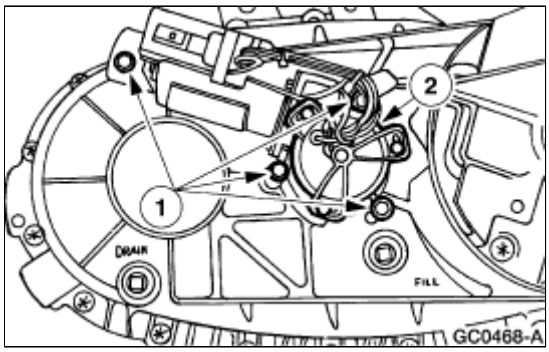


4. **CAUTION: Note each sensor wire pin location for correct installation.**

    Remove the front and rear output shaft speed sensor wire pins from the electrical connector.
    - Use the proper electrical connector pin remover.



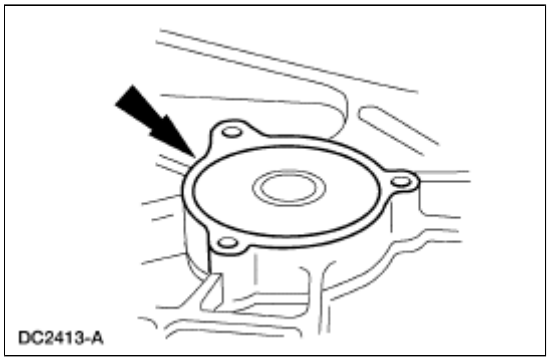
5. Remove the transfer case shift motor (7G360).
    1. Remove the four bolts.
    2. Remove the transfer case shift motor.



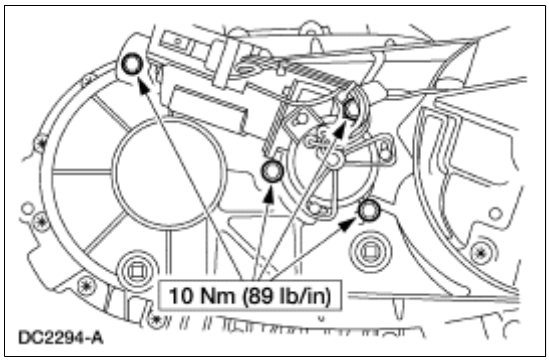
Installation

1. **NOTE:** Make sure the motor mounting surfaces are clean.

    Apply a 3-mm (1/8-inch) bead of sealant to the motor mounting surface on the case.
    - Use Black Non-Acid Cure Silicone Rubber E7TZ-19562-A or equivalent meeting Ford specification ESL-M4G273-A.



2. To install, reverse the removal procedure.

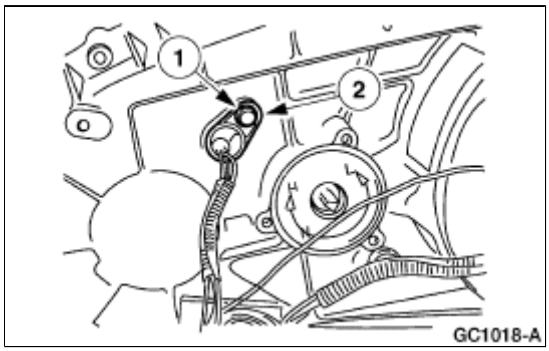

10 Nm (89 lb/in)
DC2294-A

Output Shaft Speed Sensor —Front

Removal

1. Remove the transfer case shift motor (7G360). For additional information, refer to Transfer Case Shift Motor in this section.

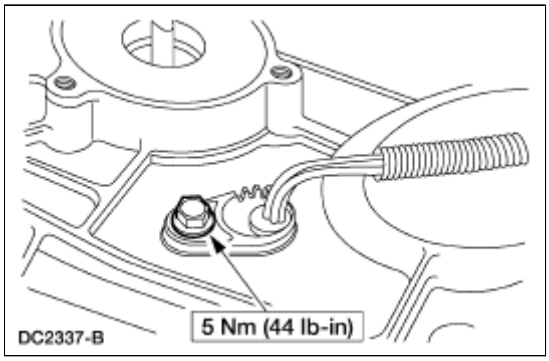
2. Remove the front output shaft speed sensor.
   1. Remove the bolt.
   2. Remove the front output shaft speed sensor.



Installation

1. **CAUTION: Make sure the sensor seats flat against the boss.**

   To install, reverse the removal procedure.

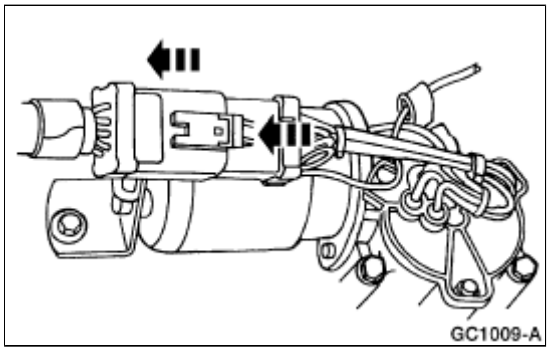


Output Shaft Speed Sensor —Rear

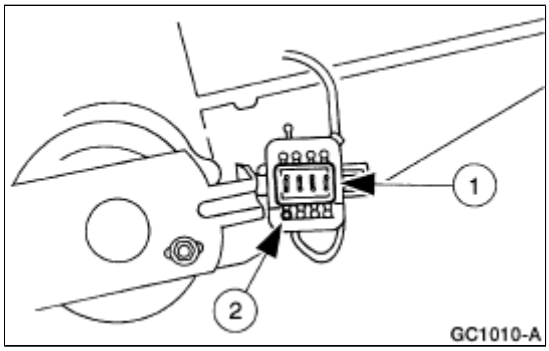
Removal

WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs which can result in shifting of the vehicle during these operations.

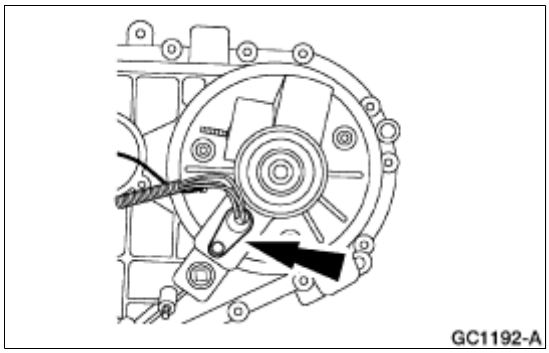
1. Raise and support vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the electrical connector.



3. Remove the rear output shaft speed sensor wires from the electrical shift motor connector.
    1. Remove the connector interlock.
    2. Remove the wires.
        - Use the proper electrical connector pin remover.



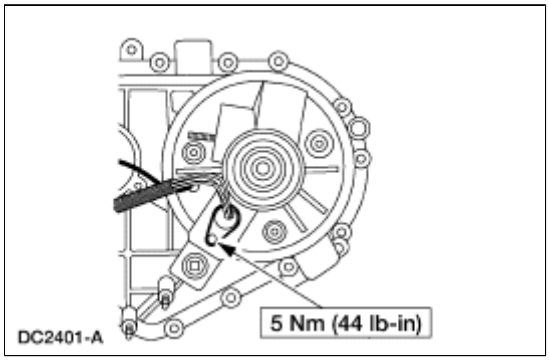
4. Remove the bolt and the sensor.



Installation

1. **CAUTION: Make sure the sensor seats flat against the boss.**

   To install, reverse the removal procedure.



Transfer Case

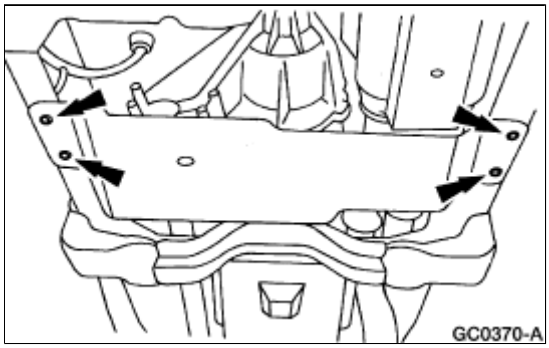
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

2. **WARNING: The electrical power supply to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs which can result in shifting of the vehicle during these operations.**

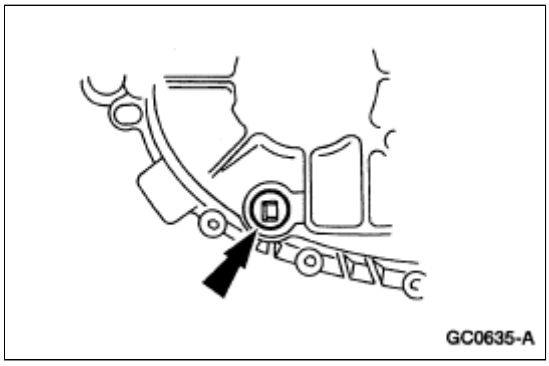
   With the transmission in neutral, raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the skid plate.

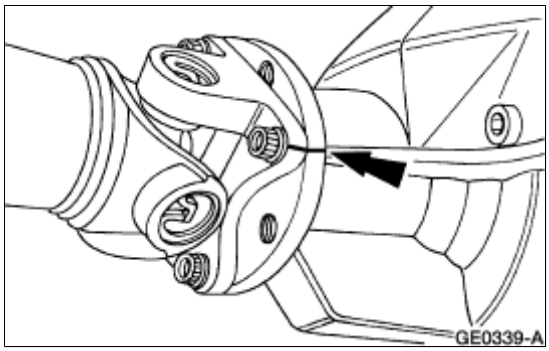


4. **NOTE:** Drain the transfer case (7A195) if disassembly is necessary.

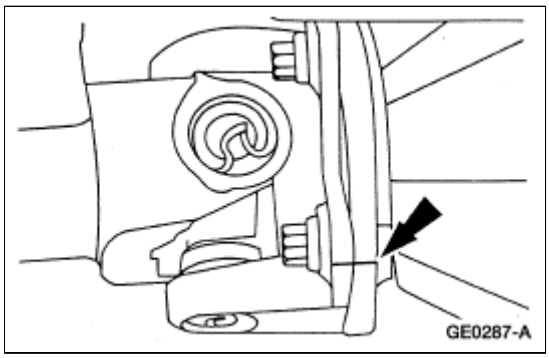
   Drain the transfer case.
   - Install the drain plug when finished draining.



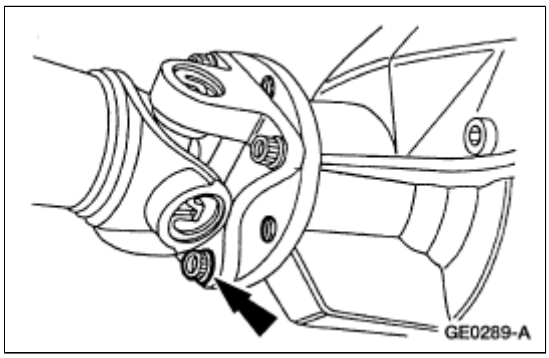
5. Index-mark the rear driveshaft yoke and pinion flange.



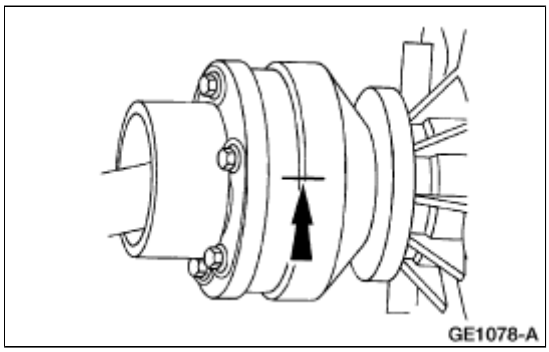
6. Index-mark the rear driveshaft yoke and rear output flange (7B214).



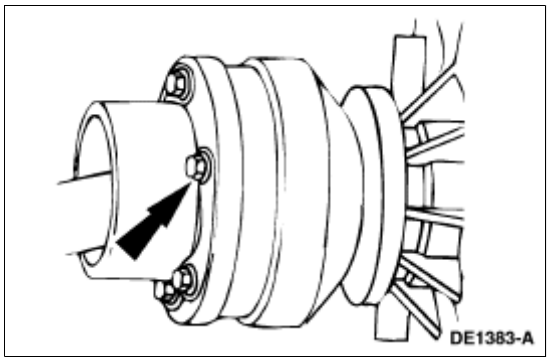
7. Remove the rear driveshaft. For additional information, refer to Section 205-01 .



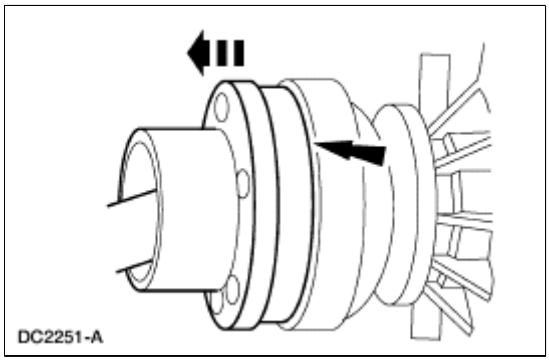
8. Index-mark the front output shaft and flange (7061) and the front driveshaft.



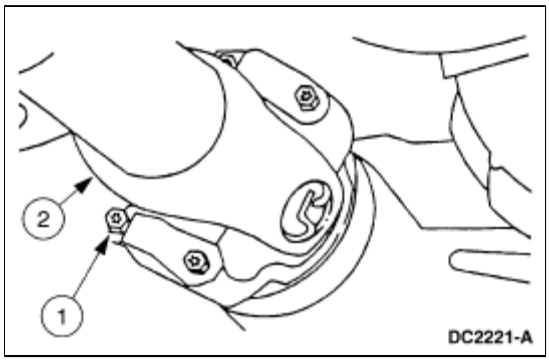
9. Remove and discard the bolts and straps.



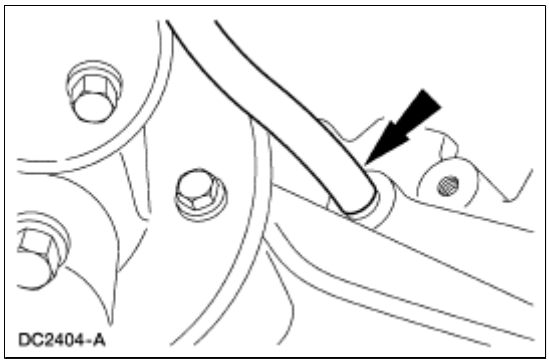
10. Separate the front driveshaft from the front output shaft and flange.



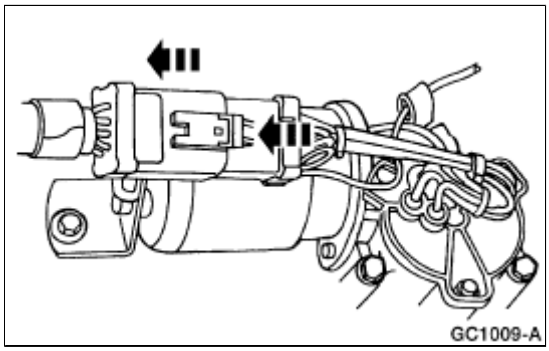
11. Remove the front driveshaft.
    1. Remove the four bolts.
    2. Disconnect the driveshaft.
    3. Carefully remove the front driveshaft.



12. Disconnect the vent tube.



13. Disconnect the shift motor electrical connector.

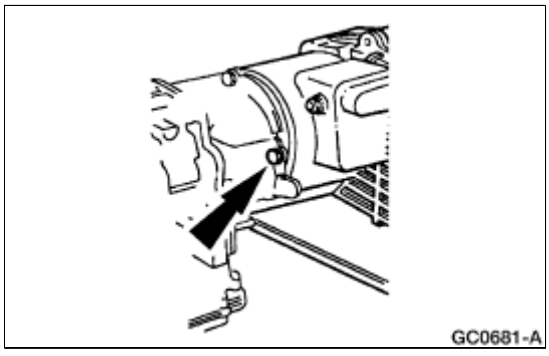


14. **CAUTION: Secure the transfer case to the jack with a safety strap.**

    Support the transfer case with a suitable hi-lift jack.

15. **CAUTION: Position a suitable drain pan below the extension housing.**

    Remove the five bolts.



16. Separate the transfer case from the extension housing.

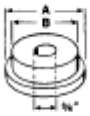
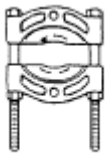
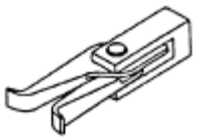
17. **CAUTION: Watch for obstructions.**

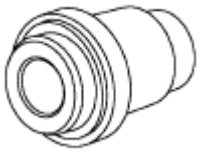
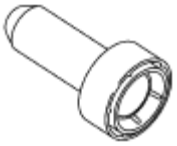
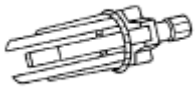
    Lower the jack and the transfer case.

18. Remove and discard the transfer case-to-extension housing gasket. Clean the gasket surfaces.

Transfer Case

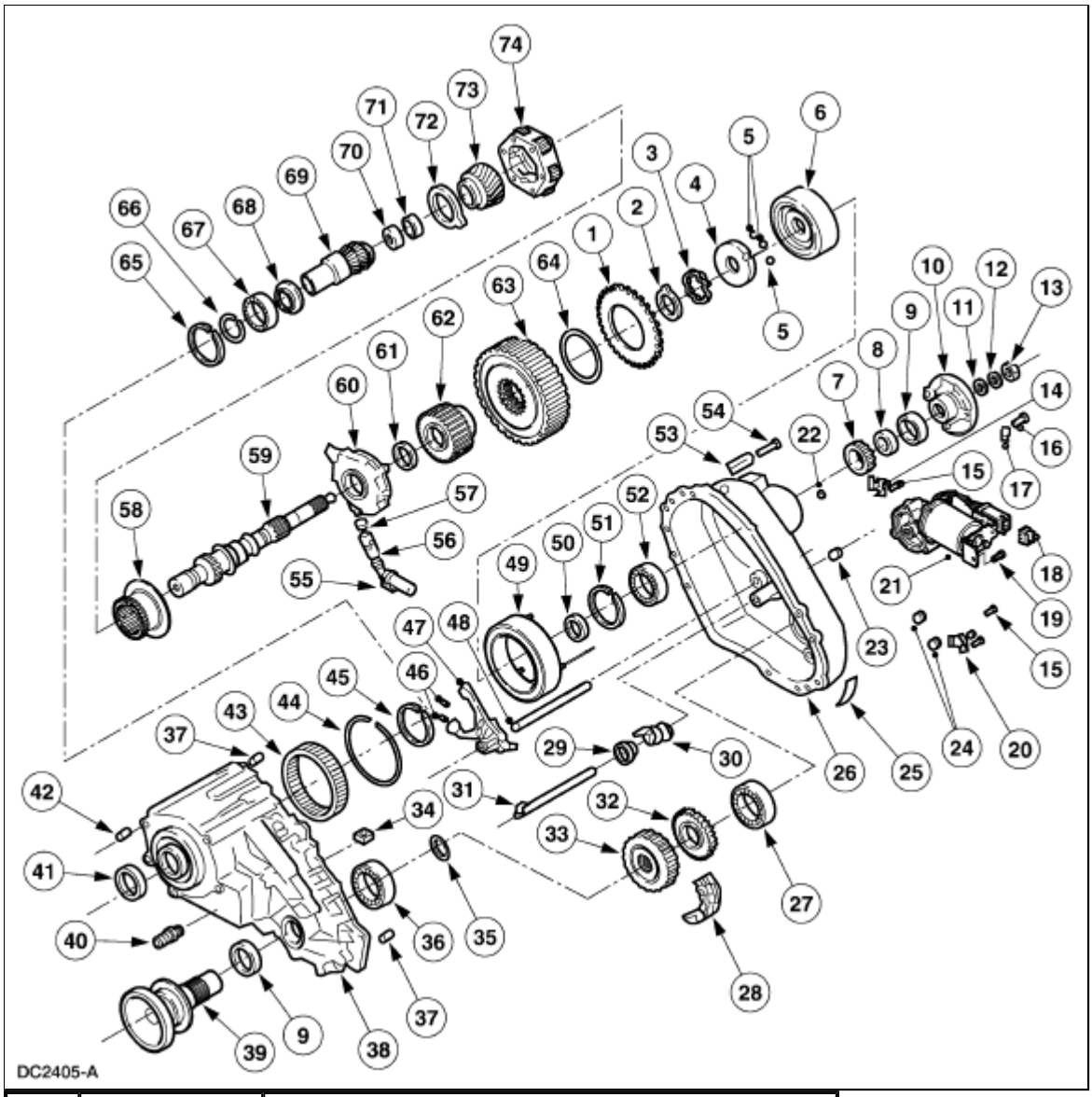
Special Tool(s)

ST1200-A	Bearing Cup Remover 308-047 (T77F-1102-A)
 ST1471-A	Bearing Cup Replacer 204-020 (T73T-1202-A)
 ST1368-A	Bearing Pulling 205-D064 (D84L-1123-A) or Equivalent
 ST1362-A	Bearing Remover 307-318 (T94P-77001-KH)
ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
ST1783-A	Differential Bearing Cup Replacer 308-163 (T88C-77000-FH)
ST1255-A	Handle 205-153 (T80T-4000-W)

ST1186-A	Holding Fixture 307-003 (T57L-500-B)
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1789-A	Input Shaft Bearing Replacer 308-085 (T83T-7025-C)
 ST2305-A	Input Shaft Seal Installer 308-186 (T90T-7127-B)
 ST1213-A	Puller 307-001 (TOOL-1175-AC) or Equivalent
ST1385-A	Seal Remover 303-409 (T92C-6700-CH)
ST1466-A	Valve Stem Seal Replacer 303-367 (T90P-6510-AH)

Disassembly

Disassembled View



Item	Part Number	Description
1	7H150	Armature
2	7917	Snap ring
3	7E085	Wave spring
4	7R428	Apply cam
5	7A534	Ball
6	7G362	Cam and coil housing assy
7	7G450	Tone wheel (upper)
8	7072	Spacer
9	7B215	Oil seal
10	7B214	Rear output flange
11	7052	Oil seal
12	7B368	Output shaft yoke washer

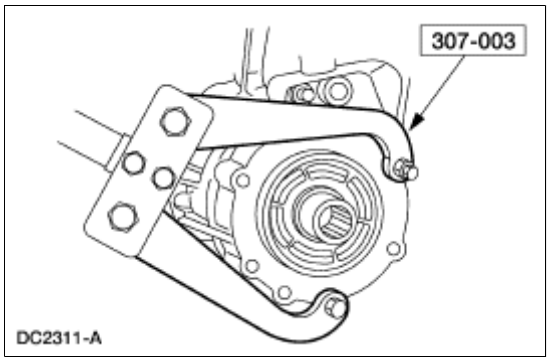
13	7045	Shaft nut
14	7F293	Speed sensor (rear output shaft)
15	7A443	Bolt
16	N800670	Bolt (3 req'd)
17	7K470	J-clip
18	—	Connector interlock (part of 7G360)
19	N802503	Bolt (hex-head)
20	7F293	Speed sensor (front output shaft)
21	7G360	Transfer case shift motor
22	N620480	Hex nut (3 req'd)
23	7288	Shifter shaft seal
24	7A010	Drain/fill plug
25	—	Identification decal (part of 7005)
26	7005	Cover
27	7025	Bearing (front output shaft rear)
28	7A029	Drive chain
29	7W074	Torsion spring
30	7F063	Electric shift cam assy
31	7N095	Shift shaft
32	7G450	Tone wheel (lower)
33	7177	Driven sprocket (30T)
34	7L027	Oil pan magnet
35	7064	Snap ring
36	7025	Bearing
37	—	Dowel pins (2 req'd) (part of 7003)
38	7005	Case assy
39	7061	Output shaft and flange (front)
40	383976	Breather barb
41	7B215	Input seal
42	—	Spiral pin (part of 7005)
43	7A153	Ring gear
44	7064	Snap ring
45	7917	Snap ring
46	7C430	Shift fork facing (2 req'd)
47	7289	Reduction shift fork
48	7240	Shift rail
49	7G361	Clutch coil assy

50	7D221	Thrust bearing
51	7917	Snap ring
52	7025	Bearing (rear output shaft support)
53	—	Identification tag (part of 7A195)
54	7A443	Bolt— hex-head (M10 x 1.5 x 30.0) (17 req'd)
55	7A098	Oil strainer
56	7A210	Pump hose
57	382846	Hose clamp
58	7100	High-low collar
59	7061	Rear output shaft
60	7A149	Pump assy
61	7Z111	Thrust washer
62	7177	Drive sprocket (30T)
63	7C108	Clutch pack assy
64	7Z104	Insulator washer
65	7064	Snap ring
66	7917	Snap ring
67	7025	Bearing (planetary gear carrier support)
68	7A385	Carrier thrust washer
69	7017	Input shaft
70	7025	Bearing
71	—	Output shaft bushing (part of 7017)
72	7B066	Thrust plate
73	7D063	Sun gear
74	7A398	Front planetary gear set assy

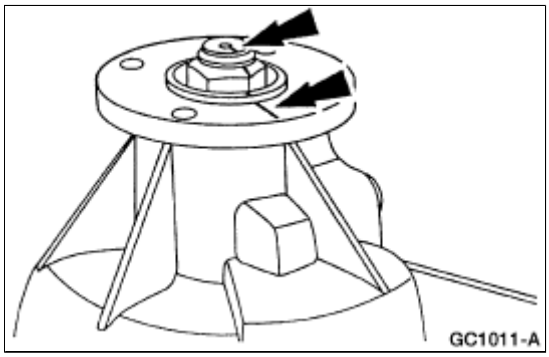
1. Remove the transfer case (7A195). For additional information, refer to Transfer Case in this section.

2. **WARNING: Make sure the Holding Fixture lock pin is secure.**

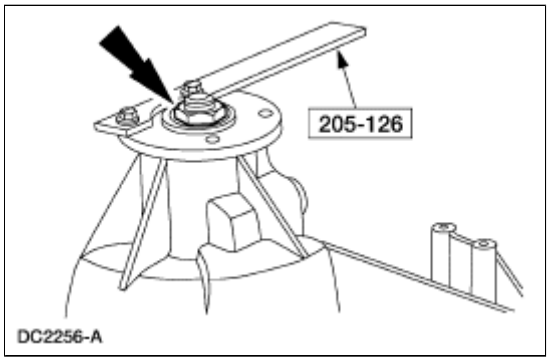
   Using the special tool, secure the transfer case to a bench.



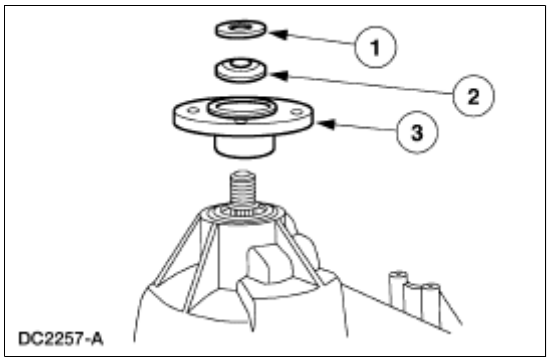
3. Index-mark the rear output flange and the rear output shaft (7061).



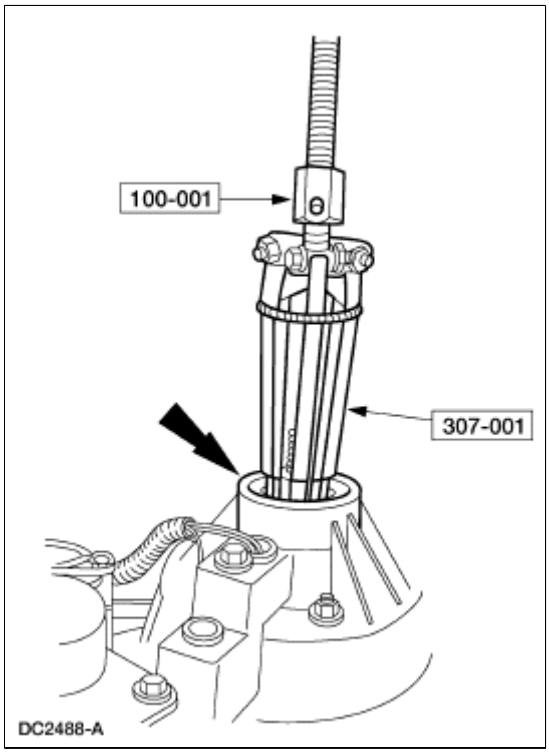
4. Use the special tool to hold the rear output flange (7B214) while removing the nut.



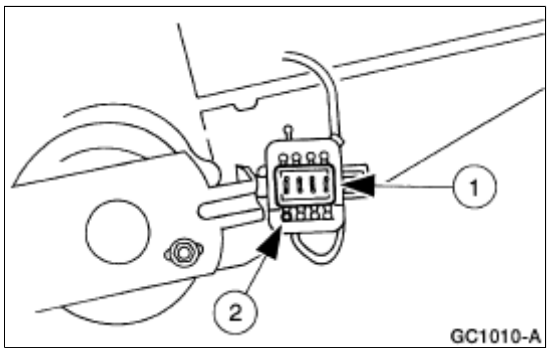
5. Remove the rear output flange.
    1. Remove the output shaft yoke washer (7B368).
    2. Remove the oil seal (7052).
    3. Remove the rear output flange.



6. Using the special tools, remove the oil seal.

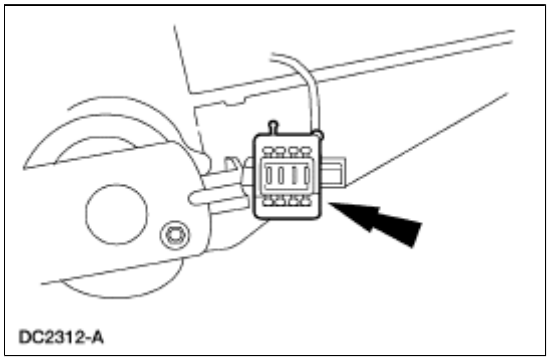


7. Remove the coil wire pin from the electrical connector.
    1. Remove the connector interlock.
    2. Remove the coil wire pin.
        - Use electrical connector pin extractor tool.

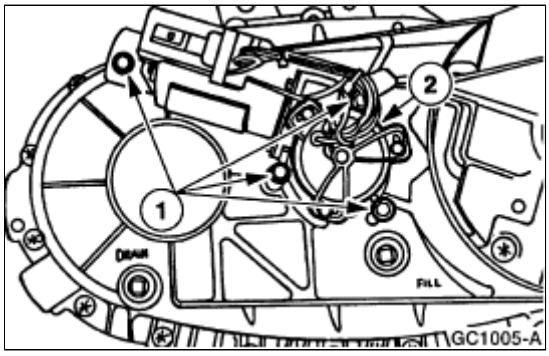


8. **CAUTION: Note each sensor wire pin location for correct installation.**

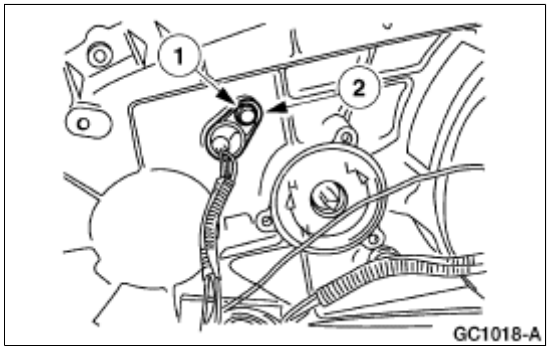
   Remove the front and rear output shaft speed sensor wire pins from the electrical connector.
   - Use an electrical connector pin extractor tool.



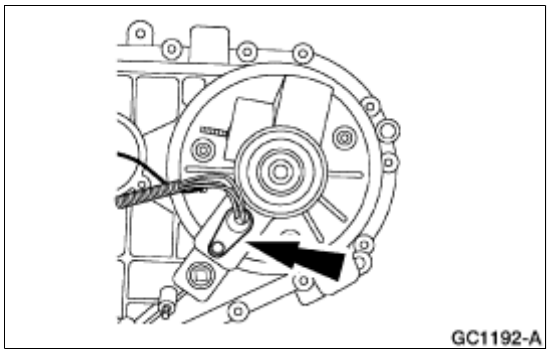
9. Remove the transfer case shift motor (7G360).
   1. Remove the bolts.
   2. Remove the transfer case shift motor.



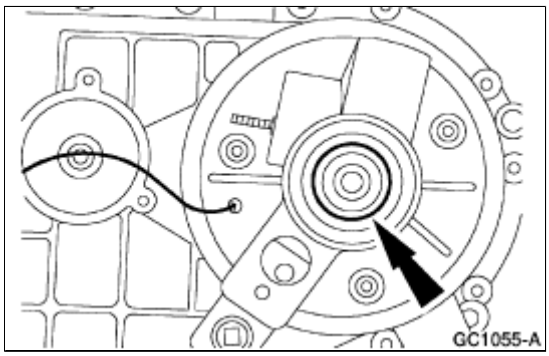
10. Remove the front output shaft speed sensor (7F293).
    1. Remove the bolt.
    2. Remove the front output shaft speed sensor.



11. Remove the bolt and the rear output shaft speed sensor (7F293).



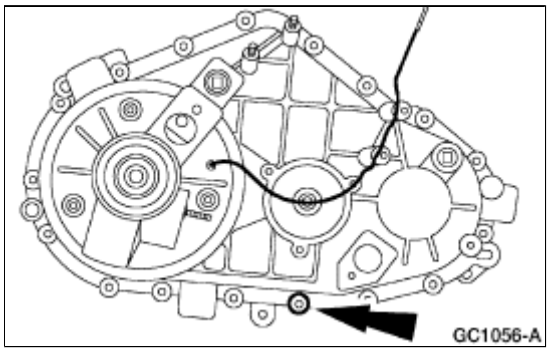
12. Remove the spacer.



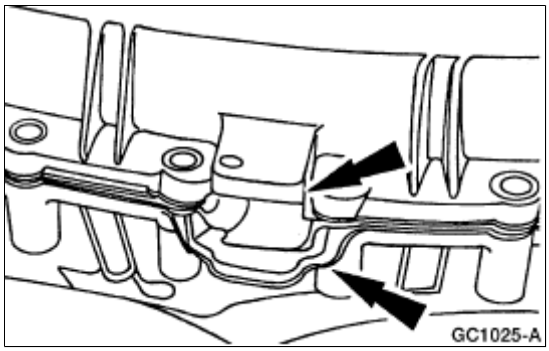
13. **NOTE:** Inspect the tone wheel teeth for damage.

    If necessary, remove and discard the tone wheel (7G450).

14. Remove the 17 bolts.

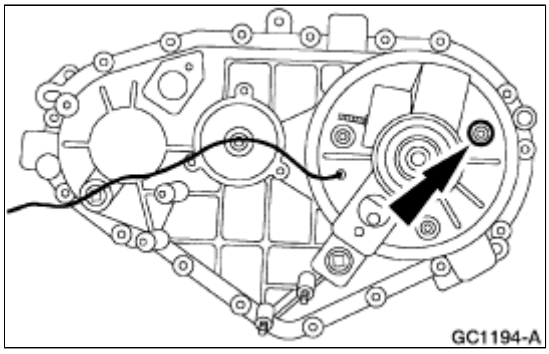


15. Separate the transfer case halves at the transfer case pry bosses.

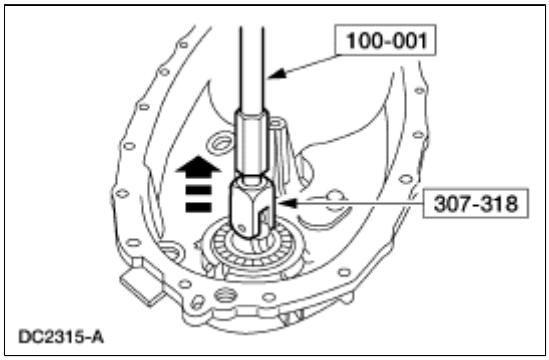


16. **CAUTION: Support the clutch coil assembly (7G361) while removing the nuts.**

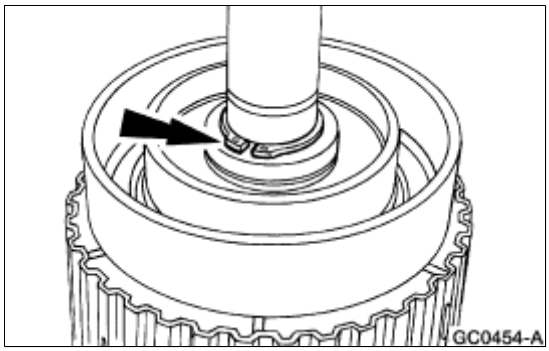
    Remove the nuts and the clutch coil assembly.



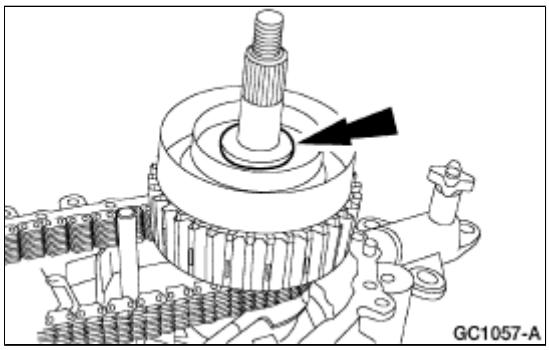
17. Using the special tools, remove the front output shaft rear bearing (7025), and remove the rear output shaft support bearing (7025).



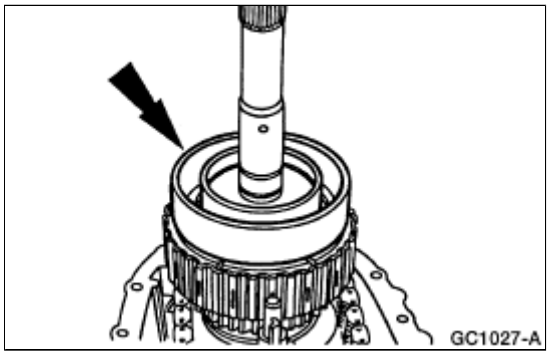
18. Remove the snap ring (7917).



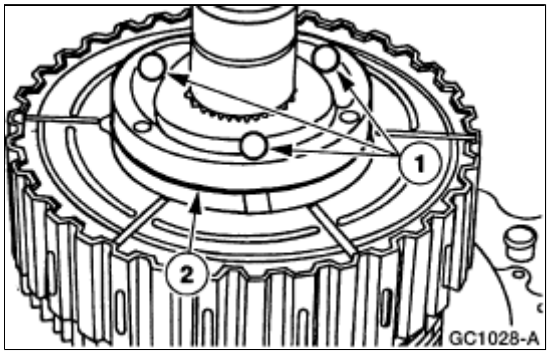
19. Remove the thrust bearing (7D221).



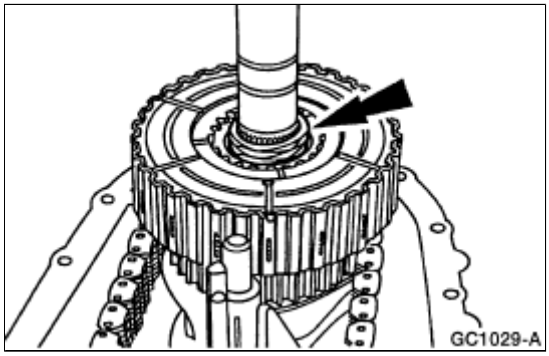
20. Remove the cam and coil housing assembly (7G362).



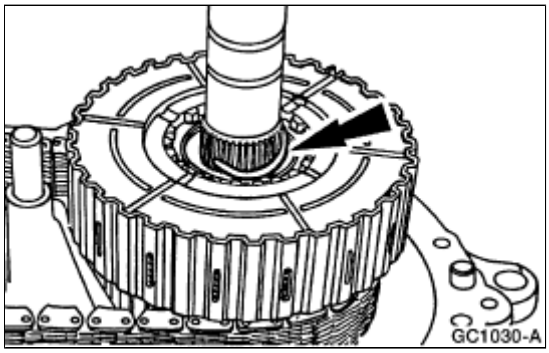
21. Remove the apply cam (7R428) and balls (7A534).
    1. Remove the steel balls.
    2. Remove the apply cam.



22. Remove the wave spring (7E085).

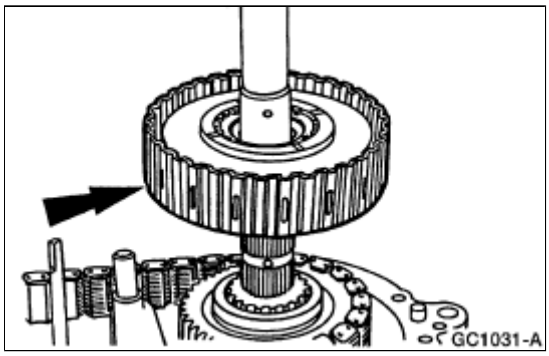


23. Remove the snap ring (7917).

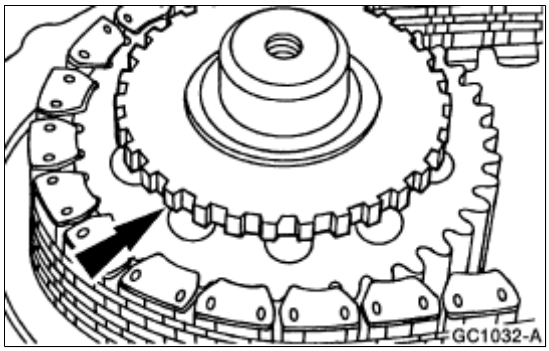


24. **CAUTION: When removing or installing the clutch pack assembly, do not separate the clutch pack assembly. Keep tension on the clutch pack upon removal. Set the clutch pack assembly on the bench in the same position as it was located in the transfer case. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem can occur.**

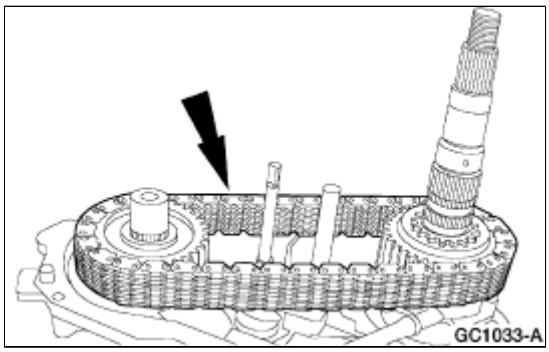
Remove the clutch pack assembly (7C108).



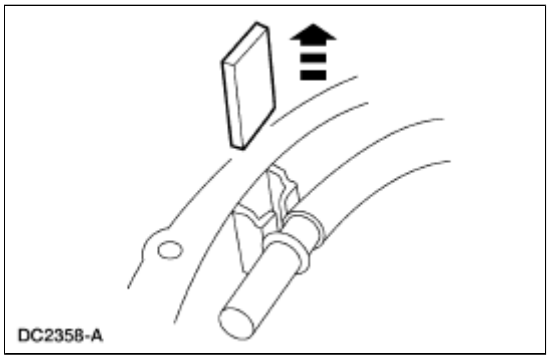
25. Remove the tone wheel (7G450).



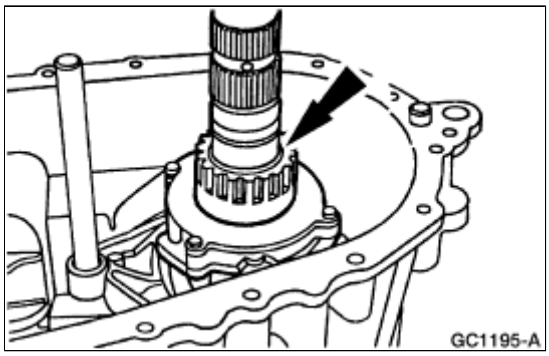
26. Remove the drive chain (7A029) and the sprockets as an assembly.



27. Remove and clean the oil pan magnet (7L027).

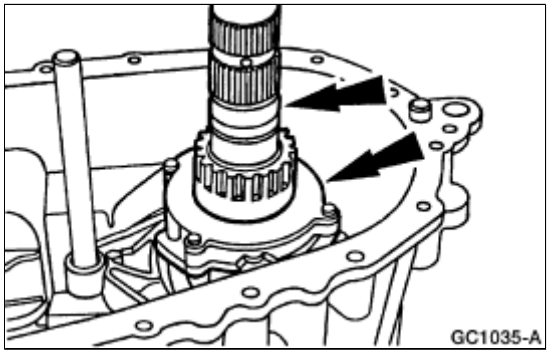


28. Remove the thrust washer (7Z111).



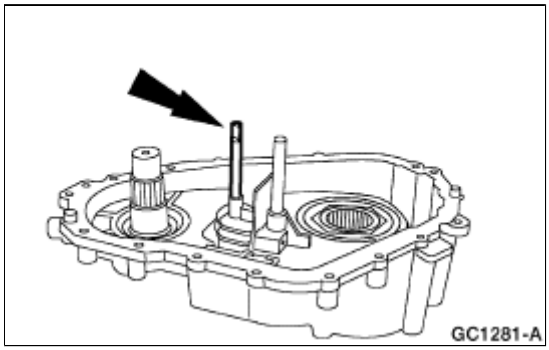
29. **CAUTION: Do not disassemble the pump assembly (7A149).**

Remove the pump assembly and the rear output shaft (7061) as an assembly.

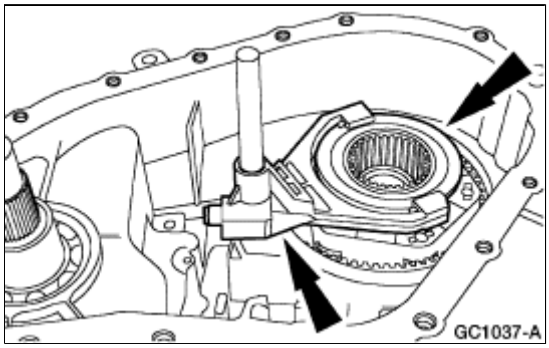


30. **CAUTION: Do not disassemble the electric shift cam assembly (7F063).**

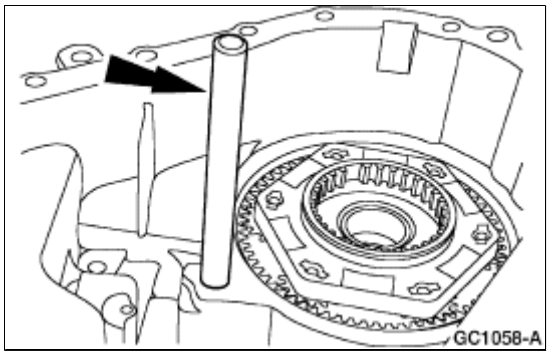
Remove the electric shift cam assembly.



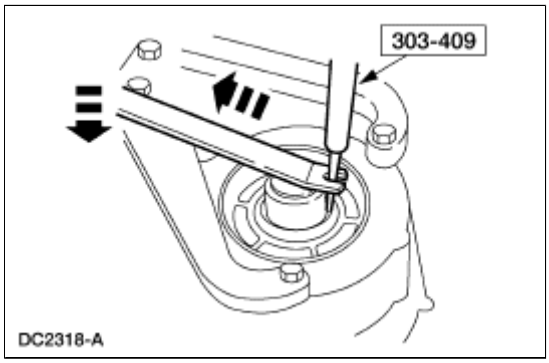
31. Remove the reduction shift fork (7289) and the high-low collar (7100) as an assembly.



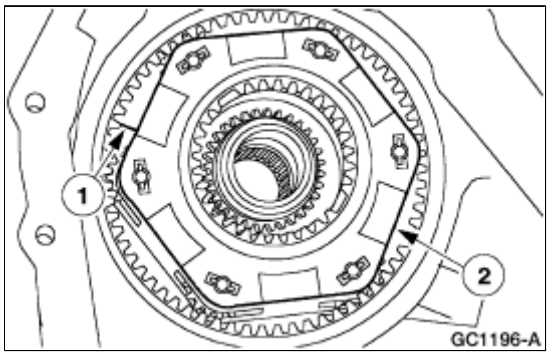
32. Remove the shift rail (7240).



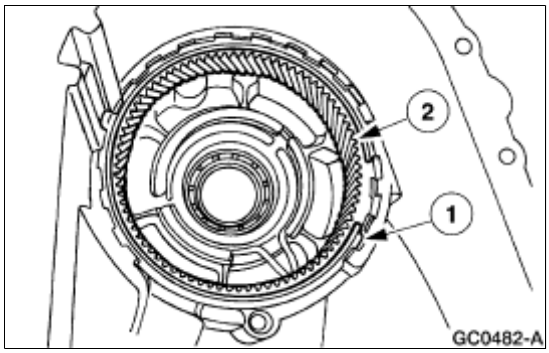
33. Using the special tool, remove the oil seal.



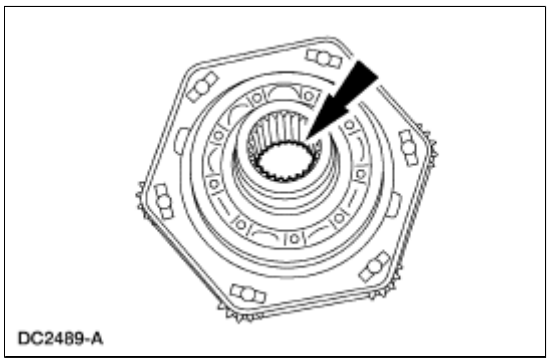
34. Remove the front planetary gear set assembly (7A398).
    1. Expand the snap ring (7064).
    2. Remove the front planetary gear set assembly.



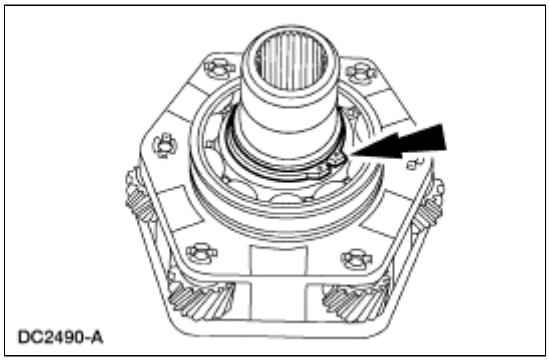
35. Remove the ring gear (7A153), if necessary.
    1. Remove the snap ring (7064).
    2. Remove the ring gear.



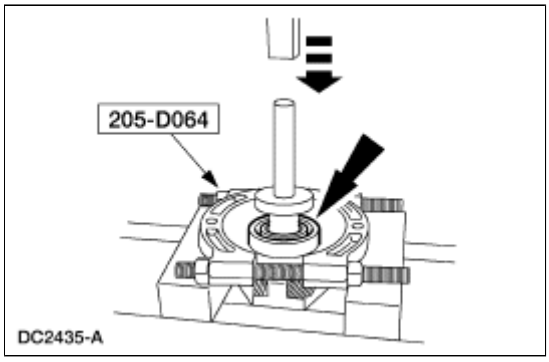
36. If necessary, using a drift and hammer, remove the output shaft bushing and bearing (7025).



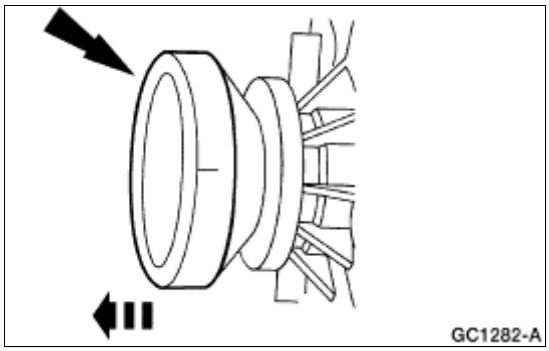
37. If planetary gear carrier support bearing (7025) removal is necessary, remove the snap ring.



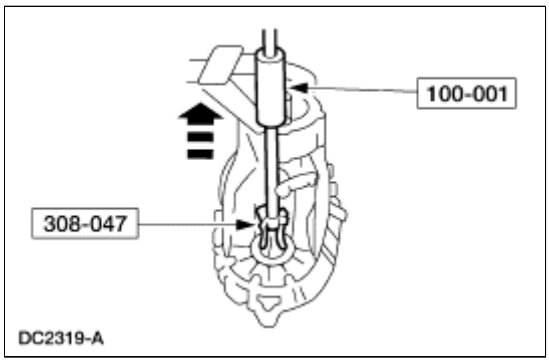
38. Using a suitable press and the special tool, remove the planetary gear carrier support bearing.



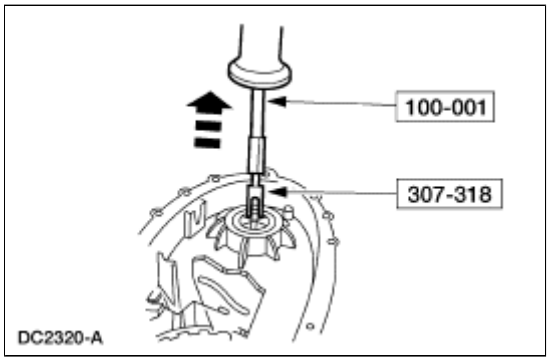
39. Remove the snap ring (7064) and the front output shaft and flange (7061).



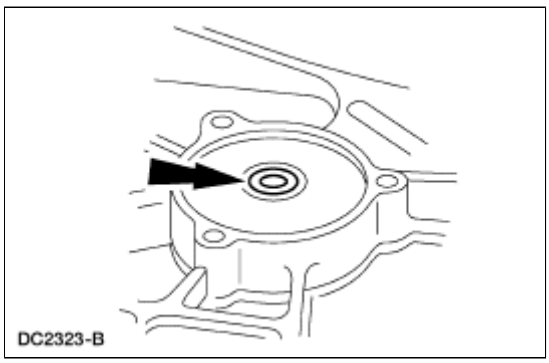
40. Using the special tools, remove the oil seal.



41. Using the special tools, remove the front output shaft support bearing (7025).



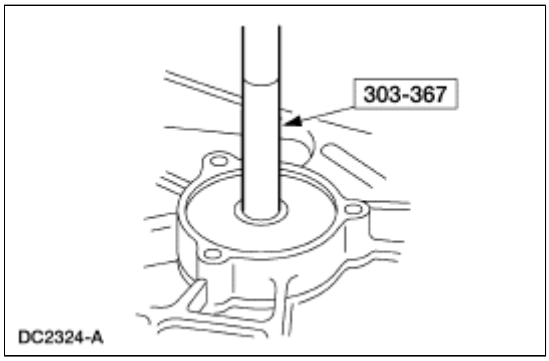
42. Using a suitable tool, remove the shifter shaft seal (7288).



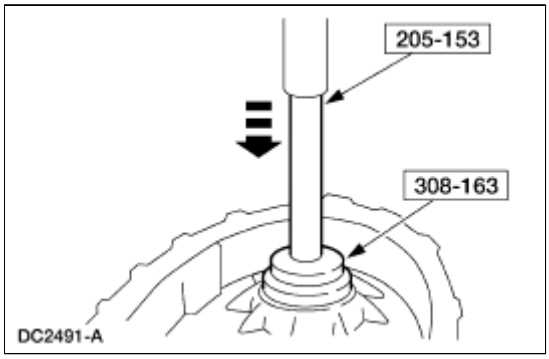
Assembly

1. **CAUTION: Do not crush the seal.**

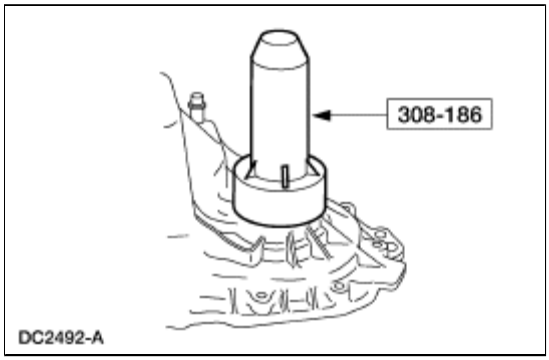
   Using the special tools, install the shifter shaft seal.



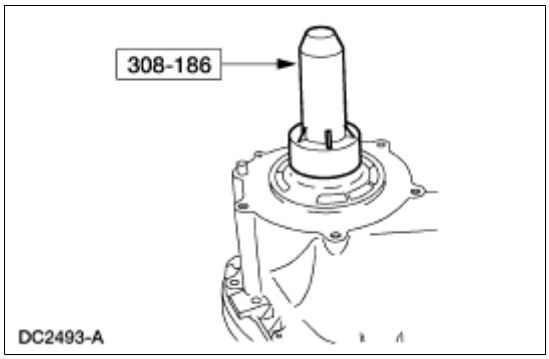
2. Using a suitable press and the special tools, install the front output shaft support bearing.



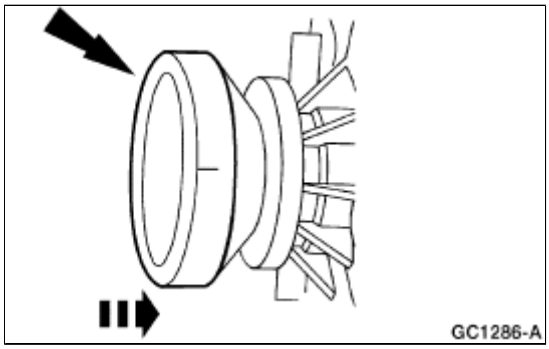
3. Using the special tool, install the oil seal.



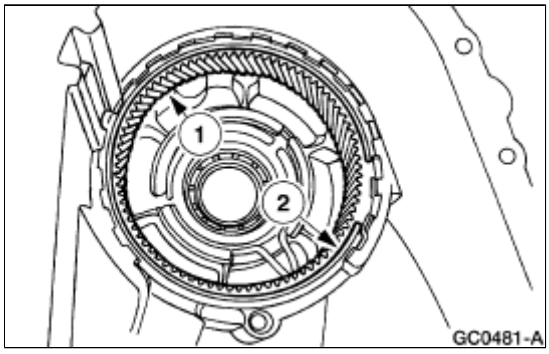
4. Using the special tool, install the oil seal.



5. Install the front output shaft and flange and snap ring.

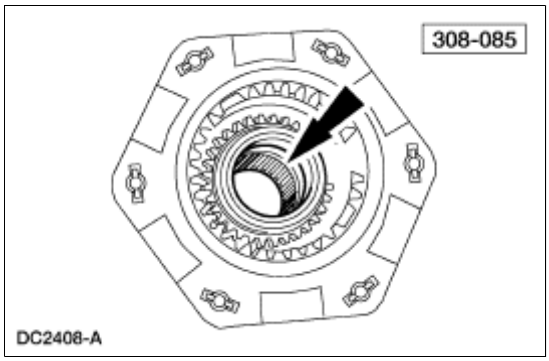


6. Install the ring gear, if removed.
    1. Position the ring gear.
    2. Install the snap ring.

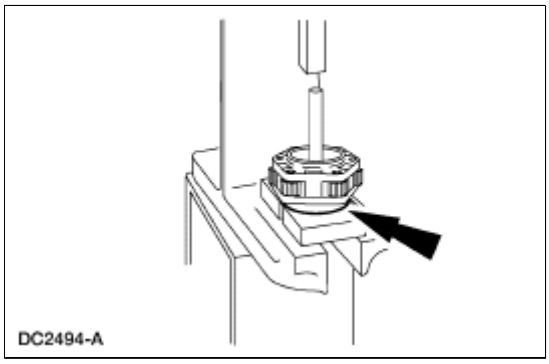


7. **CAUTION: Do not crush the bearing cage.**

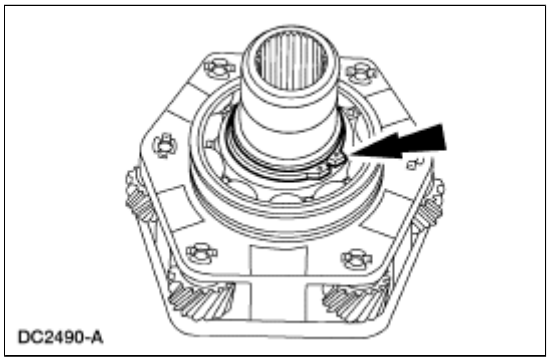
    If removed, using a suitable press and the special tool, install the bushing and the bearing.



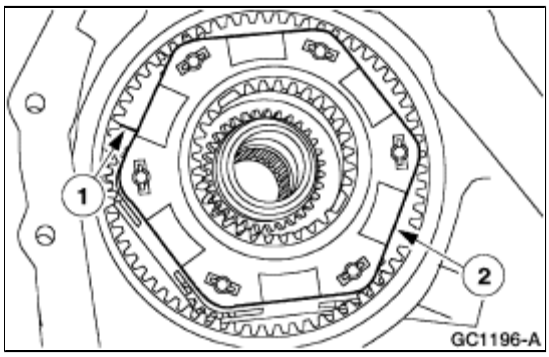
8. If removed, using a suitable press, install the planetary gear carrier support bearing.



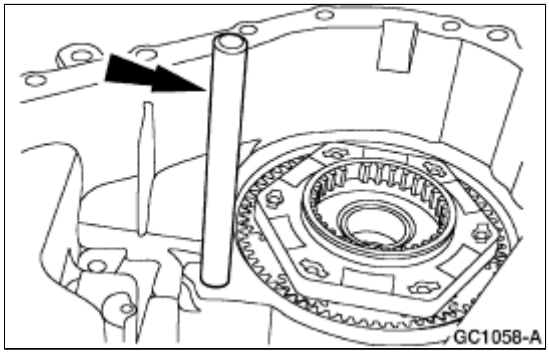
9. Install the snap ring.



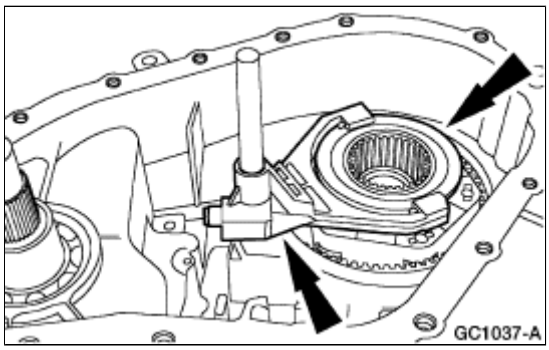
10. Install the front planetary gear set assembly.
    1. Expand the snap ring.
    2. Position the front planetary gear set assembly, and release the snap ring.



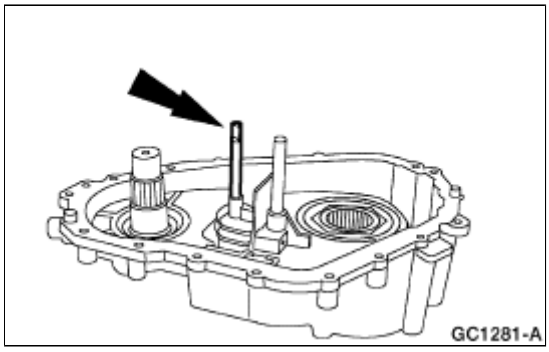
11. Install the shift rail.



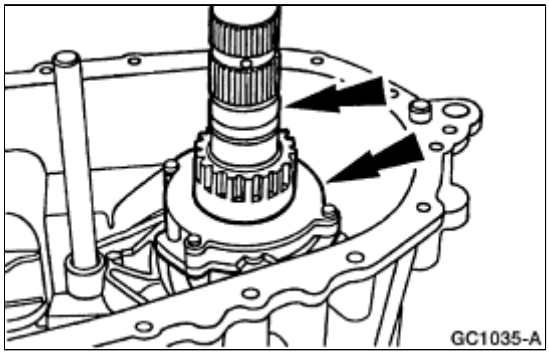
12. Install the reduction shift fork and the high-low collar as an assembly.



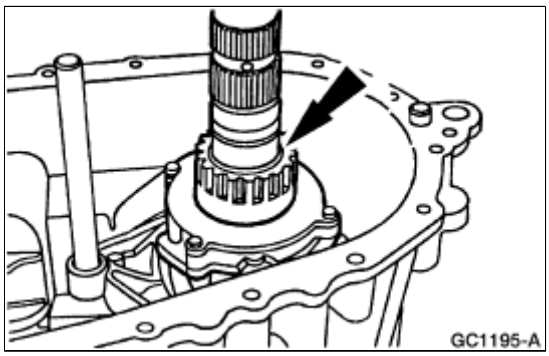
13. Install the electric shift cam assembly.



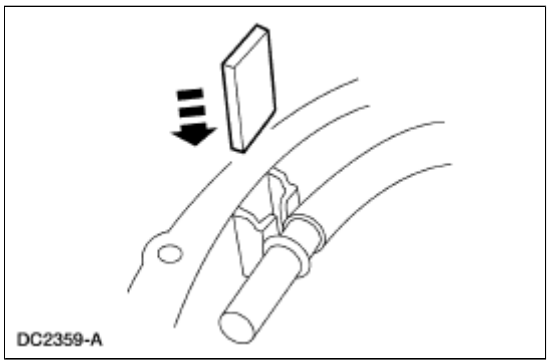
14. Install the pump assembly and the rear output shaft as an assembly.



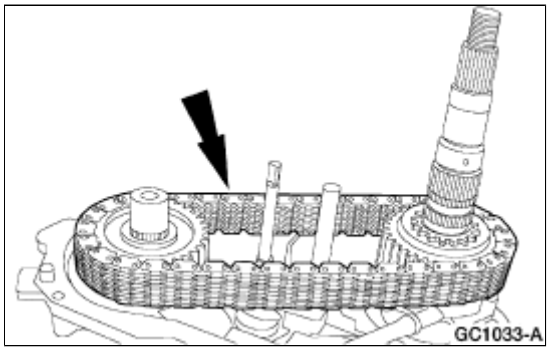
15. Install the thrust washer.



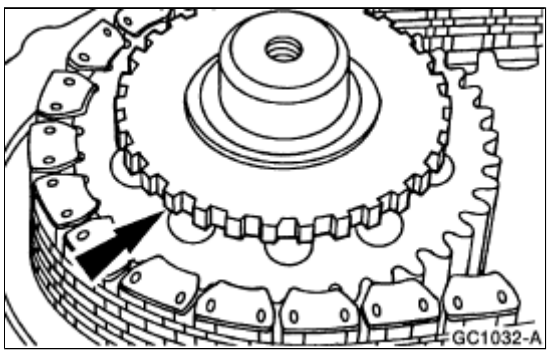
16. Install the oil pan magnet into its slot in the case.



17. Install the drive chain and sprockets as an assembly.

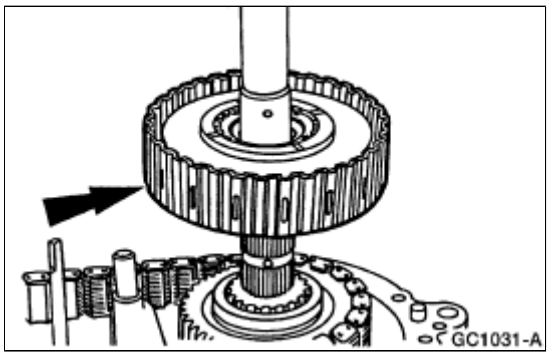


18. Install the tone wheel.



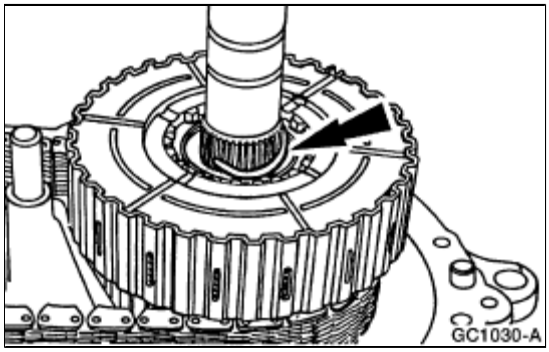
19. **CAUTION: When removing or installing the clutch pack assembly, do not separate the clutch pack assembly. Keep tension on the clutch pack upon removal. Set the clutch pack assembly on the bench in the same position as it was located in the transfer case. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem can occur.**

    Install the clutch pack assembly.

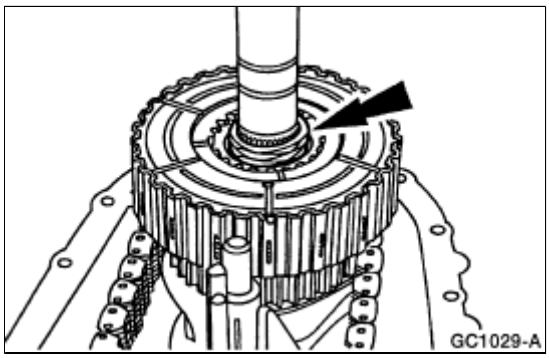


20. **CAUTION: Use a new snap ring.**

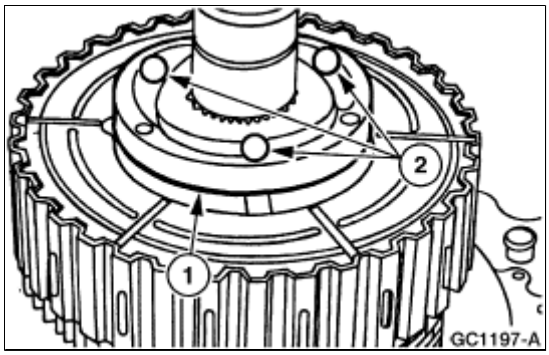
    Install a new snap ring.



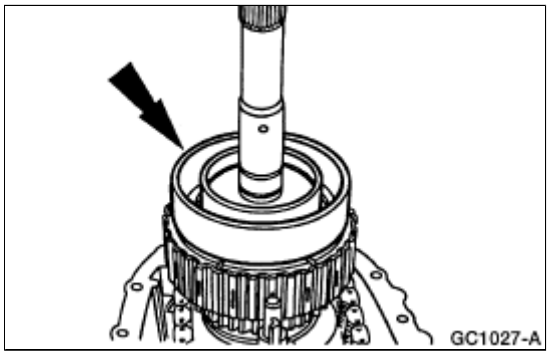
21. Install the wave spring.



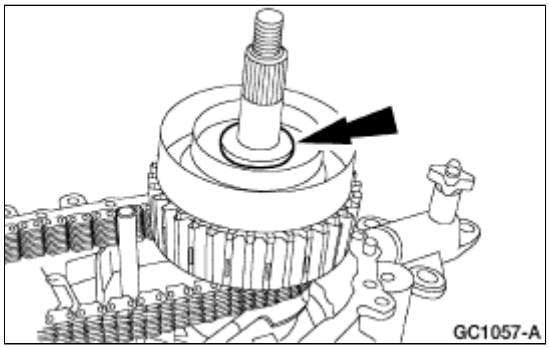
22. Install the apply cam and balls.
    1. Install the apply cam.
    2. Install the steel balls.



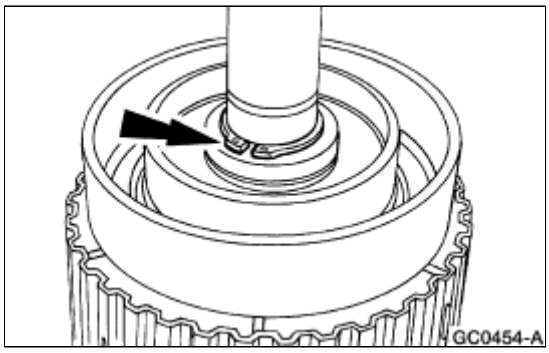
23. Install the cam and coil housing.



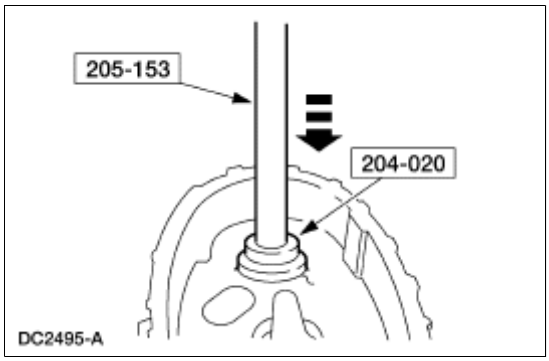
24. Install the thrust bearing.



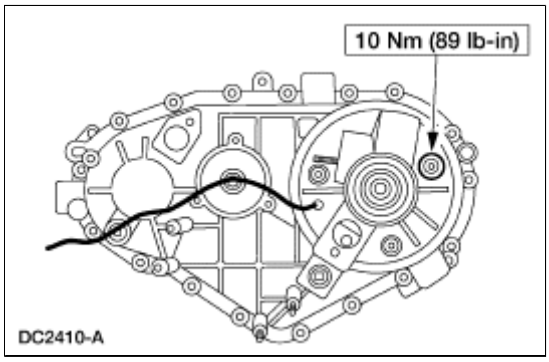
25. Install the snap ring.



26. Using a suitable press and the special tools, install the front output shaft rear bearing, and install the rear output shaft support bearing.



27. Position and support the clutch coil assembly, and install the nuts.



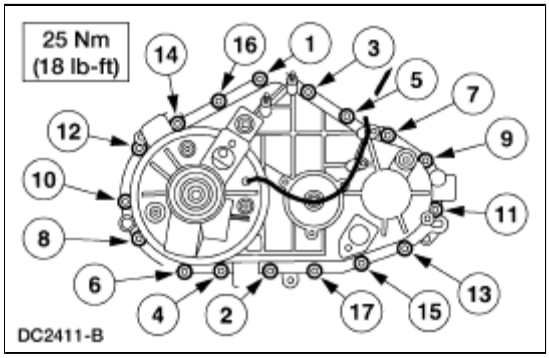
28. **CAUTION: Applying too much silicone sealant can plug the fluid filter and cause transfer case failure.**

    NOTE: Make sure the transfer case mating surfaces are clean.

    Apply a 3-mm (1/8-inch) bead of sealant to the transfer case mating surfaces.
    - U se Black Non-Acid Cure Silicone Rubber E7TZ-19562-A or equivalent meeting Ford specification ESL-M4G273-A.

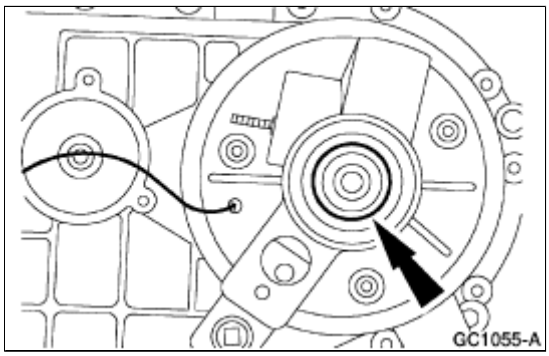
29. Position the transfer case halves together.

30. Install the bolts, and tighten them in the specified order.

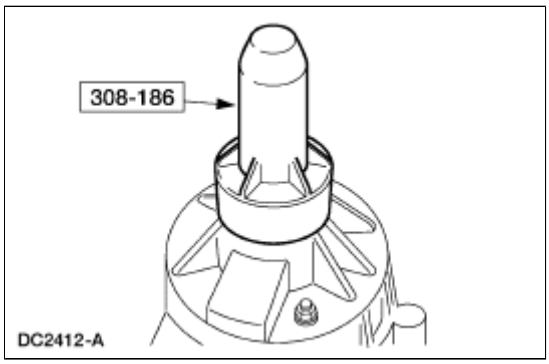


31. Install the tone wheel.

32. Install the spacer.

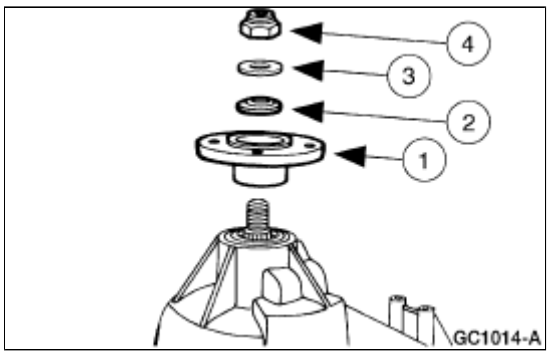


33. Install the oil seal.

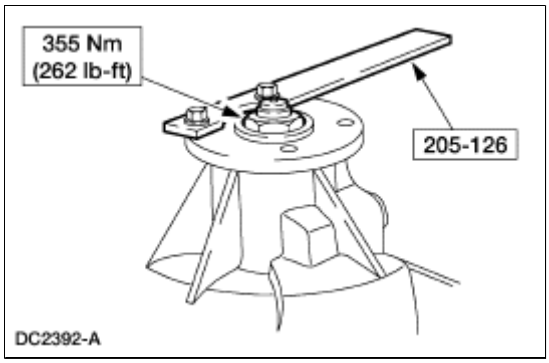


34. **NOTE:** Align the index-marks made during disassembly.

    Install the rear output flange.
    1. Position the flange.
    2. Position the oil seal.
    3. Position the output flange yoke washer.
    4. Install the nut.

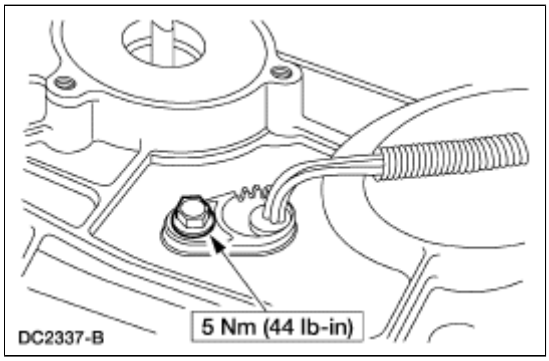


35. While holding the flange with the special tool, tighten the nut.



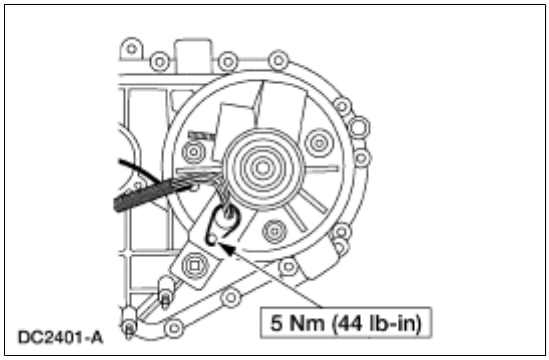
36. **CAUTION: Make sure the sensor seats flat against the boss.**

Install the front output shaft speed sensor.



37. **CAUTION: Make sure the sensor seats flat against the boss.**

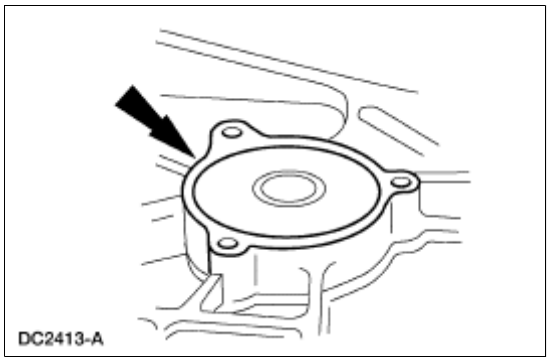
Install the rear output shaft speed sensor.



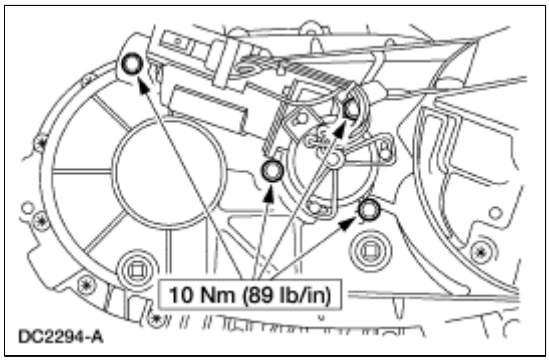
38. **NOTE:** Make sure the motor mounting surfaces are clean.

Apply a 3-mm (1/8-inch) bead of sealant to the motor mounting surface on the case.

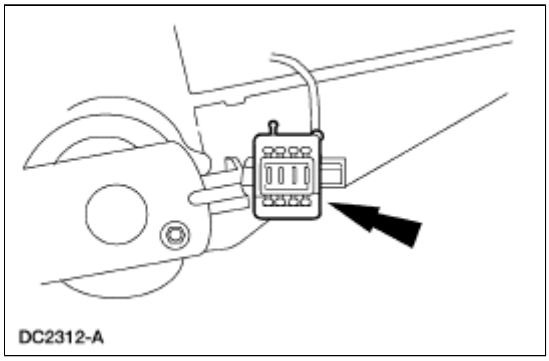
- Use Black Non-Acid Cure Silicone Rubber E7TZ-19562-A or equivalent meeting Ford specification ESL-M4G273-A.



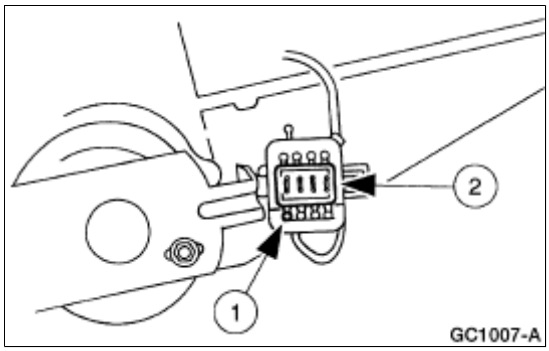
39. Install the transfer case shift motor.



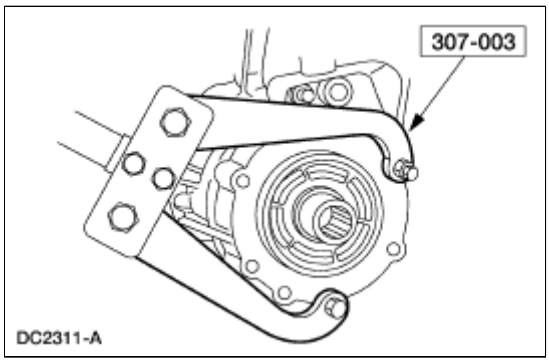
40. Install the front and rear output shaft speed sensor wire pins in the locations noted during their removal.



41. Install the coil wire pin in the electrical connector.
    1. Install the coil wire pin.
    2. Install the connector interlock.



42. Remove the transfer case from the special tool.

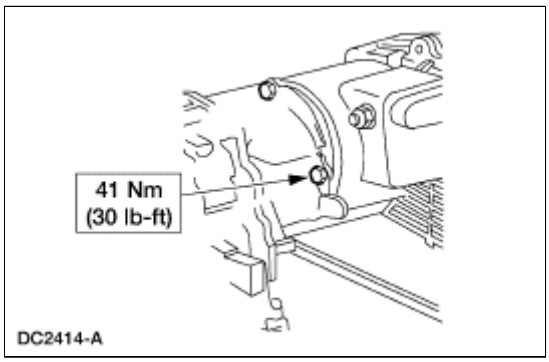


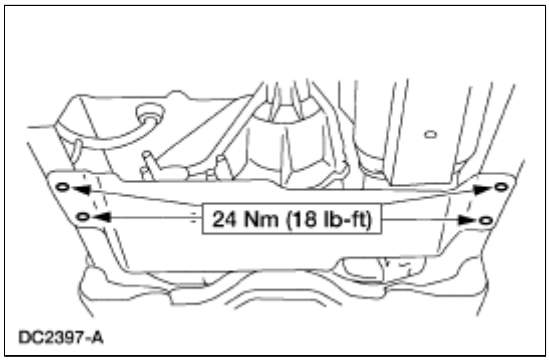
43. Install the transfer case in the vehicle. For additional information, refer to Transfer Case in this section.

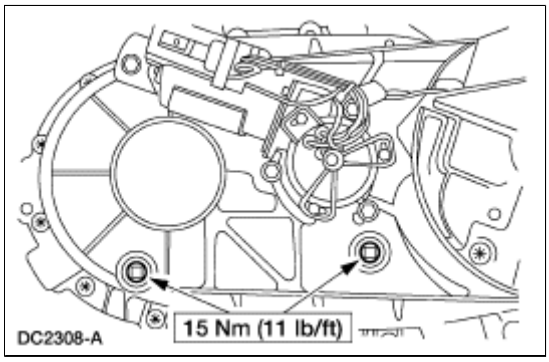
Transfer Case

Installation

1. To install, reverse the removal procedure.
    - Use a new transfer case to extension housing gasket.
    - Refer to Section 205-01 for driveshaft fastener tightening specifications.
    - Refer to Transfer Case Draining and Filling in the General Procedures portion of this section when refilling the transfer case.
    - Reactivate the air suspension system if so equipped.







Lubricant Capacity

Lubricant	Liters	U.S. Pints
Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX, XT-2-DDX or Equivalent	1.25	2.6

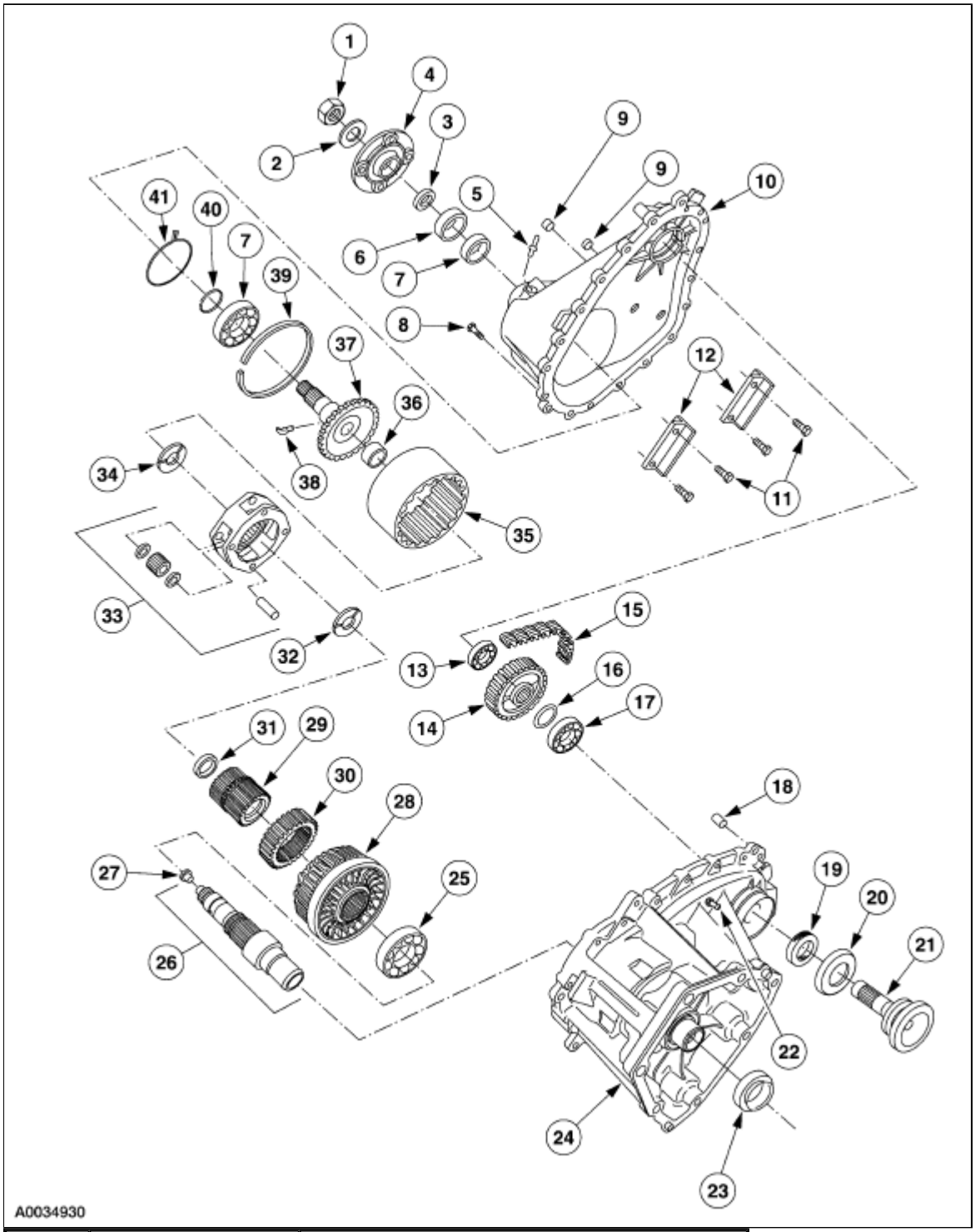
General Specifications

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4

Torque Specifications

Description	Nm	lb-ft	lb-in
Transfer case-to-extension housing bolts	40	30	—
Skid plate bolts	40	30	—
Fill and drain plug	17	13	—
Case bolts	25	18	—
Damper snubber screws	7	—	62
Rear shaft nut	355	262	—
Transmission mount nuts	90	66	—
Transfer case heat shield bolts	25	18	—
Crossmember bolts	70	52	—
Transmission mount bolts	90	66	—

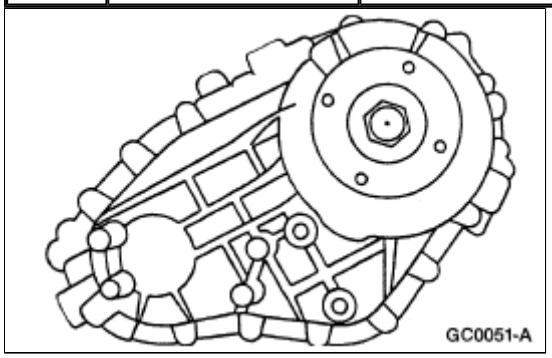
Transfer Case



Item	Part Number	Description
1	7045	Shaft nut

2	7B368	Output shaft yoke washer
3	7052	Oil seal
4	7B214	Output flange
5	7C207	Case stud
6	7B215	Yoke to flange seal
7	7025	Bearing
8	7A443	Bolt (17 req'd)
9	7A010	Drain/fill plug
10	7005	Case
11	7A771	Torx® head screw (4 req'd)
12	7F123	Damper snubber
13	7025	Bearing
14	7177	Lower drive sprocket
15	7A029	Drive chain
16	7917	Snap ring
17	7025	Bearing
18	7B362	Spring dowel bushing (2 req'd)
19	7B215	Yoke to flange seal
20	7C016	Dust deflector
21	7061	Output shaft
22	383976	Breather barb
23	7B215	Yoke to flange seal
24	7005	Case
25	7025	Bearing
26	7017	Input shaft assembly
27	7L276	Lubricating tube
28	7L499	Coupling (viscous)
29	7177	Lower drive sprocket
30	7D063	Overdrive sun gear
31	—	Bushing (part of 7D063)
32	7C341	Thrust washer
33	7A398	Front planetary gear assembly
34	7A385	Output shaft thrust washer
35	7A153	Ring gear
36	7120	Needle bearing
37	7061	Upper output shaft
38	7L290	Oil scoop
39	7C122	Snap ring

40	7R141	Snap ring
41	7917	Snap ring



The constantly activated, automatic, all-wheel drive transfer case has no external controls. A two-piece aluminum case houses the assembly. The unit is chain driven. A non-repairable viscous coupling provides torque distribution to the front and rear transfer case outputs. The viscous coupling contains slotted alternating plates through which a high viscosity fluid flows. The resistance of the fluid shear causes the plates to transmit torque at the approximate ratio of 35 percent to the front output and 65 percent to the rear output.

Operation

Torque flows through the input shaft to the front planetary gear assembly outward to the ring gear to the upper output shaft. Torque also flows through the front planetary gear assembly to the overdrive sun gear outward to the upper drive sprocket. The torque flow continues from the upper drive sprocket through the drive chain to the lower drive sprocket to the front output shaft. The viscous coupling provides the connection between the ring gear and the overdrive sun gear.

Transfer Case

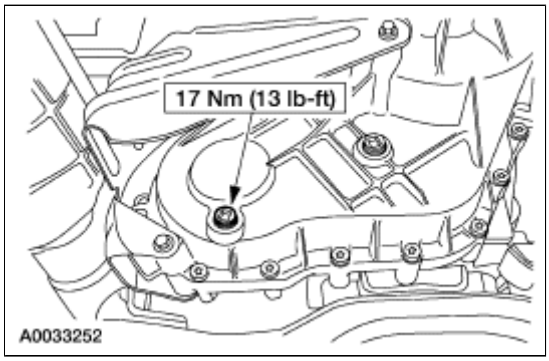
Refer to Section 308-07A .

Transfer Case Draining and Filling

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

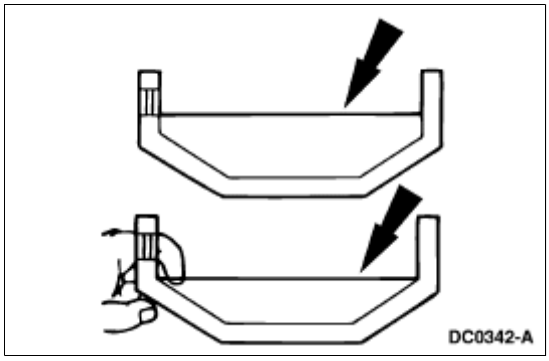
1. Remove the drain plug and drain the fluid.
   - Clean and install the drain plug after fluid is drained.



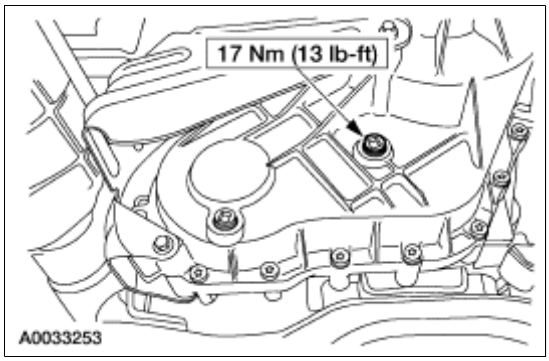
2. **CAUTION: Incorrect fluid fill can result in transfer case failure.**

   NOTE: Clean the area around the fill plug.

   Remove the fill plug, and fill the transfer case.
   - The fluid must be just below the fill plug hole. Because you can reach the fluid with a finger does not mean the fluid is at the correct level. Make sure the fluid is level with the filler opening for the correct fluid level.
   - The total transfer case fill capacity is 1.25 Liter (2.6 pints).

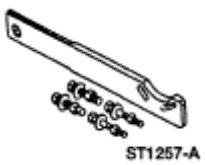
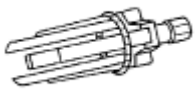


3. Install the fill plug.


17 Nm (13 lb-ft)
A0033253

Seal —Rear

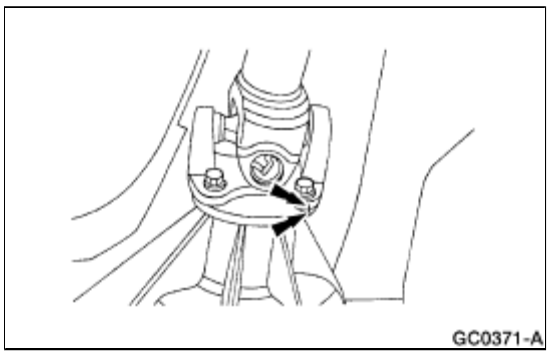
Special Tool(s)

 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
ST1185-A	Slide Hammer 100-001 (T50T-100-A)
ST2305-A	Installer, Input Shaft Oil Seal 308-186 (T90T-7172-B)
 ST1213-A	Remover, Bushing 307-001 (TOOL-1175-AC) or Equivalent

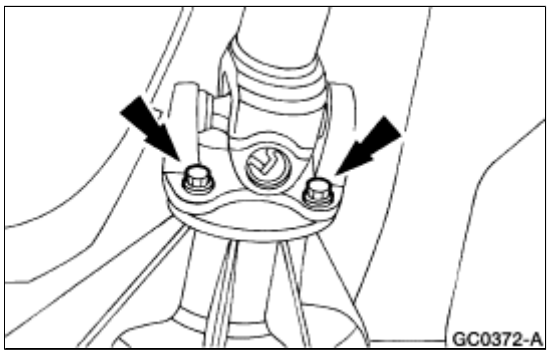
Removal

1. With the transmission in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

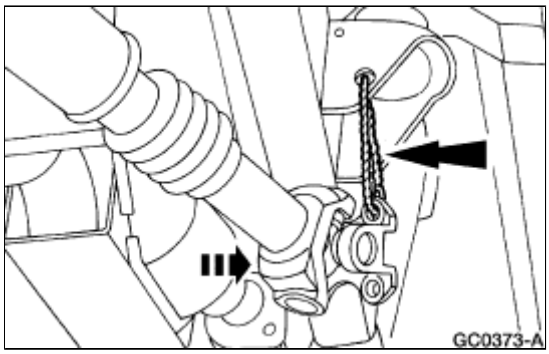
2. Index-mark the rear output flange and the driveshaft yoke.


GC0371-A

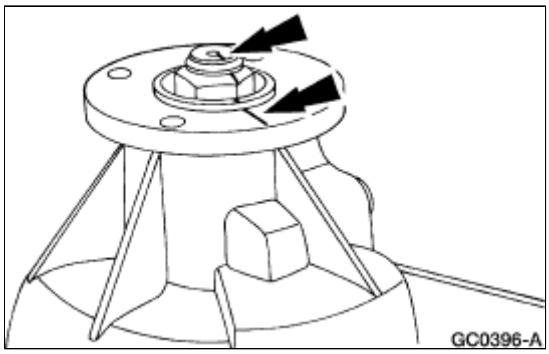
3. Remove the four bolts.



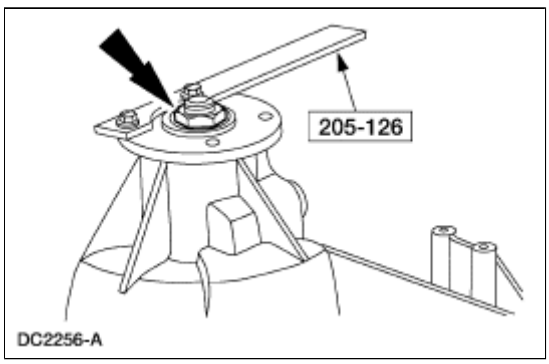
4. Separate the driveshaft from the output flange, and position the driveshaft aside.



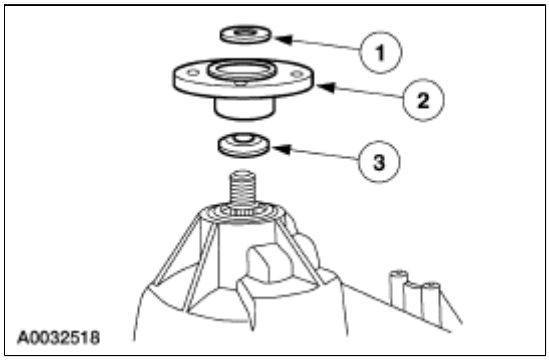
5. Index-mark the rear output flange and the upper output shaft.



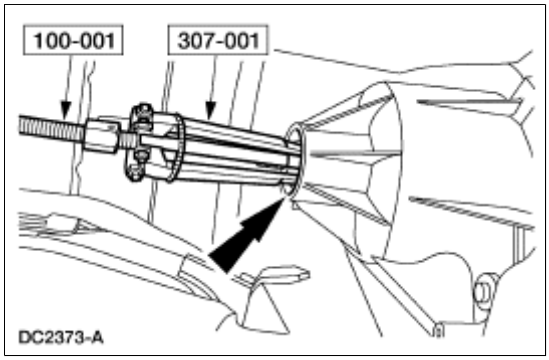
6. Use the special tool to hold the output flange while removing the nut.



7. Remove the rear output flange.
    1. Remove the output shaft yoke washer.
    2. Remove the rear output flange.
    3. Remove the oil seal.

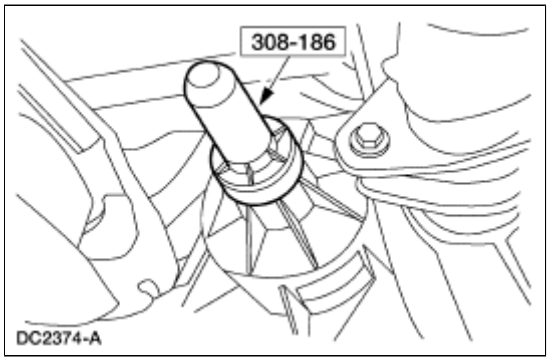


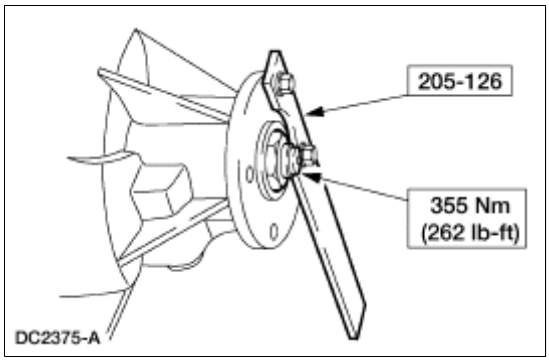
8. Using the special tools, remove the yoke to flange seal.



Installation

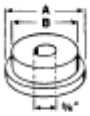
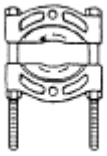
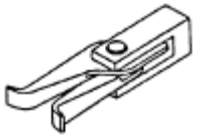
1. To install, reverse the removal procedure.
    - Use the special tool to install the yoke to flange seal.
    - Refer to Section 205-01 for driveshaft fastener tightening specifications.
    - Check, and if necessary, fill the transfer case to the specified level with the specified fluid. For additional information, refer to Transfer Case Draining and Filling in the General Procedures portion of this section.




205-126
355 Nm
(262 lb-ft)
DC2375-A

Transfer Case

Special Tool(s)

ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1471-A	Installer, Wheel Hub Bearing Cup 204-020 (T73T-1202-A)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1362-A	Remover, Stator Bearing 307-318 (T94P-77001-KH)
ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)

ST1351-A	Slide Hammer 100-001 (T50T-100-A)
ST2026-A	2 Jaw Puller 205-D026 (D80L-1002-L) or equivalent
ST2305-A	Installer, Input Shaft Oil Seal 308-186 (T90T-7127-B)

Material

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Multi-Purpose ATF XT2-QDX	Mercon®

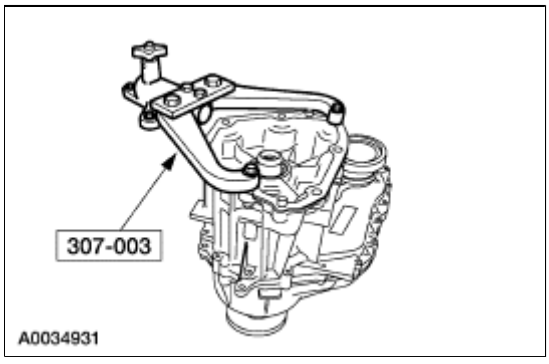
Disassembly

1. **CAUTION: Discard all seals after removing them.**

   Remove the transfer case from the vehicle. For additional information, refer to Transfer Case in this section.

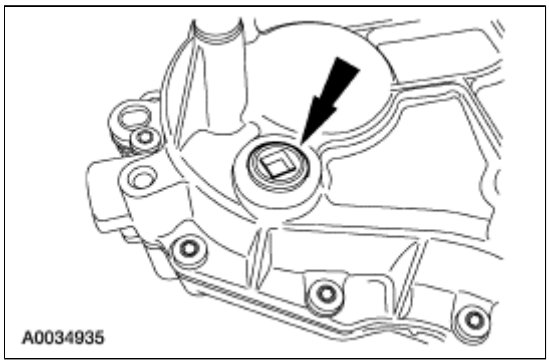
2. **WARNING: Make sure the Holding Fixture lock pin is secure.**

   Using the special tool, secure the transfer case to a bench.

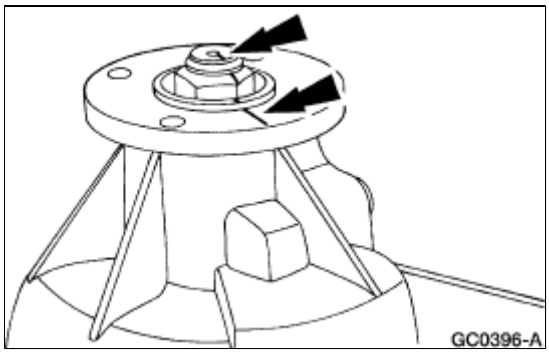


3. Remove the dampener.

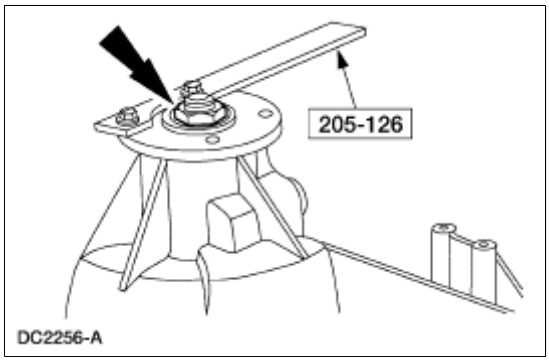
4. If not done previously, remove the drain plug and drain the fluid.
    - Install the drain plug when finished draining.



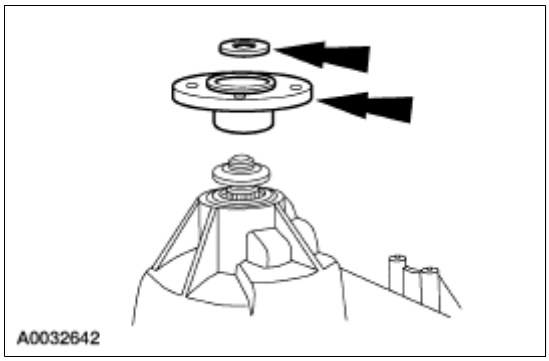
5. Index-mark the rear output flange and the upper output shaft.



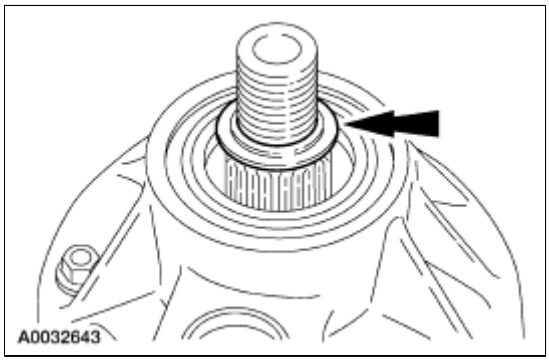
6. Using the special tool to hold the output flange, remove the nut.



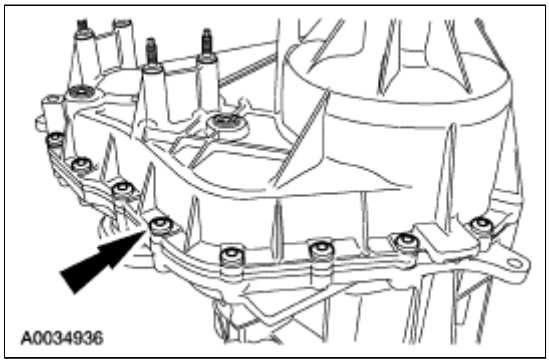
7. Remove the output flange and the output shaft yoke washer.



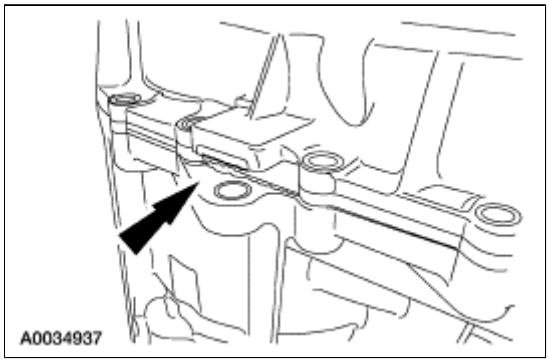
8. Remove the oil seal.

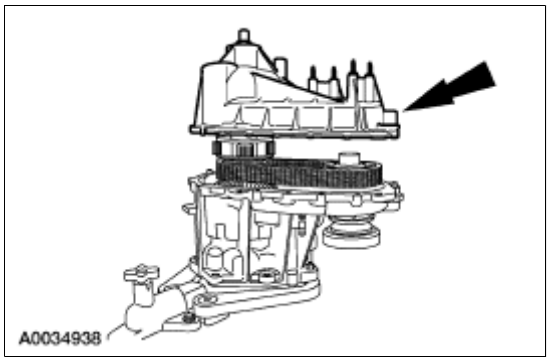


9. Remove the 17 bolts.



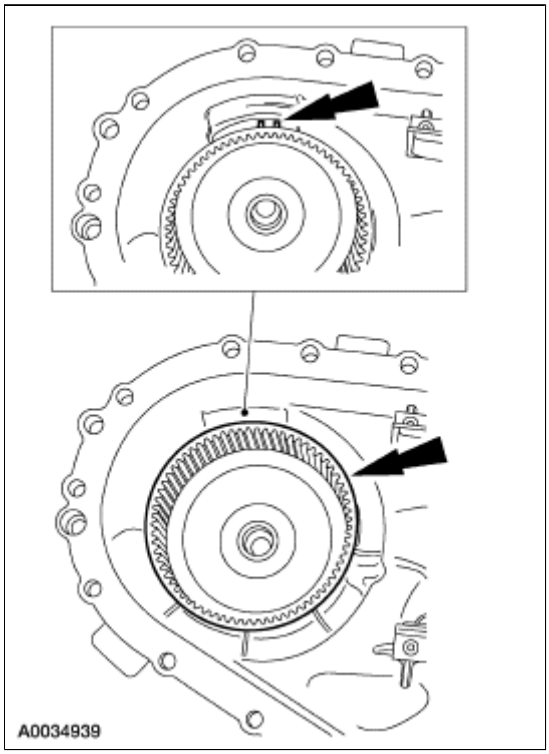
10. Using a pry bar, separate the rear case from the front case.
    - Pry only at the transfer case pry bosses.



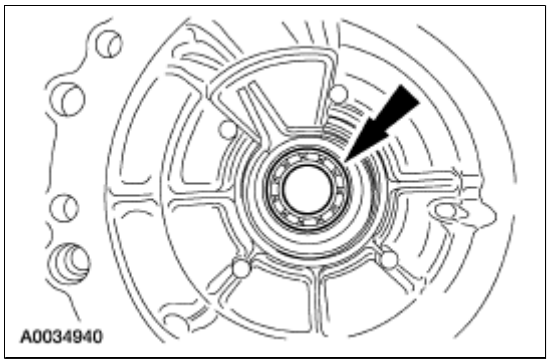


11. **CAUTION: Do not remove the needle bearing from the upper output shaft.**

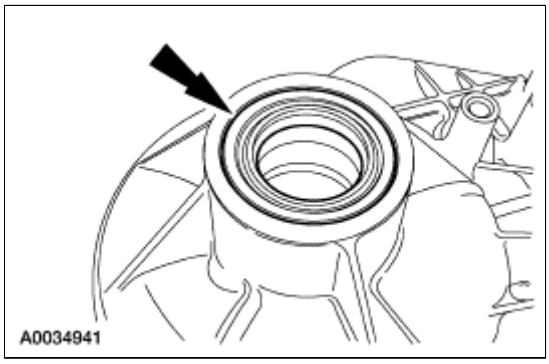
    Remove the upper output shaft and the ring gear.
    - Expand the snap ring.



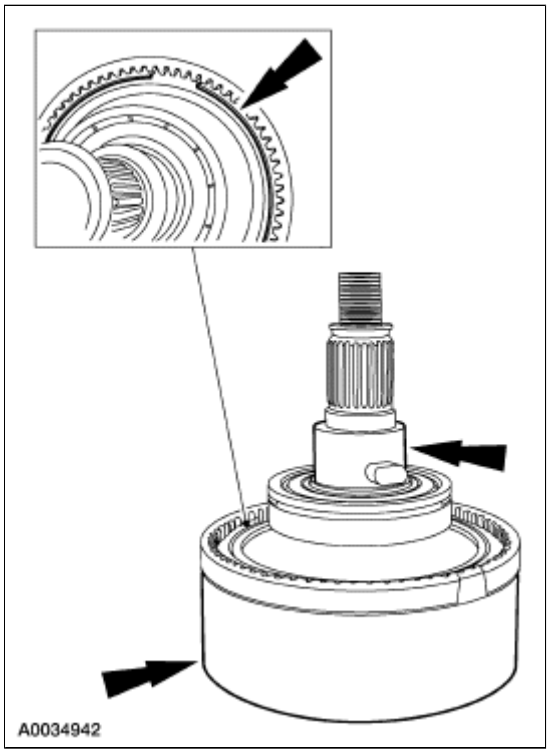
12. Remove the bearing.



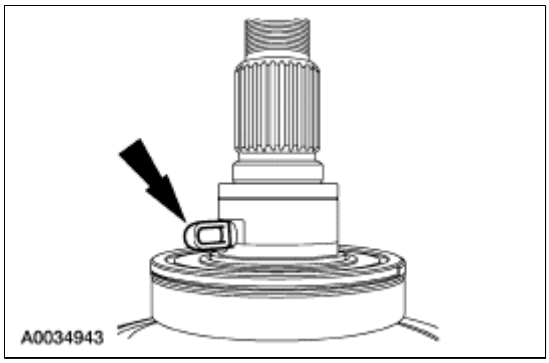
13. Remove the seal.



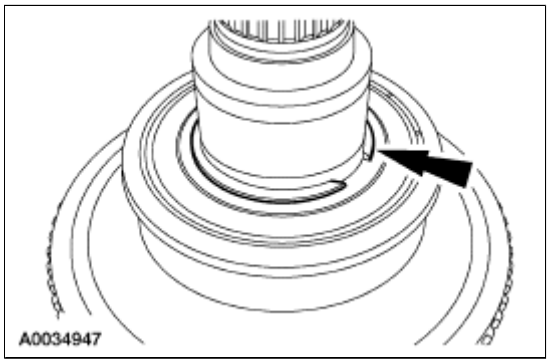
14. Remove the snap ring, then separate the upper output shaft from the ring gear.



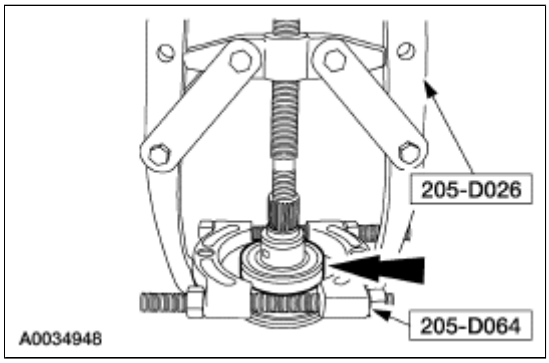
15. Remove the oil scoop.
    - Using a screwdriver, carefully pry the oil scoop out.



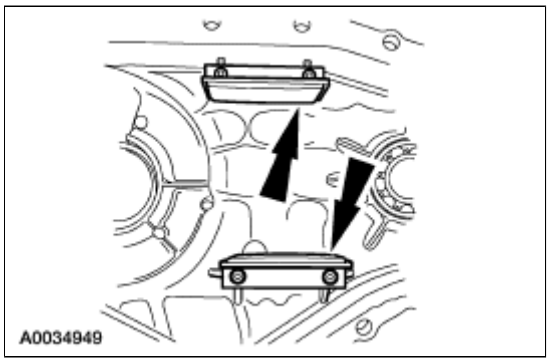
16. Remove the snap ring retaining the bearing on the upper output shaft.



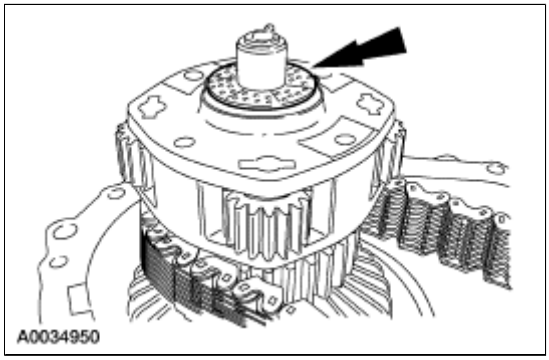
17. Using the special tools, remove the bearing.



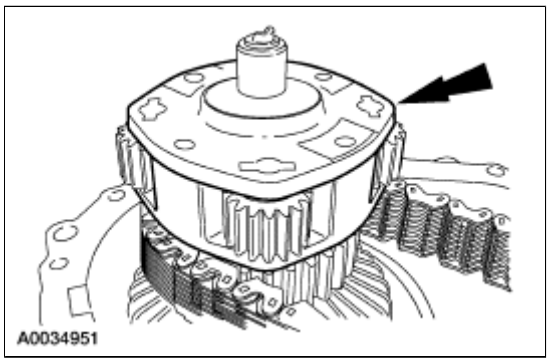
18. Remove the damper snubber.



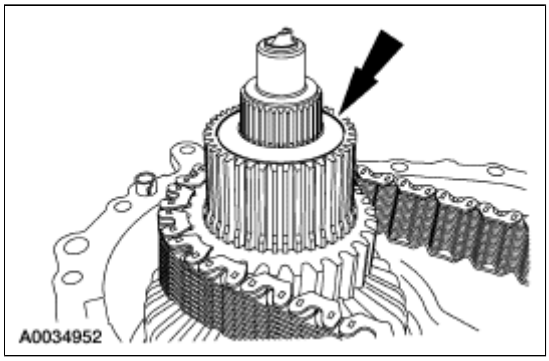
19. Remove the output shaft thrust washer.



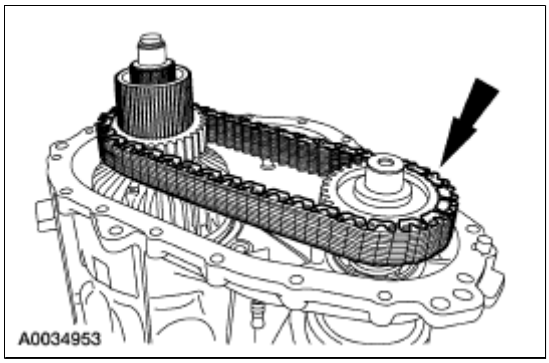
20. Remove the front planetary gear assembly.



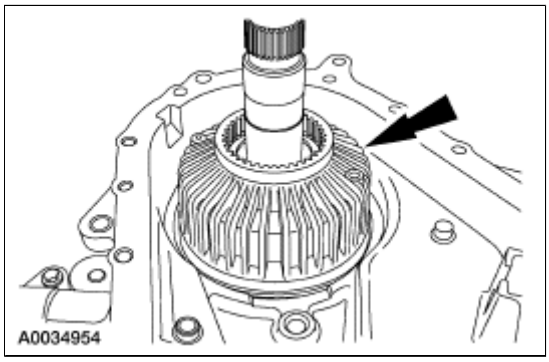
21. Remove the thrust washer.



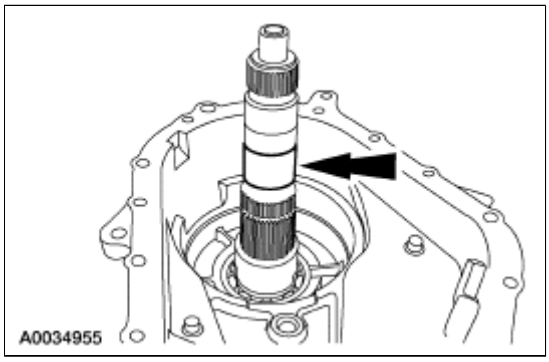
22. Remove the overdrive sun gear, the upper drive sprocket, the drive chain, and the lower drive sprocket.



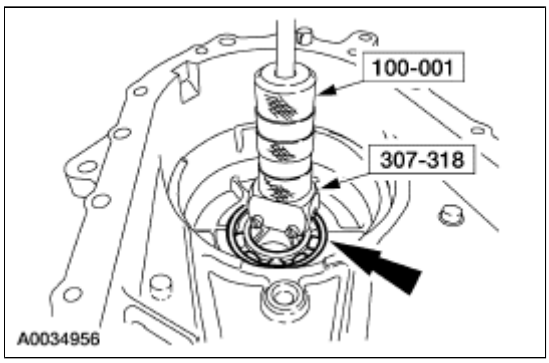
23. Remove the viscous coupling.



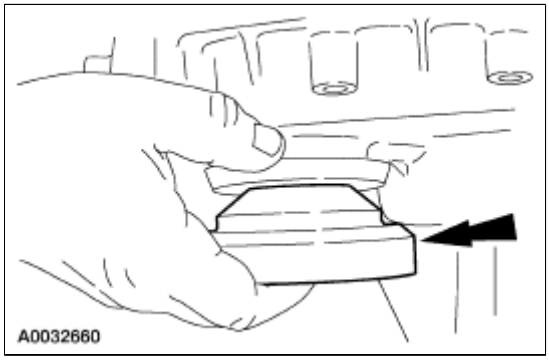
24. Remove the input shaft.

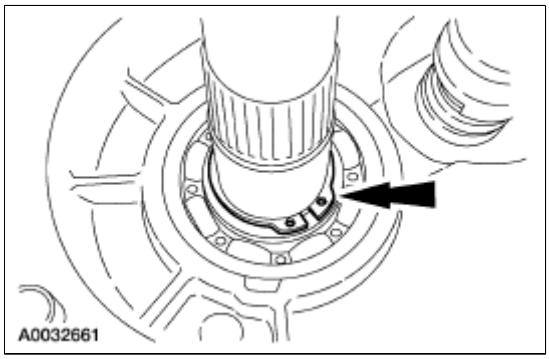


25. Using the special tools, remove the bearing.

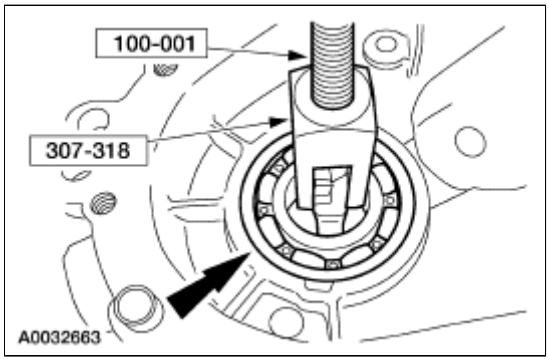


26. Holding the front output shaft, remove the snap ring and the front output shaft.



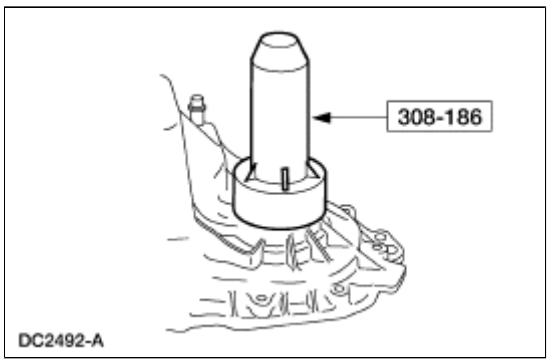


27. Using the special tools, remove the bearing, then remove the seal.

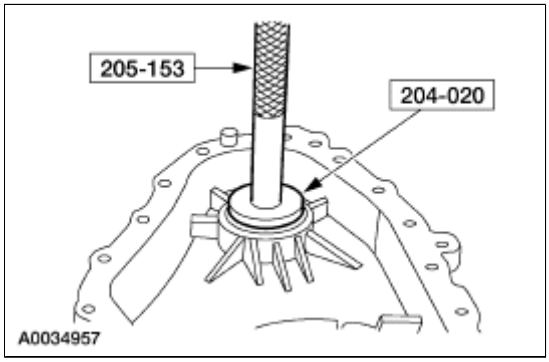


Assembly

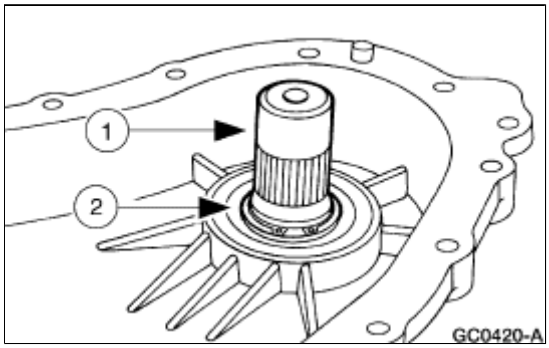
1. Using the special tool, install the seal.



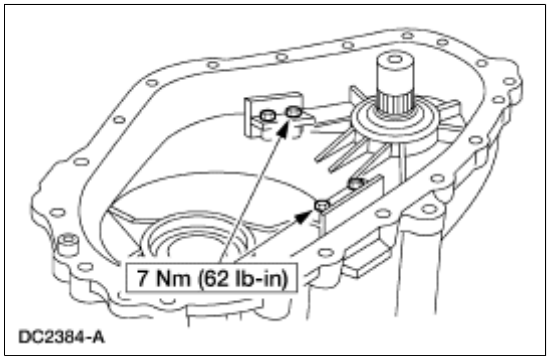
2. Using the special tools, install the bearing.



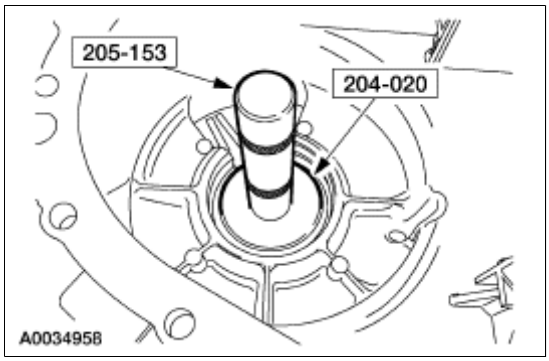
3. Install the front output shaft.
    1. Install the front output shaft.
    2. Install the snap ring.



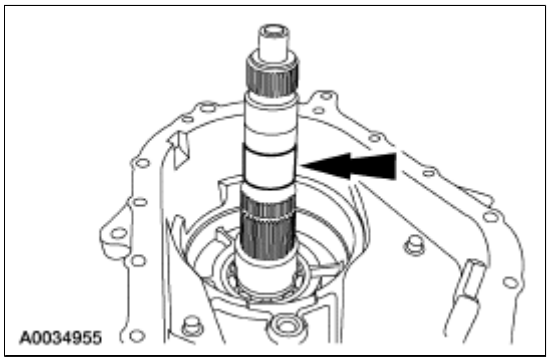
4. Install the damper snubbers.



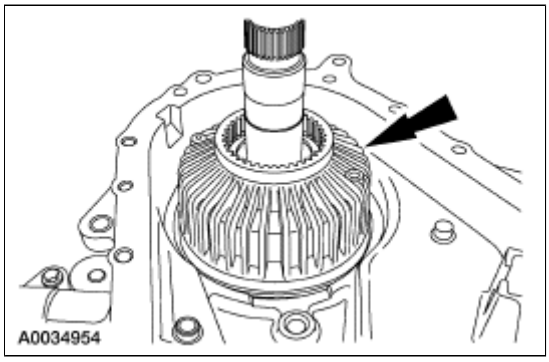
5. Using the special tools, install the bearing.



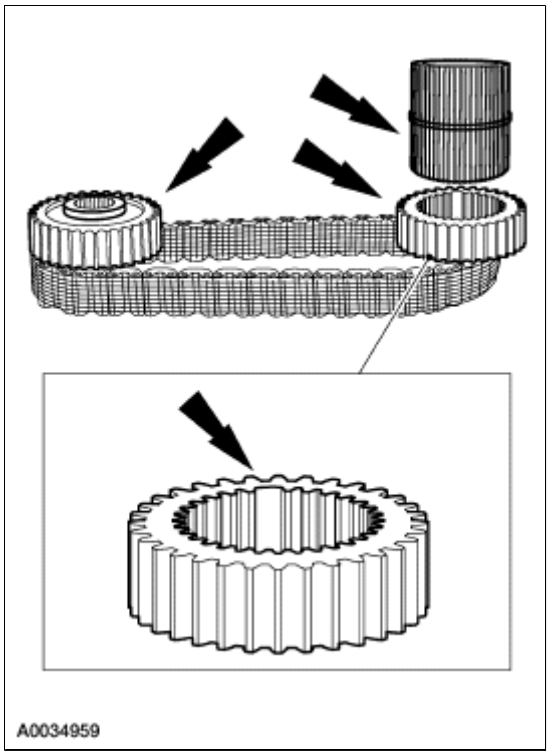
6. Install the input shaft.



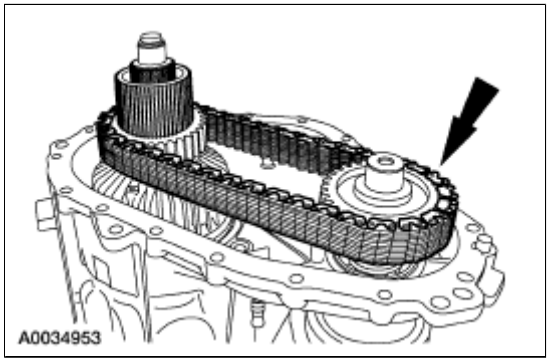
7. Install the viscous coupling.



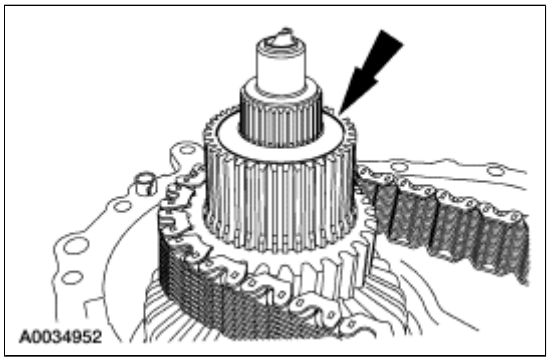
8. Assemble the overdrive sun gear, the upper drive sprocket, lower drive sprocket and the drive chain.
    - Align the blind spline on the lower drive sprocket with the narrow spline on the overdrive sun gear.



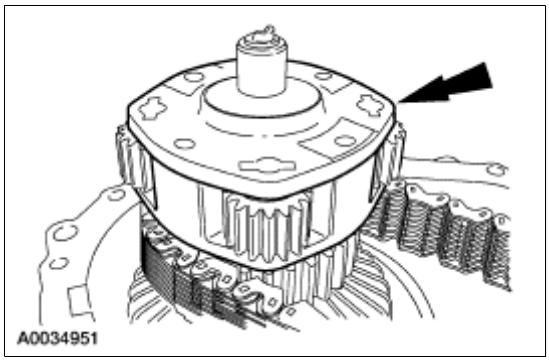
9. Install the overdrive sun gear, the upper and lower drive sprockets and the drive chain.



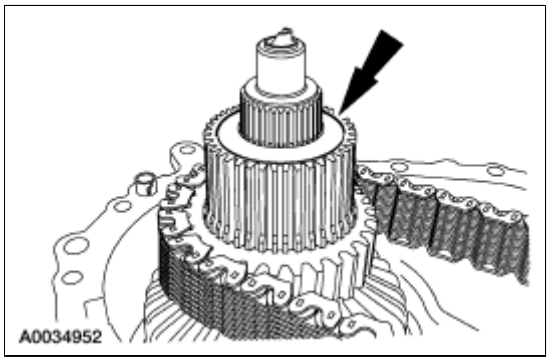
10. Install the thrust washer.



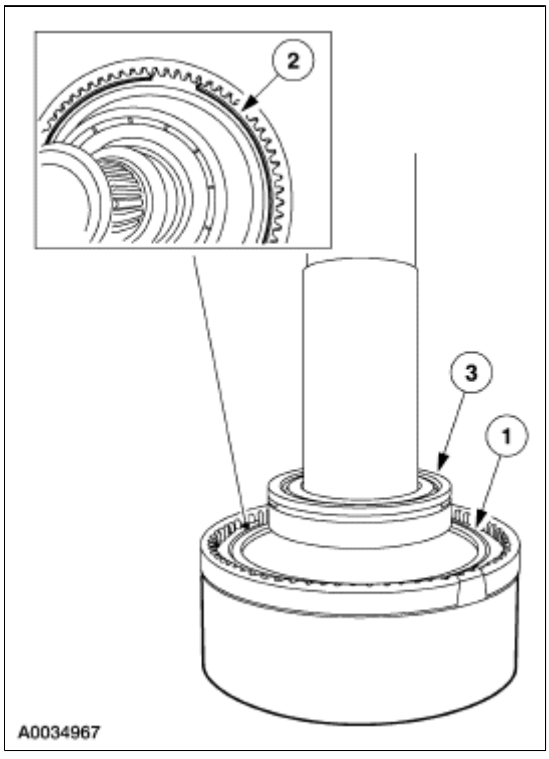
11. Install the front planetary gear assembly.



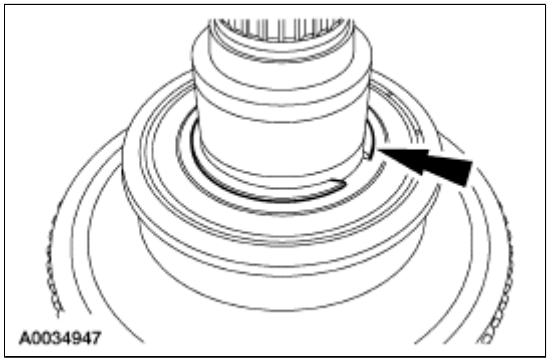
12. Install the thrust washer.



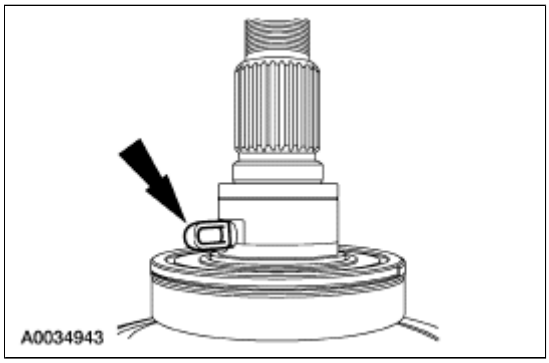
13. Assemble the upper output shaft and the ring gear.
    1. Install the output shaft.
    2. Install the snap ring.
    3. Press on the bearing.



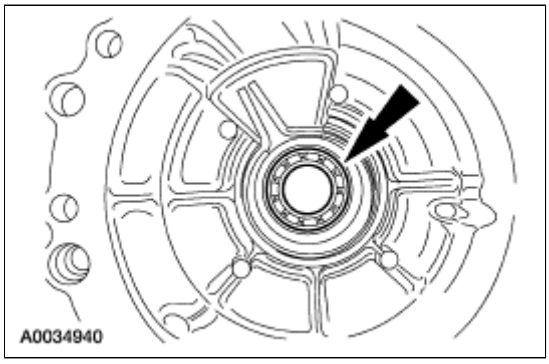
14. Install the snap ring.



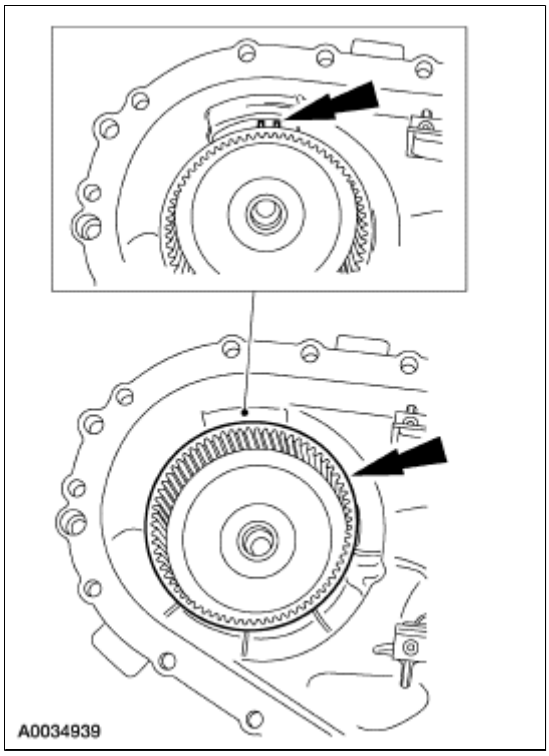
15. Install the oil scoop.



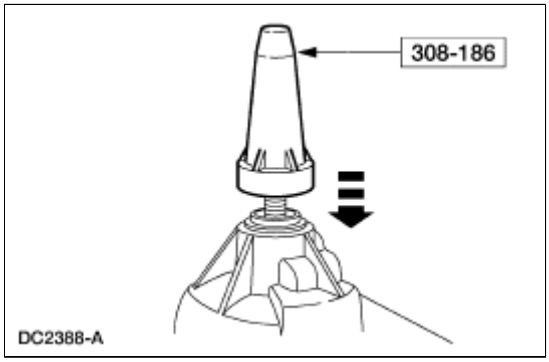
16. Install the bearing.



17. Install the upper output shaft and ring gear in the rear case half.
    - Expand the snap ring. Install the upper output shaft and the ring gear.
    - Release the snap ring.

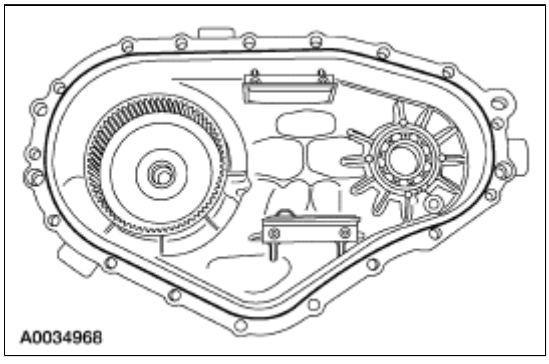


18. Using the special tool, install the yoke to flange seal.

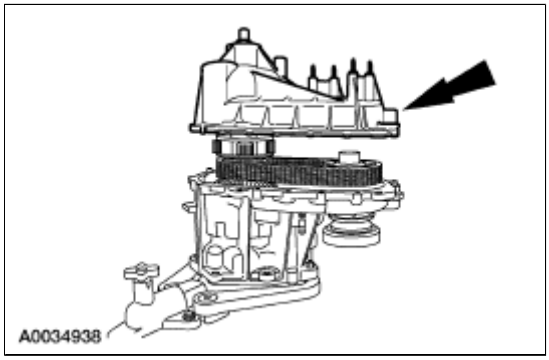


19. **CAUTION: Applying excess silicone rubber can damage the internal components.**

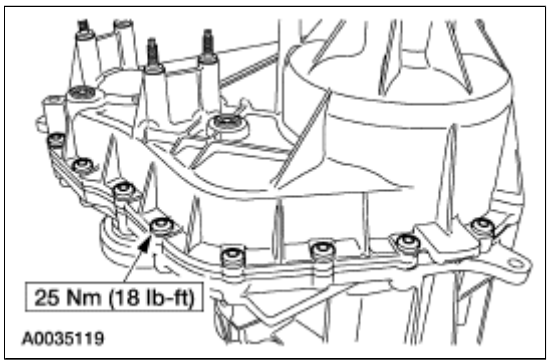
Apply a 3 mm (0.125 in) bead of silicone rubber on the rear case mating surface.



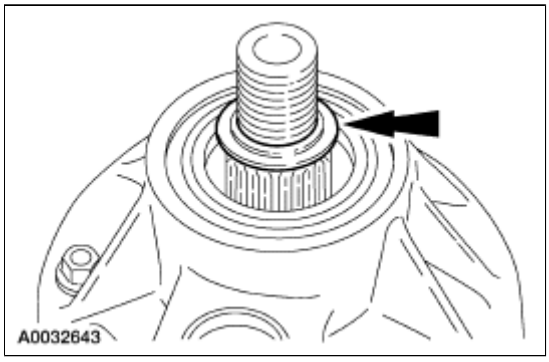
20. Assemble the front and rear case halves.



21. Install the 17 bolts.

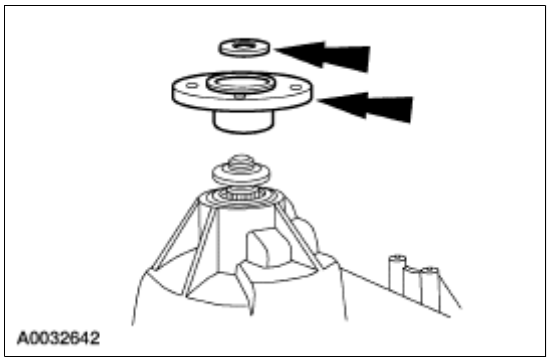


22. Install the oil seal.

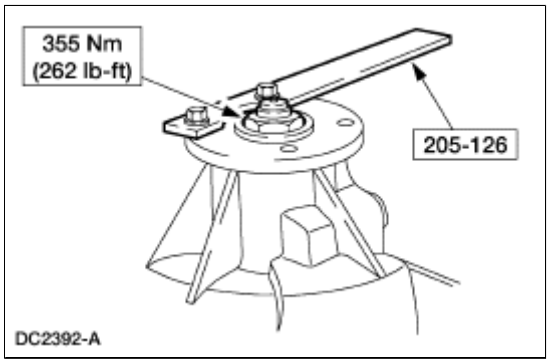


23. **NOTE:** Align the index marks made during disassembly.

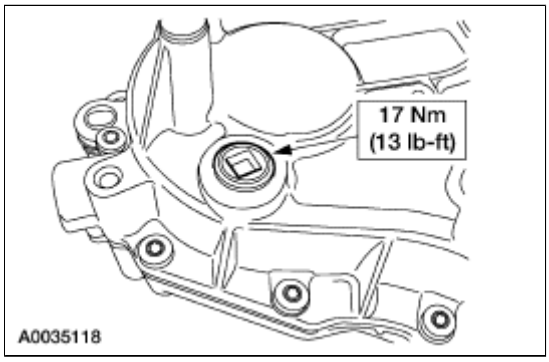
    Install the output flange and the output shaft yoke washer.



24. Install the nut. While holding the flange with the special tool, tighten the nut.

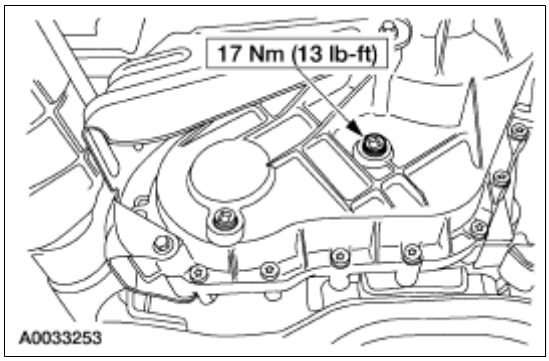


25. Tighten the drain plug.



26. Remove the fill plug, fill the transfer case with the specified fluid to the bottom of the fill hole.

27. Install the fill plug.



28. Install the damper.

Transfer Case

1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

2. **CAUTION: Index-mark the front axle pinion flange and the front driveshaft, and the front output shaft and the front driveshaft constant velocity joint.**

   CAUTION: Always disconnect the front driveshaft from the transfer case first. Otherwise, the weight of the driveshaft can pinch the boot between the shaft and the boot can and cause the boot to tear.

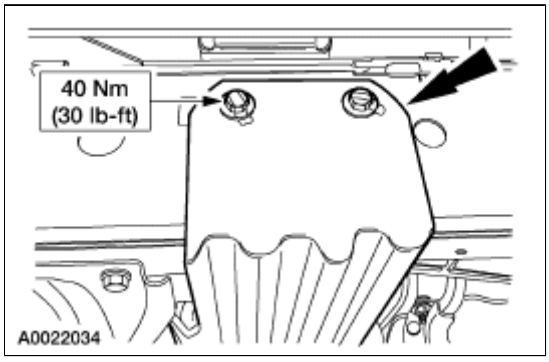
   CAUTION: Tape the bearing cups to prevent them from falling off the spider.

   Remove the front driveshaft. For additional information, refer to Section 205-01 .

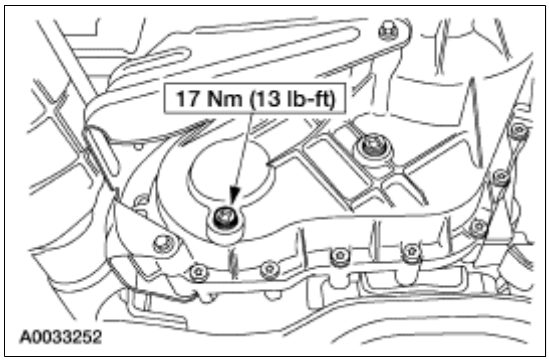
3. **CAUTION: Index-mark the front flange on the rear driveshaft and the flange on the transfer case, and the rear flange on the driveshaft and the rear axle pinion flange.**

   Remove the rear driveshaft. For additional information, refer to Section 205-01 .

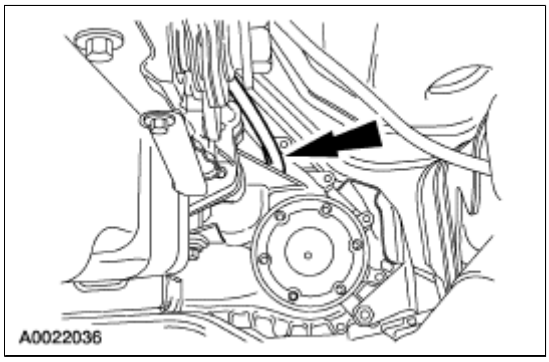
4. Remove the four bolts and the skid plate.



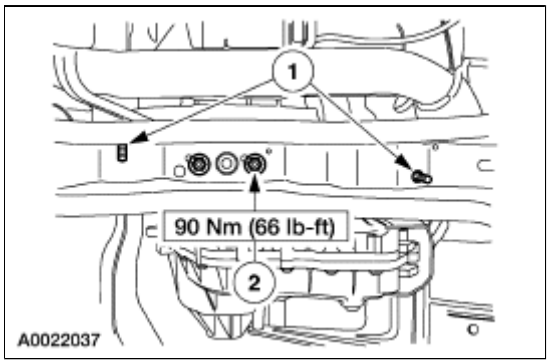
5. If transfer case disassembly is necessary, remove the drain plug and drain the fluid.
   - Install the drain plug when all of the fluid has drained.



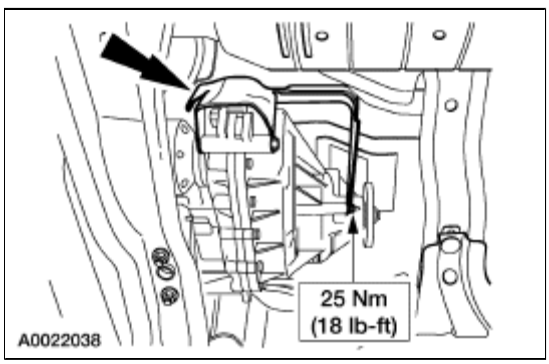
6. Disconnect the hose from the vent.



7. Carry out the following:
    1. Remove the two bolts retaining the heat shield to the crossmember.
    2. Loosen, but do not remove, the two nuts retaining the transmission mount to the crossmember.

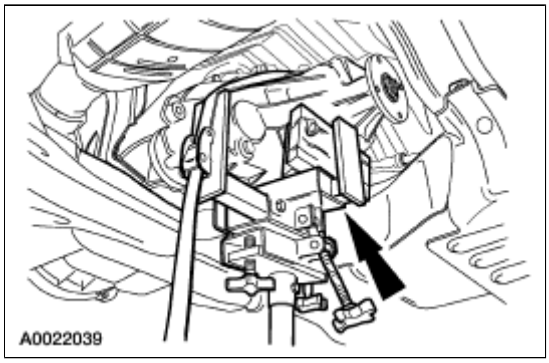


8. Remove the three bolts and the heat shield.

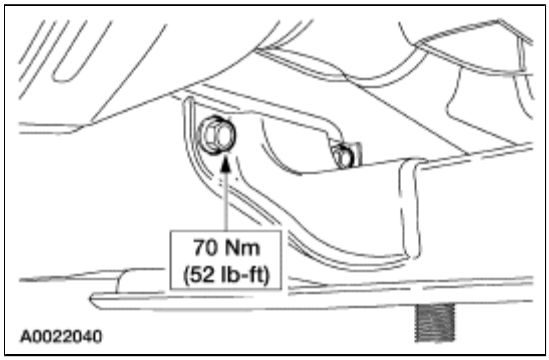


9. **WARNING: Secure the transfer case to the jack with a safety strap. Failure to follow these instructions may result in personal injury.**

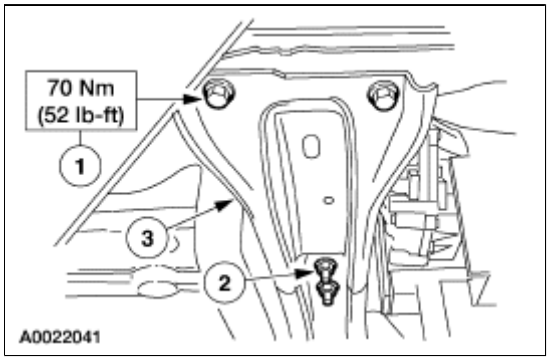
   Position a high lift jack under the transfer case.



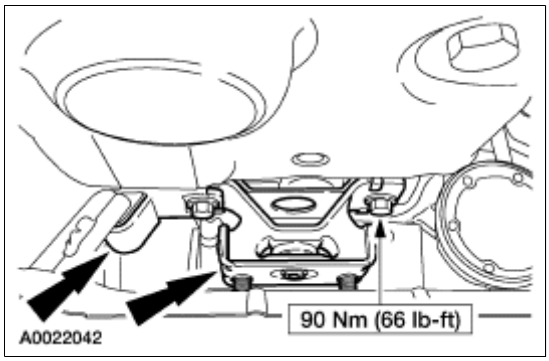
10. Remove the four upper nuts and bolts retaining the crossmember to the frame.



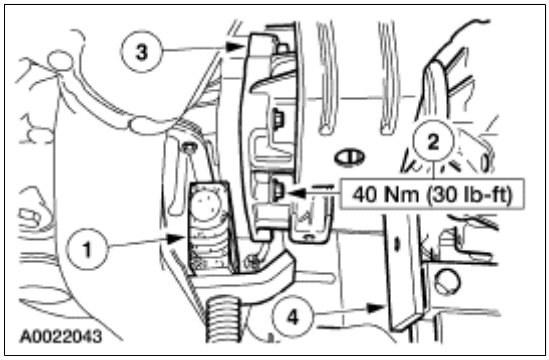
11. Carry out the following:
    1. Remove the two lower bolts retaining the crossmember to the frame.
    2. Remove the two nuts retaining the transmission mount to the crossmember.
    3. Remove the crossmember.



12. Remove the two bolts, the transmission mount, and the exhaust hanger.



13. Carry out the following:
    1. Support the transmission.
    2. Remove the seven bolts retaining the transfer case to the transmission.
    3. Separate the transfer case from the extension housing and the output shaft.
    4. Lower the transfer case from the vehicle.



14. Remove and discard the gasket, and clean the mating surfaces.

Transfer Case

Installation

1. To install, reverse the removal procedure.
    - Install a new gasket on the transfer case.
    - Watch for obstructions when installing the transfer case in the vehicle.
    - Install the original transfer case to transmission bolts. If new bolts are required, be sure to install only the specific Ford transfer case to transmission bolts.
    - Refer to Section 205-01 for driveshaft installation.
    - Fill the transfer case, as necessary, with the correct type and quantity of fluid. For additional information, refer to Transfer Case Draining and Filling in this section.

SPECIFICATIONS

General Specifications

Item	Specification
Lubricants	
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A

Torque Specifications

Description	Nm	lb-ft
Muffler-to-converter bolts and nuts	40	30
Converter-to-manifold bolts	40	30
Dual converter Y-pipe to dual three-way converter nuts (4.0L with single inlet muffler)	40	30
LH three-way converter to RH three-way converter bolts and nuts (4.0L with dual inlet muffler)	40	30
Torca clamp	48	35
U-bolt clamp	80	59
Transmission mount bolt	103	76
Transmission crossmember bolts	99	73
Skid plate bolts	24	18
Heated oxygen sensors	40	30
Catalyst monitor sensors	40	30

Exhaust System

The 4.0L with a single inlet muffler exhaust system:

- is constructed of stainless steel
- has one three-way catalytic converter (TWC) (5E212)
- has one dual converter Y-pipe

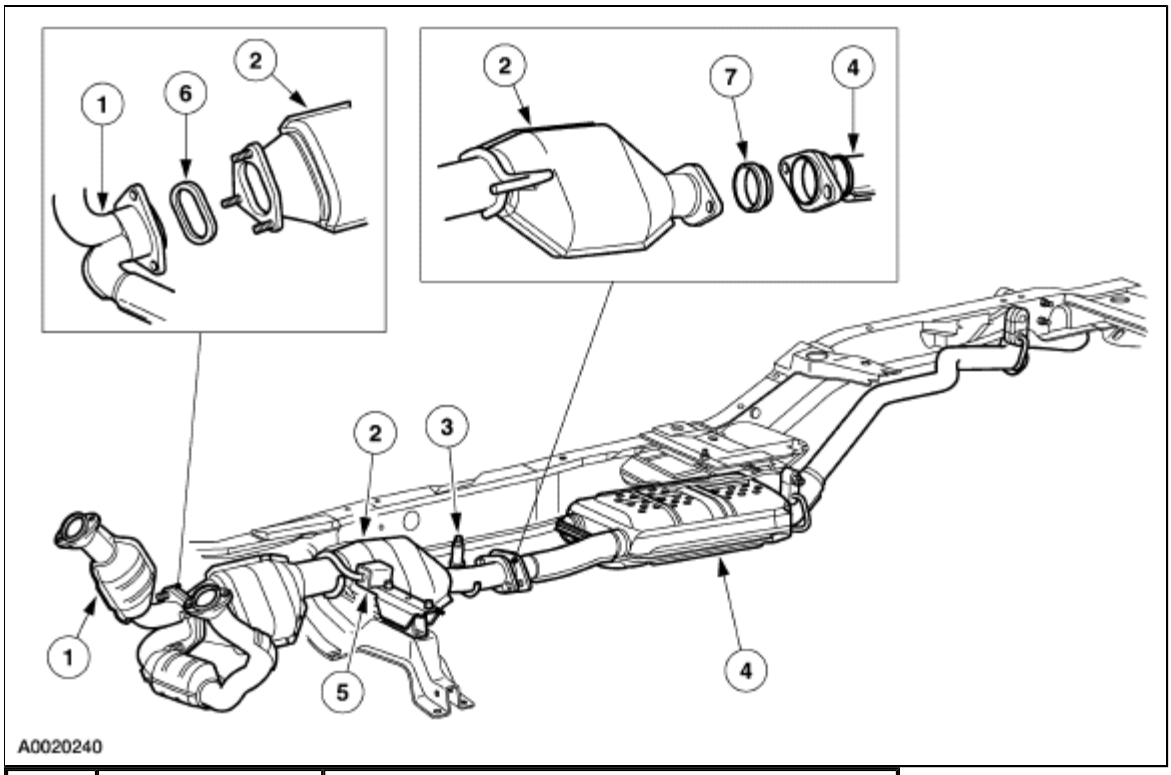
The 4.0L with a dual inlet muffler exhaust system:

- is constructed of stainless steel
- has two three-way catalytic converters
- has a muffler and resonator assembly

The 5.0L exhaust system:

- has four heated oxygen sensors
- has a front three-way catalytic converter
- has a rear three-way catalytic converter
- has a muffler and tailpipe assembly

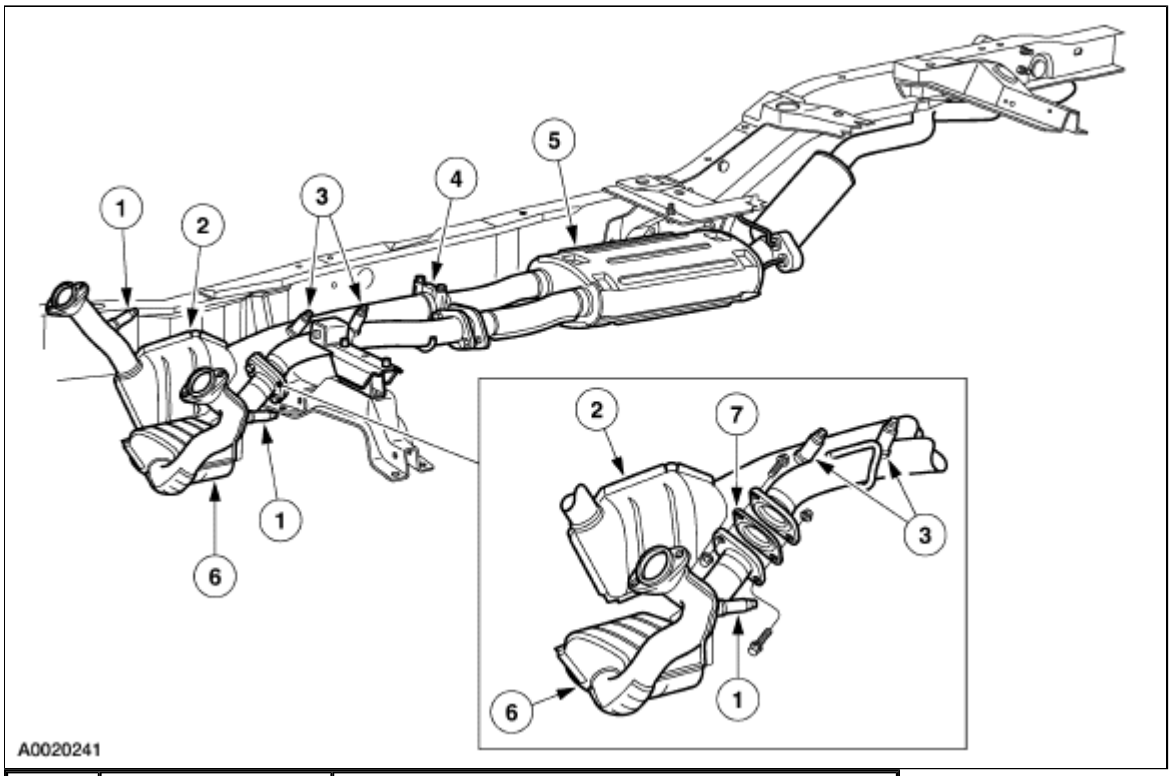
Exhaust System — 4.0L With Single Inlet Muffler



Item	Part Number	Description

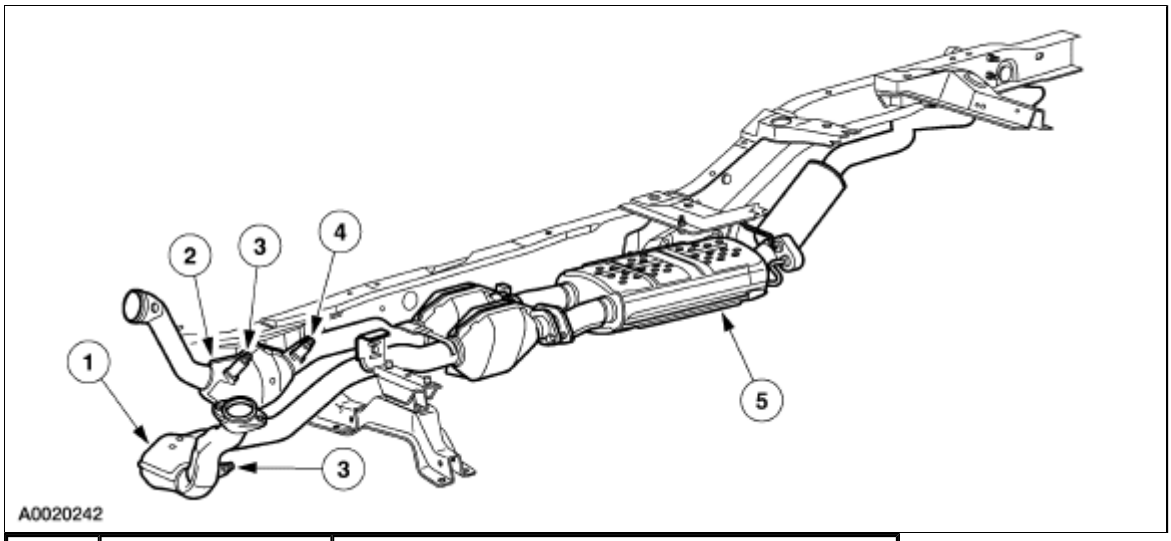
1	5F250	Dual converter Y-pipe
2	5E212	Three-way catalytic converter
3	9F472	Catalyst monitor sensor
4	5230	Muffler and tailpipe
5	5E269	Exhaust converter bracket
6	5B266	Exhaust converter inlet pipe gasket
7	5E241	Exhaust converter outlet pipe gasket

Exhaust System — 4.0L With Dual Inlet Muffler



Item	Part Number	Description
1	9F472	Heated oxygen sensors
2	—	Three-way catalytic converter (RH)
3	9F472	Catalyst monitor sensors
4	5A231	Exhaust clamp
5	5230	Muffler and tailpipe
6	5E212	Three-way catalytic converter (LH)
7	—	Gasket

Exhaust System — 5.0L



Item	Part Number	Description
1	—	Three-way catalytic converter (LH)
2	5E212	Three-way catalytic converter (RH)
3	9F472	Heated oxygen sensor
4	9F472	Catalyst monitor sensor
5	5230	Muffler and tailpipe

Exhaust System

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Noisy or Leaking Exhaust	• Broken or loose clamps and brackets. • Punctures in the muffler (5230). • Broken, loose or missing exhaust manifold fasteners or gaskets. • Loose heated oxygen sensor.	• REPAIR as necessary.
• Loss of Power	• Kinked or damaged exhaust pipe. • Clogged three-way catalytic converter (TWC) (5E212). • Foreign object in the exhaust system.	• REPAIR as necessary.

Exhaust System Alignment

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Loosen all fasteners joining the exhaust system components.
3. Align the exhaust system.
4. **NOTE:** On 4.0L SOHC and 5.0L with dual inlet muffler, the muffler inlet flange bolts must be tightened before the inlet pipe is tightened.

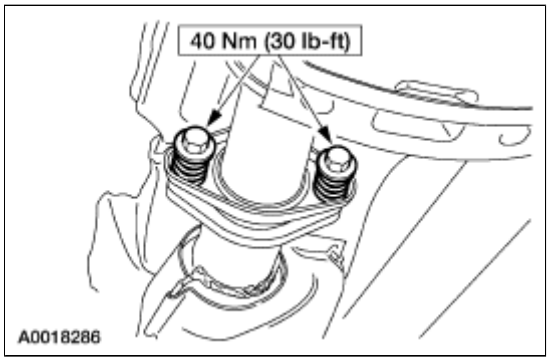
   Tighten all fasteners to specification starting from the rear of the vehicle. For additional information, refer to Specifications in this section.

Muffler/Tailpipe —4.0L with Single Inlet Muffler

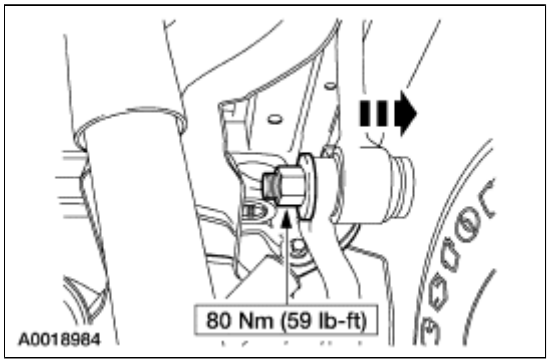
Removal and Installation

NOTE: 4.0L EFI shown, 4.0L SOHC similar.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts and springs.

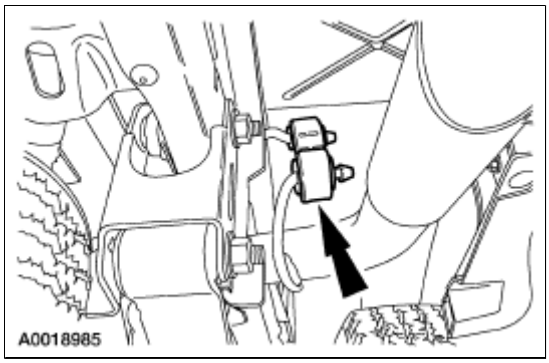


3. Remove the nut and position the right-hand stabilizer bar link out of the way.

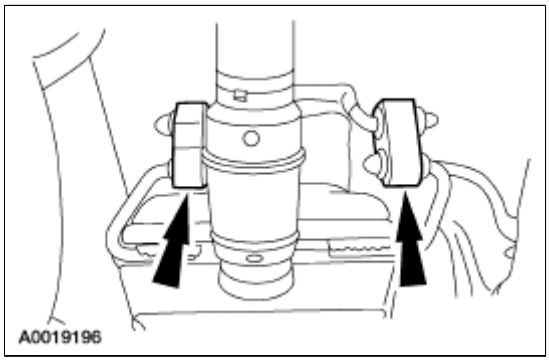


4. **NOTE:** To ease the removal and installation of the exhaust components, lubricate the insulators using a soap and water solution.

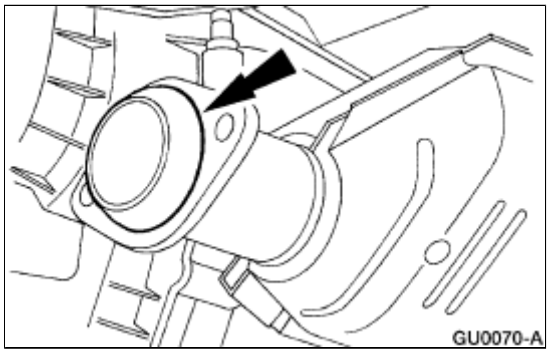
   Detach the tailpipe from the insulator.



5. Detach the muffler from the insulators and remove the muffler and tailpipe.



6. Remove and discard the gasket.

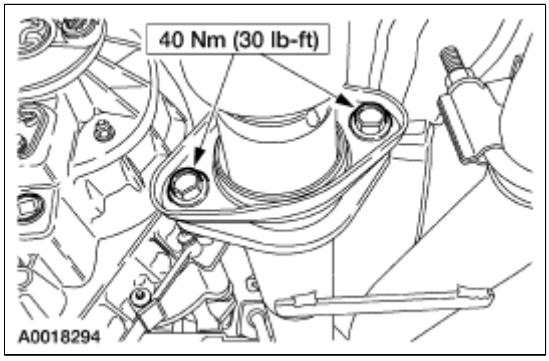


7. To install, reverse the removal procedure.

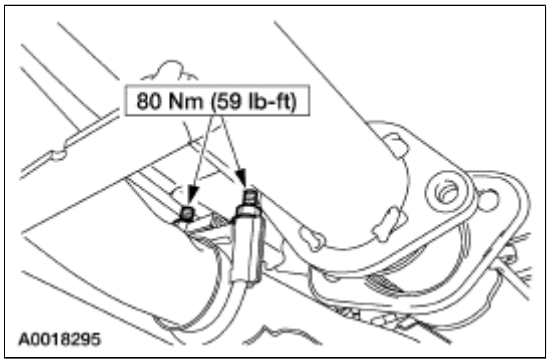
Muffler/Tailpipe —4.0L with Dual Inlet Muffler

Removal and Installation

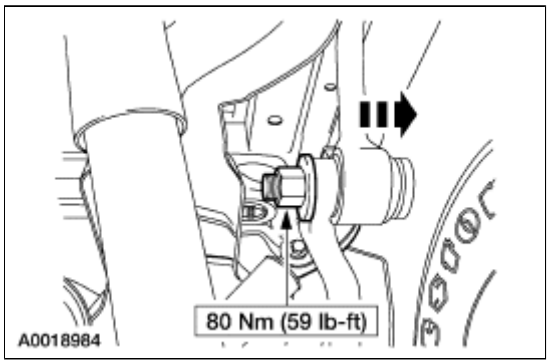
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts and the flag nuts.



3. Remove the nuts and the exhaust clamp.

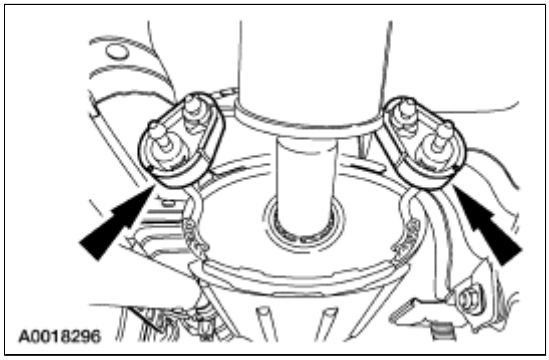


4. Remove the nut and position the right-hand rear stabilizer bar link aside.

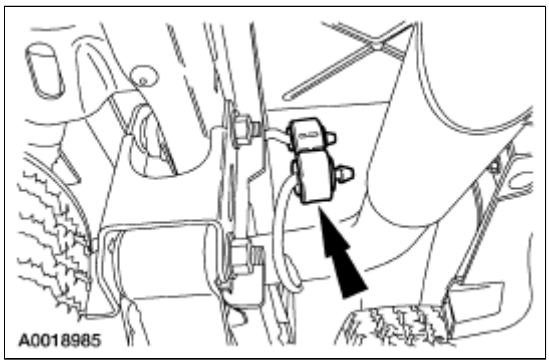


5. **NOTE:** To ease the removal and installation of the exhaust components, lubricate the insulators using a soap and water solution.

Detach the muffler from the insulators.



6. Detach the tailpipe from the insulator and remove the muffler and tailpipe.

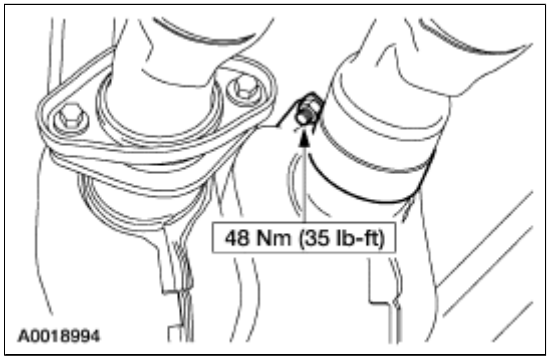


7. To install, reverse the removal procedure.

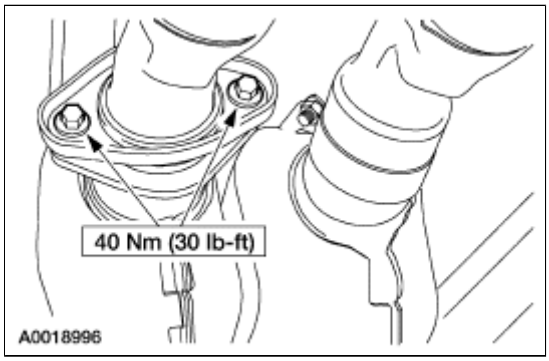
Muffler/Tailpipe —5.0L

Removal and Installation

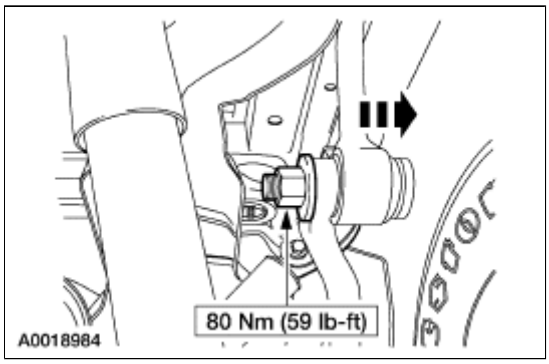
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Loosen the clamp nut.



3. Remove the bolts.

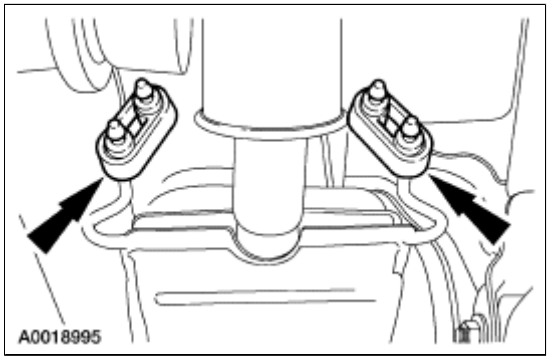


4. Remove the nut and position the right-hand rear stabilizer bar link out of the way.

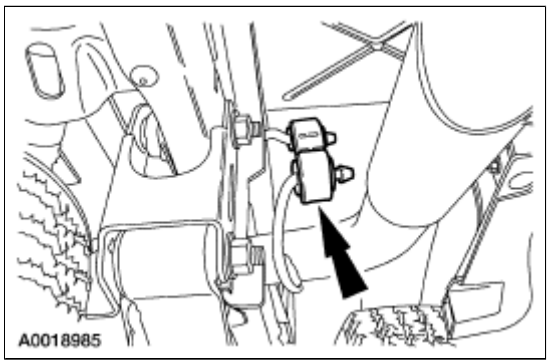


5. **NOTE:** To ease the removal and installation of the exhaust components, lubricate the insulators using using a soap and water solution.

Detach the muffler from the insulators.



6. Detach the tailpipe from the insulator and remove the muffler and tailpipe.



7. To install, reverse the removal procedure.

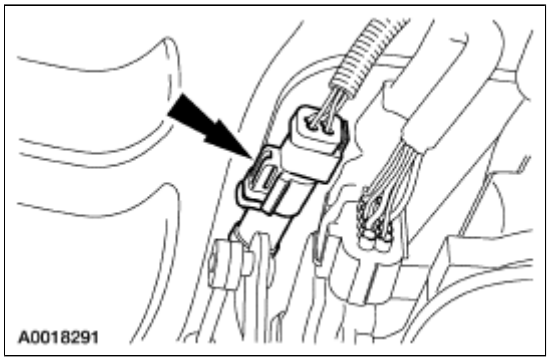
Dual Converter Y-Pipe —4.0L

Removal and Installation

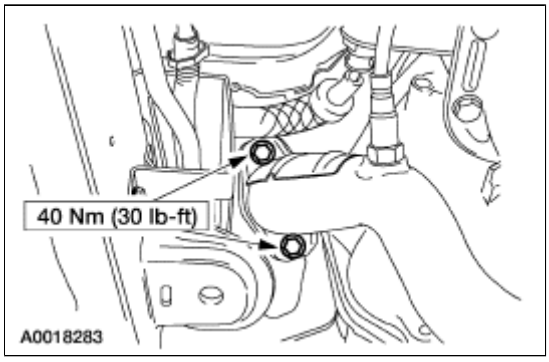
NOTE: 4.0L SOHC shown, 4.0L EFI similar.

1. Remove the three-way catalytic converter. For additional information, refer to Three Way Catalytic Converter (TWC)—4.0L with Single Inlet Muffler in this section.

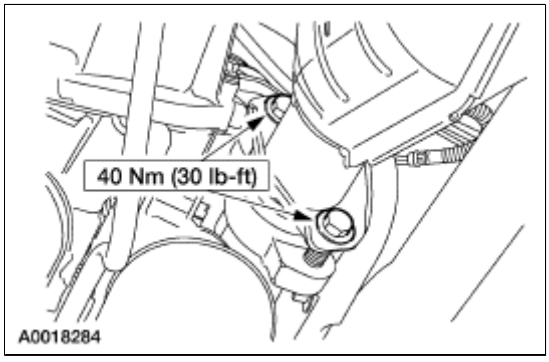
2. Disconnect the heated oxygen sensors.



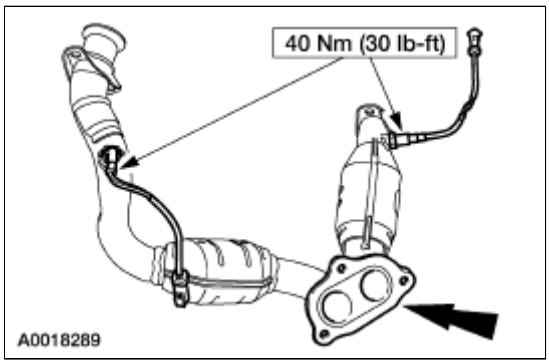
3. Remove the bolts.



4. Remove the bolts and remove the dual converter Y-pipe.



5. Remove the gasket and, if necessary, the heated oxygen sensors.
   - Discard the gasket.



6. **CAUTION: Make sure that the dual converter Y-pipe to exhaust manifold bolts are tightened after the three-way catalytic converter is installed.**

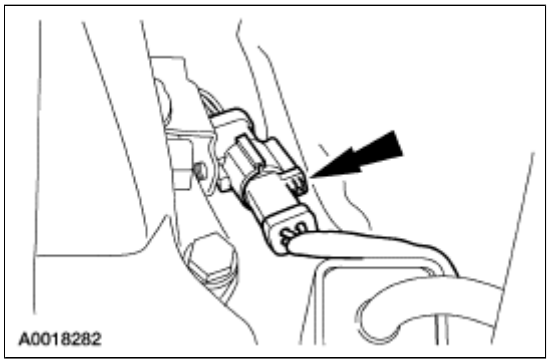
   To install, reverse the removal procedure.
   - Make sure to apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the threads of the sensors before installation.

Three Way Catalytic Converter (TWC) —4.0L with Single Inlet Muffler

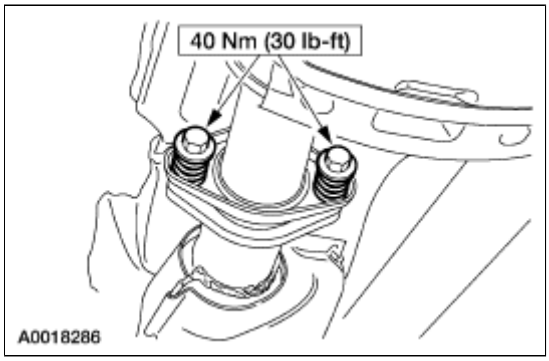
Removal and Installation

NOTE: 4.0L shown, 4.0L EFI similar.

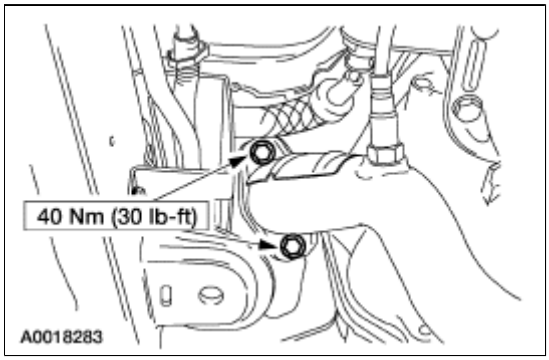
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the catalyst monitor sensor.



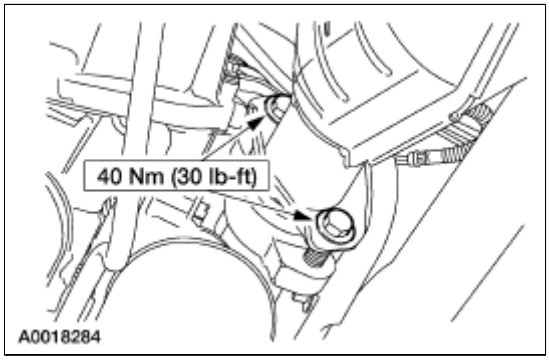
3. Remove the bolts and springs.



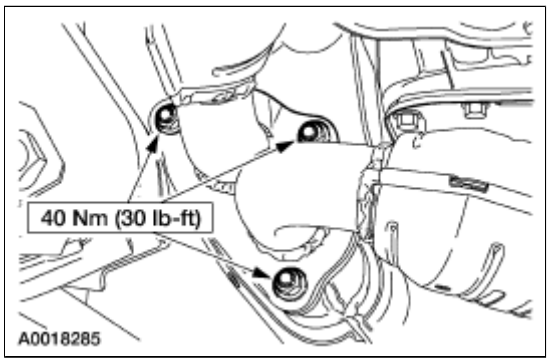
4. Loosen the bolts.



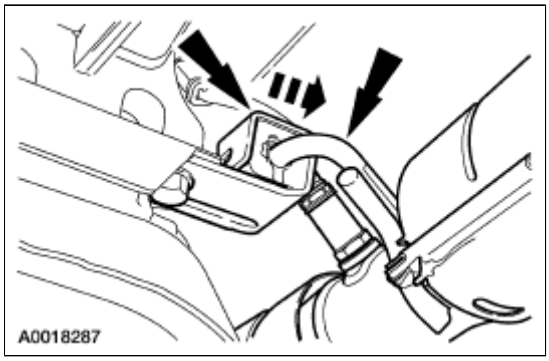
5. Loosen the bolts.



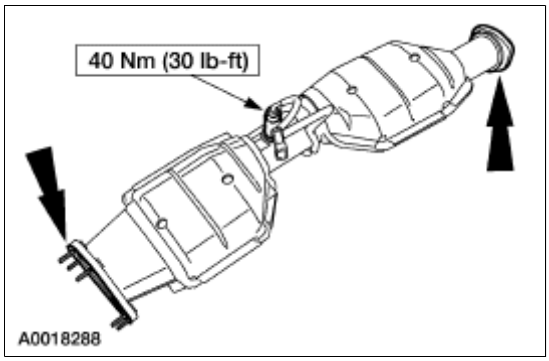
6. Remove the nuts.



7. Detach the three-way catalytic converter (TWC) from the insulator and remove the TWC.



8. Remove the gaskets and, if necessary, the catalyst monitor sensor.
    - Discard the gaskets.



9. **CAUTION: Make sure to tighten the exhaust component fasteners starting from the rear of the vehicle.**

   To install, reverse the removal procedure.
   - Make sure to apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the threads of the sensor prior to installation.

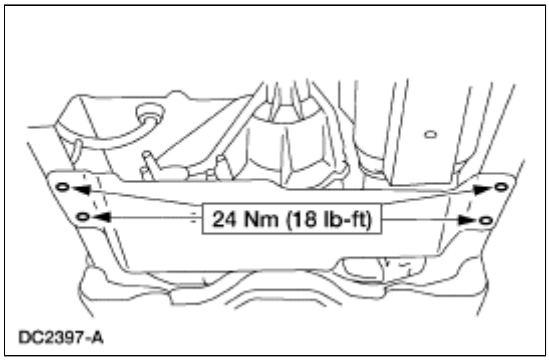
Three Way Catalytic Converter (TWC) —4.0L with Dual Inlet Muffler

Removal and Installation

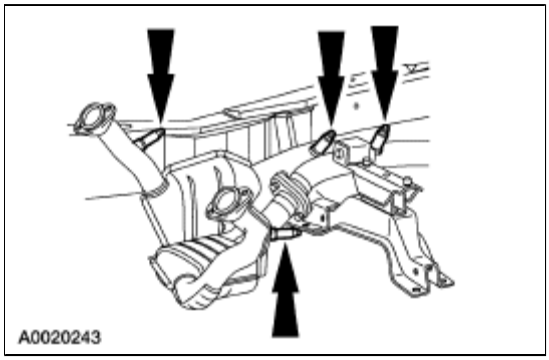
NOTE: If removing both converters, the left-hand converter must be removed before the right-hand converter.

Both converters

1. Remove the bolts and the skid plate (if equipped).

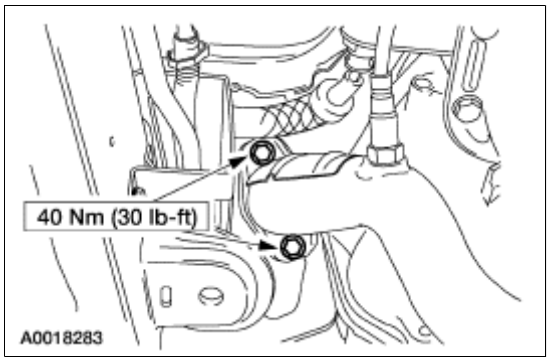


2. If removing the left-hand converter, disconnect the heated oxygen sensor. If removing left and right-hand converters, disconnect both heated oxygen sensors catalyst monitor sensors.

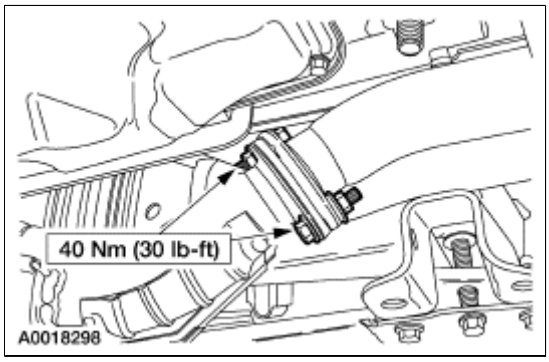


Left-hand converter

3. Remove the bolts.



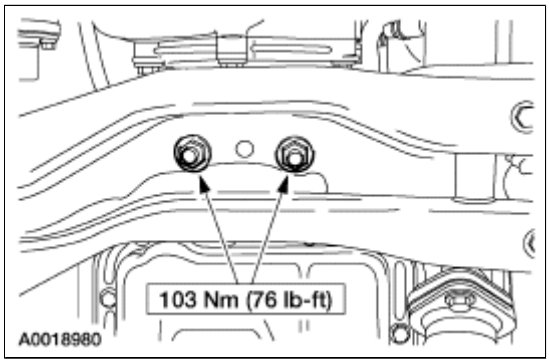
4. Remove the bolts and the flag nuts and remove the left-hand three-way catalytic converter (TWC).



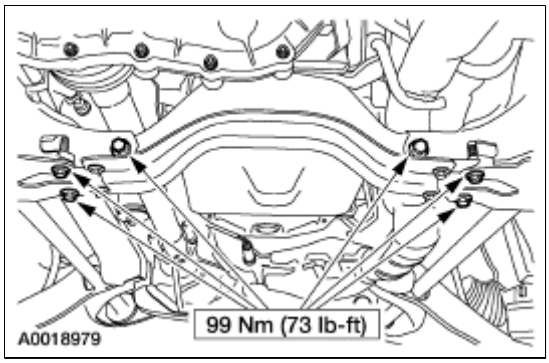
Right-hand

5. Remove the muffler and tailpipe. For additional information, refer to Muffler/Tailpipe—4.0L with Dual Inlet Muffler in this section.

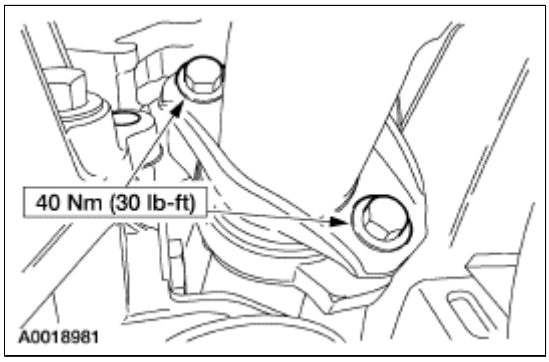
6. Remove the nuts.
   - Position a suitable transmission jack under the transmission.



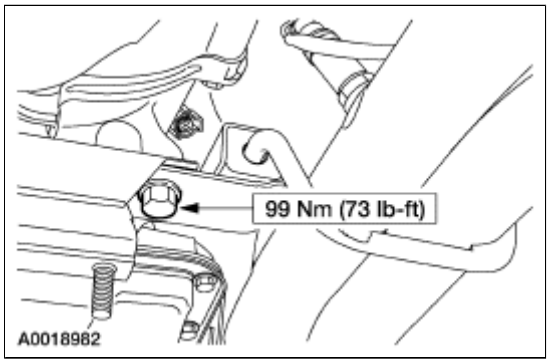
7. Remove the bolts and the transmission crossmember.



8. Remove the bolts.

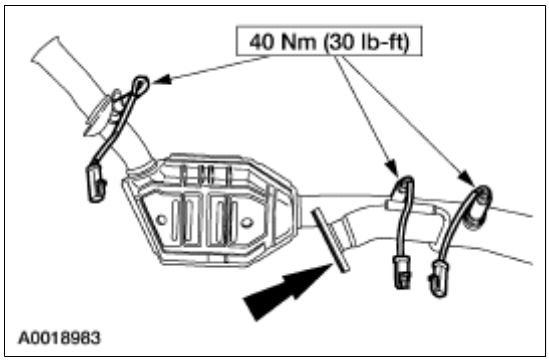


9. Remove the bolt and the right-hand TWC.



Both converters

10. Remove the gasket and the heated oxygen sensors and the catalyst monitor sensors (if necessary).
    - Discard the gasket.



11. To install, reverse the removal procedure.
    - Tighten the left-hand to right-hand converter bolts before tightening the converter to manifold bolts.
    - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the threads of the sensors prior to installation.

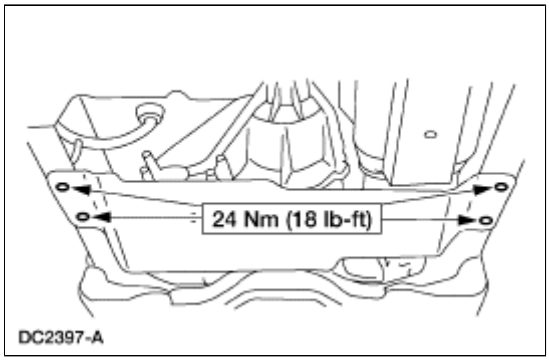
Three Way Catalytic Converter (TWC) —5.0L

NOTE: The left-hand converter must be removed before the right-hand converter.

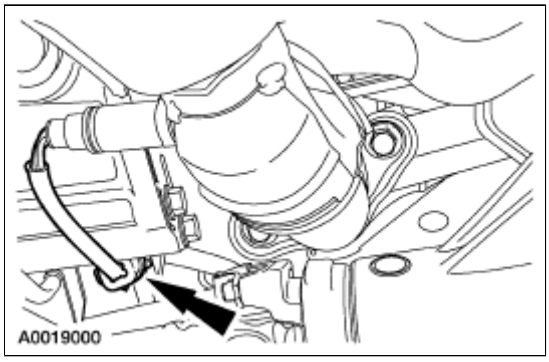
Left-hand and right-hand

1. Remove the muffler and tailpipe. For additional information, refer to Muffler/Tailpipe—5.0L in this section.

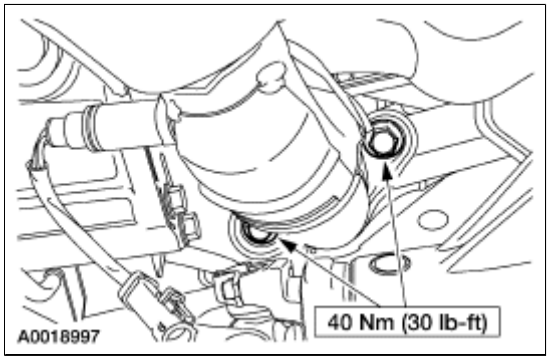
2. Remove the bolts and the skid plate (if equipped).



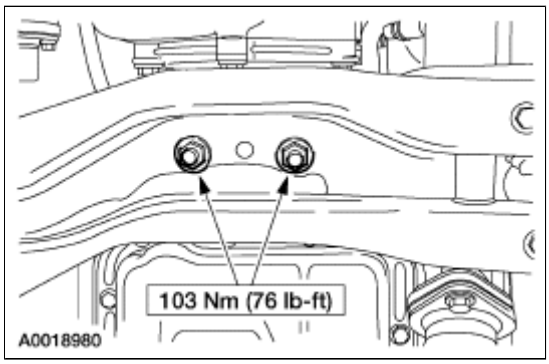
3. Disconnect the heated oxygen sensors and the catalyst monitor sensors.



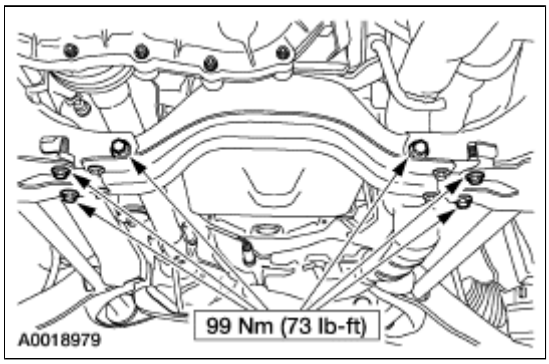
4. Remove the bolts.



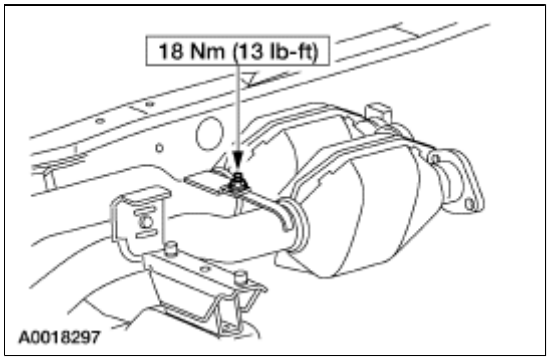
5. Remove the nuts.
    - Position a suitable transmission jack under the transmission.



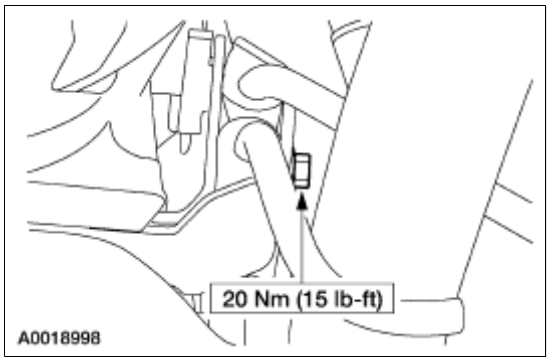
6. Remove the bolts and the transmission crossmember.



7. Remove the nut.

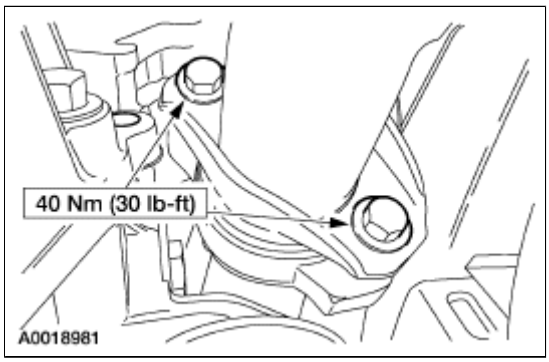


8. Remove the bolt and the three-way catalytic converter (TWC).



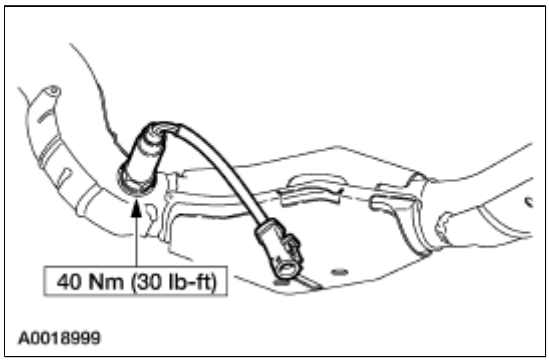
Right-hand

9. Remove the bolts and the TWC.



Left-hand and right-hand

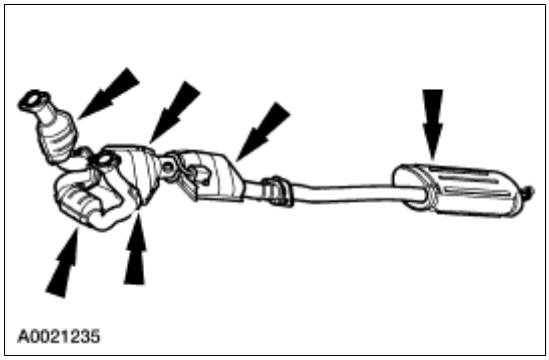
10. Remove the heated oxygen sensors and the catalyst monitor sensors (if necessary).



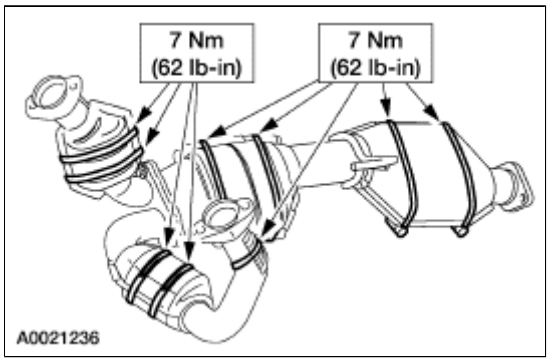
11. To install, reverse the removal procedure.
    - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the threads of the sensors prior to installation.

Heat Shield —Catalytic Converter and Muffler

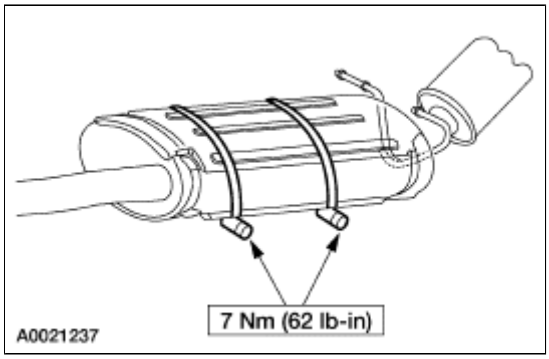
1. Raise the vehicle. For additional information, refer to Section 100-02 .
2. Inspect the catalytic converter and muffler for loose or missing heat shields.



3. Install worm clamps for heat shields that are loose.
   - Use one of the following clamps: FOTZ-5A231–A or W705949–S300.
   - Trim off the excess ear of the worm clamp.



4. If the heat shields are missing, install new heat shields. If new heat shields are not available, install a new catalytic converter. For additional information, refer to Dual Converter Y-Pipe—4.0L , Three Way Catalytic Converter (TWC)—4.0L with Single Inlet Muffler , Three Way Catalytic Converter (TWC)—4.0L with Dual Inlet Muffler or Three Way Catalytic Converter (TWC)—5.0L in this section.



5. Lower the vehicle.

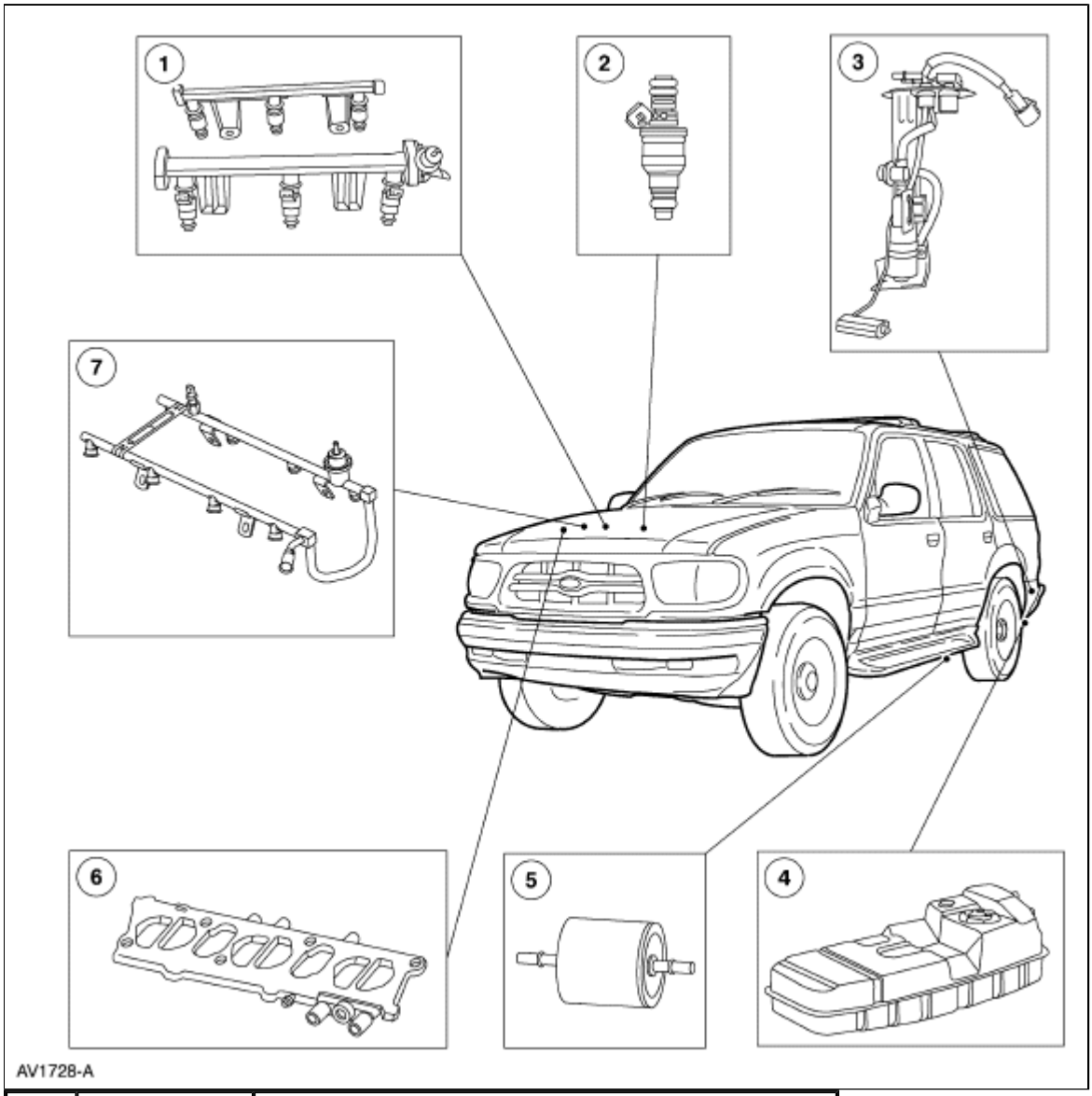
SPECIFICATIONS

General Specifications

Item	Specification
Fuel Capacity	
2-door L (GAL)	66 (17.5)
4-door L (GAL)	80 (21)
Lubricants	
Engine oil	WSS-M2C153-G

Fuel System

Fuel System Components



Item	Part Number	Description
1	9D280	Fuel injection supply manifold— (4.0L SOHC)
2	9F593	Fuel injector
3	9H307	Fuel pump assembly
4	9002	Fuel tank
5	9155	Fuel filter
6	9D280	Fuel injection supply manifold— (4.0L push rod)

7	9D280	Fuel injection supply manifold— (5.0L)

The vehicle:

- is equipped with a multiport fuel injection system.
- has separately controlled fuel injectors (9F593) mounted to the intake manifold for each cylinder.
- fuel injectors are supplied with regulated pressurized fuel from the fuel pump (9350) through the fuel injection supply manifold (9D280).
- has a fuel injection supply manifold.
- has a fuel pressure regulator controlling the pressure going to the fuel injectors.

For information concerning adjustments, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Pressure Relief

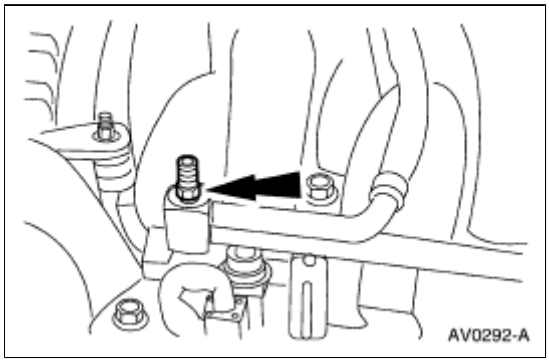
Special Tool(s)

ST1371-A	Fuel Pressure Gauge 310-012 (T80L-9974-B)

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

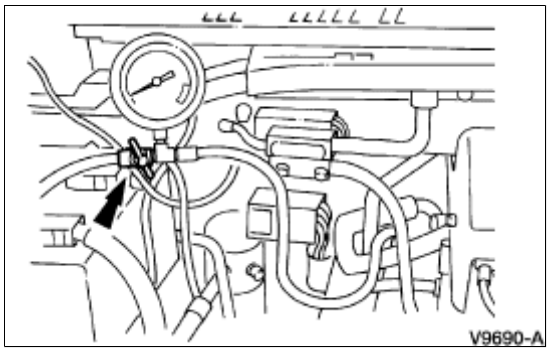
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Remove the Schrader valve cap and attach the Fuel Pressure Gauge.



2. **NOTE:** Open the manual valve slowly to relieve the system pressure. This may drain fuel from the system. Place the fuel in a suitable container.

   Open the manual valve on the Fuel Pressure Gauge slowly and relieve the fuel pressure.


V9690-A

Draining

Special Tool(s)

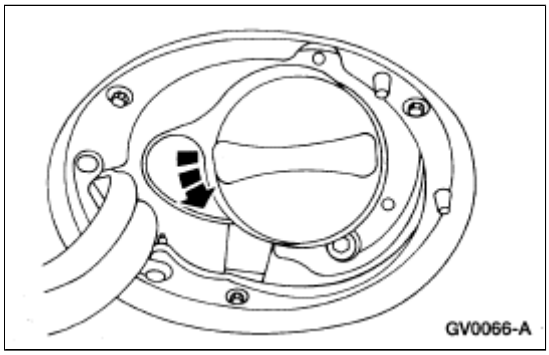
ST1114-A	30 Gallon Gasoline Hand Pump Storage Tanker 164-R3201 or equivalent

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

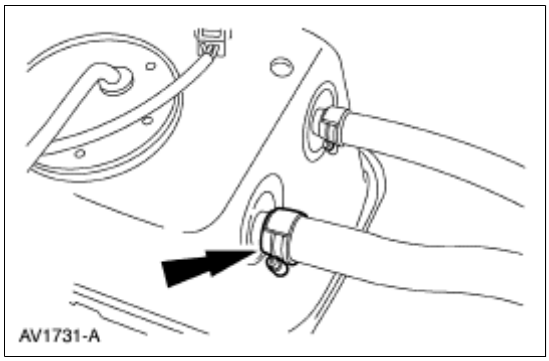
   WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

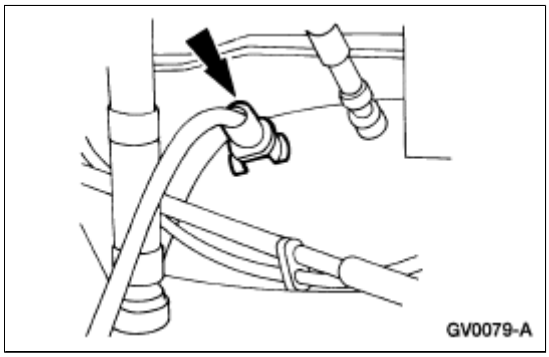
2. Remove the gas cap.



3. Disconnect the fuel filler tube at the fuel tank.

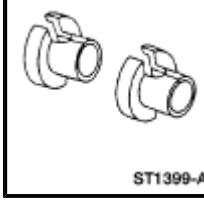


4. Use the Fuel Storage Tanker to siphon the fuel through the fuel tank spud opening.



Fittings —Push Connect

Special Tool(s)

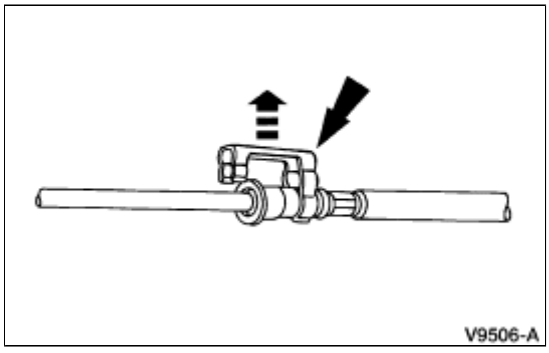
 ST1399-A	Fuel Line Disconnect Tool 310-S039 (T90T-9550-S)

Disconnect

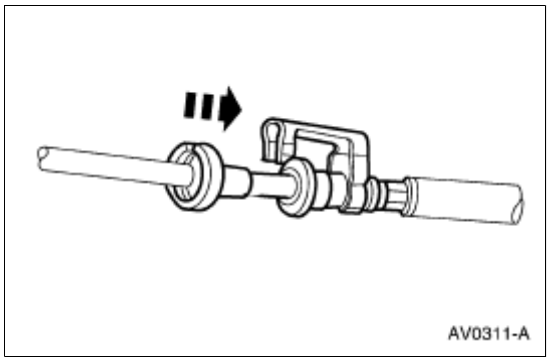
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

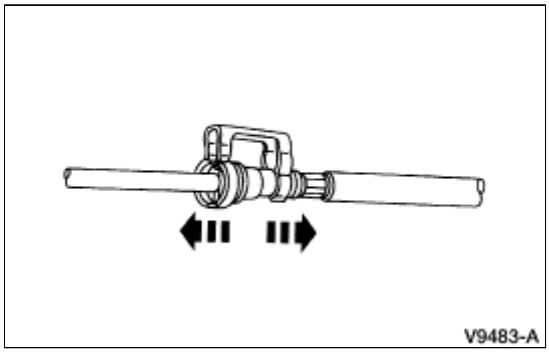
1. Relieve the fuel pressure. For additional information, refer to Pressure Relief in this section.
2. Disconnect the safety clip from the male hose.



3. Install the Fuel Line Disconnect Tool and push it into the fitting.



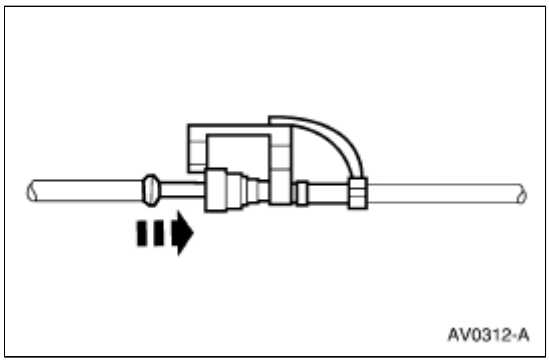
4. Separate the fittings.
    - Inspect for damage.
    - Clean the fittings.



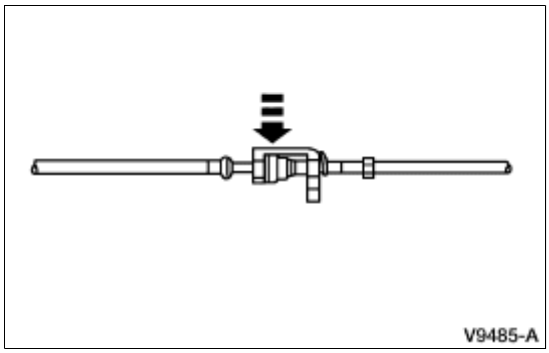
Connect

1. **NOTE:** Lubricate the tube end with clean engine oil meeting Ford specification WSS-M2C153-G to ease assembly.

   Align the tube to the fitting and push until you hear a click.



2. Pull on the fitting to make sure it is fully engaged, then install the safety clip.


V9485-A

Fittings —R-Clip

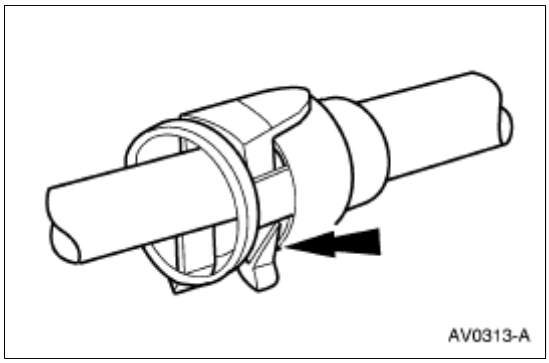
Disconnect

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

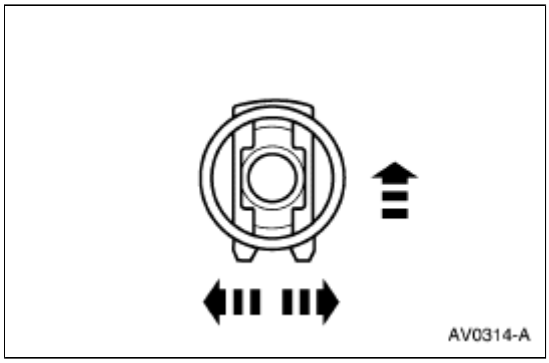
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved.

CAUTION: Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.

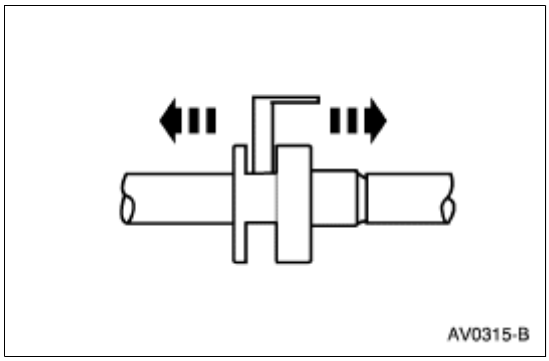
1. Relieve the fuel pressure. For additional information, refer to Pressure Relief in this section.



2. Remove the shipping tab by bending downward.
3. Spread the R-clip legs and push the clip into the fitting.

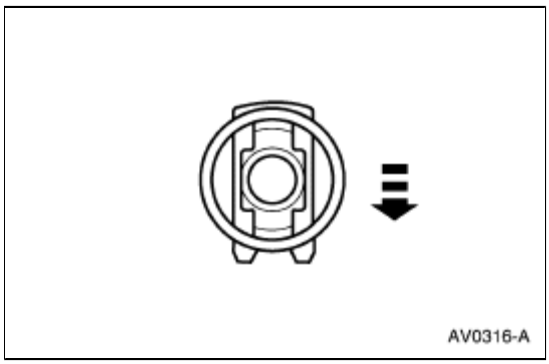


4. Separate the fitting from the tube.

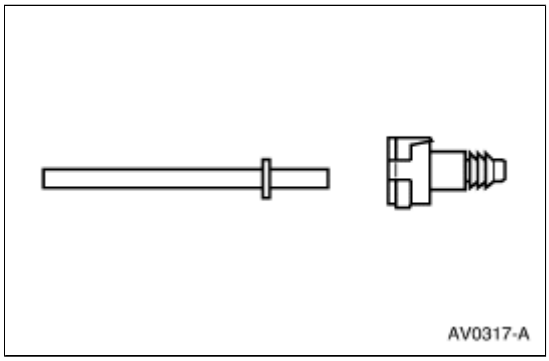


Connect

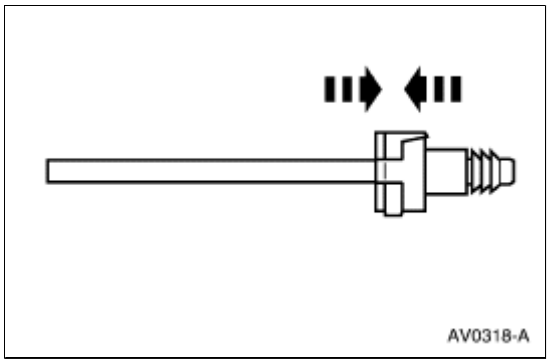
1. Inspect the fitting and the tube for damage. Remove any dirt or obstructions.
2. Apply a light coat of clean engine oil meeting Ford specification WSS-M2C153-G to the male tube end.
3. Insert the R-clip into the fitting.



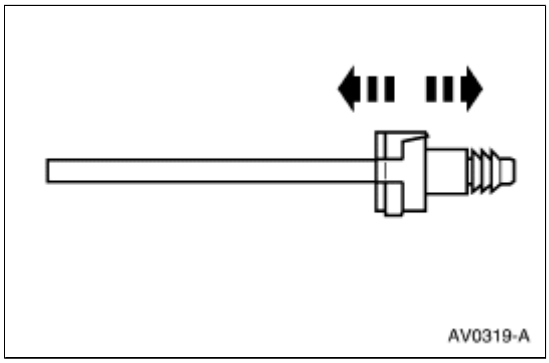
4. Align the tube and the fitting.



5. Insert the tube into the fitting and push together until a click is heard.



6. Pull on the connection to make sure it is fully engaged.



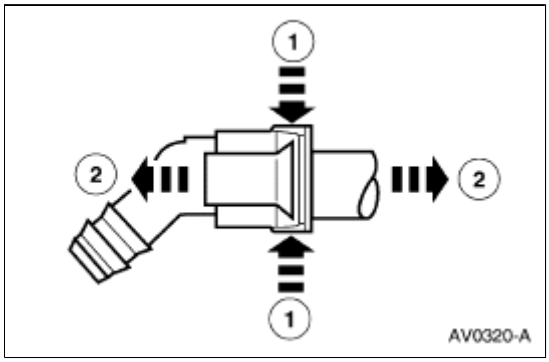
Fittings —Vapor Tube

Disconnect

1. **WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or fuel liquid is present in the area.**

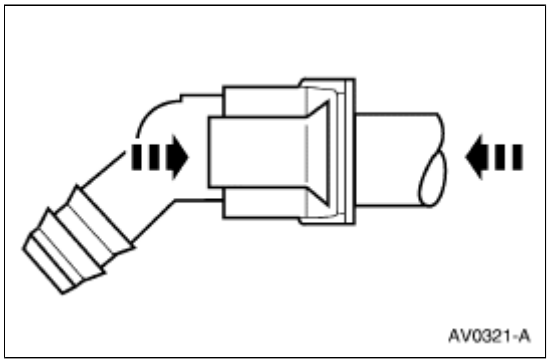
   Disconnect the battery ground cable. For additional information, refer to Section 414-01

2. Disconnect the vapor tube from the fitting.
   1. Squeeze the fitting.
   2. Disconnect the vapor tube from the fitting.

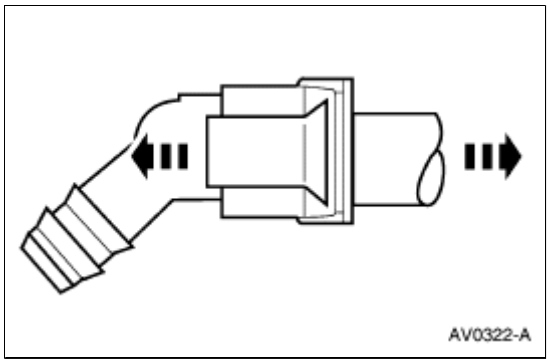


Connect

1. Inspect the fitting and the tube for damage.
2. Remove any dirt or obstructions.
3. Push the tube into the fitting until it snaps in place.



4. Pull on the connection to make sure the fitting is secure.


AV0322-A

Coupling —Spring Lock

Special Tool(s)

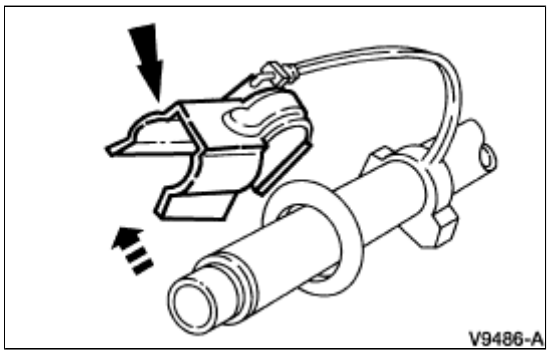
ST1146-A	Spring Lock Coupler Tool (3/8 inch) 310-D004 (D87L-9280-A) or equivalent
ST1147-A	Spring Lock Coupler Tool (1/2 inch) 310-D005 (D87L-9280-B) or equivalent

Disconnect

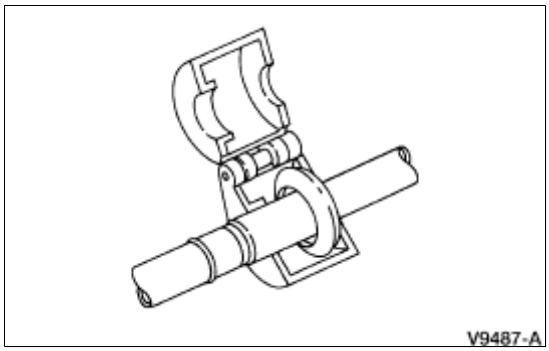
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

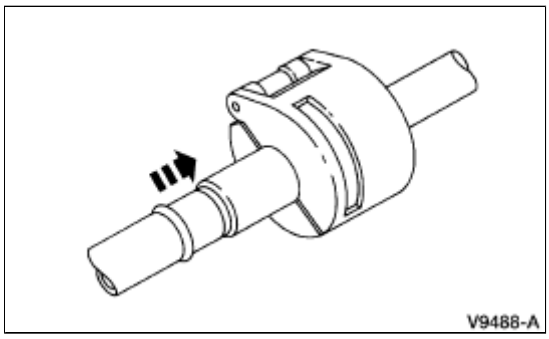
1. Relieve the fuel pressure. For additional information, refer to Pressure Relief in this section.
2. Remove the fuel tube clip.


V9486-A

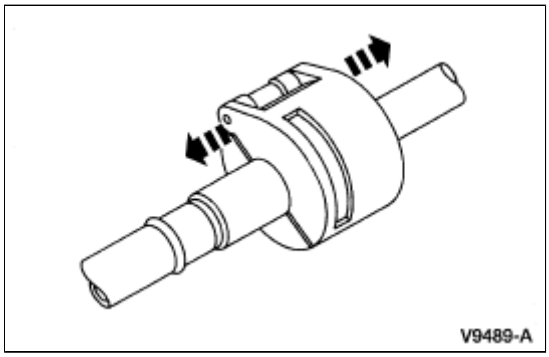
3. Install the Spring Lock Coupler Tool.



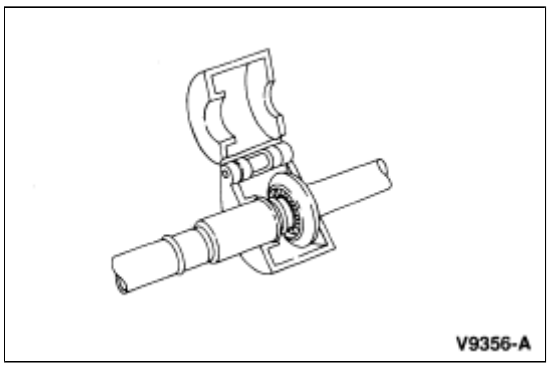
4. Close and push the Spring Lock Coupler Tool into the open side of the cage.



5. Separate the fitting.

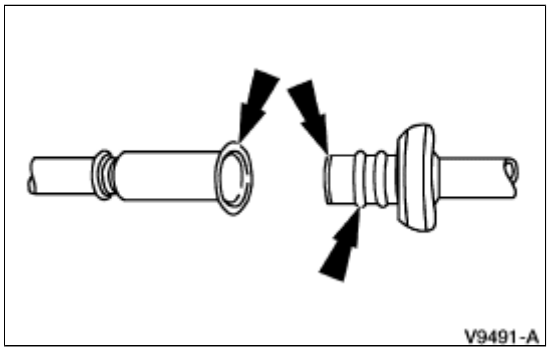


6. Remove the Spring Lock Coupler Tool.



Connect

1. Connect the fitting.
    - Inspect and clean both the coupling ends.
    - Lubricate the O-rings with clean engine oil meeting Ford specification WSS-M2C153-G.
    - Connect the fitting.
    - Pull on the fitting to make sure it is fully engaged.
    - Install the safety clip.



General Specifications

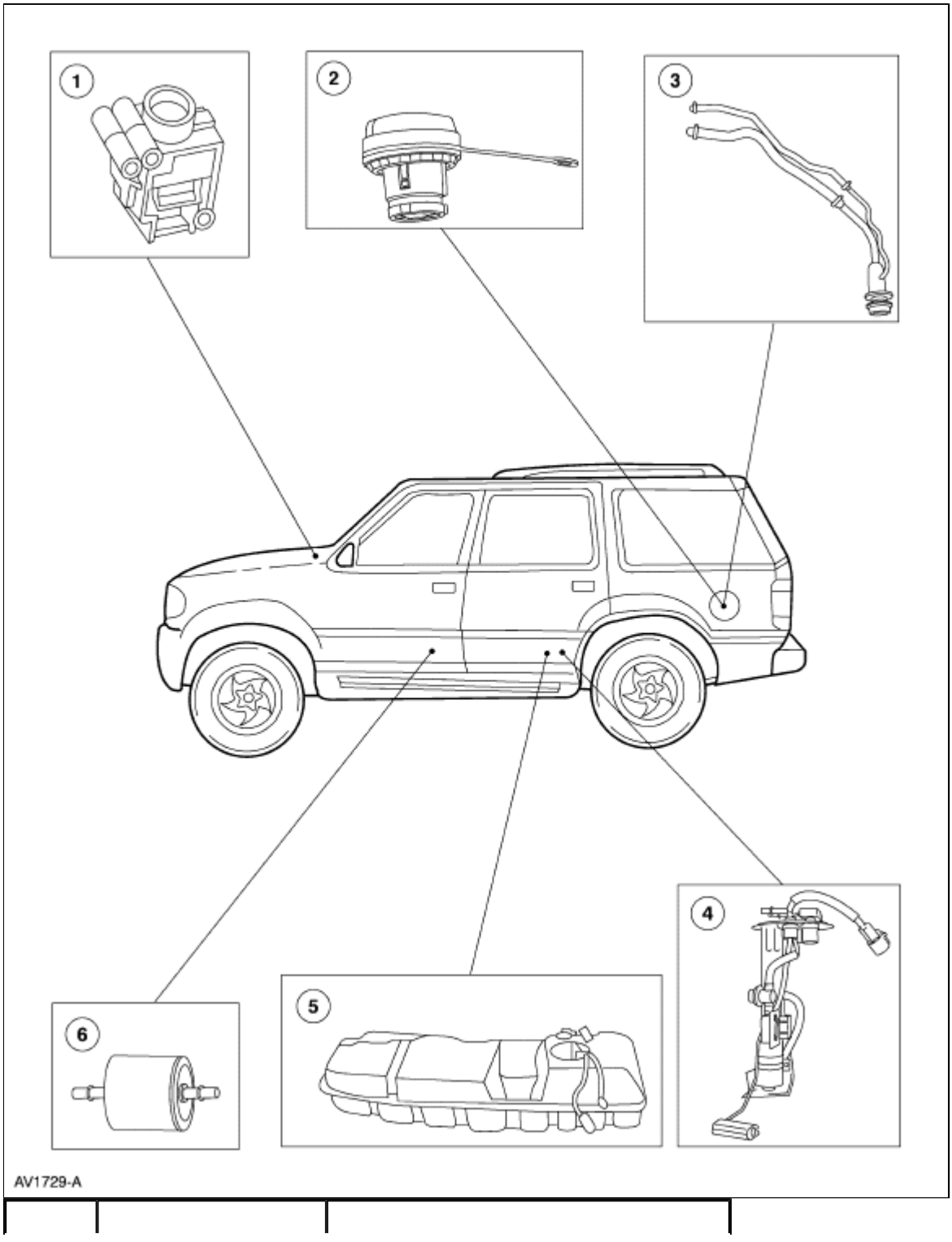
Item	Specification
Explorer Midship 2-Door	66L (17.5 Gal.)
Midship 4-Door	80L (21.0 Gal.)
Mountaineer Midship	79.5L (21.0 Gal.)
Fuel pressure	65±8 PSI

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel tank bracket bolt	34-46	25-34	—
Fuel tank skid plate bolts	40	30	—
Fuel tank support strap bolt	34-46	25-34	—
Fuel pump bolts	9-12	—	80-107

Fuel Tank and Lines

Component Locations



Item	Part Number	Description
1	9341	Inertia fuel shutoff switch
2	9030	Fuel tank filler cap
3	9034	Fuel tank filler pipe
4	9H307	Fuel pump assembly
5	9002	Fuel tank
6	9155	Fuel filter

The fuel system consists of:

- the fuel tank (9002).
- the fuel tank filler pipe (9034) which contains a restrictor plate to permit only unleaded fuel to be pumped into the fuel tank.
- a 1/8 turn type fuel tank filler cap (9030).
- a fuel filter (9155) providing filtration to protect the fuel injectors.
- fuel lines.
- a fuel pressure regulator.
- a fuel pump assembly (9H307) containing:
    - the electric fuel pump which provides pressurized fuel to the engine.
    - the fuel level sensor.
    - an inlet filter.
    - a check valve which maintains system pressure after the pump is shut off.
    - a mechanical fuel pressure regulator with pressure relief for over pressure protection.

The fuel pump is controlled by the powertrain control module (PCM) (12A650) which energizes the fuel pump relay. Electrical power to the pump is provided through the inertia fuel shutoff switch (IFS switch) (9341).

Tank

Removal

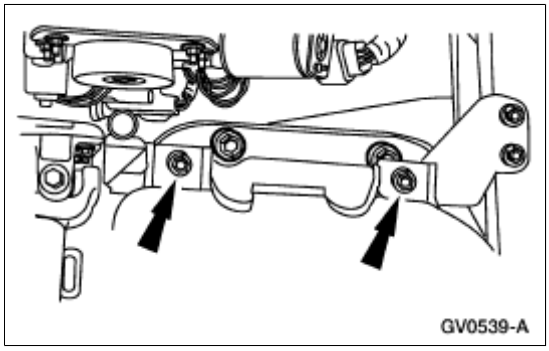
All vehicles

WARNING: Do not smoke, carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

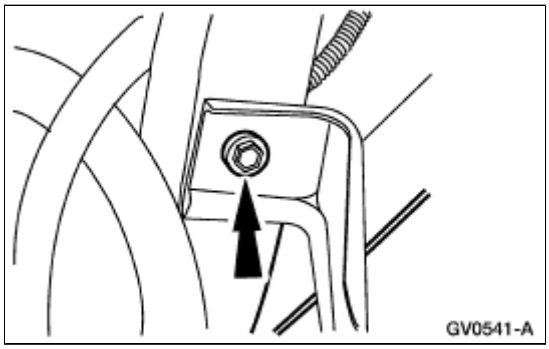
1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .
3. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Drain the fuel tank (9002). For additional information, refer to Section 310-00 .

Four wheel drive vehicles

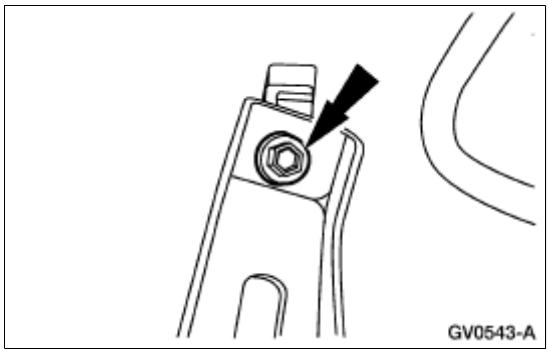
5. Remove the bolts.



6. Remove the rear LH bolt.

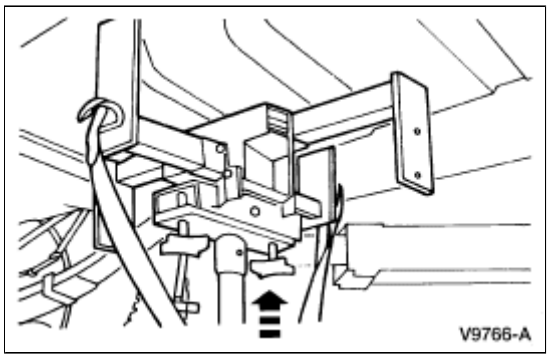


7. Remove the rear RH bolt and lower the fuel tank skid plate (9A147).

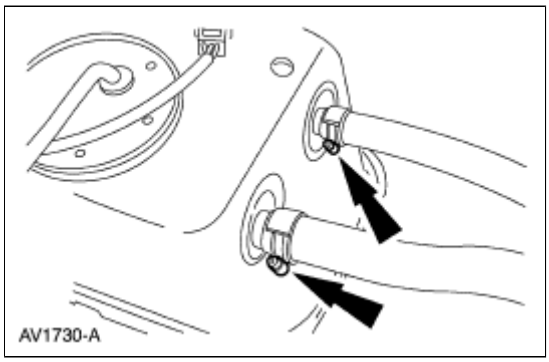


All vehicles

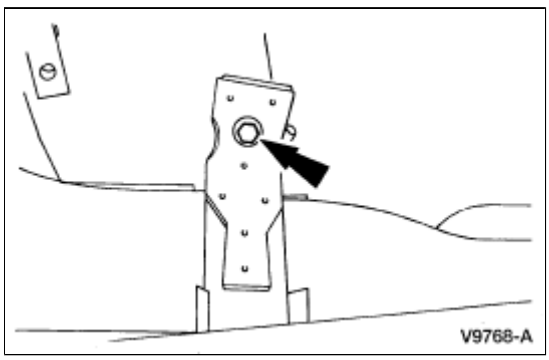
8. Use a suitable jack to support the fuel tank.



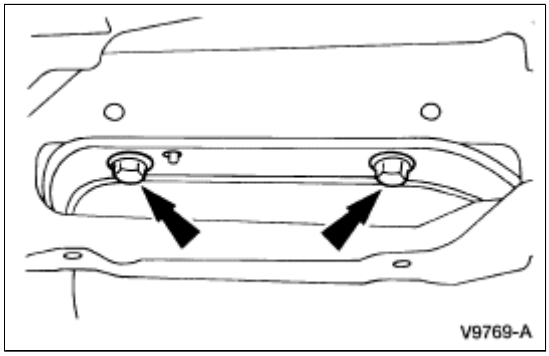
9. Remove the fuel tank filler pipe (9034) and the vent hose.



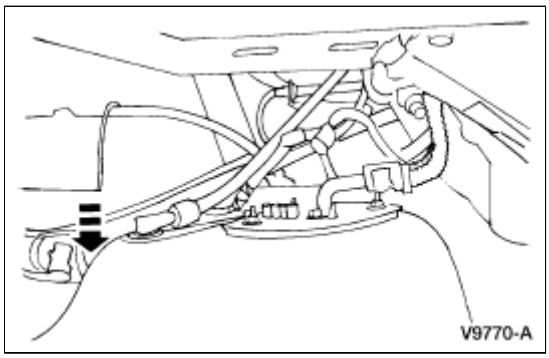
10. Remove the bolt and remove the fuel tank support strap (9057).



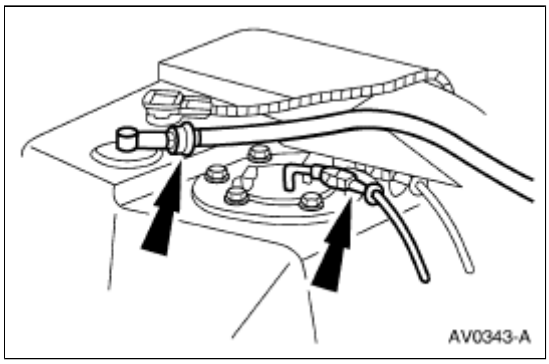
11. Remove the bolts and push the fuel tank back until the lip clears the support bracket.



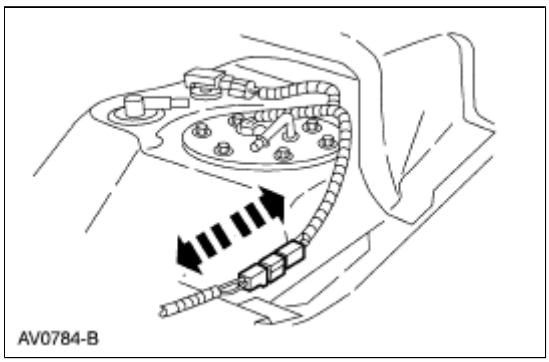
12. Lower the fuel tank just enough to expose the fuel lines and the fuel tank transducer connector.



13. Disconnect the fuel lines and the vapor lines. For additional information, refer to Section 310-00 .



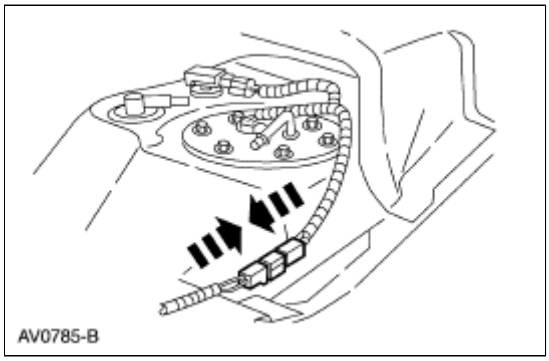
14. Disconnect the fuel tank electrical supply connector near the frame rail. Lower the fuel tank.



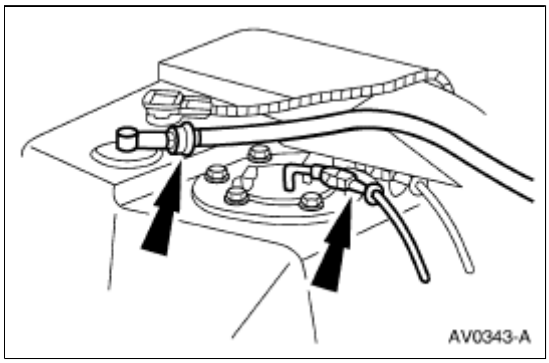
Installation

All vehicles

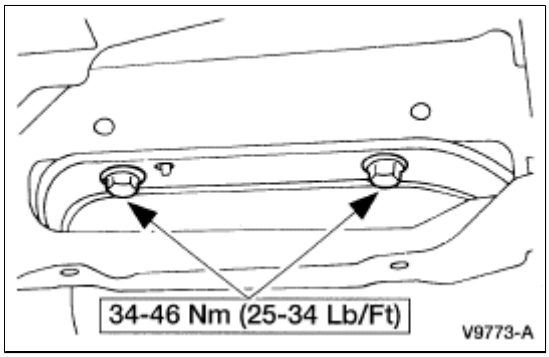
1. Connect the fuel tank electrical supply connector near the frame rail.



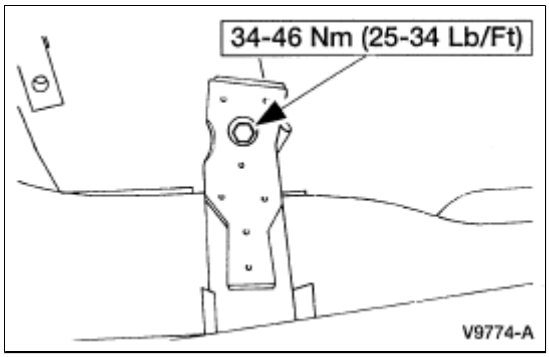
2. Connect the fuel lines and the vapor lines. For additional information, refer to Section 310-00 .



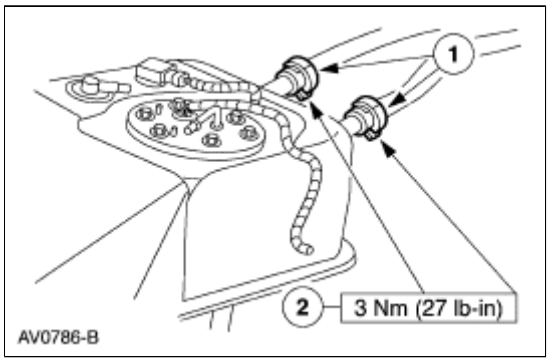
3. Raise the fuel tank into position, slide it forward into the support bracket, and install the bolts.



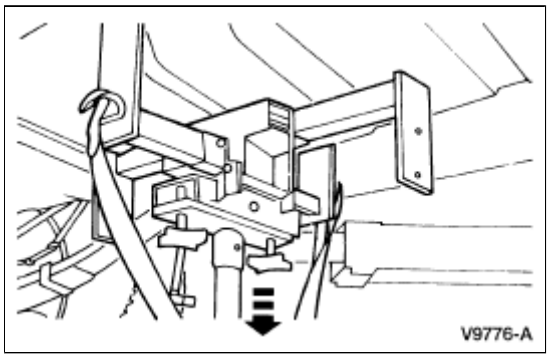
4. Position the fuel tank support strap and install the bolt.



5. Install the fuel tank filler pipe and the vent hose.
    1. Orient clamp bonding patch with top of the fuel tank.
    2. Tighten the hose clamps.

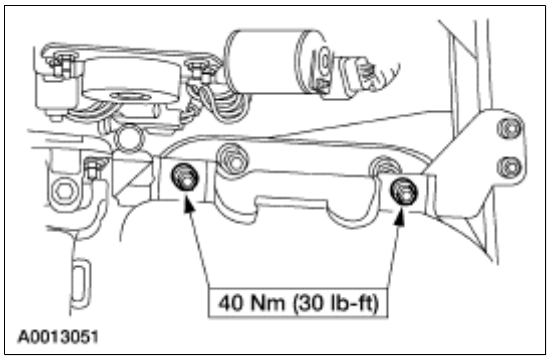


6. Remove the jack.

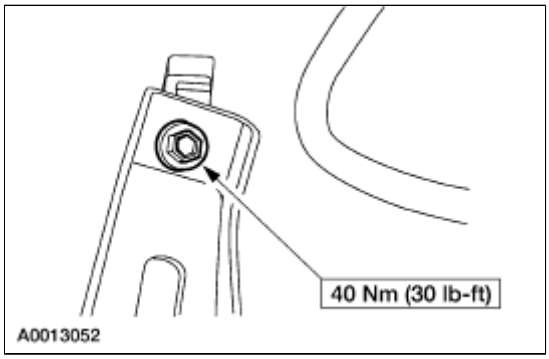


Four wheel drive vehicles

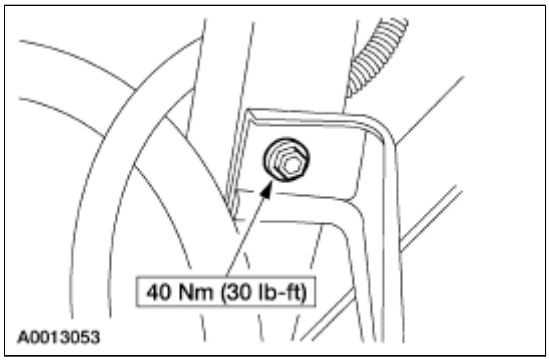
7. Position the fuel tank skid plate and install the front bolts.



8. Install the rear RH bolt.



9. Install the rear LH bolt.



All vehicles

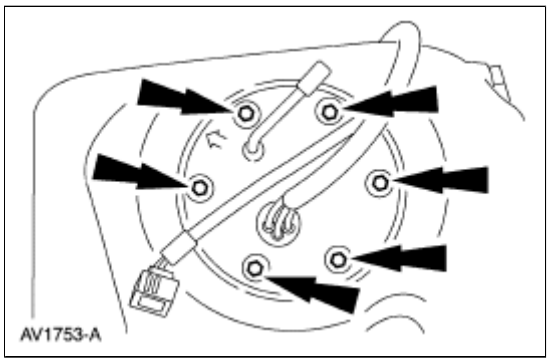
10. Lower the vehicle.
11. Fill the fuel tank.
12. Connect the battery. For additional information, refer to Section 414-01 .

Pump

Removal

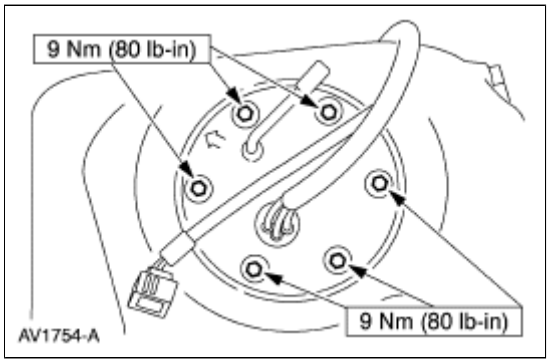
1. Remove the fuel tank (9002). For additional information, refer to Tank in this section.
2. Clean the area around the fuel pump assembly (9H307) mounting flange.
3. Disconnect the electrical connector from the fuel pressure transducer.
4. **CAUTION: The fuel pump assembly must be handled carefully to avoid damage to the float arm and the filter.**

   Remove the fuel pump mounting bolts and remove the fuel pump assembly.



Installation

1. Clean the fuel pump assembly mounting flange and the fuel tank mounting surface.
2. Install the fuel pump assembly.
   1. Position the fuel pump assembly in the fuel tank.
   2. Align the arrow on the fuel pump flange with the dimple on the fuel tank.
   3. Install the bolts.



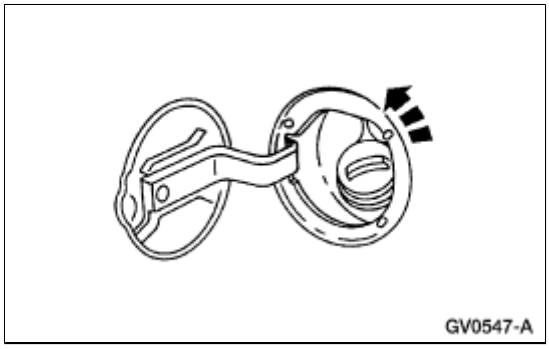
3. Connect the electrical connector to the fuel pressure transducer.

4. Install the fuel tank. For additional information, refer to Tank in this section.

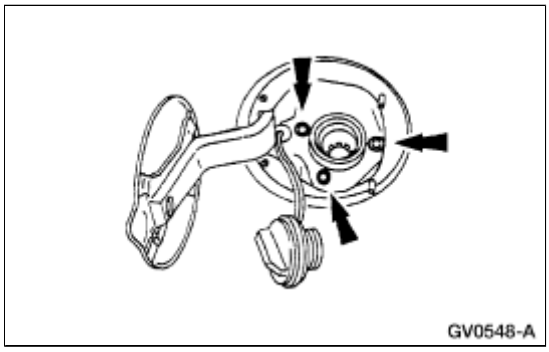
Filler Pipe

Removal

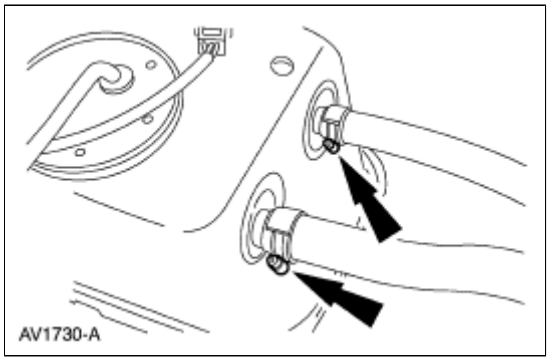
1. Remove the fuel tank filler cap (9030).



2. Remove the screws.



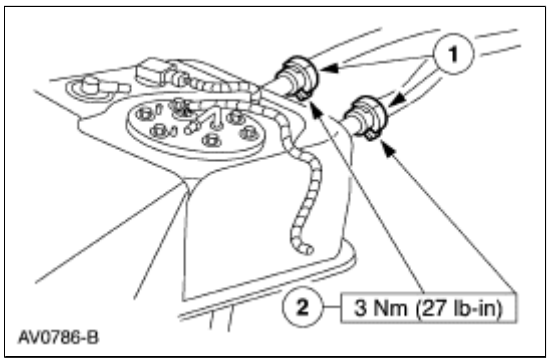
3. Remove the fuel tank filler pipe (9034) and the vent hose from the fuel tank (9002) and remove the fuel tank filler pipe.



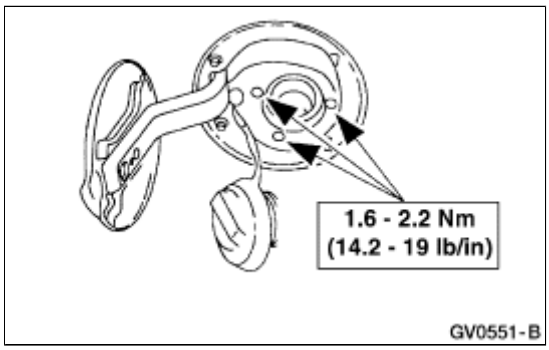
Installation

1. Install the fuel tank filler pipe and the vent hose.
    1. Orient clamp bonding patch with top of the fuel tank.

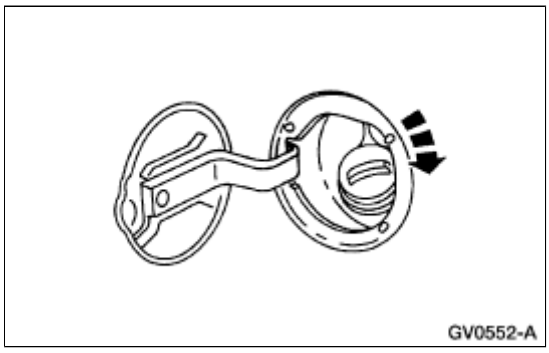
2. Tighten the hose clamps.



2. Install the three fuel tank filler pipe screws.



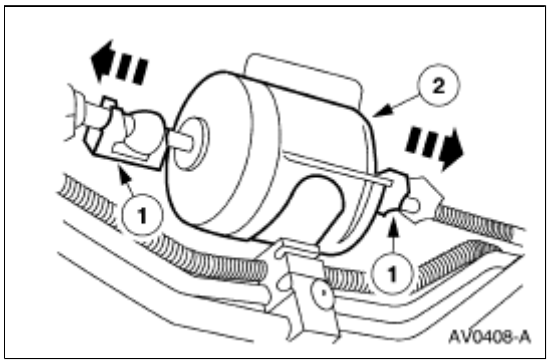
3. Install the fuel tank filler cap.



Filter

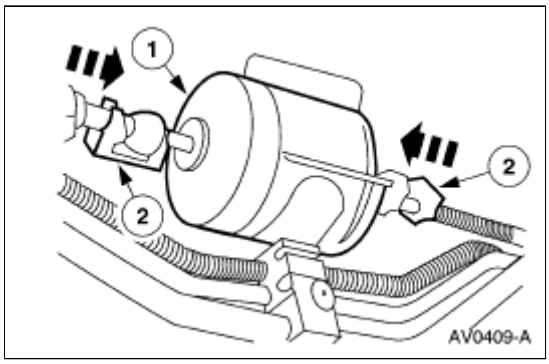
Removal

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the fuel filter (9155).
    1. Disconnect the fuel lines. For additional information, refer to Section 310-00 .
    2. Remove the fuel filter from the fuel filter support.



Installation

1. Install the fuel filter.
    1. Position the fuel filter in the fuel filter support.
    2. Install the fuel lines. For additional information, refer to Section 310-00 .

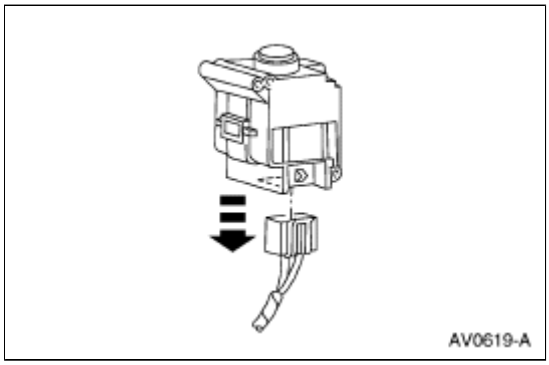


2. Lower the vehicle.

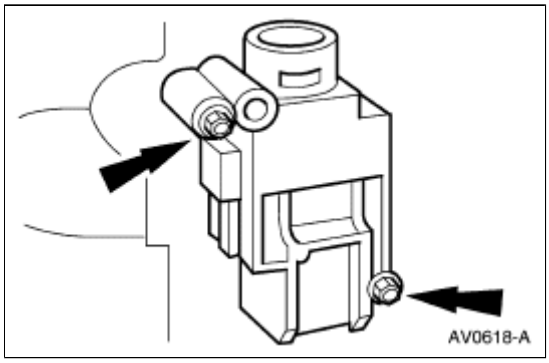
Inertia Fuel Shutoff (IFS) Switch

Removal

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Access the inertia fuel shutoff (IFS) switch (9341) on the RH toe board and disconnect the electrical connector.



3. Remove the bolts and remove the IFS switch.



Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Accelerator cable bracket to coil bracket nut	8-10	70-89
Accelerator cable bracket stud bolt	16-24	141-212
Accelerator control splash shield bolts—4.0L (push rod), 5.0L	7-9	62-79
Accelerator control splash shield bolts—4.0L SOHC	3.5	31
Accelerator control splash shield bolts—4.0L (push rod)	4.1	49
Accelerator pedal and shaft pivot screw	9-12	80-106
Throttle body-to-upper intake manifold bolts	8-10	71-89

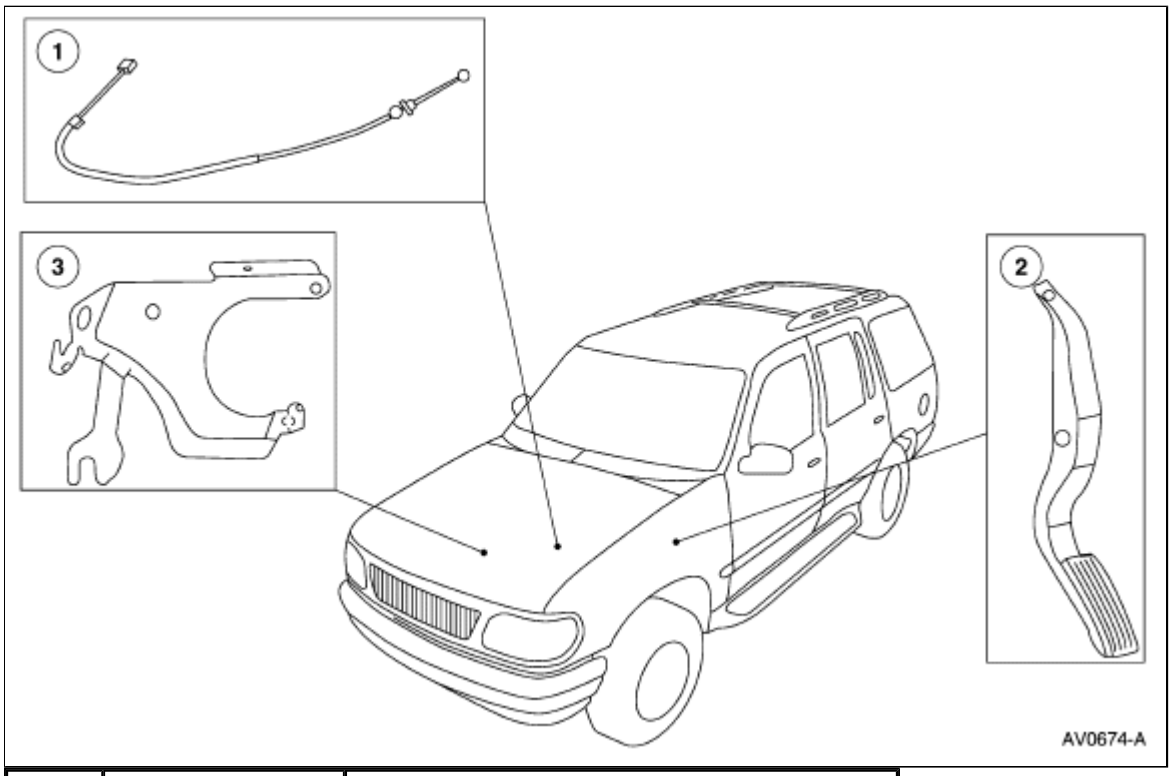
Acceleration Control

The accelerator cable (9A758) is controlled by an accelerator pedal and shaft (9725). The pedal and shaft should travel smoothly from the idle to wide-open throttle positions. Failure to return or hesitation on return to the idle position must not occur.

Surrounding components such as wiring, hoses, sound insulator and floor covering must not contact the sliding inner member of the accelerator cable or the accelerator pedal and shaft.

The speed control speedometer cable (9A820) and the accelerator cable are attached at the throttle lever on the throttle body (9E926).

Component Location



Item	Part Number	Description
1	9A758	Accelerator cable
2	9725	Accelerator pedal and shaft
3	9728	Accelerator cable bracket— 5.0L

Acceleration Control

Inspection and Verification

NOTE: Care should be exercised when performing service on or around the accelerator pedal linkage and controls.

1. Inspect the accelerator pedal and shaft (9725) and attaching linkage for damage or distortion which would bind or limit accelerator travel.
2. Inspect the accelerator cable (9A758) for kinks or fraying which may cause bending.
3. Inspect the engine idle speed adjustment to make sure of the correct idle speed specification after any accelerator linkage adjustment or repair.
4. Inspect throttle body (9E926) for excessive wear or damage.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Excessive effort needed to depress accelerator pedal and shaft	• Worn accelerator lever pivot bushing.	• INSTALL a new accelerator pedal and shaft.
	• Accelerator cable binding.	• INSTALL a new accelerator cable.
	• Worn or damaged throttle body.	• INSTALL a new throttle body. REFER to Section 303-04A (4.0L EI), Section 303-04B (4.0L SOHC) or Section 303-04C (5.0L).
• Accelerator pedal and shaft feels rough or raspy	• Frayed or binding accelerator cable.	• INSTALL a new accelerator cable.
	• Worn or damaged throttle body.	• INSTALL a new throttle body. REFER to Section 303-04A (4.0L EI), Section 303-04B (4.0L SOHC) or Section 303-04C (5.0L).
• Accelerator pedal and shaft bind or stick	• Kinked accelerator cable.	• INSTALL a new accelerator cable.
	• Foreign object caught in accelerator pedal	• CHECK the accelerator pedal linkage.

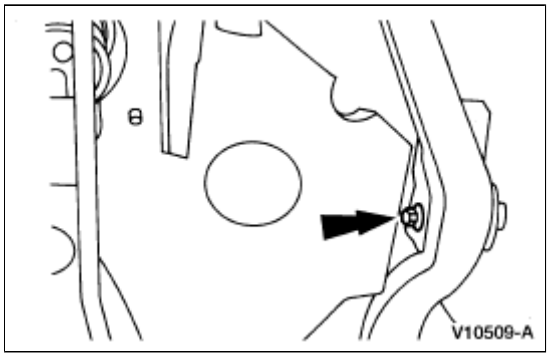
	linkage. • Worn or damaged throttle body.	• INSTALL a new throttle body. REFER to Section 303-04A (4.0L EI), Section 303-04B (4.0L SOHC) or Section 303-04C (5.0L).
• High engine idle speed	• Kinked accelerator cable. • Foreign object caught in accelerator pedal linkage. • Incorrect engine idle speed.	• INSTALL a new accelerator cable. • CHECK the accelerator pedal linkage. • REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, for diagnosis and testing of the idle control system.

Pedal —Accelerator

Removal

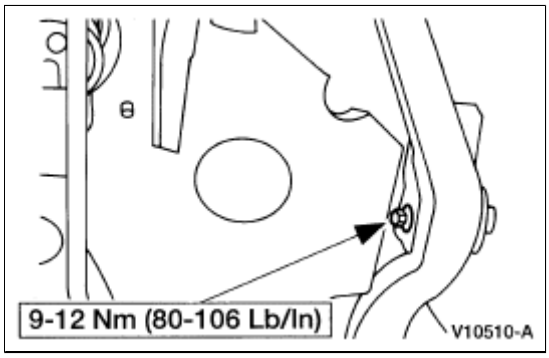
1. Disconnect the accelerator cable (9A758) from the accelerator pedal and shaft (9725) . For additional information, refer to Cable—Accelerator, 4.0L (Push Rod) , Cable—Accelerator, 4.0L SOHC or Cable—Accelerator, 5.0L in this section.

2. Remove the accelerator pedal and shaft pivot screw, and remove the accelerator pedal and shaft.



Installation

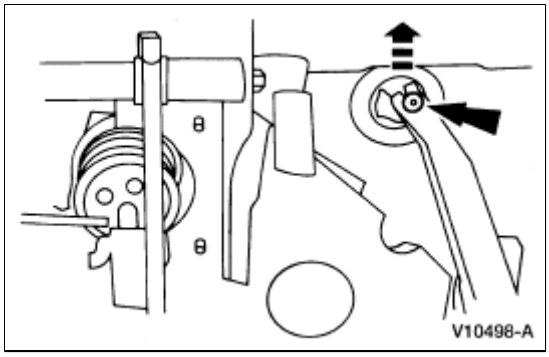
1. To install, reverse the removal procedure.



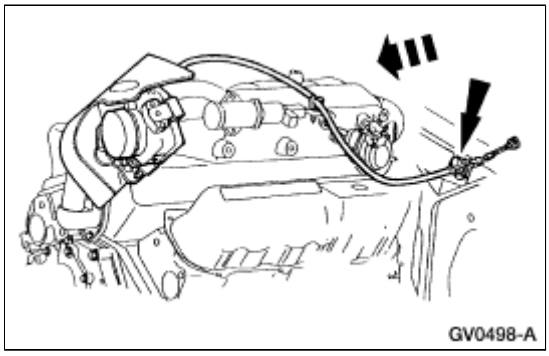
Cable —Accelerator, 4.0L (Push Rod)

Removal

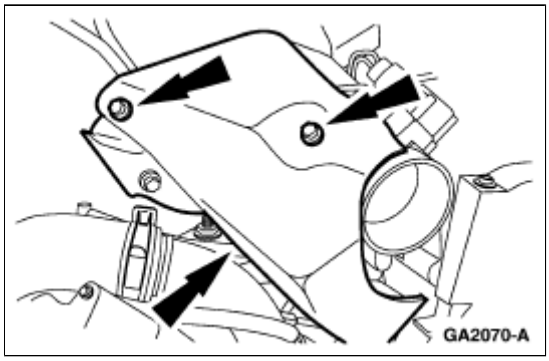
1. Disconnect the accelerator cable (9A758) from the accelerator pedal and shaft (9725).



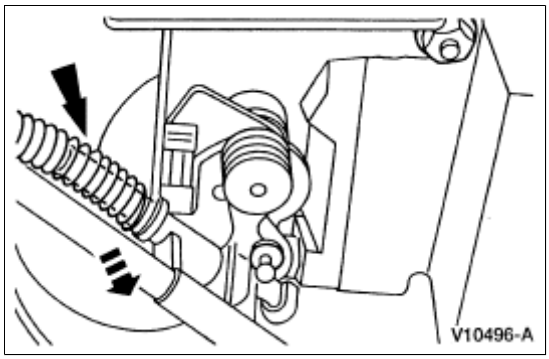
2. Collapse the clips at the dash panel and push the accelerator cable through the dash panel into the engine compartment.



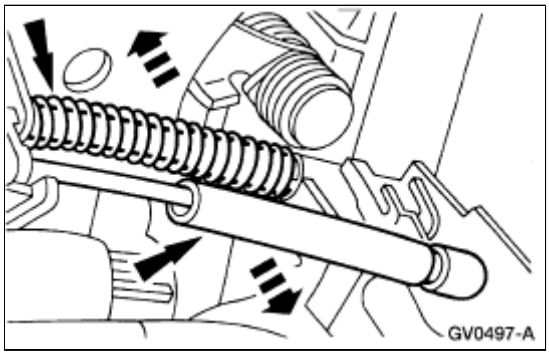
3. Remove the two bolts and the accelerator control splash shield (9E766).



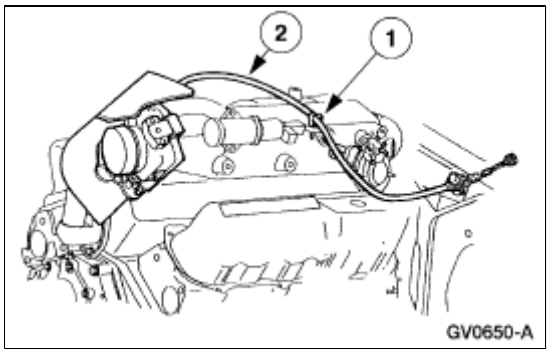
4. Disconnect the accelerator cable from the throttle body (9E926).



5. Separate the accelerator cable from the speed control actuator cable (9A825).



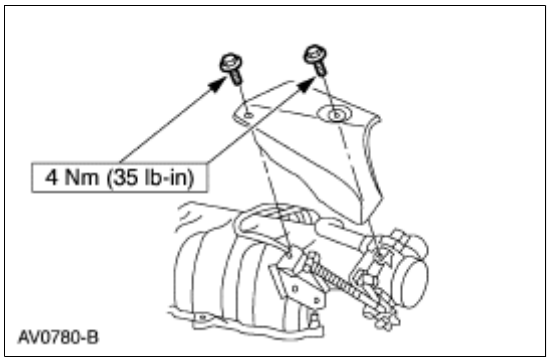
6. Remove the accelerator cable.
    1. Remove the accelerator cable from the guide clip.
    2. Remove the accelerator cable.



Installation

1. **NOTE:** The accelerator cable should be routed over the air conditioning lines and under the power brake and speed control vacuum hoses.

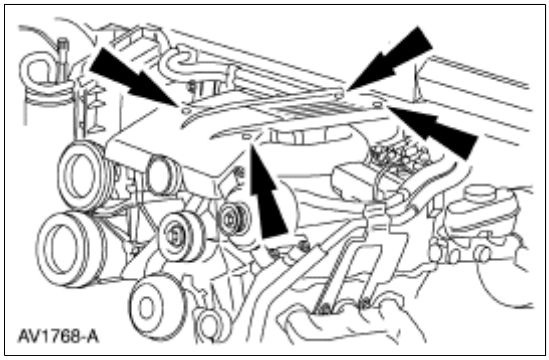
   To install, reverse the removal procedure.


4 Nm (35 lb-in)
AV0780-B

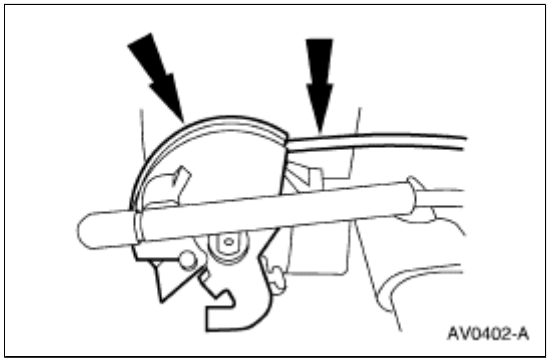
Cable —Accelerator, 4.0L SOHC

Removal

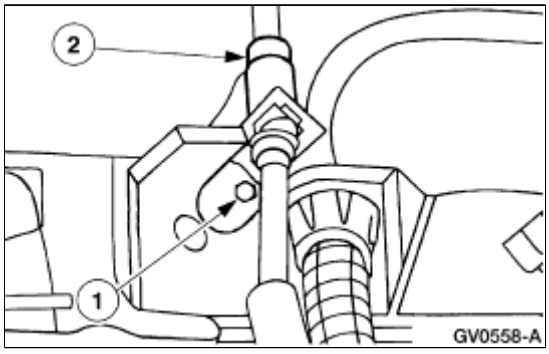
1. Remove the screws and the accelerator control splash shield (9E766).



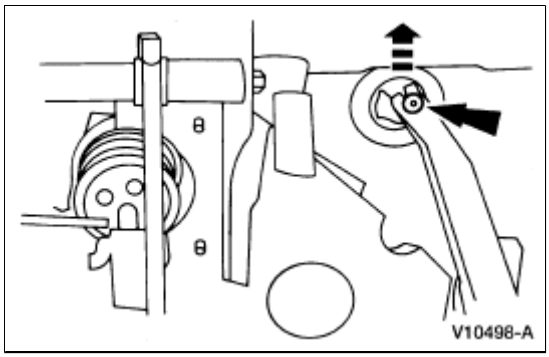
2. Disconnect the accelerator cable (9A758) from the throttle body (9E926).



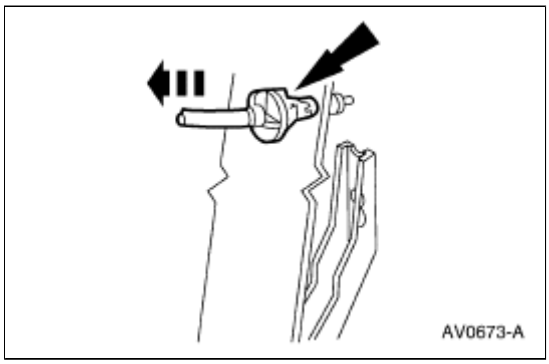
3. Disconnect the accelerator cable from the intake manifold (9424).
    1. Remove the screw.
    2. Disconnect the accelerator cable from the intake manifold.



4. From inside the vehicle, disconnect the accelerator cable from the accelerator pedal and shaft (9725).



5. Collapse the clips at the dash panel and push the accelerator cable through the dash panel into the engine compartment and remove the accelerator cable.



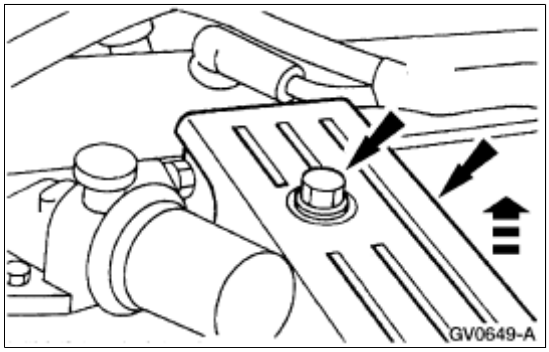
Installation

1. To install, reverse the removal procedure.

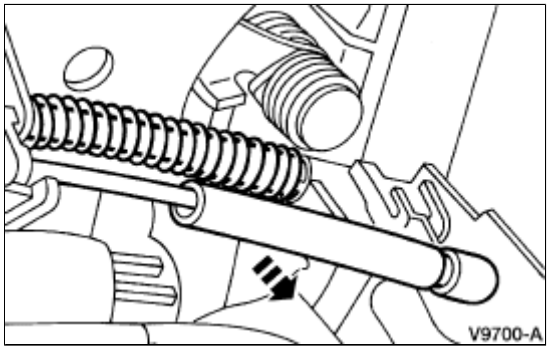
Cable —Accelerator, 5.0L

Removal

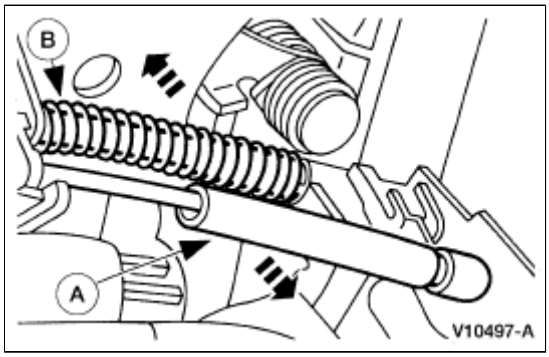
1. Remove the bolt and the accelerator control splash shield (9E766).



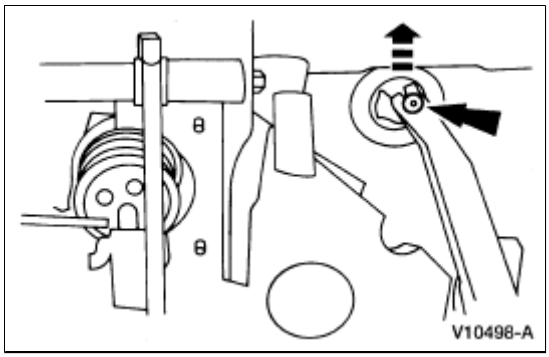
2. Disconnect the accelerator cable (9A758) from the throttle body (9E926).



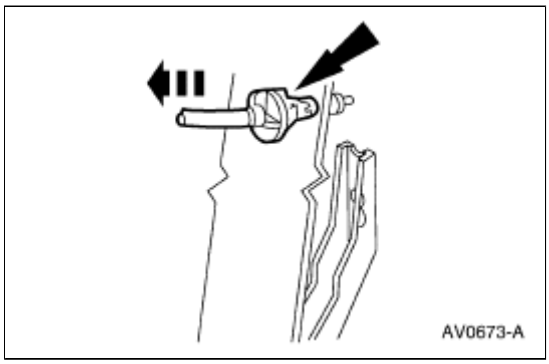
3. Separate the (B) accelerator cable from the (A) speed control actuator cable (9A825).



4. Disconnect the accelerator cable from the accelerator pedal and shaft (9725).

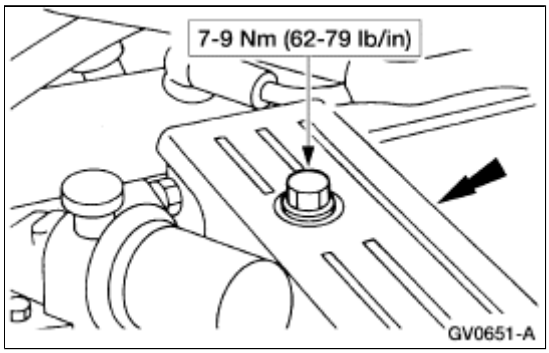


5. Collapse the clips at the dash panel and push the accelerator cable through the dash panel into the engine compartment and remove the accelerator cable.



Installation

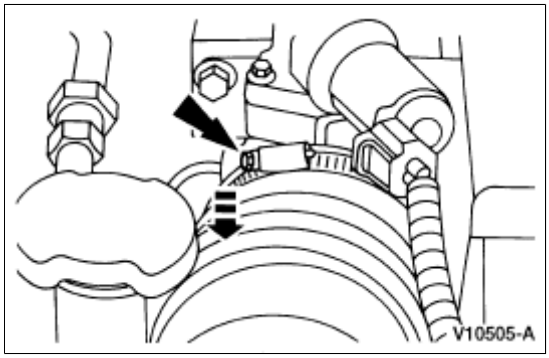
1. To install, reverse the removal procedure.



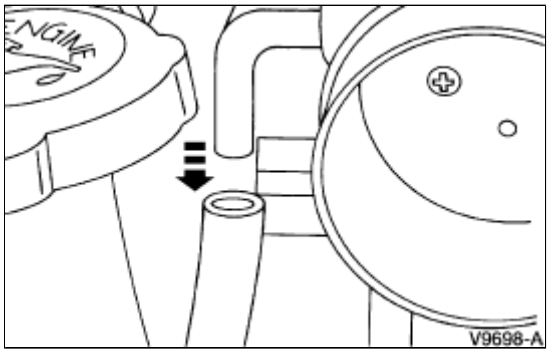
Cable Bracket —Accelerator, 5.0L

Removal

1. Loosen the engine air cleaner outlet tube clamp and remove the air cleaner outlet tube (9B659).

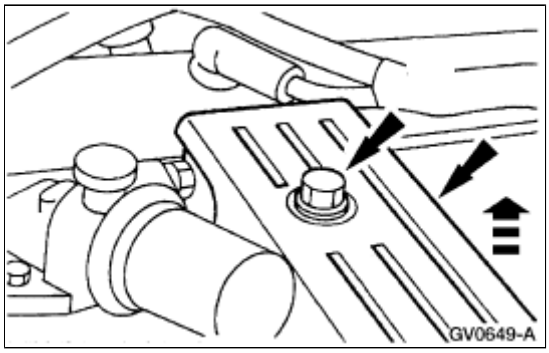


2. Disconnect the PCV vent hose.

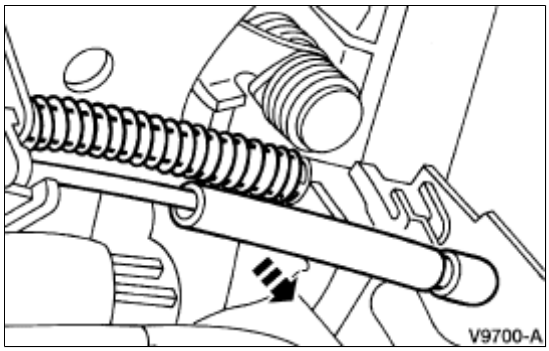


3. Disconnect the idle air control (IAC) valve electrical connector.

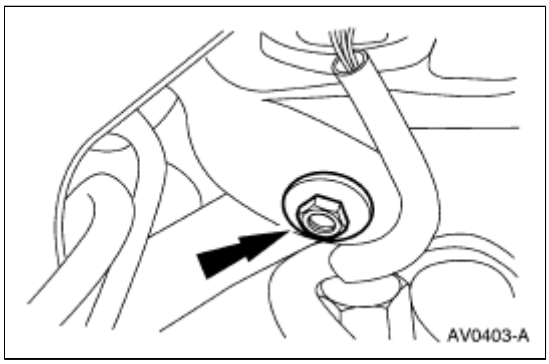
4. Remove the bolt and the accelerator control splash shield (9E766).



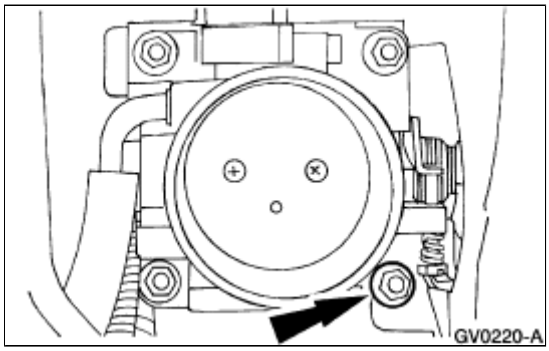
5. Disconnect the accelerator cable (9A758) from the throttle body (9E926).



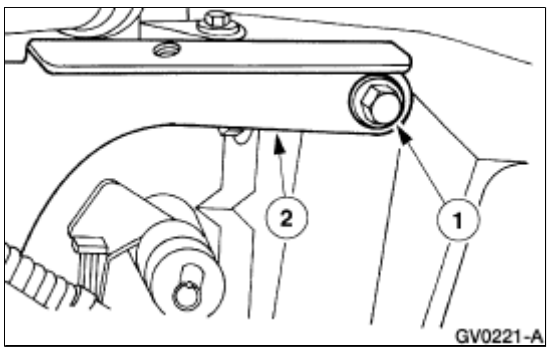
6. Remove the nut from the ignition coil bracket.



7. Remove the nut from the throttle body.

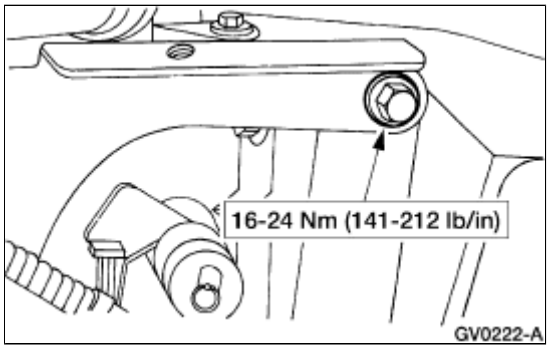


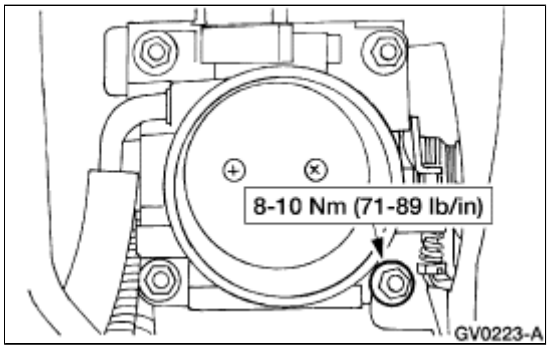
8. Remove the accelerator cable bracket (9723).
    1. Remove the bolt.
    2. Remove the accelerator cable bracket.

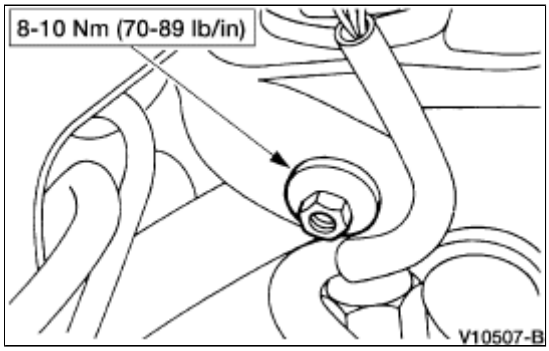


Installation

1. To install, reverse the removal procedure.







Torque Specifications

Description	Nm	lb-ft	lb-in
Accelerator Control Splash Shield Bolt (4.0L [Push Rod], 5.0L)	10	—	89
Accelerator Control Splash Shield Bolts (4.0L SOHC)	4	—	35
Battery Ground Cable	7-10	—	62-89
Deactivator Switch	15-20	11-15	—
Speed Control Actuator Cable Bolt	3.1-4.3	—	27-38
Speed Control Actuator Switch Screws	7	—	62
Speed Control Servo Bracket Bolt	9-12	7-9	—

Vehicle Speed Control

The vehicle speed control consists of the following components:

- speed control servo (9C735)
- speed control actuator cable (9A825)
- speed control indicator lamp
- speed control actuator switches (9D743)
- brake pedal position (BPP) switch (13480)
- deactivator switch
- anti-lock brake control module (2C018)
- clutch pedal position (CPP) switch

Vehicle Speed Control

Refer to Wiring Diagrams Cell 31 , Speed Control for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

The speed control system is designed to maintain vehicle speed above 48 km/h (30 mph). After the ON switch is depressed, depressing the SET/ACCEL switch will activate the speed control servo. To increase a set speed, either depress and hold for continuous acceleration, or momentarily tap the SET/ACCEL switch for 1.6 km/h (1 mph) acceleration increments. To decrease a set speed, depress and hold the COAST switch until the target speed is reached, or momentarily tap the COAST switch for 1.6 km/h (1 mph) deceleration increments. When the speed control system has been disabled by tapping the brake pedal, the RESUME switch can be depressed and the vehicle will return to the original set speed if the vehicle is traveling over 48 km/h (30 mph) and the OFF switch has not been depressed.

NOTE: The deactivator switch is provided as an additional safety feature. Normally, when the brake pedal is depressed, an electrical signal from the brake lamp circuit to the speed control servo will deactivate the system. Under increased brake pedal effort, the deactivator switch will open and remove power to the speed control servo, releasing the throttle independent of the speed control servo.

NOTE: The air bag sliding contact provides the electrical interface between the steering column wiring and the speed control actuator switches in the steering wheel.

The inputs to the speed control servo are:

- vehicle speed signal
- speed control actuator switches
- brake pedal position (BPP) switch
- clutch pedal position (CPP) switch
- deactivator switch

The outputs of the speed control servo are:

- speed control indicator
- speed control actuator cable controlling the throttle position

Inspection and Verification

Visual inspection is an important part of diagnosis. The inspection should be done to locate obvious reasons for customer concern.

When carrying out visual inspection, check all items for abnormal conditions. Look for such items as bare, broken or disconnected wires. For the speed control to function correctly, the speed control servo (9C735) (throttle actuator) and throttle linkage should operate freely and smoothly.

Any concerns found by the visual inspection should be corrected before further tests of the speed control system are made. The following items should be inspected.

- If the yellow ABS indicator in the instrument cluster stays illuminated when the ignition switch (11572) is in the RUN position, refer to Section 206-09 before continuing with the speed control diagnostics.
- Does the speedometer operate? If not, refer to Section 413-01 .
- Does the horn (13832) operate? If not, refer to Section 413-06 .
- Check the central junction box (CJB) Fuse 9 (7.5A), 10 (7.5A), and 13 (20A).

Check for unseated connectors at the speed control servo.

- Look for loose or unseated connector pins.
- Check for broken wires at the connectors.

The following items should be inspected before proceeding to the Symptom Chart.

- Misadjusted speed control actuator cable (9A825). If misadjustment is suspected, refer to Adjustments, Actuator Cable.
- Broken speed control actuator cable.
- Carry out Self-Test Diagnostics procedure before proceeding to the Symptom Chart.

Self-Test Diagnostics

WARNING: This test is a key on engine off (KOEO) test only that is conducted in PARK only with parking brake fully engaged.

- Enter Self-Test Diagnostics by depressing the speed control OFF switch while turning the ignition key ON, making sure the engine does not start and is not running. The speed control indicator lamp on the instrument panel will flash once to indicate that the speed control module entered the diagnostic mode.

NOTE: Five additional flashes at this point indicate a defective speed control servo. Release the OFF switch.

- Release the OFF switch.

- **NOTE:** If the ON switch is not pressed within five seconds after entering the diagnostic mode, the module times out and the procedure must be started over.

  Press the remaining switches in this sequence: ON, RSM (resume), CST (coast), and SET/ACCEL. The speed control indicator lamp will flash as each switch is pressed. Press each switch in the sequence immediately after the light goes out for the previous switch.
- A lamp flash with the last button (SET/ACCEL) indicates that the STATIC test passed. If the lamp

does not flash with the last button and there are no additional flashes of the lamp, the switch is defective. If the lamp does not flash with the last button, and additional flashes occur, follow the chart below for trouble codes:
    - Two flashes - Brake pedal position (BPP) switch is defective, circuit is defective, or brake pedal is applied; clutch pedal position (CPP) switch is defective, circuit is defective, or clutch pedal is applied.
    - Three flashes - Brake deactivation switch is open or circuit is defective.
    - Four flashes - Vehicle speed signal is out of range or circuit is defective.
- Immediately after the static test has passed, the speed servo will then carry out a dynamic test automatically by actuating the throttle lever from 1mm to 10 mm of travel from the idle position. During the dynamic throttle pull, observe the throttle movement to witness any binding or sticking of actuator cable, correct connection of actuator cable to throttle lever, and make sure the throttle returns back to idle position. If incorrect connection and/or binding or sticking of actuator is observed, go to the Symptom Chart. If dynamic pull at the throttle body is observed, Go To Pinpoint Test A .
- Return the ignition switch to the OFF position and proceed to the Symptom Chart.

Symptom Chart

NOTE: Self-Test Diagnostics must be carried out before proceeding to the Symptom Chart.

Symptom Chart

Condition	Possible Sources	Action
• Flash code 1 — system pass	• —	• System Pass.
• Flash code 1 — no dynamic pull at throttle body	• Speed control actuator cable. • Speed control servo.	• GO to Pinpoint Test A .
• Flash code 1 — speed control inoperative	• Circuitry. • Speed control servo.	• GO to Pinpoint Test D .
• Flash code 2 — BBP switch circuit failure	• Circuitry. • BPP switch. • CPP switch or jumper. • Speed control servo.	• GO to Pinpoint Test B .
• Flash code 3 — deactivator switch	• CJB Fuse 13 (20A). • Circuitry. • Deactivator switch. • Speed control servo.	• GO to Pinpoint Test C .
• Flash code 4 — speed signal circuit failure	• Circuitry. • Speed control servo. • Anti-lock brake control module.	• GO to Pinpoint Test D .
• Flash code 5	• Speed control servo.	• INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation.

• The speed control is inoperative — no flash codes	• CJB Fuse 10 (7.5A). • Circuitry. • BPP switch. • Speed control actuator switches (9D743). • Anti-lock brake control module. • Speed control servo.	• GO to Pinpoint Test E .
• The speed control does not disengage when the clutch is applied	• BPP switch. • CPP switch (M/T). • Circuitry.	• GO to Pinpoint Test F .
• The speed control switch is inoperative — COAST	• Speed control actuator switch. • Speed control servo.	• GO to Pinpoint Test G .
• The speed control switch is inoperative — SET/ACCEL	• Speed control actuator switches. • Speed control servo.	• GO to Pinpoint Test H .
• The speed control switch is inoperative — RESUME	• Speed control actuator switch. • Speed control servo.	• GO to Pinpoint Test J .
• The speed control switch is inoperative — OFF	• Speed control actuator switch. • Speed control servo.	• GO to Pinpoint Test K .
• The speed control indicator lamp is always on	• Circuitry. • Speed control servo. • Instrument cluster.	• GO to Pinpoint Test L .
• The speed control indicator is inoperative	• Circuitry. • Bulb. • Instrument cluster. • Speed control servo.	• REFER to Section 413-01 .
• The set speed fluctuates	• Anti-lock brake control module. • Speed control servo. • Speed control actuator switch. • Circuitry. • Speed control actuator cable. • Engine (6007).	• GO to Pinpoint Test M . • REFER to Powertrain

		Control/Emissions Diagnosis (PC/ED) manual. REPAIR engine as necessary.

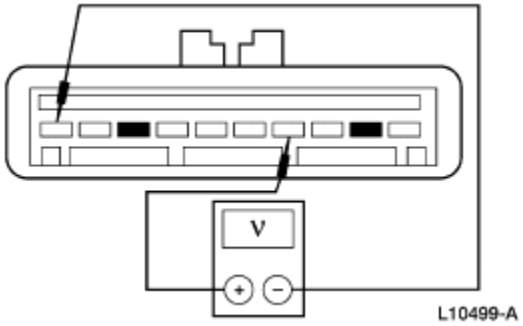
Pinpoint Tests

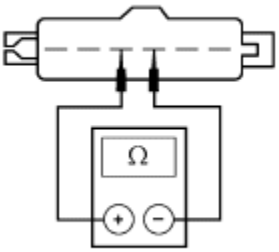
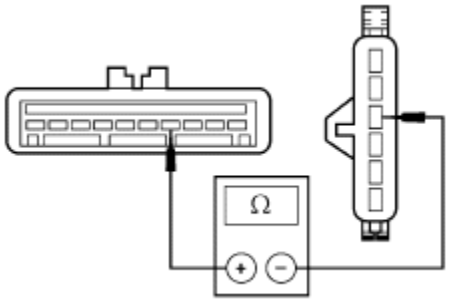
PINPOINT TEST A: FLASH CODE 1 — NO DYNAMIC PULL AT SPEED CONTROL SERVO

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE SPEED CONTROL ACTUATOR CABLE	
	1 Check the speed control actuator cable for attachment at both the speed control servo and the throttle. • **Is the speed control actuator cable attached at both the speed control servo and the throttle?** → **Yes** GO to A2 . → **No** CONNECT the speed control actuator cable. TEST the system for normal operation.
A2 CHECK FOR CORRECT AMOUNT OF SLACK IN SPEED CONTROL ACTUATOR CABLE	
	1 Remove the speed control actuator cable from the throttle. 2 Check for correct amount of slack in the speed control actuator cable. • **Is there approximately 3mm of slack in the cable?** → **Yes** GO to A3 . → **No** ADJUST the speed control actuator cable slack to approximately 3mm. REFER to Cable Adjustment—4.0L SOHC Shown (5.0L and 4.0L Push Rod Similar) . TEST the system for normal operation.
A3 CHECK FOR A STICKING OR BINDING SPEED CONTROL ACTUATOR	
	1 Disconnect the speed control actuator cable from the speed control servo. 2 Check the speed control actuator cable for sticking or binding. • **Is the speed control actuator cable OK?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation.

	→ **No** REPAIR or INSTALL a new speed control actuator cable; REFER to Actuator Cable—4.0L or Actuator Cable—5.0L Shown, 4.0L (Push Rod) Similar . TEST the system for normal operation.

PINPOINT TEST B: FLASH CODE 2 — BRAKE PEDAL POSITION SWITCH CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH CIRCUITRY	
1 2 Speed Control Servo C171 3 4  	4 Measure the voltage between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and speed control servo C171 Pin 10, Circuit 57 (BK), harness side. • **Is voltage present?** → **Yes** GO to B7 . → **No** If the vehicle is equipped with automatic transmission with high series console, GO to B5 . If the vehicle is equipped with a manual transmission or automatic transmission without high series console, GO to B2 .
B2 CHECK THE CLUTCH PEDAL POSITION (CPP) SWITCH	
1	

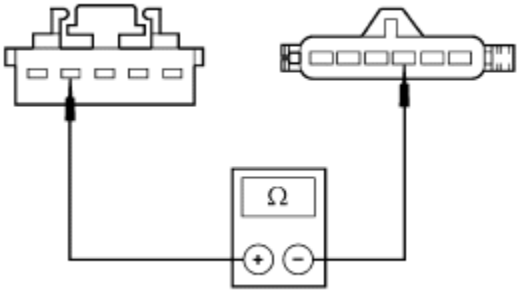
 2 CPP Switch or Jumper C209 3  GV1098-A	3 Measure the resistance between CPP switch or jumper Pin 3 (component side), and CPP switch or jumper Pin 4, (component side). • **Is the resistance less than 5 ohms?** → **Yes** GO to B3 . → **No** INSTALL a new CPP switch or jumper. TEST the system for normal operation.
B3 CHECK CIRCUIT 306 (TN/LB) FOR AN OPEN	
1  GV1038-A	1 Measure the resistance between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and CPP switch or jumper C209 Pin 3, Circuit 306 (TN/LB), harness side. • **Is the resistance less than 5 ohms?** → **Yes** GO to B4 . → **No** REPAIR the circuit. TEST the system for normal operation.

B4 CHECK CIRCUIT 810 (RD/LG) FOR AN OPEN

1

BPP Switch C224

2



2 Measure the resistance between CPP switch or jumper C209 Pin 4, Circuit 810 (RD/LG), harness side and BPP switch C224 Pin 2, Circuit 810 (RD/LG), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B6 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

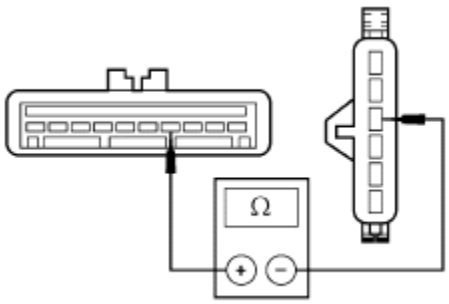
B5 CHECK CIRCUIT 810 (RD/LG) AND CIRCUIT 306 (TN/LB) FOR AN OPEN

1

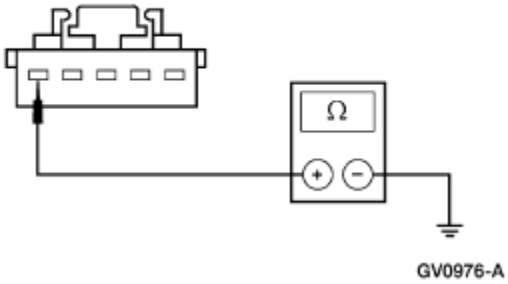
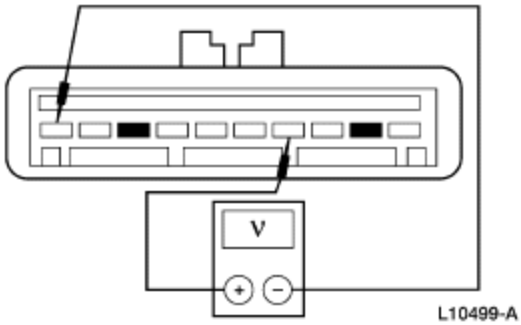
2

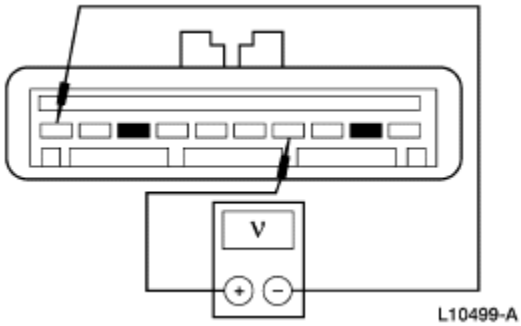
BPP Switch C224

3



3 Measure the resistance between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and BPP switch C224 Pin 2, Circuit 810 (RD/LG), harness side.

	• **Is the resistance less than 5 ohms?** → **Yes** GO to B6 . → **No** REPAIR Circuit 810 (RD/LG) or Circuit 306 (TN/LB). TEST the system for normal operation.
B6 CHECK CIRCUIT 57 (BK) AT BPP SWITCH	
1  GV0976-A	1 Measure the resistance between BPP switch C224 Pin 1, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new BPP switch; REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR Circuit 57 (BK). TEST the system for normal operation.
B7 CHECK THE BPP SWITCH	
1 BPP Switch C224	
2  L10499-A	2 Measure the voltage between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and speed control servo C171 Pin 10, Circuit 57 (BK), harness side.

	• **Is voltage present?** → **Yes** If the vehicle is equipped with automatic transmission with high series console, REPAIR Circuit 810 (RD/LG) or Circuit 306 (TN/LB). If the vehicle is equipped with a manual transmission or automatic transmission without high series console, GO to B8 . → **No** INSTALL a new BPP switch; REFER to Section 417-01 . TEST the system for normal operation.
B8 CHECK CIRCUIT 306 (TN/LB) FOR SHORT TO POWER	
1 CPP Switch or Jumper C209 2  	2 Measure the voltage between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and speed control servo C171 Pin 10, Circuit 57 (BK), harness side. • **Is voltage present?** → **Yes** REPAIR Circuit 810 (RD/LG). TEST the system for normal operation. → **No** REPAIR Circuit 306 (TN/LB). TEST the system for normal operation.

PINPOINT TEST C: FLASH CODE 3 — DEACTIVATOR SWITCH CIRCUIT FAILURE

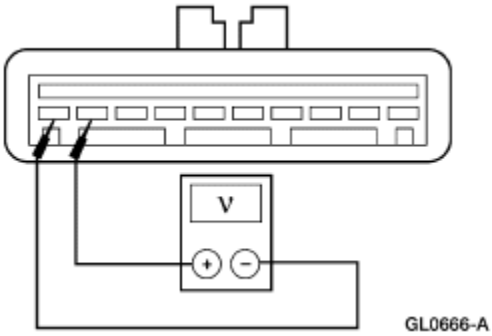
CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE DEACTIVATOR SWITCH CIRCUITRY	
1	

2

Speed Control Servo C171

3

4



4 Measure the voltage between speed control servo C171 Pin 9, Circuit 307 (BK/YE), harness side and speed control servo C171 Pin 10, Circuit 57 (BK), harness side.

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation.

→ **No**
GO to C2 .

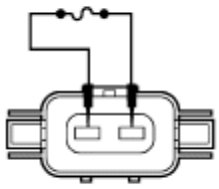
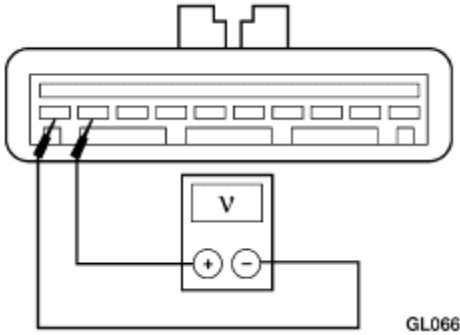
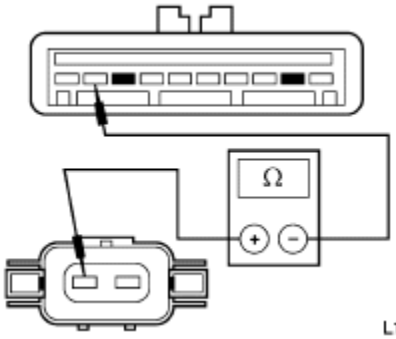
C2 CHECK THE DEACTIVATOR SWITCH

1

2

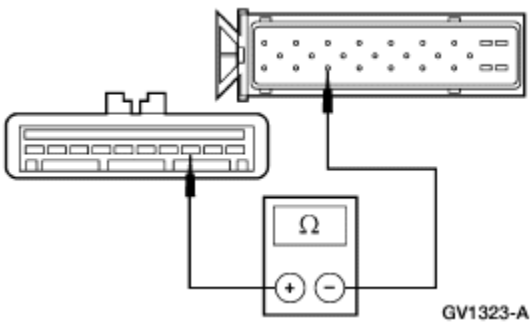
Deactivator Switch C102

3

4  GV1322-A	4 Connect a 10A fused jumper wire between deactivator switch C102, Circuit 10 (LG/RD), harness side and deactivator switch C102, Circuit 307 (BK/YE), harness side.
5  GL0666-A	5 Measure the voltage between speed control servo C171 Pin 9, Circuit 307 (BK/YE), harness side and speed control servo C171 Pin 10, Circuit 57 (BK), harness side. • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new deactivator switch; REFER to Switch—Deactivator . TEST the system for normal operation. → **No** GO to C3 .
C3 CHECK CIRCUIT 307 (BK/YE) FOR AN OPEN	
1  L10503-A	1 Measure the resistance between speed control servo C171 Pin 9, Circuit 307 (BK/YE), harness side and deactivator switch C102, Circuit 307 (BK/YE), harness side. • **Is the resistance less than 5 ohms?** → **Yes** REPAIR Circuit 10 (LG/RD). TEST the system for normal operation.

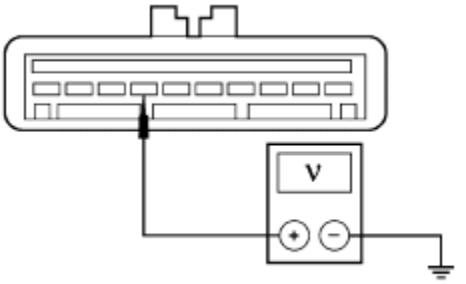
	→ **No** REPAIR Circuit 307 (BK/YE). TEST the system for normal operation.

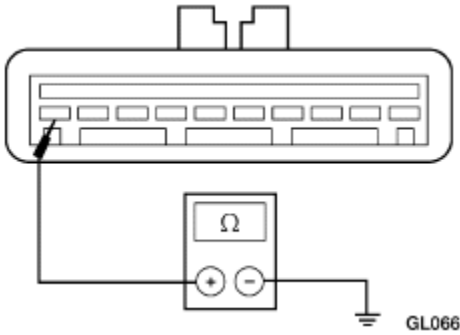
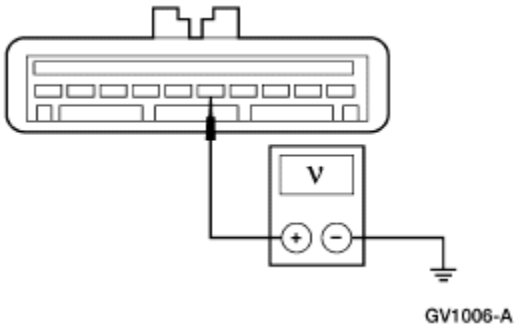
PINPOINT TEST D: FLASH CODE 1 — SPEED CONTROL INOPERATIVE

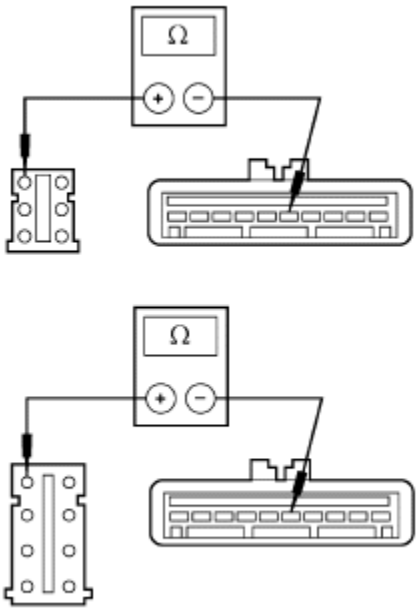
CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE SPEEDOMETER OPERATION	
	1 Check the speedometer for correct operation by driving the vehicle. • **Does the speedometer operate correctly?** → **Yes** GO to D2 . → **No** REFER to Section 413-01 .
D2 CHECK CIRCUIT 679 (GY/BK) FOR AN OPEN	
1 2 Speed Control C171 3 Anti-Lock Brake Control Module C186 4  	4 Measure the resistance between anti-lock brake control module C186 Pin 19, Circuit 679 (GY/BK), harness side and the speed control servo C171 Pin 3, Circuit 679 (GY/BK), harness side.

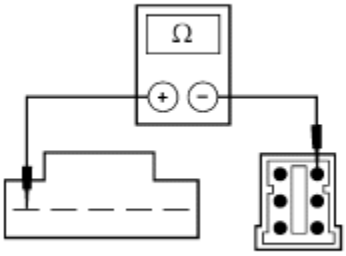
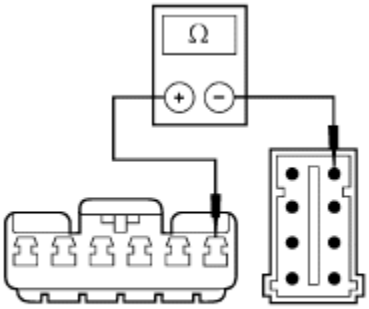
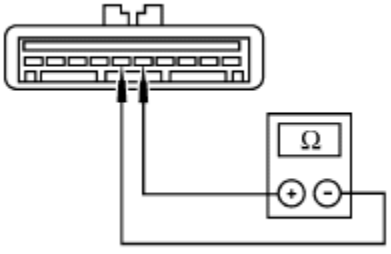
	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** REPAIR circuit 679 (GY/BK). TEST the system for normal operation.

PINPOINT TEST E: THE SPEED CONTROL IS INOPERATIVE — NO FLASH CODES

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK CIRCUIT 1003 (GY/YE) FOR AN OPEN	
1 2 Speed Control Servo C171 3 4  GV1005-A	4 Measure the voltage between speed control servo C171 Pin 7, Circuit 1003 (GY/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to E2 . → **No**

	REPAIR the circuit. TEST the system for normal operation.
E2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1 2 	2 Measure the resistance between speed control servo C171 Pin 10, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to E3 . → **No** REPAIR the circuit. TEST the system for normal operation.
E3 CHECK THE SPEED CONTROL ACTUATOR SWITCH CIRCUITRY	
1 2 	2 Measure the voltage between speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side and ground, while pressing the speed control actuator switch ON. • **Is the voltage greater than 10 volts?** → **Yes** GO to E6 .

	→ **No** GO to E4 .
E4 CHECK CIRCUIT 151 (LB/BK) FOR AN OPEN	
1 2 Air Bag Sliding Contact C220 3  GV1039-A	3 **NOTE:** If the vehicle is equipped with remote audio/climate controls, C220 is an eight pin connector and if the vehicle is not equipped with remote audio/climate controls, C220 is a six pin connector. Measure the resistance between air bag sliding contact C220F Pin 1, Circuit 151 (LB/BK), harness side and speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side. • **Is the resistance less than 5 ohms?** → **Yes** GO to E5 . → **No** REPAIR the circuit. TEST the system for normal operation.
E5 CHECK THE AIR BAG SLIDING CONTACT	
	1 Remove the driver side air bag. Refer to Section 501-20B .

2   GV1041-B	2 If not equipped with remote audio/climate controls, measure the resistance between top of air bag sliding contact Pin 1 (component side), and air bag sliding contact C220M Pin 1 (component side). If equipped with remote audio/climate controls, measure the resistance between top of air bag sliding contact Pin 6 (component side), and air bag sliding contact C220M Pin 1 (component side). • **Is the resistance less than 1 ohm?** → **Yes** If not equipped with remote audio/climate controls, INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) . TEST the system for normal operation. If equipped with remote audio/climate controls, GO to E7 . → **No** INSTALL a new air bag sliding contact; REFER to Section 501-20B . TEST the system for normal operation.
E6 CHECK THE SPEED CONTROL ACTUATOR SWITCH OPERATION	
1  DL0037-A	1 Measure the resistance between speed control servo C171 Pin 5, Circuit 151 (LB/PK), harness side and speed control servo C171 Pin 6, Circuit 848 (DG/OG), harness side while pressing the speed control actuator switch OFF.

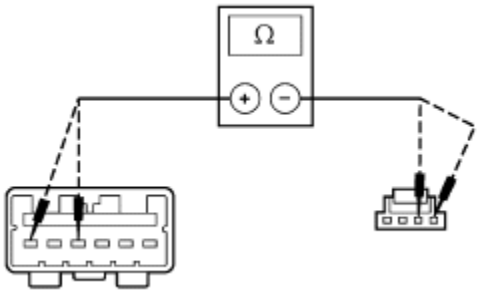
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to E8 .

→ **No**
If not equipped with remote audio/climate controls, INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) . TEST the system for normal operation. If equipped with remote audio/climate controls, GO to E7 .

E7 CHECK THE SPEED CONTROL ACTUATOR SWITCH WIRE HARNESS

1



1 Measure the resistance between top of air bag sliding contact connector, and speed control actuator switch connector as follows:

Top of Air Bag Sliding Contact Connector	Speed Control Actuator Switch Connector
Pin 6	Pin 1
Pin 4	Pin 2

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.

→ **No**
INSTALL a new speed control actuator switch wire harness. TEST the system for normal operation.

E8 CHECK CIRCUIT 679 (GY/BK) FOR AN OPEN

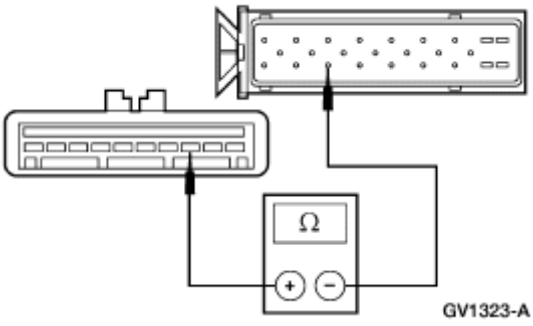
1

2

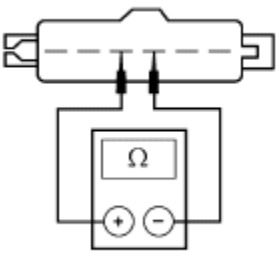
Anti-Lock Brake Control Module C186

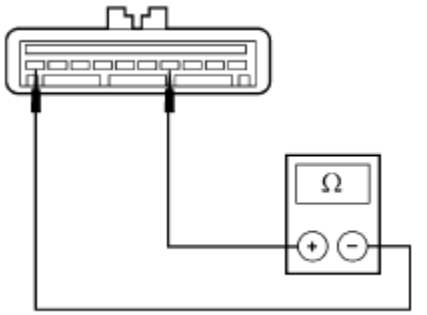
3

3 Measure the resistance between anti-lock

	brake control module C186 pin 19, circuit 679 (GY/BK), harness side and the speed control servo C171 pin 3, circuit 679 (GY/BK), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** REPAIR circuit 679 (GY/BK). TEST the system for normal operation.

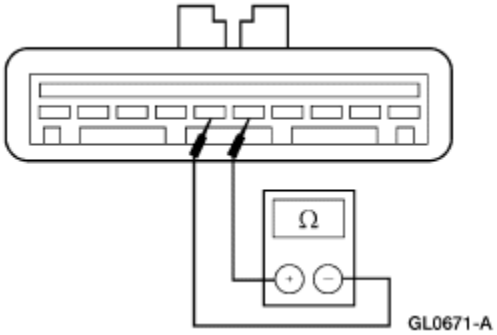
PINPOINT TEST F: THE SPEED CONTROL DOES NOT DISENGAGE WHEN THE CLUTCH IS APPLIED

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE CPP SWITCH	
1 2 CPP Switch C209 3 	3 Measure the resistance between CPP switch Pin 3 (component side), and CPP switch Pin 4 (component side), while pressing the clutch pedal. • **Is the resistance greater than 10,000**

	ohms? → **Yes** GO to F2 . → **No** INSTALL a new CPP switch. TEST the system for normal operation.
F2 CHECK CIRCUIT 306 (TN/LB) FOR SHORT TO GROUND	
1 Speed Control Servo C171 2  GV1165-A	2 Measure the resistance between speed control servo C171 Pin 4, Circuit 306 (TN/LB), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** REPAIR Circuit 306 (TN/LB). TEST the system for normal operation.

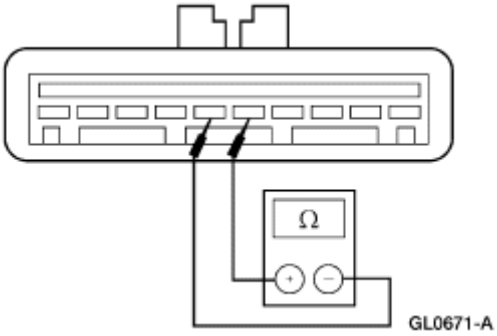
PINPOINT TEST G: THE SPEED CONTROL SWITCH IS INOPERATIVE — COAST

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
1 2	

 Speed Control Servo C171 3 	3 Measure the resistance between speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C171 Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch COAST. • **Is the resistance between 108 and 132 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) or REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.

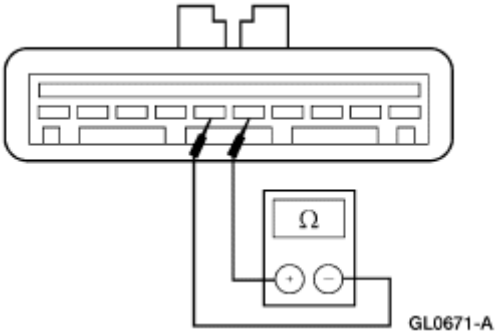
PINPOINT TEST H: THE SPEED CONTROL SWITCH IS INOPERATIVE — SET/ACCEL

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
1 2 Speed Control Servo C171 3	3 Measure the resistance between speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C171

	Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch SET/ACCEL. • **Is the resistance between 612 and 748 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) or REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.

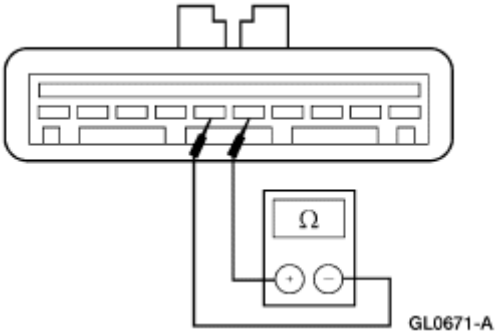
PINPOINT TEST J: THE SPEED CONTROL SWITCH IS INOPERATIVE — RESUME

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
1 2 Speed Control Servo C171 3	3 Measure the resistance between speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C171 Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch RESUME.

	• **Is the resistance between 1,980 and 2,420 ohms?** → **Yes** INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation. → **No** INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) or REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.

PINPOINT TEST K: THE SPEED CONTROL SWITCH IS INOPERATIVE — OFF

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
1 2 Speed Control Servo C171 3	3 Measure the resistance between speed control servo C171 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C171 Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch OFF.



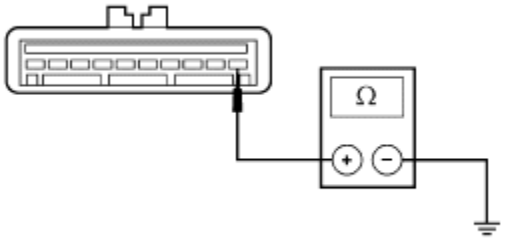
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation.

→ **No**
INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) or REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.

PINPOINT TEST L: THE SPEED CONTROL INDICATOR LAMP IS ALWAYS ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK SPEED CONTROL SERVO FOR SHORT TO GROUND	
1 2 Speed Control Servo C171 3 	• **Is the indicator lamp illuminated?** → **Yes** GO to L2 .

	→ **No** INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator (Without Remote Audio/Climate Controls) or REFER to Switch—Speed Control Actuator (With Remote Audio/Climate Controls) . TEST the system for normal operation.
L2 CHECK CIRCUIT 203 (OG/LB) FOR SHORT TO GROUND	
1 2 Instrument Cluster C286 3  GV0981-A	3 Measure the resistance between speed control servo C171 Pin 1, Circuit 203 (OG/LB), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit; REFER to Section 413-01 . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

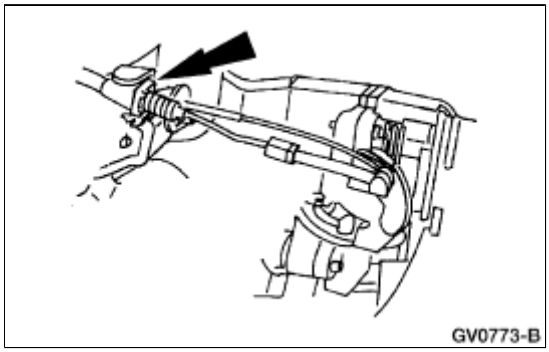
PINPOINT TEST M: THE SET SPEED FLUCTUATES

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK THE SPEED CONTROL ACTUATOR CABLE/THROTTLE BODY LINKAGE	
1	

	2 Remove the speed control actuator cable from the speed control servo. Visually inspect the core wire and check the speed control actuator cable by pulling on it and noting the throttle movement. • **Is the speed control actuator cable OK?** → **Yes** GO to M2 . → **No** INSTALL a new speed control actuator cable or REFER to Section 310-02 for repair of the throttle body linkage. TEST the system for normal operation.
M2 CHECK THE SPEEDOMETER OPERATION	
	1 Drive the vehicle at a steady speed and observe the speedometer operation. • **Does the speedometer needle fluctuate?** → **Yes** REFER to Section 413-01 . → **No** GO to A2 .

Cable Adjustment —4.0L SOHC Shown (5.0L and 4.0L Push Rod Similar)

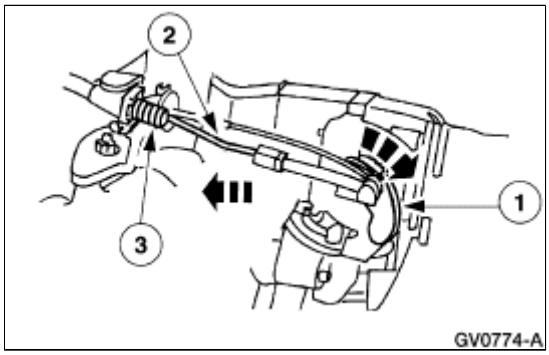
1. Remove the speed control actuator cable clip.



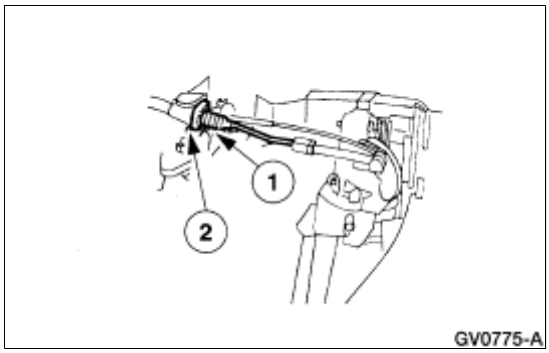
2. **NOTE:** The speed control actuator cable must not be pulled tight for proper operation.

   NOTE: The throttle body cam will automatically spring set to the closed position. The throttle body cam must be in the closed position.

   Adjust the speed control actuator cable.
   1. Make sure the throttle body cam is in the closed position.
   2. Pull on the speed control actuator cable to remove any slack.
   3. Back off the speed control actuator cable one notch.



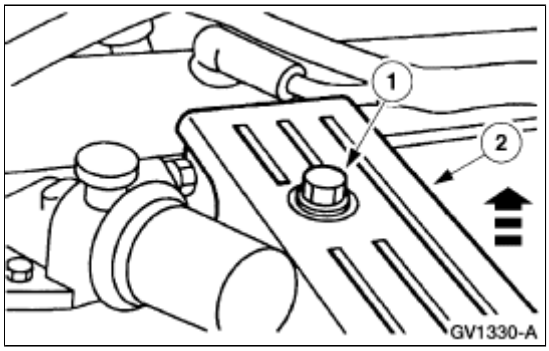
3. Install the speed control actuator cable clip.
   1. Hold the speed control actuator cable.
   2. Insert the speed control actuator clip securely.


1
2
GV0775-A

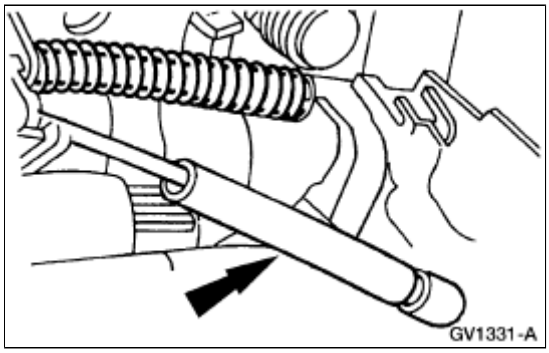
Actuator Cable —5.0L Shown, 4.0L (Push Rod) Similar

Removal

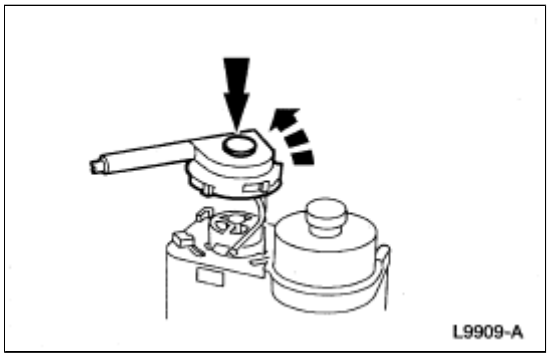
1. Remove the accelerator control splash shield.
    1. Remove the bolt.
    2. Remove the splash shield.



2. Remove the speed control cable from the accelerator bracket.

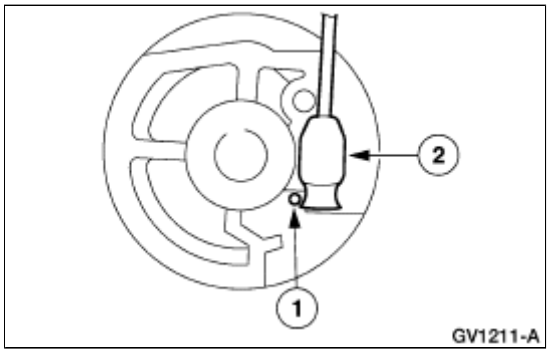


3. Remove the speed control actuator cable cap from the speed control servo (9C735).
    - Push in the locking arm on the speed control actuator cable cap then rotate the cap counterclockwise.



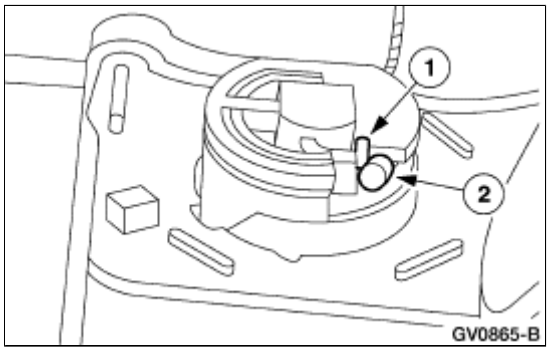
4. Disconnect the speed control core wire end from the speed control servo pulley.

1. Depress the spring retainer.
2. Slide the core wire end out of the speed control servo pulley.



Installation

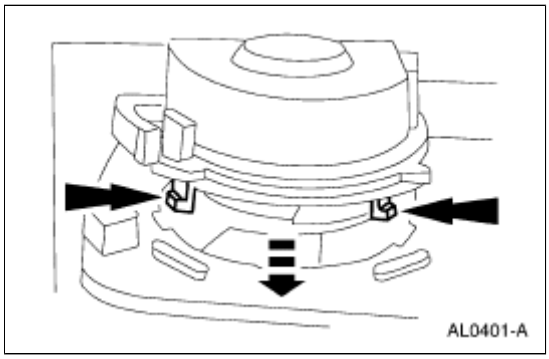
1. Insert the speed control cable slug into the speed control servo pulley slot.
    1. Gently compress the speed control servo spring.
    2. Insert the speed control cable slug into the speed control servo pulley slot.



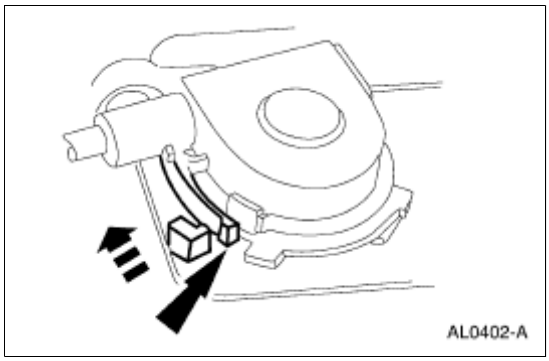
2. **WARNING: Incorrect wrapping of the speed control actuator cable around the speed control servo pulley may result in a high idle condition.**

    NOTE: Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

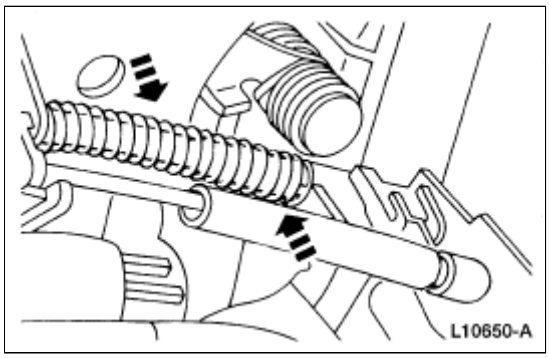
    Release the compressed spring while aligning the speed control actuator cable cap tabs with the slots in the speed control servo housing.



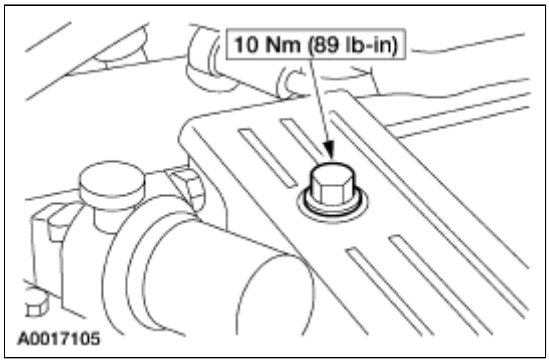
3. Rotate the speed control actuator cable cap until the locking arm engages.



4. Snap the speed control actuator cable and the accelerator cable together in the clip and install the cables onto the accelerator cable bracket (9723).



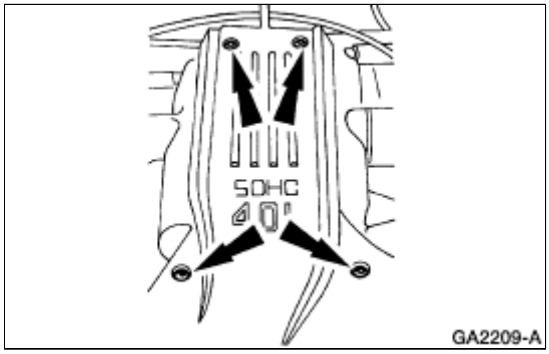
5. Position the accelerator control splash shield and install the bolt.



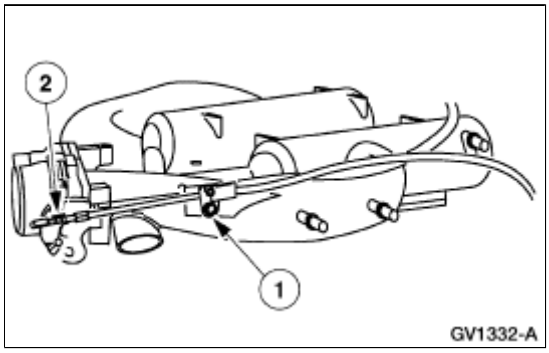
Actuator Cable —4.0L

Removal

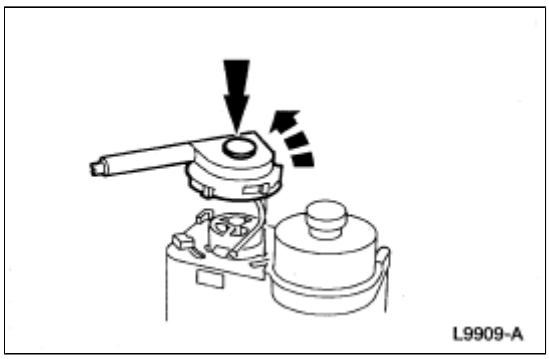
1. Remove the accelerator control splash shield.
   - Remove the bolts.



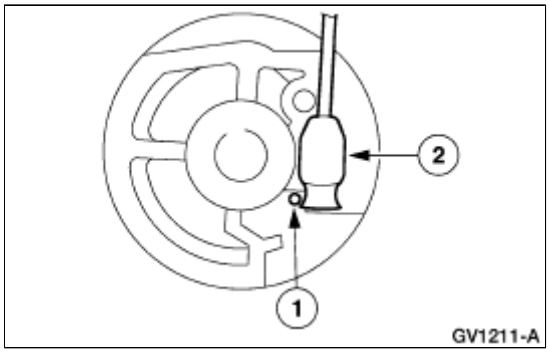
2. Remove the speed control actuator cable (9A825).
   1. Remove the bolt.
   2. Remove the speed control actuator cable from the throttle linkage.



3. Remove the speed control actuator cable cap from the speed control servo (9C735).
   - Push in the locking arm on the speed control actuator cable cap then rotate the cap counterclockwise.

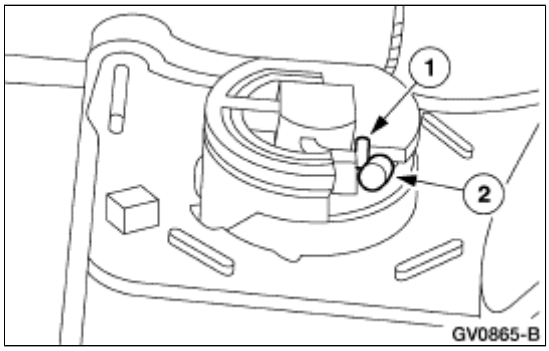


4. Disconnect the speed control core wire end from the speed control servo pulley.
    1. Depress the spring retainer.
    2. Slide the core wire end out of the speed control servo pulley.



Installation

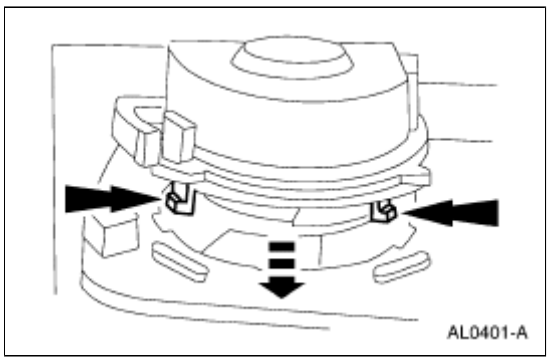
1. Insert the speed control cable slug into the speed control servo pulley slot.
    1. Gently compress the speed control servo spring.
    2. Insert the speed control cable slug into the speed control servo pulley slot.



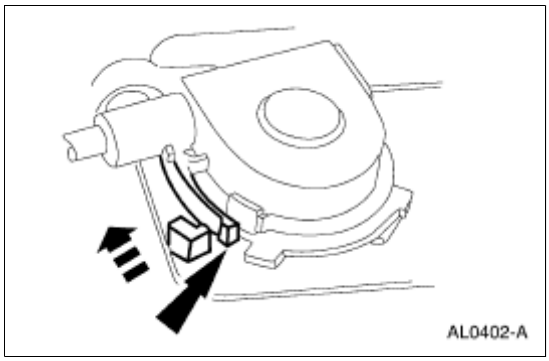
2. **WARNING: Incorrect wrapping of the speed control actuator cable around the speed control servo pulley may result in a high idle condition.**

    NOTE: Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

    Release the compressed spring while aligning the speed control actuator cable cap tabs with the slots in the speed control servo housing.

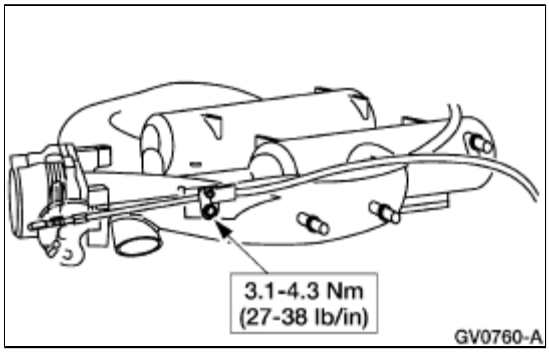


3. Rotate the speed control actuator cable cap until the locking arm engages.

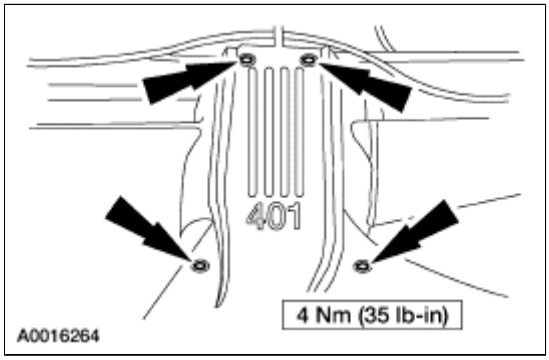


4. **CAUTION: The guide pin must be fully seated before installing the speed control actuator cable bolt.**

   Snap the speed control actuator cable and the accelerator cable together in the clip and install the cables onto the accelerator cable bracket (9723).



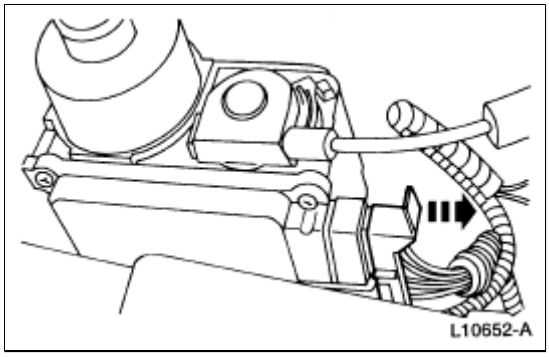
5. Position the accelerator control splash shield and install the bolts.



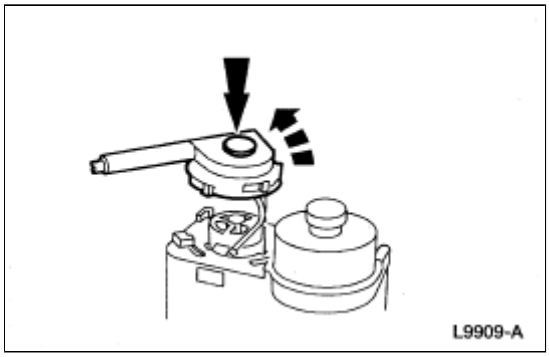
Actuator —Speed Control Servo

Removal

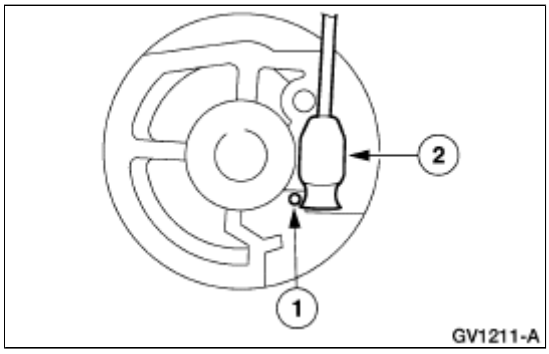
1. Disconnect the speed control servo electrical connector.



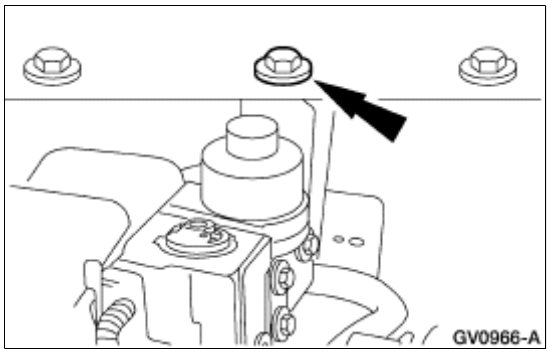
2. Remove the speed control actuator cable cap from the speed control servo (9C735).
   - Push the locking arm on the speed control actuator cable cap then rotate the cap counterclockwise



3. Disconnect the speed control core wire end from the speed control servo pulley.
   1. Depress the spring retainer.
   2. Slide the core wire end out of the speed control servo pulley.



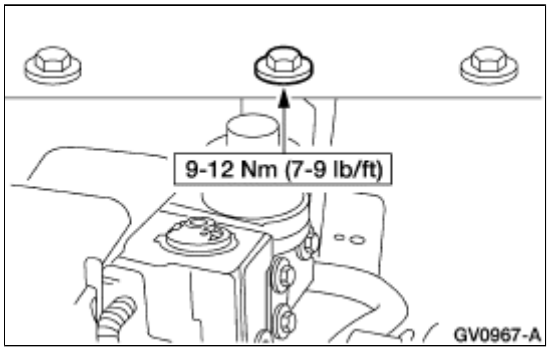
4. Remove the speed control servo bracket bolt.



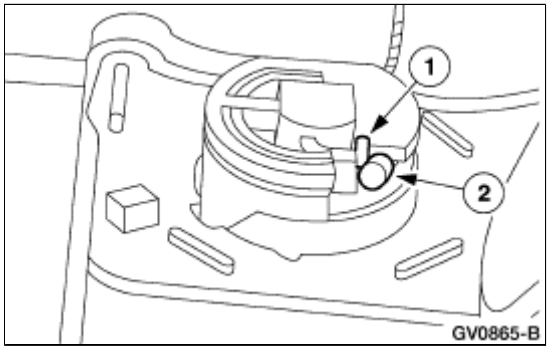
5. Remove the speed control servo.

Installation

1. Install the speed control servo bracket bolt.



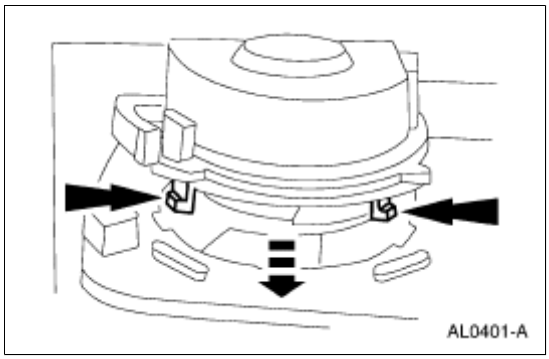
2. Insert the speed control cable slug into the speed control servo pulley slot.
    1. Gently compress the speed control servo spring.
    2. Insert the speed control cable slug into the speed control servo pulley slot.



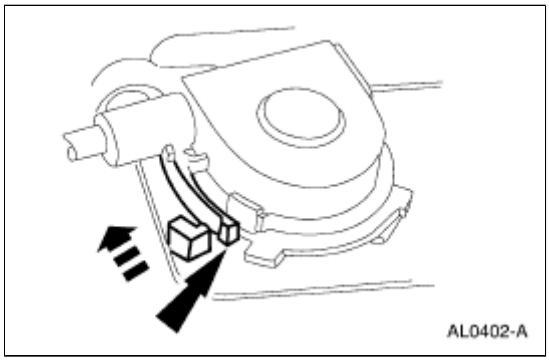
3. **WARNING: Incorrect wrapping of the speed control actuator cable around the speed control servo pulley may result in a high idle condition.**

    NOTE: Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

    Release the compressed spring while aligning the speed control actuator cable cap tabs with the slots in the speed control servo housing.



4. Rotate the speed control actuator cable cap until the locking arm engages.

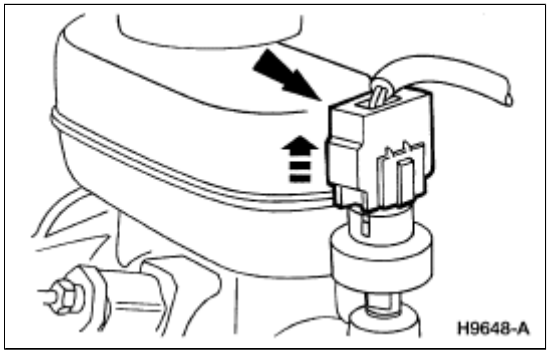


Switch —Deactivator

Removal

1. Disconnect the battery ground cable.

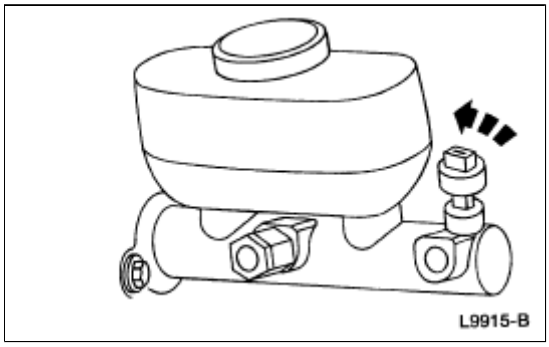
2. Disconnect the deactivator switch electrical connector.



3. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

   Remove the deactivator switch.



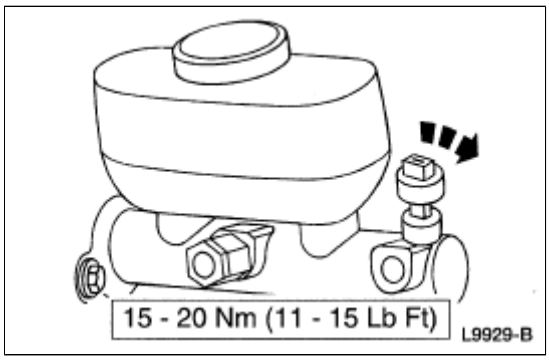
Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   NOTE: After the deactivator switch is installed, it is necessary to bleed the brake system; refer to

Section 206-00 .

To install, reverse the removal procedure.

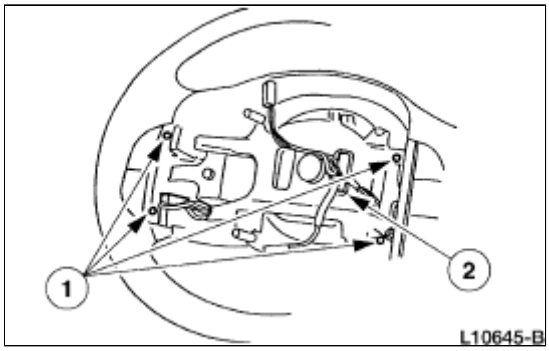


Switch —Speed Control Actuator (Without Remote Audio/Climate Controls)

Removal

1. Remove the driver side air bag module (043B13). Refer to Section 501-20B .

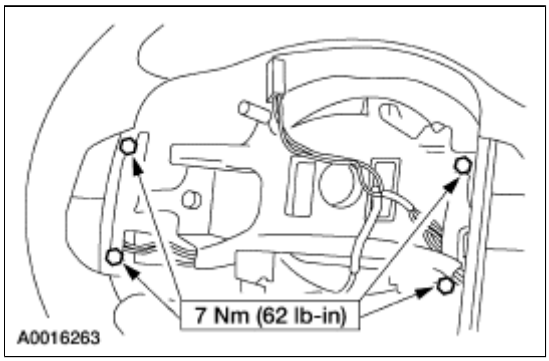
2. Remove the speed control actuator switches.
    1. Remove the screws.
    2. Disconnect the electrical connector then remove the speed control actuator switches.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    To install, reverse the removal procedure.



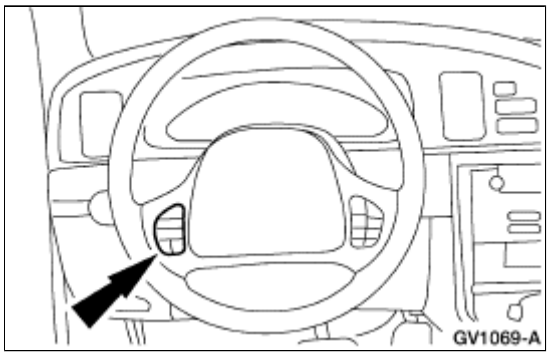
Switch —Speed Control Actuator (With Remote Audio/Climate Controls)

Removal

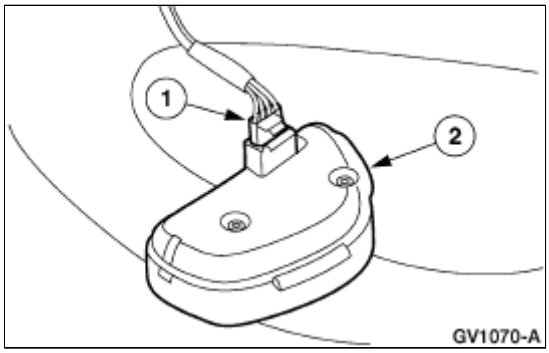
1. Disconnect the battery ground cable.

2. **CAUTION: When separating the speed control actuator switch from the steering wheel, it is necessary to take precautions not to damage the steering wheel.**

   Separate the speed control actuator switch out of the steering wheel.



3. Remove the speed control actuator switch.
   1. Disconnect the speed control actuator switch electrical connector.
   2. Remove the speed control actuator switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn its strategy.

   To install, reverse the removal procedure.

SPECIFICATIONS

General Specifications

Item	Specification
A/C compressor	FS-10 swashplate, 5 double acting pistons
Magnetic Clutch	
Air gap between pulley and hub mm (in)	0.35-0.75 (0.014-0.030)
Lubricant	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Capacity ml (oz)	266 (9)
Refrigerant	
R-134a Refrigerant YN-19	WSH-M17B19-A
Capacity kg (oz)	0.85 (30)
Cleaner	
A/C Systems Flushing Solvent Ford F4AZ-19579-A	—

Torque Specifications

Description	Nm	lb-in
Peanut fitting nut	7-9	62-79

Climate Control System

WARNING: To avoid accidental deployment and possible injury, the air bag system backup power supply must be depleted before repairing any climate control components. To deplete the backup power supply, disconnect the battery positive cable and wait one minute.

WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

WARNING: R-134a is classified as a safe refrigerant, but misuse can make it dangerous. The following precautions must be observed.

- **Always wear safety goggles when repairing an air conditioning system.**
- **Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°c (-13°f) under atmospheric pressure and it will freeze skin tissue.**
- **Never allow refrigerant R-134a gas to escape in quantity in an occupied space. R-134a is non-toxic, but it will displace the oxygen needed to support life.**
- **Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but when it is exposed to high temperatures, such as a torch flame, it decomposes. During decomposition it releases irritating and toxic gases (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.**
- **Do not allow any portion of the charged air conditioning system to become too hot. The pressure in an air conditioning system rises as the temperature rises and temperatures of approximately 85°C (185°F) can be dangerous.**
- **Allow the engine to cool sufficiently prior to carrying out maintenance or serious burns and injury can occur.**

CAUTION: To avoid damaging the vehicle or A/C components, the following precautions must be observed.

- **The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to due so can contaminate the shop bulk refrigerant and other vehicles.**
- **Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These two types of refrigerant must never be mixed. Doing so can damage the A/C system.**
- **Charge the A/C system with the engine running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.**
- **Use only R-134a refrigerant. Due to environmental concerns, when the air conditioning system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal law REQUIRES that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as MACS, ASI, etc. Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the air conditioning system.**
- **Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high**

concentrations of air and higher pressures.

- **A number of manufacturers are producing refrigerant products that are described as direct substitutes for Refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled Refrigerant R-134a.**

CAUTION: To avoid contamination of the A/C system:

- **Never open or loosen a connection recovering the refrigerant using approved equipment.**
- **When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.**
- **Evacuate a system that has been opened to install a new component or one that has discharged through leakage before charging.**
- **Seal open fittings with a cap or plug immediately after disconnecting a component from the system.**
- **Clean the outside of the fittings thoroughly before disconnecting a component from the system.**
- **Do not remove the sealing caps from a new component until ready to install.**
- **Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using. Store the oil in a clean, moisture-free container.**
- **Install a new O-ring seal before connecting an open fitting. Coat the fitting and O-ring seal with refrigerant oil before connecting.**
- **When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.**
- **Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening.**
- **When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.**
- **Do not open a refrigerant system or uncap a new component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.**

The manual climate control system heats and/or cools the vehicle depending on the function selector switch position and the temperature selected.

- The function selector switch position determines heating or cooling and air distribution.
- The temperature control setting determines the air temperature.
- The heater blower motor switch (18578) varies the blower motor speed.

The electronic automatic temperature control system maintains the selected vehicle interior temperature by heating and/or cooling the air.

- During A/C operation the system also reduces the relative humidity of the air.
- The driver may override the automatic mode of operation.

Principles of Operation

There are four main principles involved with the basic theory of operation:

- heat transfer
- latent heat of vaporization

- relative humidity
- effects of pressure

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (converts to gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (converts back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing the moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (converts to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

The Refrigerant Cycle

During stabilized conditions (air conditioning system shutdown), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor (19703) is in operation it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core (19712).

The A/C condenser core, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser core and enters the inlet side of the A/C evaporator core orifice (19D990).

The A/C evaporator core orifice is the restriction in the refrigerant system that creates the high pressure buildup in the A/C evaporator core (19860) and separates the high and low pressure sides of the A/C system. As the liquid refrigerant leaves this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator core, it absorbs heat from the passenger compartment airflow passing over the plate/fin sections of the A/C evaporator core. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler passenger compartment air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The suction accumulator/drier (19C836) is designed to remove moisture from the refrigerant and to prevent any liquid refrigerant that may not have been vaporized in the A/C evaporator core from reaching the A/C compressor. The A/C compressor is designed to pump refrigerant vapor only, as liquid refrigerant will not compress and can damage the A/C compressor.

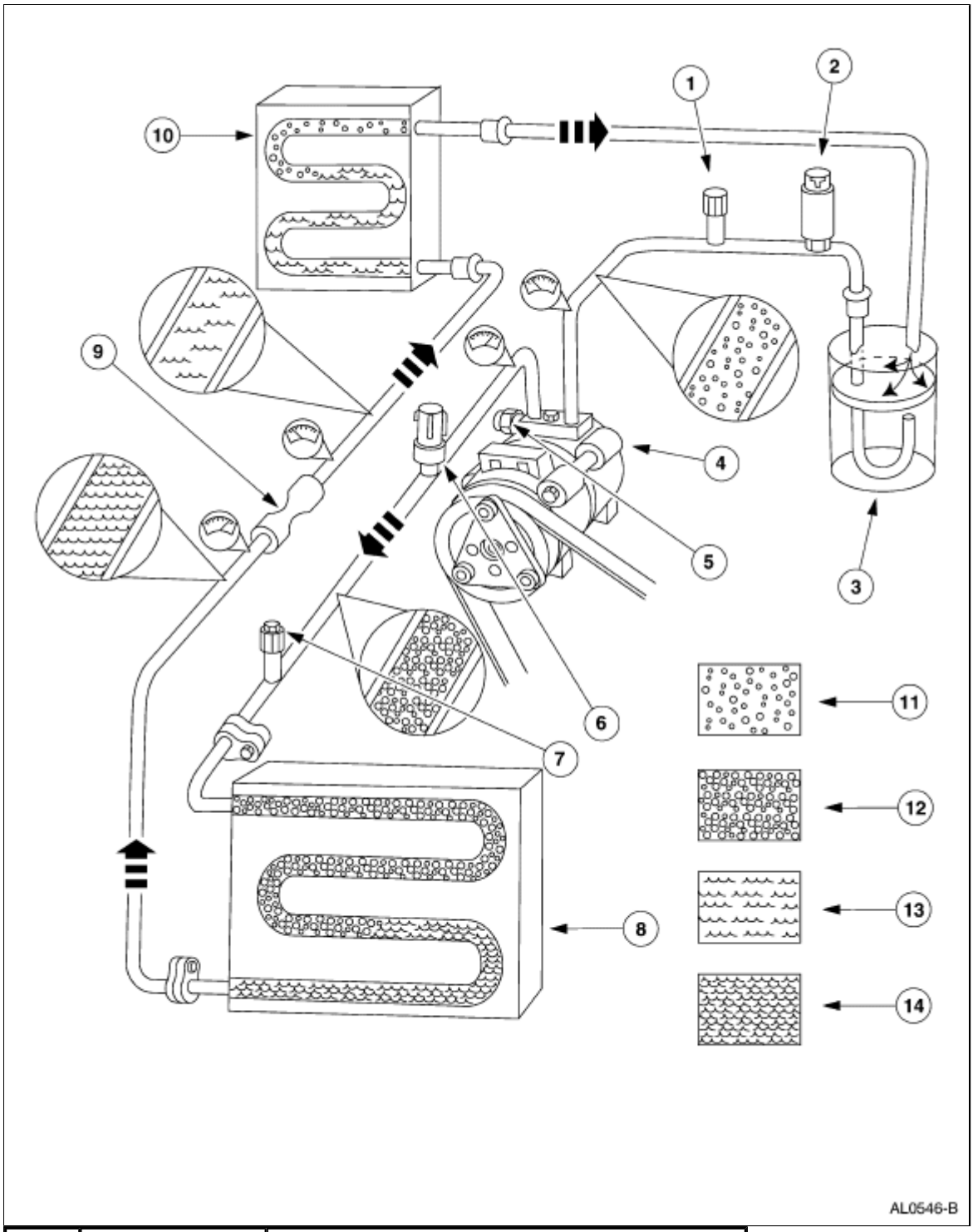
The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

The A/C cycling switch (19E561) interrupts compressor operation before the external temperature of the A/C evaporator core gets low enough to cause the condensed water vapor (excess humidity) to turn to ice. It does this by monitoring low side line pressure. It is known that a refrigerant pressure of approximately 210 kPa (30 psi) will yield an operating temperature of 0°C (32°F). The A/C cycling switch controls system operation in an effort to maintain this temperature.

The high side line pressure is also monitored so that A/C compressor operation can be interrupted if system pressure becomes too high.

The A/C compressor pressure relief valve (19D644) will open and vent refrigerant to relieve unusually high system pressure.

Clutch Cycling Orifice Tube Type Refrigerant System

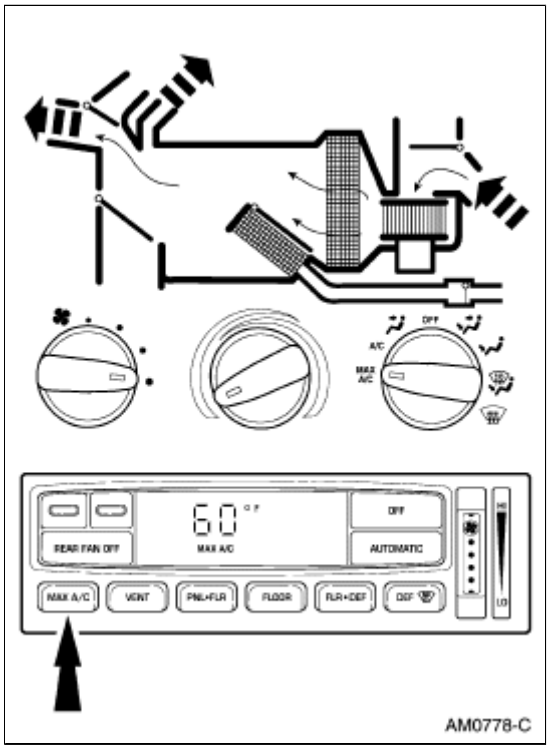


Item	Part Number	Description
1	19E762	A/C charge valve port (low side)
2	19E561	A/C cycling switch
3	19C836	Suction accumulator/drier
4	19703	A/C compressor
5	19D644	A/C compressor pressure relief valve

6	19D594	A/C pressure cut-off switch
7	19E762	A/C charge valve port (high side)
8	19712	A/C condenser core
9	19D990	A/C evaporator core orifice
10	19860	A/C evaporator core
11	—	Low pressure vapor
12	—	High pressure vapor
13	—	Low pressure liquid
14	—	High pressure liquid

System Airflow Description

MAX A/C



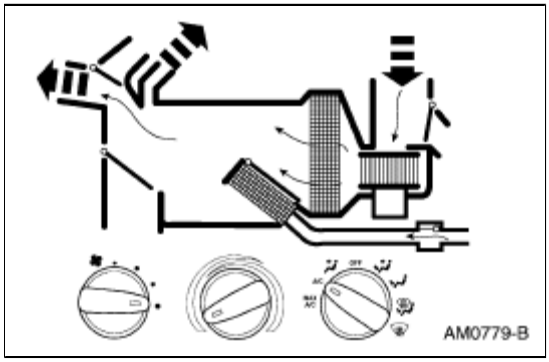
When MAX A/C is selected:

- The air inlet duct door is at full vacuum, closing off outside air and admitting only recirculated air.
- The heater water control valve (18495) is at full vacuum, preventing hot coolant from reaching the heater core (18476).
- The panel/defrost door is at full vacuum and the floor/panel door is at no vacuum, directing airflow to the A/C registers (19893).
- Temperature control is usually set for maximum cold but because the heater water control valve is preventing hot coolant from reaching the heater core, the air cannot be heated in any temperature control position.
- Air will be picked up at the recirc opening by the blower motor (18527). With the temperature control set for maximum cold, airflow across the A/C evaporator core will be diverted past the heater core

and then directed into the passenger compartment through the instrument panel A/C registers. There is also some airflow to the side window demisters.

- The A/C compressor will be enabled when MAX A/C is selected.
- The blower motor is on.

A/C

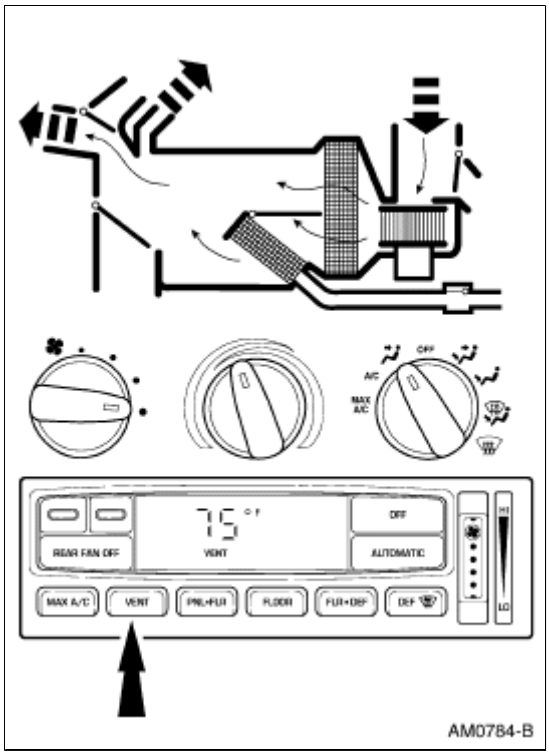


A/C

When A/C is selected:

- The air inlet duct door is set at no vacuum, blocking the recirc passage and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- All other door positions are the same as described.
- Temperature setting can be changed manually.
- The A/C compressor will be enabled when A/C is selected.
- The blower motor is on.

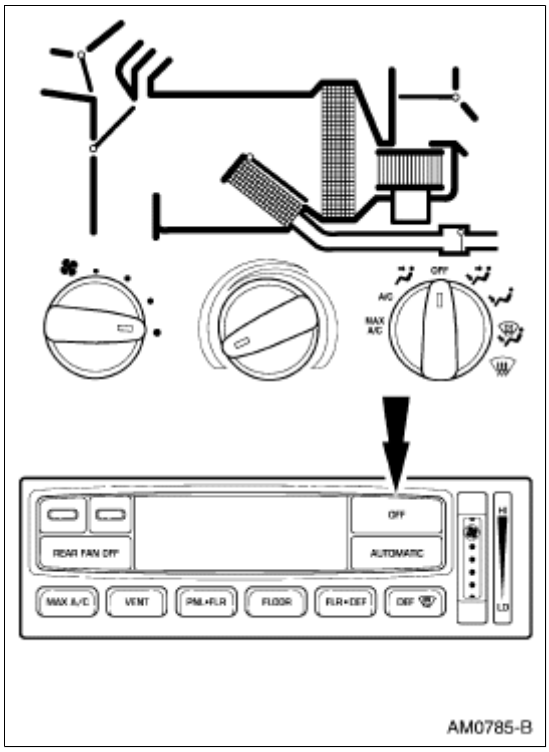
VENT



When vent is selected:

- The air inlet duct door, with no vacuum being applied, will block recirculated air and admit outside air. From there, air flows through the system to the instrument panel A/C registers. There is also some airflow to the side window demisters.
- The heater water control valve is at no vacuum, allowing hot coolant into the heater core.
- The floor/panel door is in the no vacuum position to block airflow to the heater outlet floor duct.
- The panel/defrost door is at full vacuum, closing off airflow to the windshield defroster hose nozzle (18490).
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature.
- The A/C compressor will be disabled when VENT is selected.
- The blower motor is on.

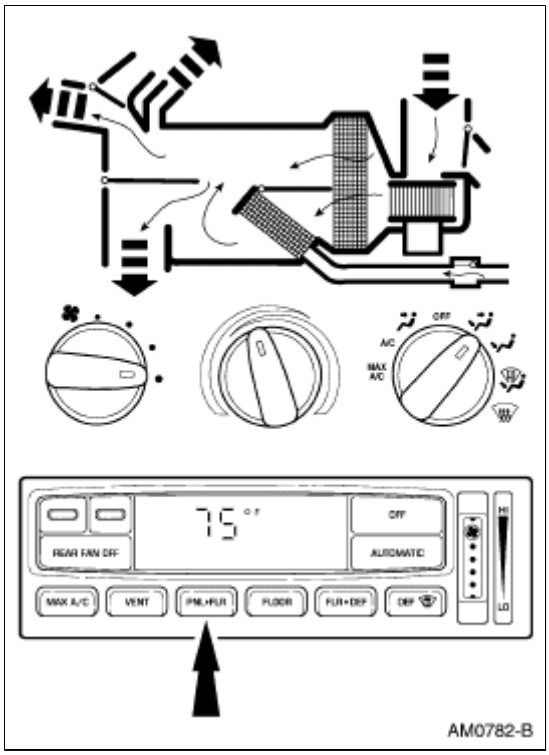
OFF



When OFF is selected:

- The A/C inlet duct door is at full vacuum, closing off outside air and admitting only recirc air.
- The heater water control valve is at full vacuum, preventing hot coolant from reaching the heater core.
- The floor/panel and panel/defrost doors are at full vacuum, closing off the passages to the A/C registers.
- The blower motor and the A/C compressor are off.

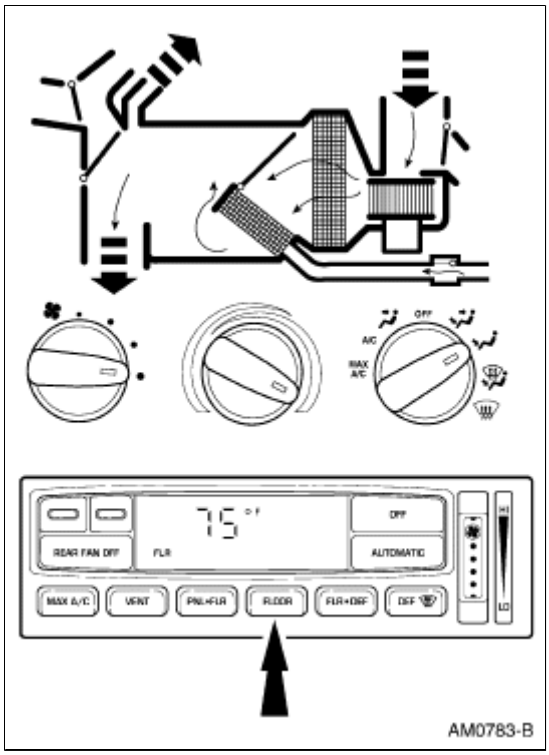
PANEL/FLOOR



When PANEL/FLOOR is selected:

- The air inlet duct door is set at no vacuum, blocking the recirc passage and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel airflow door is in the partial vacuum position, allowing airflow to both the A/C registers and the heater outlet floor duct.
- The panel/defrost airflow door is at full vacuum, closing off airflow to the windshield defroster hose nozzle and directing airflow to the A/C registers. There is also some airflow to the side window demisters.
- The A/C compressor will be enabled when PANEL/FLOOR is selected.
- The blower motor is on.

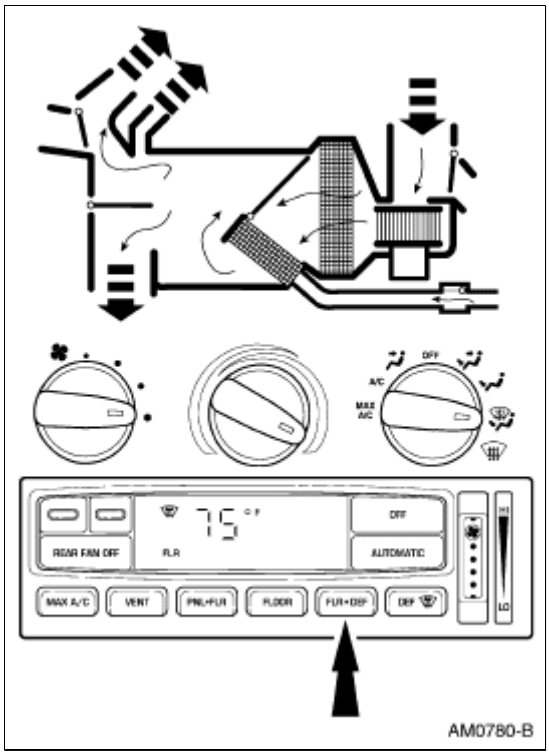
FLOOR



When FLOOR is selected:

- The air inlet duct door is in the no vacuum position, blocking recirc air and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel airflow door is in the full vacuum position, directing all airflow to the heater outlet floor duct. There is also some airflow to the side window demisters.
- The temperature can be adjusted to mix airflowing through and around the heater core to achieve the desired temperature level.
- The panel/defrost airflow door is in the no vacuum position, blocking air circulation to the panel A/C registers.
- The A/C compressor will be disabled when FLOOR is selected.
- The blower motor is on.

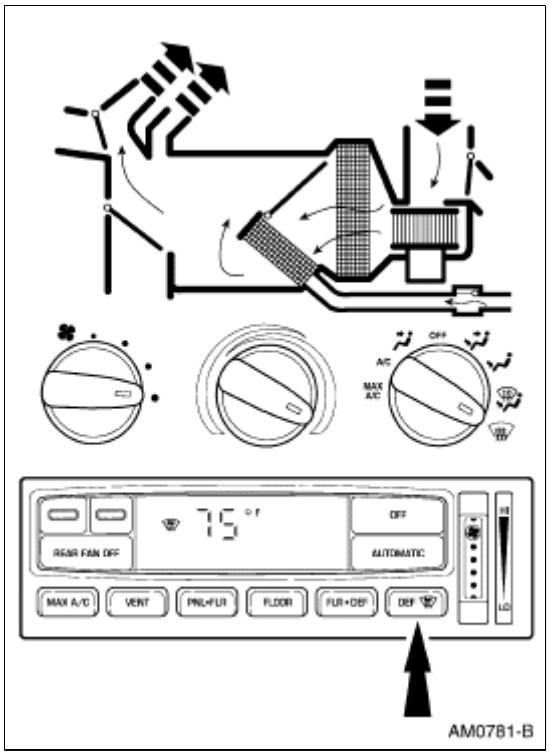
FLOOR/DEFROST



When FLOOR/DEFROST is selected:

- The air inlet duct door is in the no vacuum position blocking recirc air and admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- The floor/panel airflow door is in the partial vacuum position, allowing airflow to both the windshield defroster hose nozzle and the heater outlet floor duct.
- The panel/defrost airflow door is in the no vacuum position, directing airflow to the windshield defroster hose nozzle. There is also some airflow to the side window demisters.
- The A/C compressor will be enabled when FLOOR/DEFROST is selected to dehumidify the air and reduce windshield fogging.
- The blower motor is on.

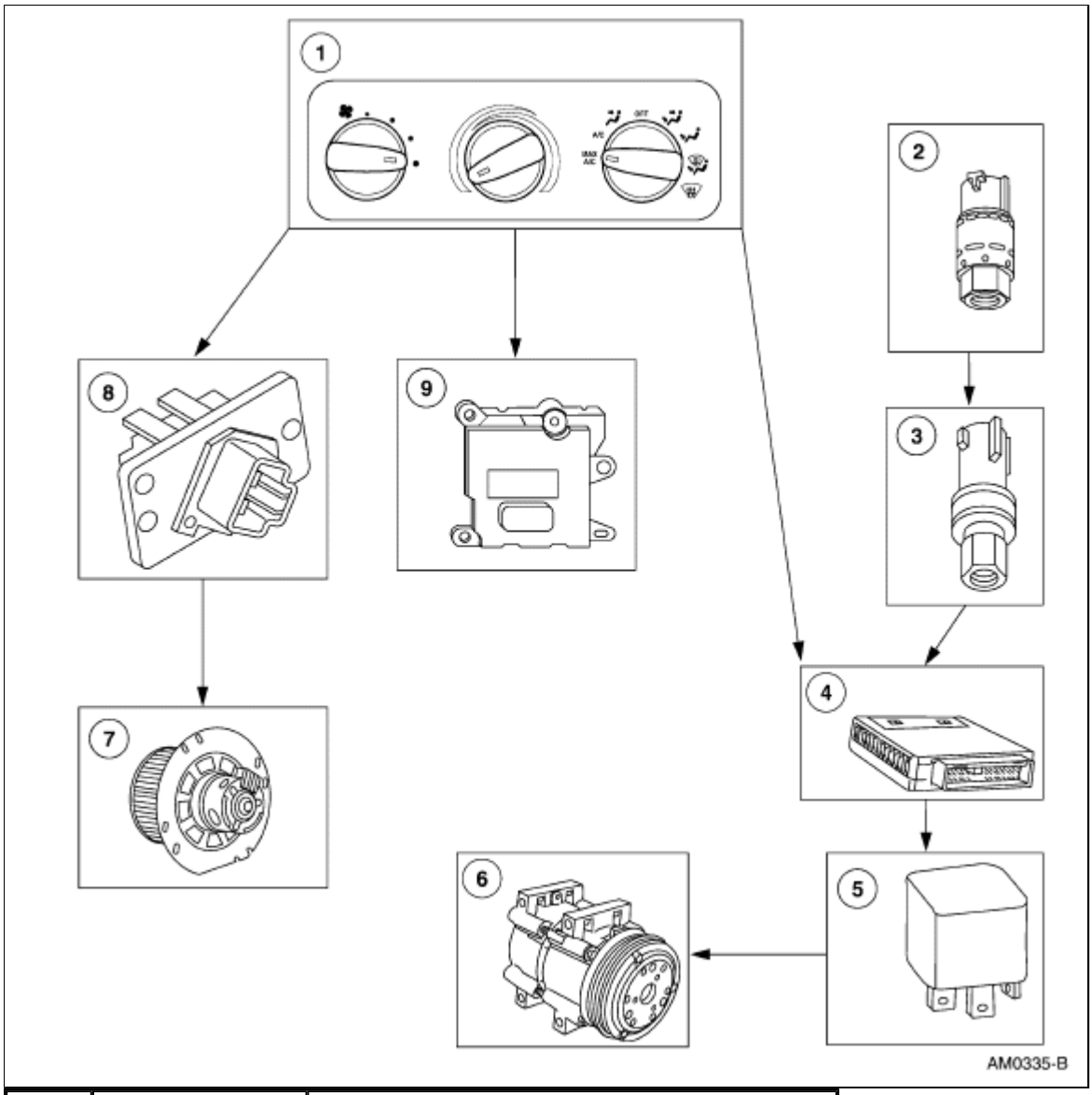
DEFROST



When DEFROST is selected:

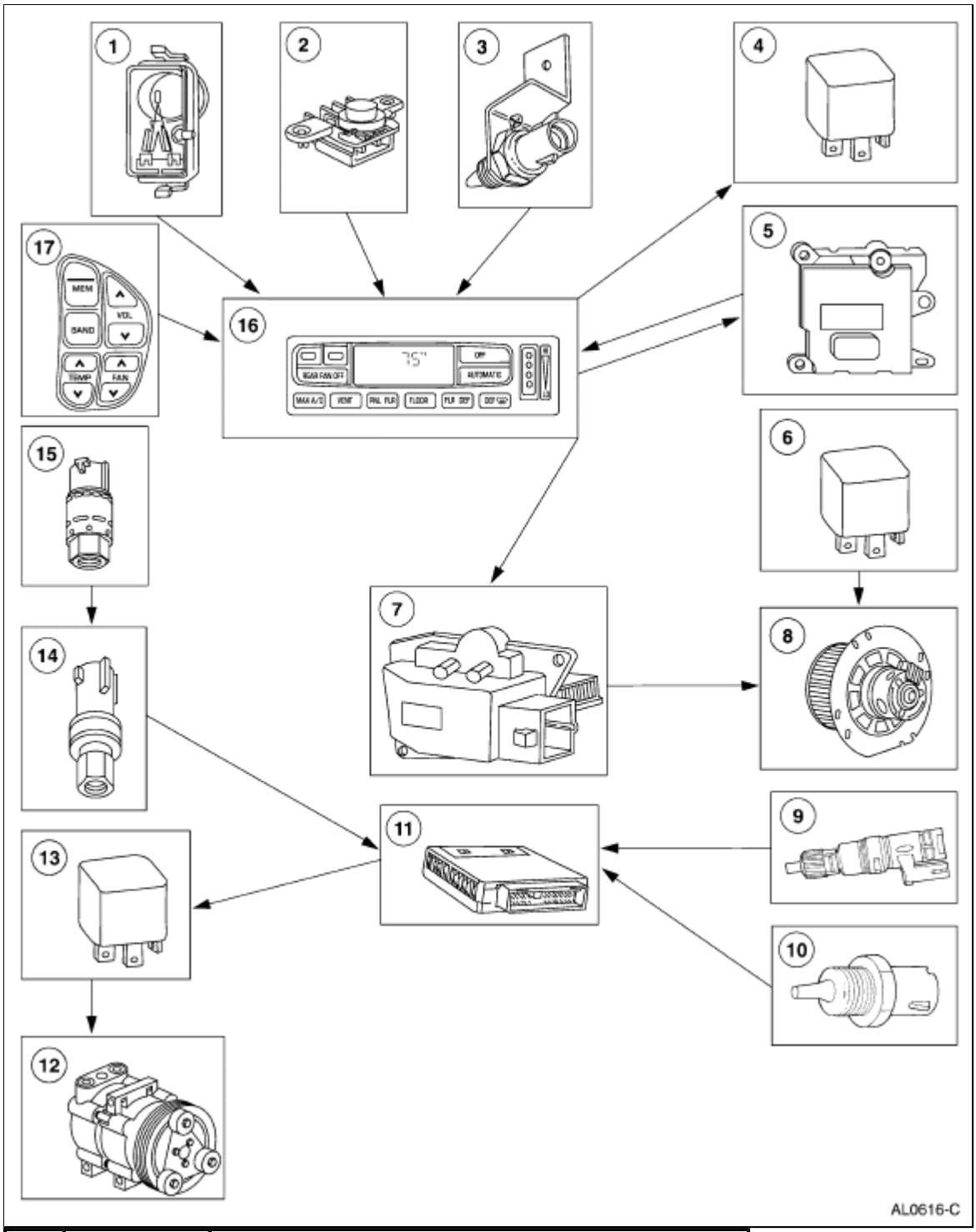
- The air inlet duct door is in the no vacuum position, admitting outside air.
- The heater water control valve is also at no vacuum, allowing hot coolant into the heater core.
- Both the floor/panel airflow door and the panel/defrost airflow door are in the no vacuum position so that most of the incoming air is directed to the windshield defroster hose nozzle. There is also airflow to the side window demisters.
- The temperature setting will determine the amount of air that is directed through the heater core and the amount that bypasses the heater core.
- The A/C compressor will be enabled when DEFROST is selected to dehumidify the air and reduce windshield fogging.
- The blower motor is on.

Manual A/C Electrical Components



Item	Part Number	Description
1	19980	Manual A/C control assembly
2	19E561	A/C cycling switch
3	19D594	A/C pressure cut-off switch
4	12A650	Powertrain control module
5	14B192	WOT A/C relay
6	19703	A/C compressor
7	18527	Blower motor
8	18591	Heater blower motor switch resistor
9	19E616	A/C electronic door actuator motor

Electronic Automatic Temperature Control Electrical Components



Item	Part Number	Description
1	19D888	Automatic temperature control sensor hose and elbow
2	19E663	A/C sunload sensor
3	19E702	A/C ambient air temperature sensor and bracket
4	14B192	Rear console blower relay

5	19E616	A/C electronic door actuator motor
6	14B192	Blower motor relay
7	19E624	A/C blower motor speed control
8	18527	Blower motor
9	9E731	Vehicle speed sensor
10	12A648	Engine coolant temperature sensor
11	12A650	Powertrain control module
12	2987	A/C clutch field coil
13	14B192	WOT A/C relay
14	19D594	A/C pressure cut-off switch
15	19E561	A/C cycling switch
16	19980	Electronic automatic temperature control module
17	—	Remote control buttons

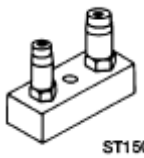
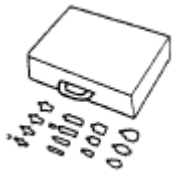
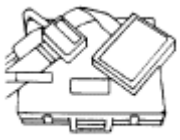
Climate Control System

Refer to Wiring Diagrams Cell 54 , Air Conditioner/Heater for schematic and connector information.

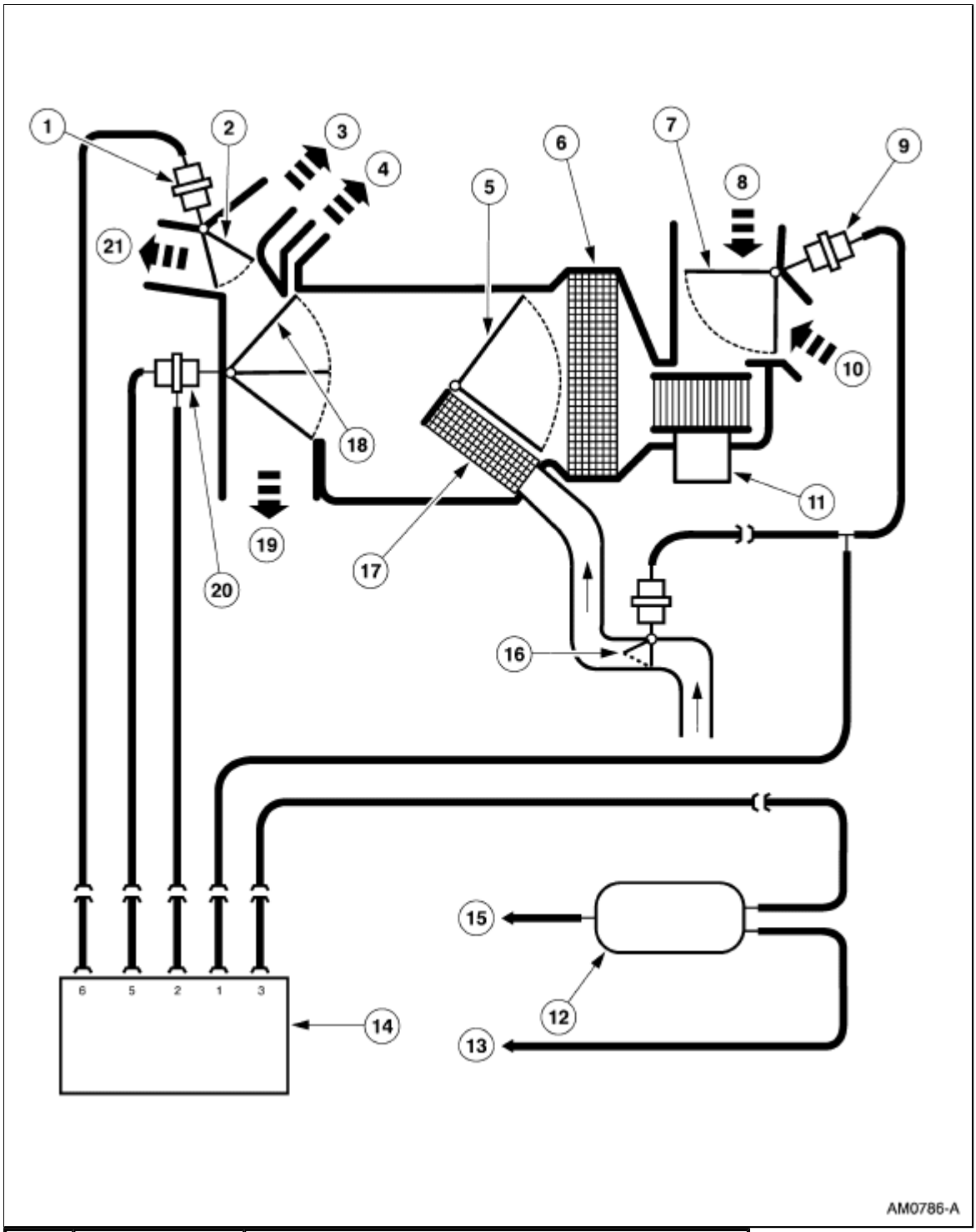
Refer to Wiring Diagrams Cell 55 , Electronic Automatic Temperature Control (EATC) for schematic and connector information.

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1179-A	Alternator, Regulator, Battery and Starter Tester (ARBST) 010-00735 or equivalent
ST2173-A	Starter, Alternator, Battery Regulator, Electrical Tester (S.A.B.R.E.) 010-00730 or equivalent
ST1137-A	Rotunda 73 Digital Multimeter 105-R0051 or equivalent
ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent
ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

 ST1501-A	A/C Pressure Test Adapter 412-093 (T94P-19623-E)
 ST1252-A	R-12/R-134a Air Conditioning Test Fitting Set 412-DS028 (014-00333, D93L-19703-B) or equivalent
ST2351-A	Refrigerant Leak Detector 216-00001 or equivalent
ST1474-A	Pressure Tester 014-R1072 or equivalent
 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950, T94L-50-EEC-V)

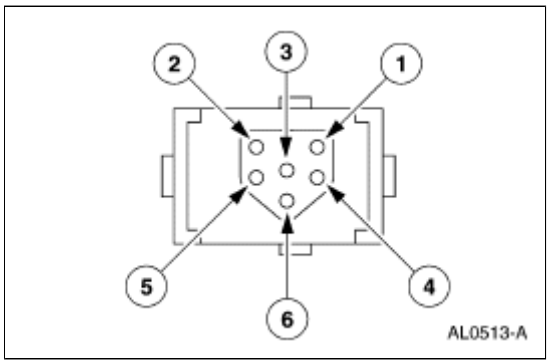
Vacuum Schematic — Manual A/C



Item	Part Number	Description
1	18A318	Vacuum control motor, panel/defrost door
2	18A478	Panel/defrost door (full vacuum position)
3	—	Defrost airflow
4	—	Side window demister airflow
5	18B545	Temperature blend door (full heat position)

6	19860	A/C evaporator core
7	19A813	Air inlet duct door (full vacuum position)
8	—	Outside air inlet
9	18A318	Vacuum control motor, air inlet duct door
10	—	Recirculated air inlet
11	19805	A/C blower motor
12	19A566	A/C vacuum reservoir tank and bracket
13	—	Vacuum from the engine intake manifold
14	19B888	A/C — heater function selector switch
15	—	Vacuum to the 4x4 hub solenoids
16	18495	Water diverter valve
17	18476	Heater core
18	18A559	Floor/panel door (full vacuum position)
19	—	Floor airflow
20	18A318	Vacuum control motor, floor/panel door
21	—	Panel vent airflow

Vacuum Connector End View — Manual A/C



Port No.	Hose Color	Function
1	White	Air inlet duct door and water diverter valve
2	Yellow	Floor/panel door
3	Black	Vacuum source
4	—	Not used
5	Blue	Floor/panel door
6	Red	Panel/defrost door

VACUUM APPLICATION CHART—MANUAL A/C

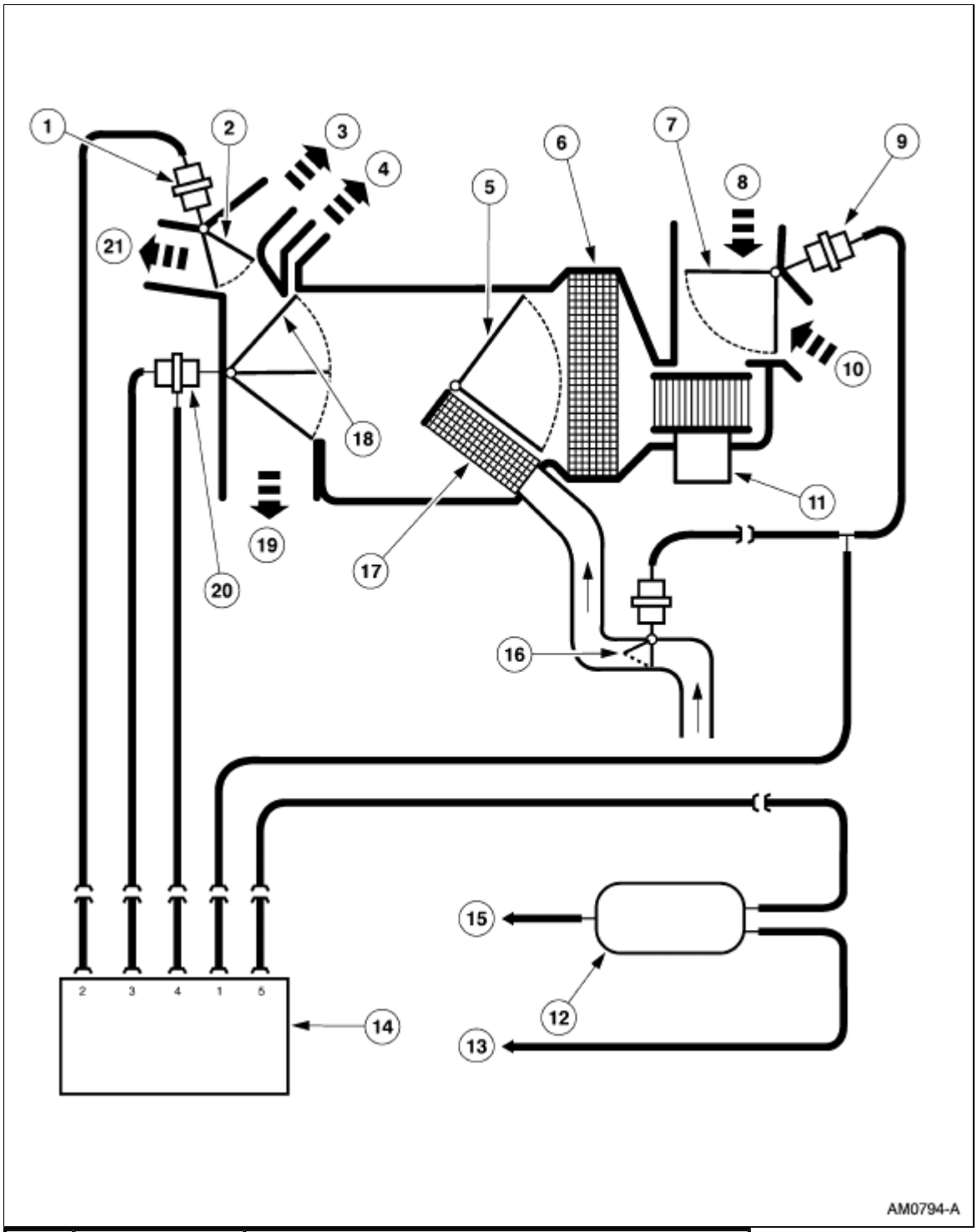
			Function Selector Switch Position							

Switch Port	Color	Function	MAX A/C	A/C	PNL/ VENT	OFF	FLR/ PNL	FLR	FLR/ DEF	DEF
1	White	Outside/recirc, water diverter	V	NV	NV	V	NV	NV	NV	NV
2	Yellow	Floor/panel	NV	NV	NV	V	NV	V	NV	NV
3	Black	Vacuum source	V	V	V	V	V	V	V	V
5	Blue	Full floor	NV	NV	NV	V	V	V	V	NV
6	Red	Panel/defrost	V	V	V	NV	V	NV	NV	NV

V = Vacuum

NV= No Vacuum

Vacuum Schematic — Electronic Automatic Climate Control System



Item	Part Number	Description
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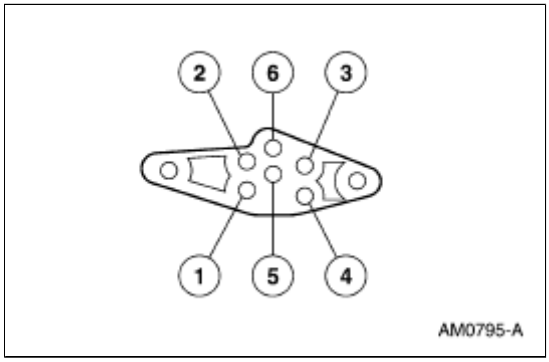
2	18A478	Panel/defrost door (full vacuum position)
3	—	Defrost airflow
4	—	Side window demister airflow
5	18B545	Temperature blend door (full heat position)
6	19860	A/C evaporator core

7	19A813	Air inlet duct door (full vacuum position)
8	—	Outside air inlet
9	18A318	Vacuum control motor, air inlet duct door
10	—	Recirculated air inlet
11	19805	A/C blower motor
12	19A566	A/C vacuum reservoir tank and bracket
13	—	Vacuum from the engine intake manifold
14	19B888	A/C — heater function selector switch
15	—	Vacuum to the 4x4 hub solenoids
16	18495	Water diverter valve
17	18476	Heater core
18	18A559	Floor/panel door (full vacuum position)
19	—	Floor airflow
20	18A318	Vacuum control motor, floor/panel door
21	—	Panel vent airflow

Vacuum Connector End View — Electronic Automatic Climate Control



Port No.	Hose Color	Function
1	White	Air inlet duct door
2	Red	Panel/defrost door
3	Blue	Floor/panel door
4	Yellow	Floor/panel door
5	Black	Source vacuum
6	—	Not used

VACUUM APPLICATION CHART—ELECTRONIC AUTOMATIC CLIMATE CONTROL

Vacuum Harness Hose Color	Function	Manual Override Selector Buttons						
		OFF	MAX A/C	VENT	PNL & FLR	FLOOR	FLR & DEF	DEFROST

White	Outside/recirc, water diverter	V	V	NV	NV	NV	NV	NV
Yellow	Full floor	NV	NV	NV	NV	V	NV	NV
Blue	Floor-panel (partial)	NV	NV	NV	V	V	V	NV
Red	Panel-defrost	NV	V	V	V	NV	NV	NV
Black	Source	V	V	V	V	V	V	V

V = Vacuum

NV = No Vacuum

Inspection and Verification

1. Verify the customer's concern by operating the climate control system to duplicate the condition.

2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Loose, missing or damaged A/C compressor drive belt. • Loose or disconnected A/C clutch. • Loose, misrouted or damaged vacuum lines. [a] • Broken or leaking vacuum control motor [a] • Broken or leaking refrigerant lines. • Obstructed in-vehicle temperature sensor.	• Open fuses. • Blower motor inoperative. • A/C compressor inoperative. • Circuitry open/shorted. • Disconnected electrical connectors.

[a] A leak in the vacuum control circuit may occur during acceleration (slow leak), may exist at all times (large leak), and may exist only when specific functions are selected (indicating a leak in that portion of the circuit). The vacuum hoses used in the passenger compartment control circuit are constructed from PVC plastic material. The vacuum hoses used in the engine compartment are constructed of Hytrel®. Because of the materials used, never pinch the vacuum hoses off during diagnosis to locate a leak. A wood golf tee can be used as a plug when it is necessary to plug one end of the vacuum hose for leak test purposes.

3. If the inspection reveals obvious concern(s) that can be readily identified, repair as required.

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the vehicle selection cannot be entered:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

If the scan tool still does not allow the vehicle selection to be entered, refer to the scan tool manual.

5. Perform the DATA LINK DIAGNOSTIC TEST using the scan tool. If the scan tool responds with:
   - CKT 914 and CKT 915 = ALL MODULE NO RESPONSE/NOT EQUIPPED, go to Communication System Diagnostics in Section 418-00 to diagnose network concern.

- If the powertrain control module (PCM) is not listed for a communication concern, turn the A/C controls to OFF and execute self-test diagnostics for the PCM.
- If equipped with EATC, and the EATC module is not listed for a communication concern, execute self-test diagnostics for the EATC module.

6. If any PCM or EATC DTCs are retrieved, and are related to the concern, go to the Powertrain Control Module Diagnostic Trouble Code (DTC) Index or the Electronic Automatic Temperature Control (EATC) Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, go to the Symptom Chart to continue diagnostics.

8. If the electronic automatic temperature control module cannot be accessed by the scan tool, GO to Pinpoint Test A.

Electronic Automatic Temperature Control Module Self-Test

- The EATC module self-test will not detect concerns associated with data link messages like engine coolant temperature or vehicle speed signals. A scan tool tester must be used to retrieve these concerns.
- The EATC module self-test will detect concerns in the system control functions and will display hard diagnostic trouble codes (DTC) in addition to intermittent diagnostic trouble codes for concerns that occur during system operation. The vehicle interior temperature should be between 4°-32°C (40-90° F) when performing the self-test. If the temperatures are not within the specified ranges, false in-vehicle temperature sensor DTCs will be displayed.
- The self-test can be initiated at any time. Normal operation of the system stops when the self-test is activated.
- To enter the self-test, press the OFF and FLOOR buttons simultaneously and then press the AUTOMATIC button within two seconds. The display will show a pulse tracer going around the center of the display window. The test may run as long as 30 seconds. Record all DTCs displayed.
- If any DTCs appear during the self-test, follow the diagnostics procedure given under ACTION for each DTC given.
- If a condition exists but no DTCs appear during the self-test, refer to the Symptom Chart Condition: The EATC System Is Inoperative, Intermittent or Improper Operation.
- To exit self-test and retain all intermittent DTCs, push the blue (cooler) button. The control will exit self-test, retain all intermittent diagnostic trouble codes and then turn OFF (display blank).
- To exit self-test and clear all diagnostic trouble codes, press the DEFROST button. The vacuum fluorescent display window will show 888 and all function symbols for one second. Then, the EATC control assembly will turn OFF (display blank) and all DTCs will be cleared.
- Always exit the self-test before powering the system down (system turned OFF).
- Intermittent DTCs will be deleted after 80 ignition switch ON cycles after the intermittent condition occurs.

Powertrain Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
P1460	WOT A/C cutout circuit malfunction	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1464	A/C demand out of self test range	GO to DTC P1464.

ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (EATC) MODULE DIAGNOSTIC TROUBLE CODE (DTC) INDEX

DTC	EATC (Hard) Self-Test Faults	EATC (Intermittent) Run-Time Faults	Description	Action to Take
B1249	024	022	Blend door short	
		025	Blend door failure	Go To Pinpoint Test A .
B1251	031	N/A	A/C in-vehicle temperature sensor open circuit	Go To Pinpoint Test B .
B1253	030	N/A	A/C in-vehicle temperature sensor short to ground	Go To Pinpoint Test B .
B1255	041	043	A/C ambient temperature sensor open circuit	Go To Pinpoint Test C .
B1257	040	042	A/C ambient temperature sensor short to ground	Go To Pinpoint Test C .
B1261	050	052	A/C solar radiation sensor circuit short to ground	Go To Pinpoint Test D .
U1073	N/A	N/A	SCP invalid or missing data for engine coolant	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1341	N/A	N/A	SCP invalid data for vehicle speed	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• No communication with the electronic automatic temperature control module	• Circuitry short/open. • EATC module communication network.	• Go To Pinpoint Test E .
• The EATC system is inoperative, intermittent or incorrect operation	• Circuitry short/open. • Input sensor (s)/erratic input signals. • Charging system. • Automatic temperature control sensor hose and elbow.	• Go To Pinpoint Test F .

• Incorrect/erratic direction of airflow from outlet — manual A/C	• Function selector switch. • A/C vacuum check valve. • Vacuum hose. • A/C vacuum reservoir tank and bracket. • Vacuum control motor. • Vacuum actuator arm.	• Go To Pinpoint Test G .
• Incorrect/erratic direction of airflow from outlet — EATC	• No vacuum to the A/C control. • A/C control leaks vacuum. • Kinked/pinched vacuum hose. • Vacuum control motor. • A/C vacuum check valve. • A/C vacuum reservoir tank and bracket. • Vacuum actuator arm not connected to the door crank.	• Go To Pinpoint Test H .
• Insufficient, erratic, or no heat	• Low engine coolant level. • Engine overheating. • Plugged or partially plugged heater core. • Temperature blend door binding/stuck. • A/C electric blend door actuator.	• Go To Pinpoint Test I .
• The A/C does not operate/does not operate correctly — manual A/C	• Fuse. • Circuitry short/open. • A/C cycling switch. • A/C system. • Function selector switch. • A/C refrigerant.	• Go To Pinpoint Test J .
• The A/C does not operate/does not operate correctly — EATC	• Open fuse. • Circuitry short/open. • A/C cycling switch. • A/C system discharged/low charge. • A/C pressure cutoff switch.	• Go To Pinpoint Test K .

	• A/C control.	
• The A/C is always on — manual A/C	• Circuit short/open. • A/C cycling switch. • A/C control.	• Go To Pinpoint Test L .
• The A/C is always on — EATC	• Circuit short/open. • A/C cycling switch. • A/C control.	• Go To Pinpoint Test M .
• No operation in all temperature settings — manual A/C	• Temperature blend door. • Temperature blend door actuator control. • A/C electronic blend door actuator motor. • Circuitry short/open.	• Go To Pinpoint Test N .
• The blower motor does not operate — manual A/C	• Fuse. • Circuitry short/open. • A/C blower motor switch. • A/C blower motor resistor. • A/C blower motor.	• Go To Pinpoint Test O .
• The blower motor is inoperative — EATC	• Circuitry short/open. • A/C blower motor. • A/C blower motor speed control. • Blower motor relay.	• Go To Pinpoint Test P .
• The blower motor does not operate correctly — manual A/C	• Circuitry short/open. • A/C blower motor resistor. • A/C blower motor switch.	• Go To Pinpoint Test Q .
• The blower motor does not operate correctly — EATC	• Circuitry short/open. • A/C blower motor speed control. • EATC module.	• Go To Pinpoint Test R .
• No operation in high blower setting — manual A/C	• A/C blower motor resistor. • A/C blower motor switch.	• Go To Pinpoint Test S .
• The temperature set point does not repeat after turning the ignition switch OFF — EATC	• Fuse(s). • Circuitry short/open. • EATC module.	• CHECK circuit 54 (LG/YE) for a short or open and repair as necessary. If okay, INSTALL a new EATC module.
• The temperature display will not switch	• EATC module.	• PRESS the MAX A/C and DEFROST buttons

between Celsius and Fahrenheit — EATC		simultaneously for at least 0.75 second. If the temperature display does not switch between Celsius and Fahrenheit, INSTALL a new EATC module.
• One or more steering wheel control switches is inoperative	• Circuitry short/open. • Steering wheel control switch. • EATC module. • Clockspring.	• Go To Pinpoint Test T .
• The console blower motor does not operate	• Fuse. • Circuitry short/open. • Console blower motor. • Console blower resistor. • Rear integrated control panel.	• Go To Pinpoint Test U .

Pinpoint Tests

PINPOINT TEST P1464: DTC P1464: A/C DEMAND OUT OF SELF TEST RANGE

CONDITIONS	DETAILS/RESULTS/ACTIONS
P14641 VERIFY THE CLIMATE CONTROL SYSTEM	
	1 Check the climate control head installed in the vehicle. • **Is the vehicle equipped with EATC?** → **Yes** GO to P14645 . → **No** GO to P14642 .
P14642 RECHECK FOR THE DTC	
1	1 Make sure the function selector switch is in the OFF position.

AM0577-A

2

3

PCM Self-Test

- **Is DTC P1464 retrieved?**

→ **Yes**
GO to P14643 .

→ **No**
The system is functioning correctly. This DTC will set if the A/C is turned on when carrying out the PCM self-test.

P14643 CHECK PID ACCS WITH THE A/C CONTROL DISCONNECTED

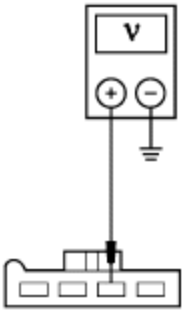
1

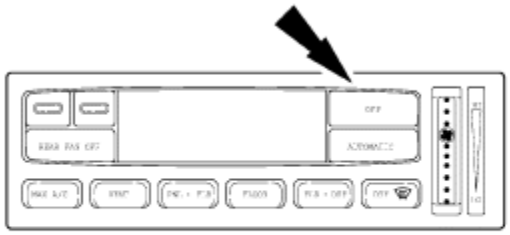
2

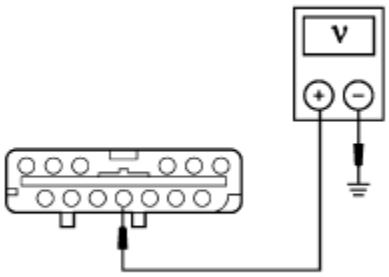
Function Selector Switch C231

3

4

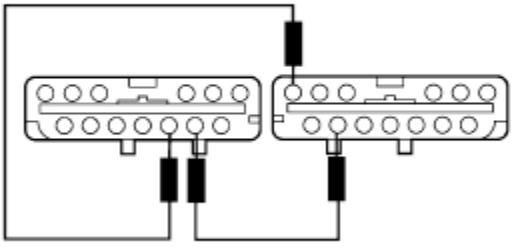
PCM PID ACCS	• **Does PID ACCS read ON?** → **Yes** GO to P14644 . → **No** INSTALL a new function selector switch. REFER to Section 412-04 . REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.
P14644 CHECK CIRCUIT 348 (VT) FOR A SHORT TO B+	
1 2 PCM C202 3 4  AM0582-A	4 Measure the voltage at the function selector switch pin C231, circuit 348 (VT). • **Is voltage present?** → **Yes** REPAIR circuit 348 (VT) for a short to B+. REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved. → **No** INSTALL a new powertrain control module. REFER to Section 303-14 . REPEAT the PCM self-test and verify DTC P1464 is no longer

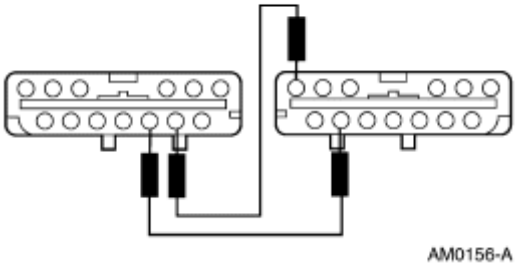
	retrieved.
P14645 RECHECK FOR THE DTC	
1 2  AM0852-A 3 PCM Self-Test	2 Press the OFF button on the electronic automatic temperature control module. • **Is DTC P1464 retrieved?** → **Yes** GO to P14646 . → **No** The system is functioning correctly. This DTC will set if the A/C is turned on when carrying out the PCM self-test.
P14646 CHECK PID ACCS WITH THE A/C CONTROL DISCONNECTED	
1 2 EATC Module C297 3 	

4 PCM PID ACCS	• **Does PID ACCS read ON?** → **Yes** GO to P14647 . → **No** INSTALL a new EATC module. REFER to Section 412-04 . REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.
P14647 CHECK CIRCUIT 348 (VT) FOR A SHORT TO B+	
1 2 PCM C202 3 4  AM0856-A	4 Measure the voltage at the EATC module connector pin C297-11, circuit 348 (VT). • **Is voltage present?** → **Yes** REPAIR circuit 348 (VT) for a short to B+. REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.

	→ **No** INSTALL a new powertrain control module. REFER to Section 303-14 . REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.

PINPOINT TEST A: DTC B1249 — BLEND DOOR FAILURE OR SHORT

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE BLEND DOOR ACTUATOR CLOCKWISE OPERATION	
1 EATC Module C297 and C298 2 3  AM0155-A	3 Connect a fused jumper wire between EATC module C297 pin 13, circuit 250 (OG) and EATC module C298 pin 2, circuit 54 (LG/YE). Connect a second fused jumper wire between EATC module C297 pin 26, circuit 249 (DB/LG) and EATC module C298 pin 3, circuit 57 (BK). • **Does the air bypass door actuator motor move in the closed direction?** → **Yes** GO to A2 . → **No** GO to A3 .
A2 CHECK THE BLEND DOOR ACTUATOR COUNTERCLOCKWISE OPERATION	
1	1 Connect a fused jumper wire between EATC module C297 pin 26, circuit 249 (DB/LG) and EATC module C298 pin 2, circuit 54 (LG/YE). Connect a second fused jumper wire between EATC module C297 pin 13, circuit 250 (OG) and EATC module C298 pin 3, circuit 57 (BK).


AM0156-A

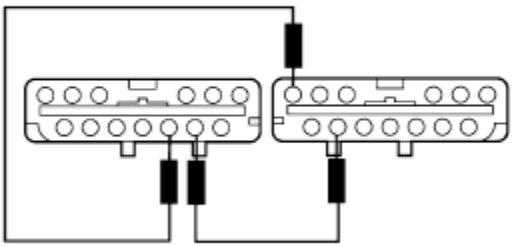
- **Does the actuator motor move in the clockwise direction?**

→ **Yes**
GO to A9 .

→ **No**
GO to A3 .

A3 CHECK THE ACTUATOR CLOCKWISE OPERATION

2


AM0155-A

1 Remove the door actuator and disengage the actuator driveshaft from the actuator door. Refer to Section 412-04 .

2 Connect a fused jumper wire between EATC module C297 pin 13, circuit 250 (OG) and EATC module C298 pin 2, circuit 54 (LG/YE). Connect a second fused jumper wire between EATC module C297 pin 26, circuit 249 (DB/LG) and EATC module C298 pin 3, circuit 57 (BK).

- **Does the air bypass door actuator motor move in the closed direction?**

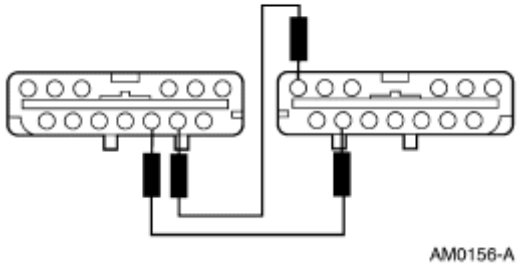
→ **Yes**
INSPECT for binding, broken door or linkage. If no condition is found, INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.

→ **No**
GO to A4 .

A4 CHECK THE ACTUATOR COUNTERCLOCKWISE OPERATION

1

1 Connect a fused jumper wire between EATC module C297 pin 26, circuit 249 (DB/LG) and


AM0156-A

EATC module C298 pin 2, circuit 54 (LG/YE).
Connect a second fused jumper wire between EATC module C297 pin 13, circuit 250 (OG) and EATC module C298 pin 3, circuit 57 (BK).

- **Does the actuator motor move in the clockwise direction?**

→ **Yes**
INSPECT for binding or broken door or linkage. If no condition is found, INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.

→ **No**
GO to A5 .

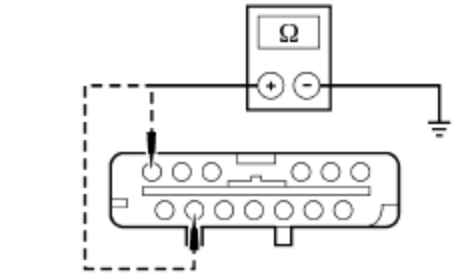
A5 CHECK CIRCUIT 249 (DB/LG) AND CIRCUIT 250 (OG) FOR A SHORT TO GROUND

1

2

Temperature Blend Door Actuator C270

3

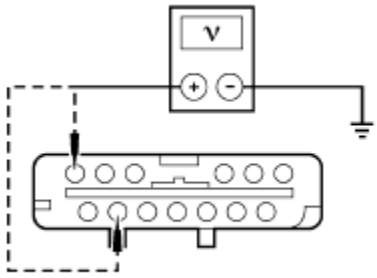
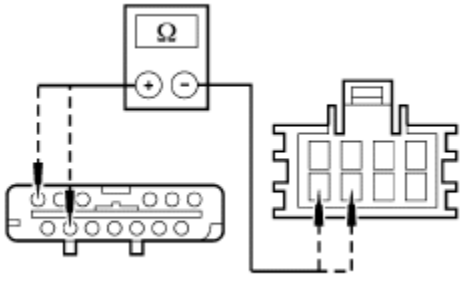


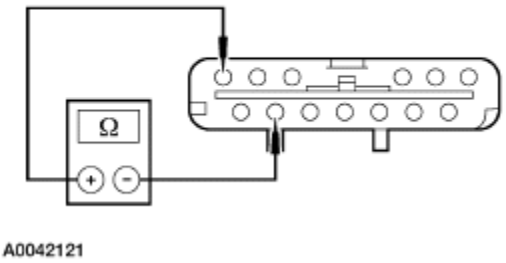
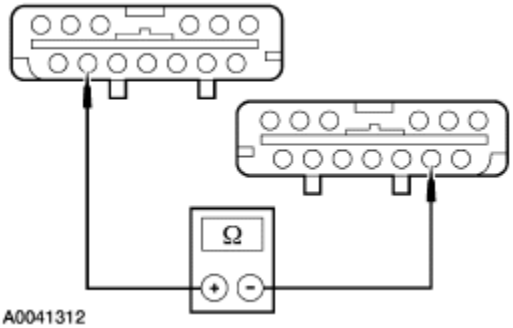
A0042517

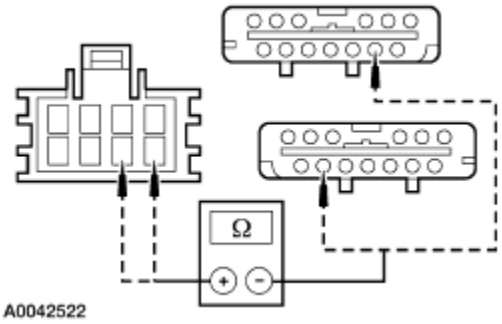
3 Measure the resistance between EATC module C297 pin 26, circuit 249 (DB/LG) and ground. Measure the resistance between EATC module C297 pin 13, circuit 250 (OG) and ground.

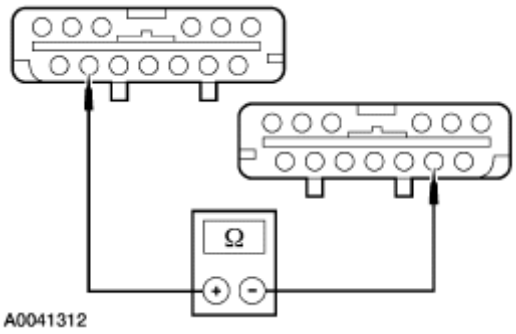
- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
GO to A6 .

	→ **No** REPAIR the affected circuit for a short to ground. TEST the system for normal operation.
A6 CHECK CIRCUIT 249 (DB/LG) AND CIRCUIT 250 (OG) FOR A SHORT TO POWER	
1 2  A0042518	2 Measure the voltage between EATC module C297 pin 26, circuit 249 (DB/LG) and ground. Measure the voltage between EATC module C297 pin 13, circuit 250 (OG) and ground. • **Is voltage present?** → **Yes** REPAIR the affected circuit for a short to power. TEST the system for normal operation. → **No** GO to A7.
A7 CHECK CIRCUIT 249 (DB/LG) AND CIRCUIT 250 (OG) FOR AN OPEN	
1 2  A0042519	2 Measure the resistance between EATC module C298 pin 26, circuit 249 (DB/LG) and the temperature blend door actuator C270 pin 8, circuit 249 (DB/LG). Measure the resistance between EATC module C297 pin 13, circuit 250 (OG) and the temperature blend door actuator C270 pin 7, circuit 250 (OG). • **Are the resistances less than 5 ohms?**

	→ **Yes** GO to A8 . → **No** REPAIR the affected circuit for an open. TEST the system for normal operation.
A8 CHECK CIRCUIT 250 (OG) AND CIRCUIT 249 (DB/LG) FOR A SHORT TOGETHER	
1  A0042121	1 Measure the resistance between EATC module C297 pin 13, circuit 250 (OG) and EATC module C297 pin 26, circuit 249 (DB/LG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR circuit 250 (OG) and circuit 249 (DB/LG) for a short together. TEST the system for normal operation.
A9 CHECK THE FEEDBACK POTENTIOMETER TOTAL RESISTANCE	
1 2  A0041312	2 Measure the resistance between EATC module C298 pin 6, circuit 243 (LG/OG) and EATC module C297 pin 9, circuit 776 (OG/BK). • **Is the resistance between 5,000 and 6,000 ohms?**

	→ **Yes** GO to A12 . → **No** If the resistance is greater than 6,000 ohms, GO to A10 . If the resistance is less than 5,000 ohms, GO to A11 .
A10 CHECK CIRCUIT 243 (LG/OG) AND CIRCUIT 776 (OG/BK) FOR AN OPEN	
1 Temperature Blend Door Actuator C270 2  A0042522	2 Measure the resistance between EATC module C298 pin 6, circuit 243 (LG/OG) and the temperature blend door actuator C270 pin 5, circuit 243 (LG/OG). Measure the resistance between EATC module C297 pin 9, circuit 776 (OG/BK) and the temperature blend door actuator C270 pin 6, circuit 776 (OG/BK). • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new temperature blend door actuator. REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR the affected circuit for an open. TEST the system for normal operation.
A11 CHECK CIRCUIT 776 (OG/BK) FOR A SHORT TO CIRCUIT 243 (LG/OG)	
1 Temperature Blend Door Actuator C270 2	2 Measure the resistance between EATC module C297 pin 9, circuit 776 (OG/BK) and EATC module C298 pin 6, circuit 243 (LG/OG).



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new temperature blend door actuator (19E616). REFER to Section 412-04 . TEST the system for normal operation.

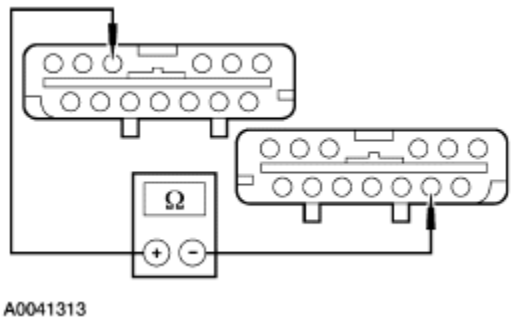
→ **No**
REPAIR circuit 776 (OG/BK) for a short to circuit 243 (LG/OG). TEST the system for normal operation.

A12 CHECK POTENTIOMETER LOW SIDE RESISTANCE

1 Drive the actuator to the full counterclockwise position. Refer to Step A2.

2 Measure the resistance between EATC module C298 pin 18, circuit 351 (BN/WH) and EATC module C297 pin 9, circuit 776 (OG/BK).

2

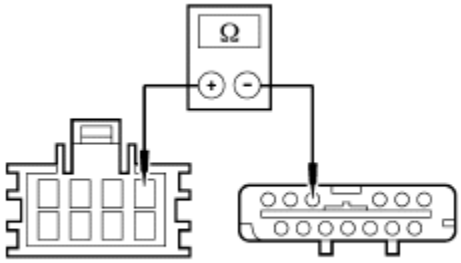
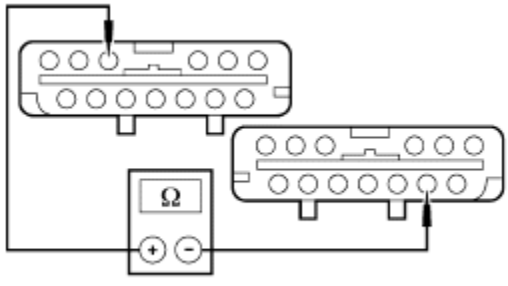


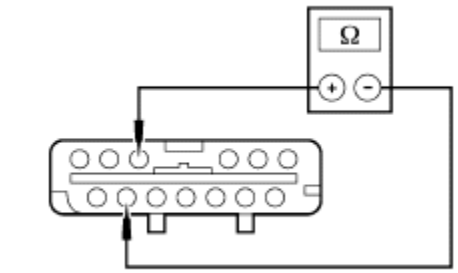
- **Is the resistance between 250 and 3,000 ohms?**

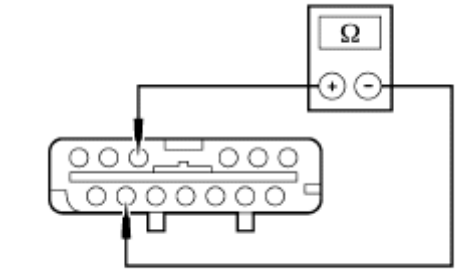
→ **Yes**
GO to A15 .

→ **No**
If the resistance is greater than 3,000 ohms, GO to A13 .
If the resistance is less than 250 ohms, GO to A14 .

A13 CHECK CIRCUIT 351 (BN/WH) FOR AN OPEN

1 Temperature Blend Door Actuator C270 2  A0042524	2 Measure the resistance between EATC module C298 pin 18, circuit 351 (BN/WH) and the temperature blend door actuator C270 pin 1, circuit 351 (BN/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new temperature blend door actuator (19E616). REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR circuit 351 (BN/WH) for an open. TEST the system for normal operation.
A14 CHECK CIRCUIT 776 (OG/BK) AND CIRCUIT 351 (BN/WH) FOR A SHORT TOGETHER	
1 Temperature Blend Door Actuator C270 2  A0041313	2 Measure the resistance between EATC module C297 pin 9, circuit 776 (OG/BK) and EATC module C298 pin 18, circuit 351 (BN/WH). • **Is the resistance greater than 10,000 ohms?** → **Yes**

	INSTALL a new temperature blend door actuator (19E616). REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR circuit 351 (BN/WH) for a short to circuit 776 (OG/BK). TEST the system for normal operation.
A15 CHECK POTENTIOMETER HIGH SIDE RESISTANCE	
1  A0041314	1 Measure the resistance between EATC module C298 pin 6, circuit 243 (LG/OG) and EATC module C298 pin 18, circuit 351 (BN/WH). • **Is the resistance between 3,000 and 6,000 ohms?** → **Yes** GO to A17 . → **No** If the resistance is greater than 6,000 ohms, INSTALL a new temperature blend door actuator. REFER to Section 412-04 . TEST the system for normal operation. If the resistance is less than 3,000 ohms, GO to A16 .
A16 CHECK CIRCUIT 243 (LG/OG) AND CIRCUIT 351 (BN/WH) FOR A SHORT TOGETHER	
1 Temperature Blend Door Actuator C270	
2	2 Measure the resistance between EATC module C298 pin 6, circuit 243 (LG/OG) and EATC module C298 pin 18, circuit 351 (BN/WH).



A0041314

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new temperature blend door actuator (19E616). REFER to Section 412-04 . TEST the system for normal operation.

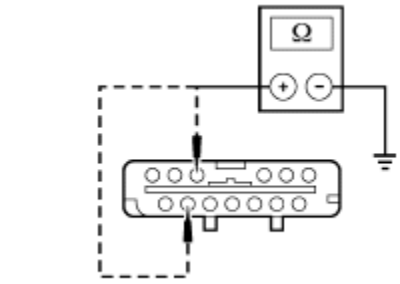
→ **No**
REPAIR circuits 243 (LG/OG) and circuit 351 (BN/WH) for a short together. TEST the system for normal operation.

A17 CHECK CIRCUIT 243 (LG/OG) AND CIRCUIT 351 (BN/WH) FOR A SHORT TO GROUND

1

Temperature Blend Door Actuator C270

2



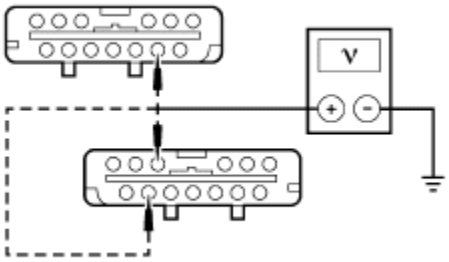
A0042526

2 Measure the resistance between EATC module C298 pin 6, circuit 243 (LG/OG) and ground. Measure the resistance between EATC module C298 pin 18, circuit 351 (BN/WH) and ground.

- **Are the resistances greater than 10,000 ohms?**

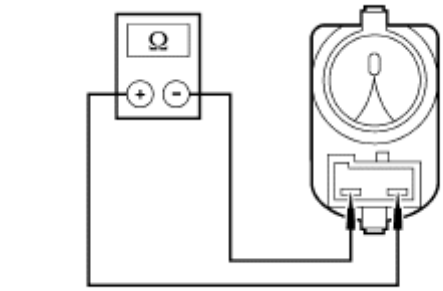
→ **Yes**
GO to A18 .

→ **No**
REPAIR the affected circuit 243 (LG/OG) or circuit 351 (BN/WH) for a short to ground.

	TEST the system for normal operation.
A18 CHECK CIRCUITS 243 (LG/OG) 351 (BN/WH) AND 776 (OG/BK) FOR A SHORT TO POWER	
1 2  A0042527	2 Measure the voltage between EATC module C298 pin 6, circuit 243 (LG/OG), EATC module C298 pin 18, circuit 351 (BN/WH) and EATC module C297 pin 9, circuit 776 (OG/BK) and ground. • **Is voltage present?** → **Yes** REPAIR the affected circuit for a short to power. TEST the system for normal operation. → **No** INSPECT for a broken door or linkage. If no condition is found, INSTALL a new EATC module. REFER to Section 412-04 . TEST the system for normal operation.

PINPOINT TEST B: DTC B1251 OR DTC B1253 — A/C IN-VEHICLE TEMPERATURE SENSOR OPEN CIRCUIT OR SHORT TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE SENSOR RESISTANCE	
1 2 In-Vehicle Temperature Sensor C296 3	3 Measure the resistance between the in-vehicle temperature sensor terminals.



A0041320

- **Is the resistance within the specified values for these temperature ranges: 10-20°C (50-68°F), 37,000-58,000 ohms; 20-30°C (68-86°F), 24,000-37,000 ohms; 30-40°C (86-104°F), 16,000-24,000 ohms?**

→ **Yes**
GO to B2 .

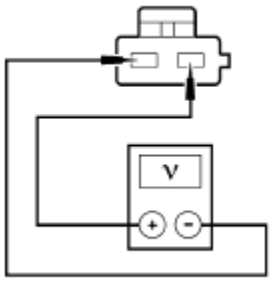
→ **No**
INSTALL a new in-vehicle temperature sensor (19D888). TEST the system for normal operation.

B2 CHECK THE EATC SENSOR OUTPUT VOLTAGE

1

2 Press the AUTOMATIC button.

3



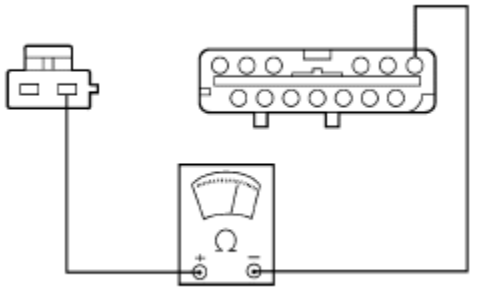
A0041321

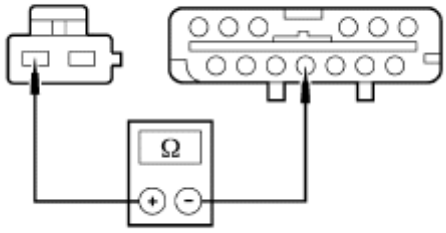
3 Measure the voltage between the in-vehicle temperature sensor C296, circuit 790 (WH/OG) and circuit 470 (PK/BK).

- **Is the voltage between 4.7 and 5.1 volts?**

→ **Yes**
INSTALL a new EATC module (19980). TEST the system for normal operation.

→ **No**
If diagnosing DTC B1251, GO to B3 .

	If diagnosing DTC B1253, GO to B5 .
B3 CHECK CIRCUIT 790 (WH/OG) FOR AN OPEN	
1 2 EATC Module C297 3  AL0581-A	3 Measure the resistance between the EATC module C297 pin 21, circuit 790 (WH/OG) and the in-vehicle temperature sensor C296, circuit 790 (WH/OG). • **Is the resistance less than 5 ohms?** → **Yes** GO to B4 . → **No** REPAIR circuit 790 (WH/OG) for an open. TEST the system for normal operation.
B4 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN	
NOTE: When performing tests, allow time for resistance measurement to stabilize.	
1 EATC Module C298 2	2 Measure the resistance between the EATC module C298 pin 4, circuit 470 (PK/BK) and the in-vehicle temperature sensor C296, circuit 470 (PK/BK).



A0041323

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new EATC module (19980). TEST the system for normal operation.

→ **No**
REPAIR circuit 470 (PK/BK) for an open. TEST the system for normal operation.

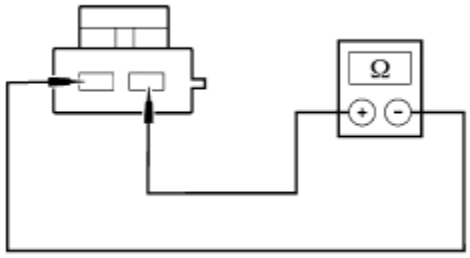
B5 CHECK CIRCUIT 790 (WH/OG) FOR A SHORT TO CIRCUIT 470 (PK/BK)

1

2

EATC Module C297

3



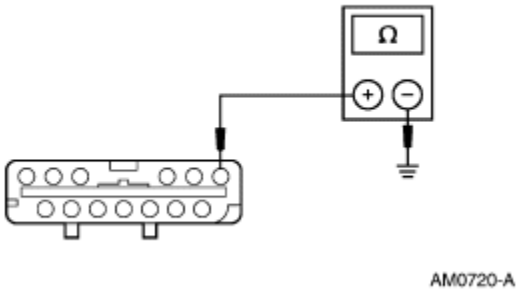
A0038067

3 Measure the resistance between the in-vehicle temperature sensor C296, circuit 790 (WH/OG) and circuit 470 (PK/BK).

- **Is the resistance greater than 10,000 ohms?**

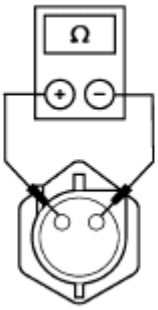
→ **Yes**
GO to B6 .

→ **No**

	REPAIR circuit 790 (WH/OG) for a short to circuit 470 (PK/BK). TEST the system for normal operation.
B6 CHECK CIRCUIT 790 (WH/OG) FOR A SHORT TO GROUND	
1  AM0720-A	1 Measure the resistance between the EATC module C297 pin 21, circuit 790 (WH/OG) and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new EATC module (19980). TEST the system for normal operation. → **No** REPAIR circuit 790 (WH/OG) for a short to ground. TEST the system for normal operation.

PINPOINT TEST C: DTC B1255 OR DTC B1257 — A/C AMBIENT TEMPERATURE SENSOR OPEN CIRCUIT OR SHORT TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE AMBIENT TEMPERATURE SENSOR RESISTANCE	
1 	
2 Ambient Temperature Sensor C196	
3	3 Measure the resistance between the ambient temperature sensor terminals.



A0002817

- **Is the resistance within the specified values for these temperature ranges: 10-20°C (50-68°F), 37,000-58,000 ohms; 20-30°C (68-86°F), 24,000-37,000 ohms; 30-40°C (86-104°F), 16,000-24,000 ohms?**

→ **Yes**
GO to C2 .

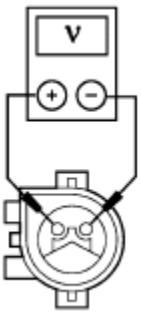
→ **No**
INSTALL a new ambient air temperature sensor (19E702). TEST the system for normal operation.

C2 CHECK THE EATC MODULE OUTPUT VOLTAGE

1

2 Press the AUTOMATIC button.

3



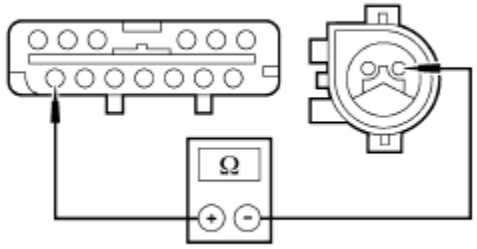
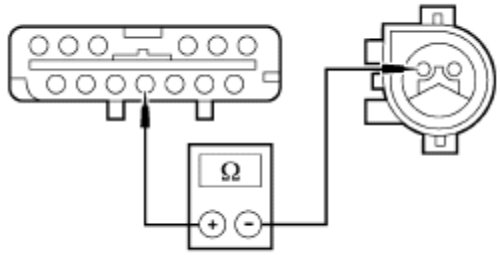
A0002818

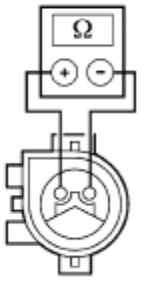
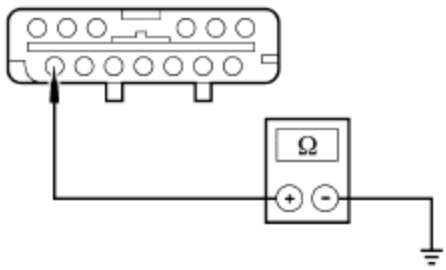
3 Measure the voltage between the ambient temperature sensor C196, circuit 767 (LB/OG) and circuit 470 (PK/BK).

- **Is the voltage between 4.7 and 5.1 volts?**

→ **Yes**
INSTALL a new EATC module (19980). TEST the system for normal operation.

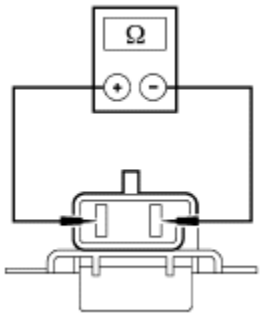
→ **No**
If diagnosing DTC B1255, GO to C3 .

	If diagnosing DTC B1257, GO to C5 .
C3 CHECK CIRCUIT 767 (LB/OG) FOR AN OPEN	
1 2 EATC Module C298 3  A0041324	3 Measure the resistance between the EATC module C298 pin 7, circuit 767 (LB/OG) and the ambient temperature sensor C196, circuit 767 (LB/OG). • **Is the resistance less than 5 ohms?** → **Yes** GO to C4 . → **No** REPAIR circuit 767 (LB/OG) for an open. TEST the system for normal operation.
C4 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN	
1  A0041325	1 Measure the resistance between the EATC module C298 pin 4, circuit 470 (PK/BK) and the ambient temperature sensor C196, circuit 470 (PK/BK). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new EATC module (19980). TEST

	the system for normal operation. → **No** REPAIR circuit 470 (PK/BK) for an open. TEST the system for normal operation.
C5 CHECK CIRCUIT 767 (LB/OG) FOR A SHORT TO CIRCUIT 470 (PK/BK)	
1 2 EATC Module C298 3  A0038068	3 Measure the resistance between the ambient temperature sensor C196, circuit 767 (LB/OG) and circuit 470 (PK/BK). • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C6 . → **No** REPAIR circuit 767 (LB/OG) for a short to ground. TEST the system for normal operation.
C6 CHECK CIRCUIT 767 (LB/OG) FOR A SHORT TO GROUND	
1  A0041326	1 Measure the resistance between the EATC module C298 pin 7, circuit 767 (LB/OG) and ground.

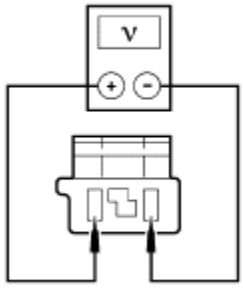
	• **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new EATC module (19980). TEST the system for normal operation. → **No** REPAIR circuit 767 (LB/OG) for a short to ground. TEST the system for normal operation.

PINPOINT TEST D: DTC B1261 — A/C SOLAR RADIATION SENSOR CIRCUIT SHORT TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE SOLAR RADIATION SENSOR RESISTANCE	
1 2 Solar Radiation Sensor C294 3  A0041327	3 **NOTE:** Connect the ground lead of the multimeter to ground on the sensor, circuit 470 (PK/BK). Measure the resistance between the solar radiation sensor terminals. • **Is the resistance greater than 0 ohms?** → **Yes** GO to D2 . → **No** INSTALL a new solar radiation sensor (19E663). TEST the system for normal operation.
D2 CHECK THE SOLAR RADIATION SENSOR REFERENCE VOLTAGE	

1

3



A0041328

2 Press the AUTOMATIC button.

3 Measure the voltage between the solar radiation sensor C294, circuit 468 (BN) and circuit 470 (PK/BK).

- **Is the voltage between 4.7 and 5.1 volts?**

→ **Yes**
INSTALL a new EATC module (19980). TEST the system for normal operation.

→ **No**
GO to D3 .

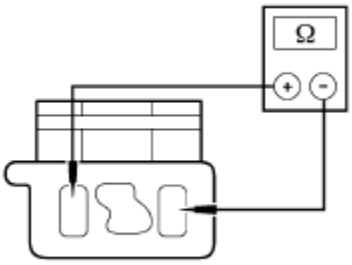
D3 CHECK CIRCUIT 468 (BN) FOR A SHORT TO CIRCUIT 470 (PK/BK)

1

2

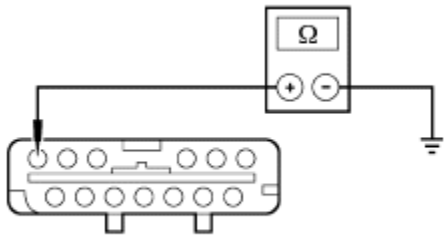
EATC Module C298

3



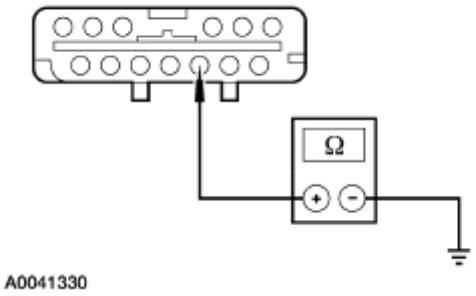
A0038069

3 Measure the resistance between the solar radiation sensor C294, circuit 468 (BN) and circuit 470 (PK/BK).

	• **Is the resistance greater than 10,000 ohms?** → **Yes** GO to D4 . → **No** REPAIR circuit 468 (BN) for a short to circuit 470 (PK/BK).
D4 CHECK CIRCUIT 468 (BN) FOR A SHORT TO GROUND	
1  A0041329	1 Measure the resistance between the EATC module C298 pin 20, circuit 468 (BN) and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new EATC module (19980). TEST the system for normal operation. → **No** REPAIR circuit 468 (BN) for a short to ground. TEST the system for normal operation.

PINPOINT TEST E: NO COMMUNICATION WITH THE ELECTRONIC AUTOMATIC TEMPERATURE CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1 2 EATC Module C298 3	



3 Measure the resistance between the EATC module C298 pin 3, circuit 57 (BK) and ground.

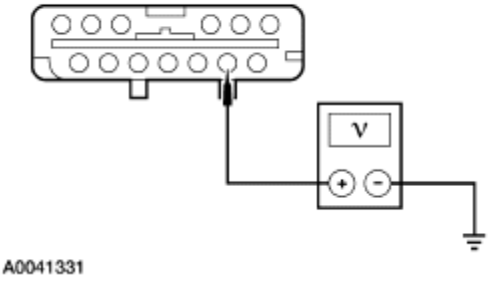
- **Is the resistance less than 25 ohms?**

→ **Yes**
GO to E2 .

→ **No**
REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.

E2 CHECK CIRCUIT 54 (LG/YE) FOR B+

1



1 Measure the voltage between the EATC module C298 pin 2, circuit 54 (LG/YE) and ground.

- **Is the voltage B+?**

→ **Yes**
GO to E3 .

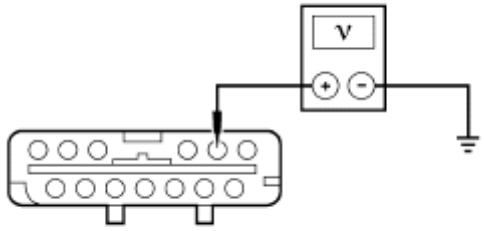
→ **No**
REPAIR circuit 54 (LG/YE) for an open. TEST the system for normal operation.

E3 CHECK CIRCUIT 364 (BK/LG) FOR B+

1

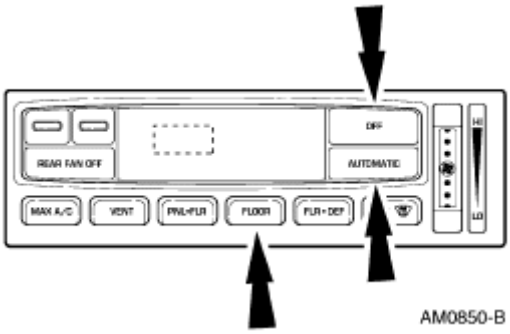
2

2 Measure the voltage between the EATC module C298 pin 16, circuit 364 (BK/LG) and ground.

 A0041332	• **Is the voltage B+?** → **Yes** REFER to Section 418-00 to diagnose a network concern. → **No** REPAIR circuit 364 (BK/LG) for an open. TEST the system for normal operation.

PINPOINT TEST F: THE EATC SYSTEM IS INOPERATIVE, INTERMITTENT OR INCORRECT OPERATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 VERIFY AUTOMATIC OPERATION	
1 	2 Press the AUTOMATIC button. • **Does AUTO and the selected temperature appear in the display window?** → **Yes** GO to F2 . → **No** GO to F11 .
F2 CARRY OUT THE EATC MODULE SELF-TEST	
1	1 Carry out the EATC module self-test. Refer to the Electronic Automatic Temperature Control Module Self-Test in this section. Record the DTCs displayed, if any.



- **Were any DTCs displayed as a result of the EATC self-test?**

→ **Yes**
REFER to the Electronic Automatic Temperature Control (EATC) Module Diagnostic Trouble Code (DTC) Index. CARRY OUT the necessary diagnosis and REPAIR as required.

→ **No**
GO to F3 .

F3 CHECK THE VACUUM FLUORESCENT DISPLAY

1 Exit self-test by pressing the DEFROST button. Observe the function symbols displayed on the vacuum fluorescent display.

- **Is the display correct and complete without any missing elements?**

→ **Yes**
GO to F4 .

→ **No**
INSTALL a new EATC module (19980). TEST the system for normal operation.

F4 CHECK THE BLOWER MANUAL OVERRIDE OPERATION

1 Slowly rotate the blower motor speed override control from LO to HI.

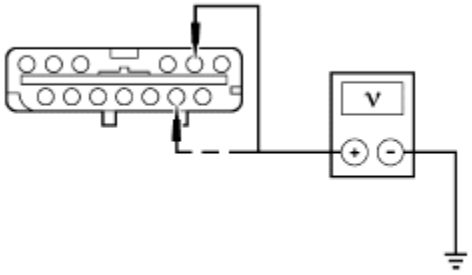
- **Does the blower motor speed increase smoothly from low speed to high speed?**

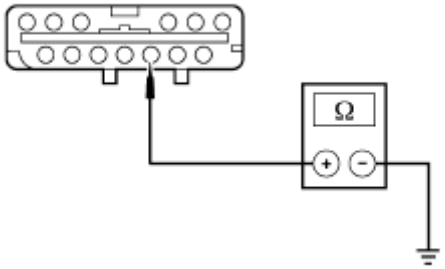
→ **Yes**
GO to F5 .

→ **No**
If the blower motor is inoperative, Go To Pinpoint Test M .

	If the blower motor operates continuously in high speed, Go To Pinpoint Test Q . If the blower motor is inoperative only in some speeds, Go To Pinpoint Test R .
F5 VERIFY THE DEFROST OVERRIDE OPERATION	
	1 Press the override button for DEFROST operation. • **Is outside air being discharged from the windshield defroster nozzle and the side window demisters?** → **Yes** GO to F6 . → **No** Go To Pinpoint Test H .
F6 VERIFY THE FLOOR OVERRIDE OPERATION	
	1 Press the override button for FLOOR operation. • **Is outside air being discharged from the floor duct?** → **Yes** GO to F7 . → **No** Go To Pinpoint Test H .
F7 VERIFY THE VENT OVERRIDE OPERATION	
	1 Press the override button for VENT operation. • **Is outside air being discharged from the instrument panel registers?** → **Yes** GO to F8 . → **No** Go To Pinpoint Test H .
F8 VERIFY THE A/C CLUTCH DOES NOT ENGAGE IN THE VENT MODE	
	1 Press the override button for VENT operation. • **Does the A/C clutch engage when the VENT override button is pressed?**

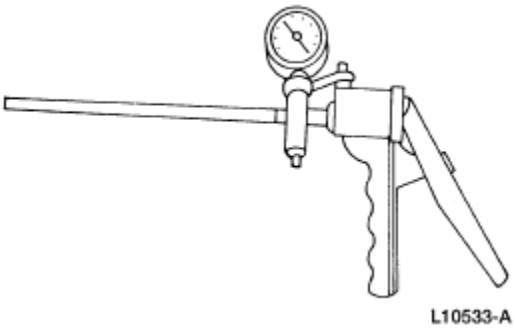
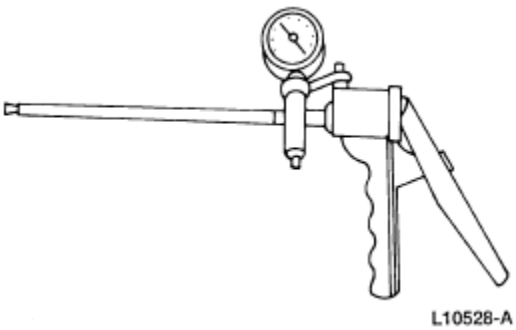
	→ **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. → **No** GO to F9.
F9 VERIFY THE MAX A/C OVERRIDE OPERATION	
	1 Make sure the ambient air temperature is above 5°C (41°F). 2 Press the override button for MAX A/C operation. • **Is recirculated air being discharged from the instrument panel registers?** → **Yes** GO to F10. → **No** Go To Pinpoint Test H.
F10 VERIFY A/C CLUTCH ENGAGEMENT IN THE MAX A/C MODE	
	1 Press the override button for MAX A/C operation. • **Does the A/C clutch engage when the MAX A/C override button is pressed?** → **Yes** The test is complete. The system is functioning normally. → **No** Go To Pinpoint Test I.
F11 CHECK THE EATC MODULE FUNCTIONS	
	1 Press each function button and observe the display. • **Does the EATC perform and display any functions?** → **Yes** INSTALL a new EATC module (19980). TEST the system for normal operation. → **No** GO to F12.
F12 CHECK THE VOLTAGE TO THE EATC	
1	

 2 EATC Module C298 3 4  A0038636	4 Measure the voltage between ground and: • EATC module C298 pin 2, circuit 54 (LG/YE) • EATC module C298 pin 16, circuit 364 (BK/LG) • **Are the voltages greater than 10 volts?** → **Yes** GO to F13 . → **No** REPAIR the affected circuit. TEST the system for normal operation.
F13 CHECK THE GROUND CIRCUIT TO THE EATC	
1 2	2 Measure the resistance between the EATC module C298 pin 3, circuit 57 (BK) and ground.

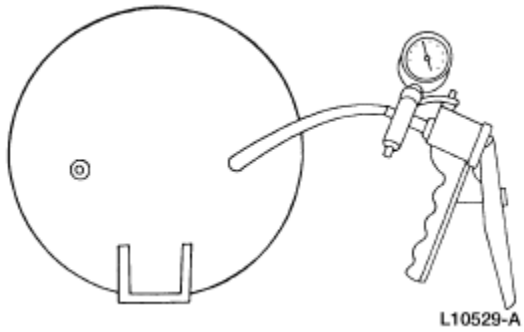
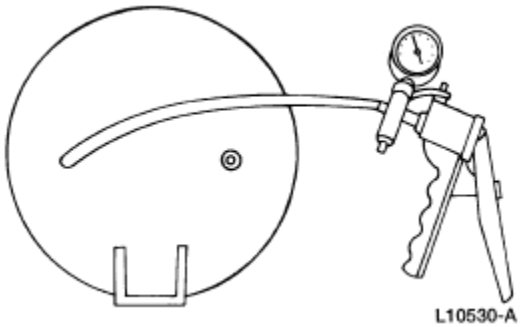
 A0038714	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new EATC module (19980). TEST the system for normal operation. → **No** REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.

PINPOINT TEST G: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLET — MANUAL CLIMATE CONTROL

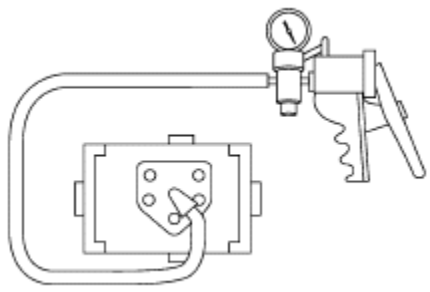
CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE AIRFLOW IN EACH SETTING	
1 	2 Set the blower motor speed to maximum. 3 Check the airflow in each function selector switch setting at engine idle and under acceleration. • **Is the airflow from only the defroster outlets in each function selector switch setting?** → **Yes** GO to G2 . → **No** GO to G7 .
G2 CHECK THE VACUUM RESERVOIR SUPPLY LINE FOR BLOCKAGE	
	1 Disconnect the vacuum reservoir supply line at the vacuum reservoir and the vacuum

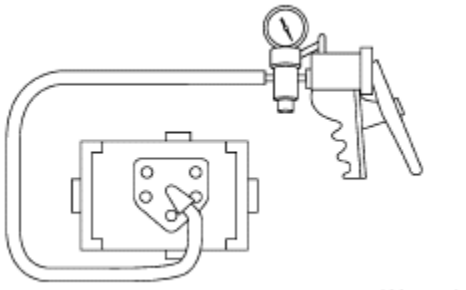
2  L10533-A	source. 2 Connect the vacuum pump to the vacuum reservoir supply line and attempt to pull a vacuum. • **Can a vacuum be pulled on the vacuum reservoir supply line?** → **Yes** REPAIR or INSTALL a new vacuum reservoir supply line. TEST the system for normal operation. → **No** GO to G3 .
G3 CHECK THE VACUUM RESERVOIR SUPPLY LINE FOR LEAKS	
2  L10528-A	1 Plug the vacuum reservoir supply line at the vacuum source connection. 2 Leak test the vacuum reservoir supply line using the vacuum pump. • **Does the vacuum reservoir line leak?** → **Yes** REPAIR or INSTALL a new vacuum reservoir supply line. TEST the system for normal operation. → **No** GO to G4 .
G4 CHECK THE VACUUM RESERVOIR FOR A LEAK	
NOTE: The reservoir has two vacuum hoses, these hoses are not interchangeable. The A/C check	

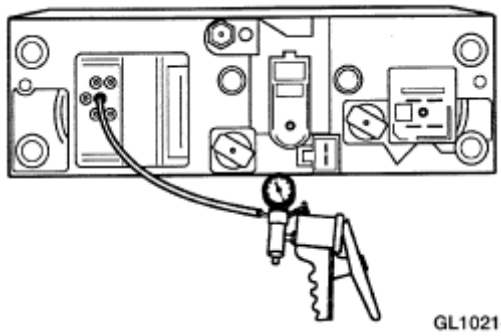
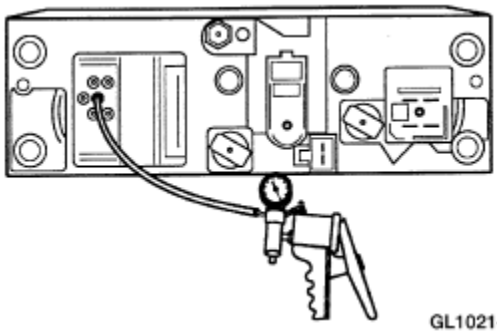
valve is built into the vacuum reservoir tank.

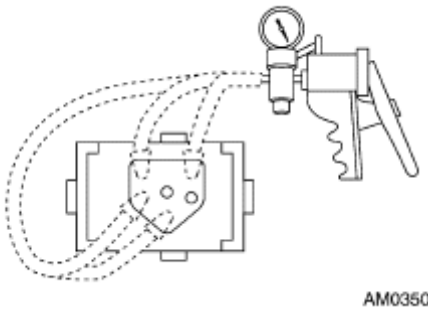
	1 Connect the vacuum pump reservoir line to the vacuum reservoir.
2  L10529-A	2 With the vacuum pump connected to the vacuum reservoir, leak test the vacuum reservoir.
3  L10530-A	3 With the vacuum pump connected to the vacuum reservoir, leak test the vacuum reservoir.
	• **Does the vacuum reservoir leak?** → **Yes** INSTALL a new vacuum reservoir (19A566). TEST the system for normal operation. → **No** GO to G5 .

G5 CHECK THE FUNCTION SELECTOR SWITCH VACUUM SOURCE LINE FOR BLOCKAGE

	1 Disconnect the function selector switch vacuum connector.
2  AM0342-A	2 Connect the vacuum pump to the function selector switch vacuum source line and attempt to pull a vacuum.

	• **Can a vacuum be pulled on the function selector switch vacuum source line?** → **Yes** REPAIR or INSTALL a new function selector switch vacuum source line. TEST the system for normal operation. → **No** GO to G6 .
G6 CHECK THE FUNCTION SELECTOR SWITCH VACUUM SOURCE LINE FOR LEAKS	
2  AM0342-A	1 Plug the function selector switch vacuum source line at the vacuum reservoir connection. 2 Leak test the function selector switch vacuum source line using the vacuum pump. • **Does the function selector switch vacuum source line leak?** → **Yes** REPAIR or INSTALL a new function selector switch vacuum source line. TEST the system for normal operation. → **No** INSTALL a new function selector switch (19B888). REFER to Section 412-04 . TEST the system for normal operation.
G7 CHECK THE FUNCTION SELECTOR SWITCH FOR BLOCKAGE	
1 Function Selector Switch Vacuum Harness 2	2 Connect a vacuum pump to the function selector switch vacuum supply port and try to pull a vacuum in each function selector switch position. If the vacuum pump can pull and hold a vacuum, the switch is plugged. If the

 GL1021-A	vacuum pump pulls a vacuum that slowly decays, the function selector switch is restricted. • **Is the function selector switch plugged or restricted?** → **Yes** INSTALL a new function selector switch (19B888). REFER to Section 412-04 . TEST the system for normal operation. → **No** GO to G8 .
G8 LEAK TEST THE FUNCTION SELECTOR SWITCH	
1  GL1021-A	1 Connect a vacuum pump to the function selector switch vacuum supply port and plug each control port. 2 At each function selector switch position apply 51 kPa (15 in-Hg) of vacuum. • **Does the vacuum drop exceed 3.37 kPa (1 in-Hg) per minute?** → **Yes** INSTALL a new function selector switch (19B888). REFER to Section 412-04 . TEST the system for normal operation. → **No** GO to G9 .
G9 CHECK THE VACUUM HOSE	
2	1 Disconnect the suspect hose. 2 Connect a vacuum pump to each hose and


AM0350-A

attempt to pull and hold a vacuum.

- **Does the vacuum drop in any hose exceed 3.37 kPa (1 in-Hg) per minute?**

→ **Yes**
GO to G10 .

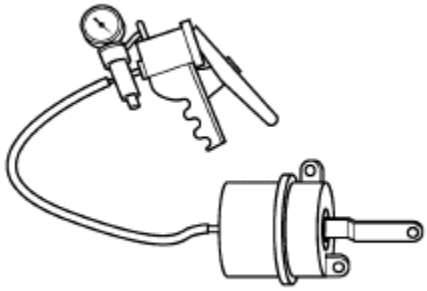
→ **No**
GO to G11 .

G10 CHECK THE VACUUM CONTROL MOTOR

1

Vacuum Control Motor

2


AL0136-A

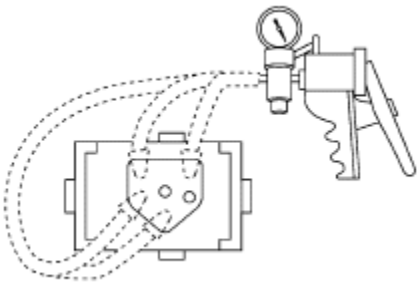
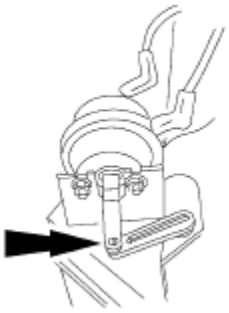
2 Connect a vacuum pump to the affected vacuum control motor. Apply 51 kPa (15 in-Hg) of vacuum.

- **Does the vacuum drop exceed 1.68 kPa (0.5 in-Hg) per minute?**

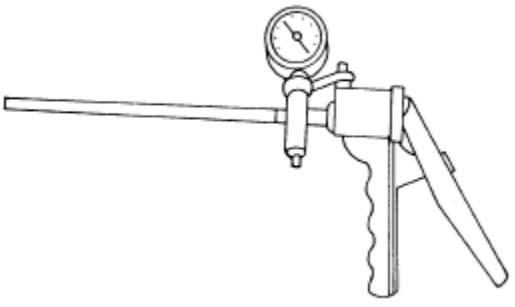
→ **Yes**
INSTALL a new vacuum control motor (18A318). REFER to Section 412-04 . TEST the system for normal operation.

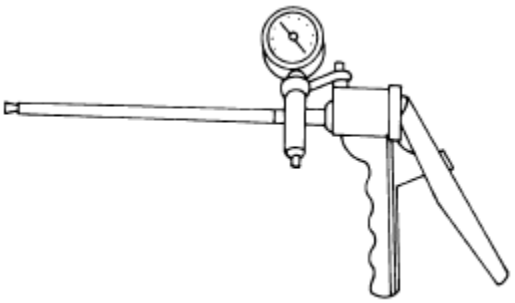
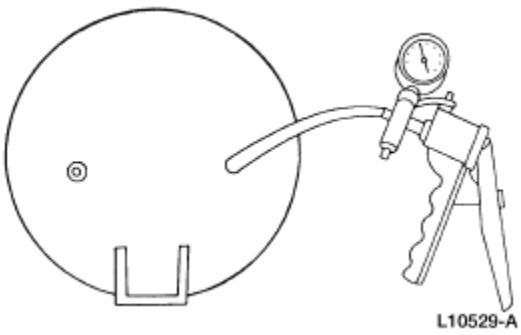
→ **No**
REPAIR or INSTALL a new vacuum harness (19C827). TEST the system for normal operation.

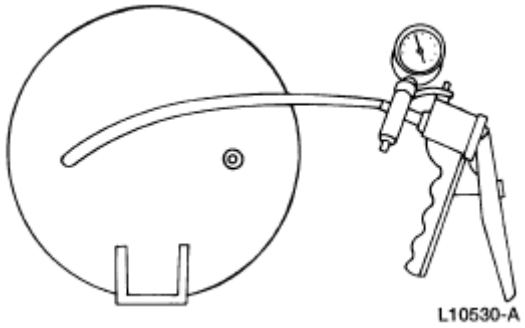
G11 CHECK THE VACUUM CONTROL MOTOR HOSES FOR BLOCKAGE

1 Vacuum Control Motors 2  AM0350-A	2 Connect a vacuum pump to each hose and try to pull a vacuum. If the vacuum pump can pull and hold a vacuum, the hose is plugged. If the vacuum pump pulls a vacuum that slowly decays, the hose is restricted. • **Is the hose plugged or restricted?** → **Yes** REPAIR or INSTALL a new vacuum harness (19C827). TEST the system for normal operation. → **No** GO to G12 .
G12 CHECK THE VACUUM CONTROL MOTOR INSTALLATION	
1  AL0158-A	1 Check the attachment of the vacuum control motor arm to the damper door. • **Is the vacuum control motor arm attached to the door or door crank arm?** → **Yes** REPAIR the damper door. TEST the system for normal operation. → **No** CONNECT the vacuum control motor arm to the door crank arm. TEST the system for normal operation.

PINPOINT TEST H: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLET — EATC

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE AIRFLOW IN EACH SETTING	
1 	2 Check the airflow in each manual override setting on the EATC module during engine idle and under acceleration. • **Is the airflow correct in each manual override setting?** → **Yes** The system is operating normally. → **No** If the airflow is from the defrost outlet only in all settings, GO to H2 . If the airflow is incorrect in one setting only, NOTE the non-functional setting. GO to H7 . If the airflow is incorrect in MAX only, GO to H11 .
H2 CHECK THE VACUUM RESERVOIR SUPPLY LINE FOR BLOCKAGE	
2  L10533-A	1 Disconnect the vacuum reservoir supply line at the vacuum reservoir and the vacuum source. 2 Connect the vacuum pump to the vacuum reservoir supply line and attempt to pull a vacuum. • **Can a vacuum be pulled on the vacuum reservoir supply line?** → **Yes** REPAIR or INSTALL a new vacuum reservoir supply line. TEST the system for normal operation.

	→ **No** GO to H3 .
H3 CHECK THE VACUUM RESERVOIR SUPPLY LINE FOR LEAKS	
2  L10528-A	1 Plug the vacuum reservoir supply line at the vacuum source connection. 2 Leak test the vacuum reservoir supply line using the vacuum pump. • **Does the vacuum reservoir line leak?** → **Yes** REPAIR or INSTALL a new vacuum reservoir line. TEST the system for normal operation. → **No** GO to H4 .
H4 CHECK THE VACUUM RESERVOIR FOR A LEAK	
NOTE: The reservoir has two vacuum hoses, these hoses are not interchangeable. The A/C check valve is built into the vacuum reservoir tank.	
2  L10529-A 3	1 Connect the vacuum pump to the vacuum reservoir. 2 With the vacuum pump connected to the vacuum reservoir, leak test the vacuum reservoir. 3 With the vacuum pump connected to the vacuum reservoir, leak test the vacuum reservoir.



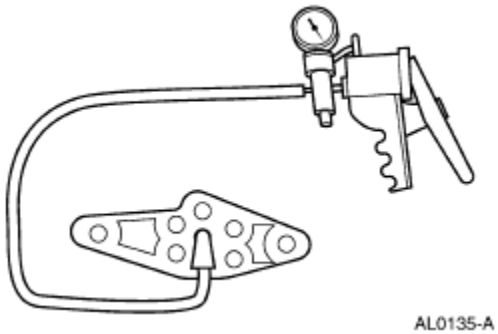
- **Does the vacuum reservoir leak?**

→ **Yes**
INSTALL a new vacuum reservoir. TEST the system for normal operation.

→ **No**
GO to H5 .

H5 CHECK THE EATC MODULE VACUUM SOURCE LINE FOR BLOCKAGE

2



1 Disconnect the EATC module vacuum connector.

2 Connect the vacuum pump to the EATC module vacuum source line and attempt to pull a vacuum.

- **Can a vacuum be pulled on the EATC module vacuum source line?**

→ **Yes**
REPAIR or INSTALL a new EATC module vacuum source line. TEST the system for normal operation.

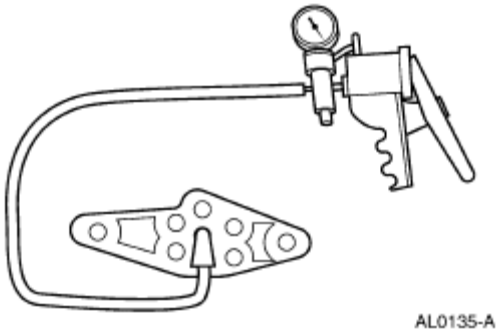
→ **No**
GO to H6 .

H6 CHECK THE EATC MODULE VACUUM SOURCE LINE FOR LEAKS

2

1 Plug the EATC module vacuum source line at the vacuum reservoir connection.

2 Leak test the EATC module vacuum source line using the vacuum pump.


AL0135-A

- **Does the EATC module vacuum source line leak?**

→ **Yes**
REPAIR or INSTALL a new EATC module vacuum source line. TEST the system for normal operation.

→ **No**
INSTALL a new EATC module (19980). TEST the system for normal operation.

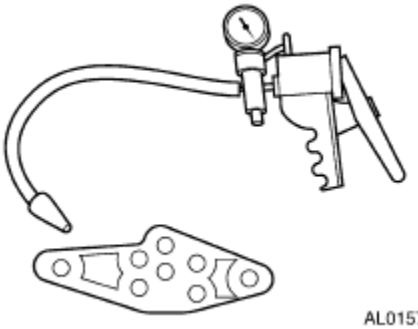
H7 CHECK THE VACUUM CONTROL MOTOR LINE FOR BLOCKAGE

1

2 Disconnect the EATC module vacuum connector.

3 Disconnect the vacuum line from the appropriate vacuum control motor noted in Step H1.

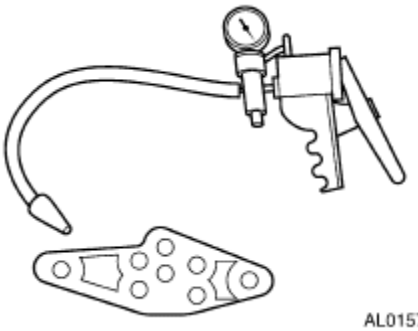
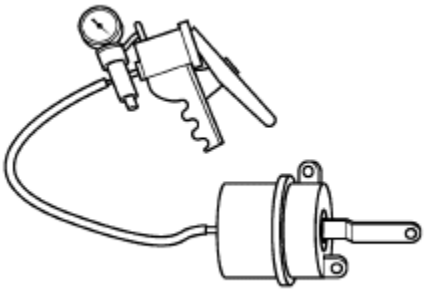
4

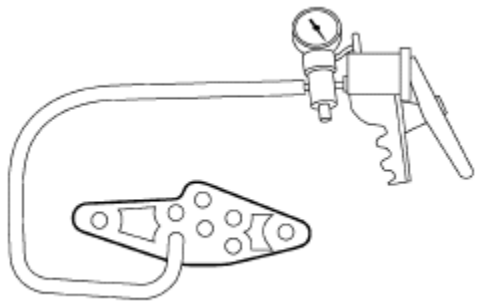

AL0157-A

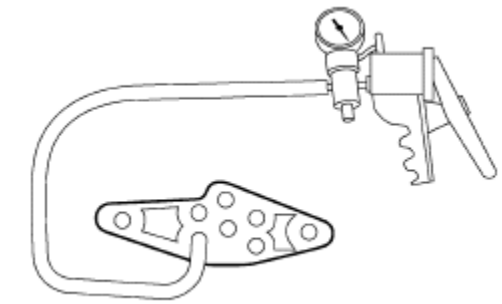
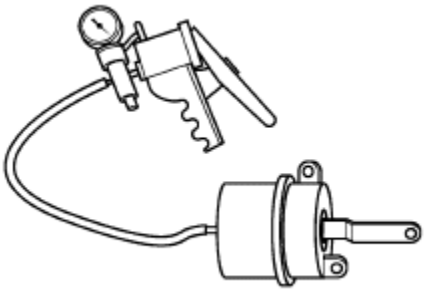
4 Connect the vacuum pump to the appropriate vacuum control motor line noted in Step H1, and attempt to pull a vacuum.

- **Can a vacuum be pulled on the vacuum control motor line?**

→ **Yes**
REPAIR or INSTALL a new plenum vacuum

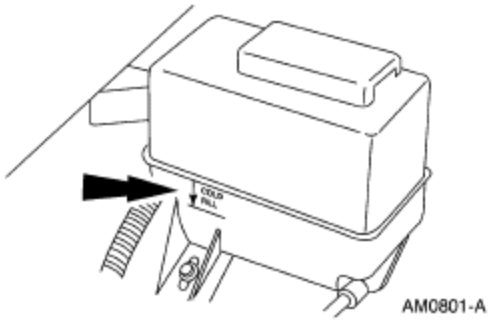
	harness (19C827). TEST the system for normal operation. → **No** GO to H8.
H8 CHECK THE VACUUM CONTROL MOTOR LINE FOR LEAKS	
2  AL0157-A	1 Plug the vacuum control motor line at the vacuum control motor connection. 2 Leak test the vacuum control motor line using the vacuum pump. • **Does the vacuum control motor line leak?** → **Yes** REPAIR or INSTALL a new vacuum harness. TEST the system for normal operation. → **No** GO to H9.
H9 CHECK THE VACUUM CONTROL MOTOR FOR LEAKS AND CORRECT OPERATION	
1  AL0136-A	1 Connect the vacuum pump to the appropriate vacuum control motor and pull a vacuum. • **Does the vacuum control motor operate and hold vacuum?** → **Yes** GO to H10. → **No**

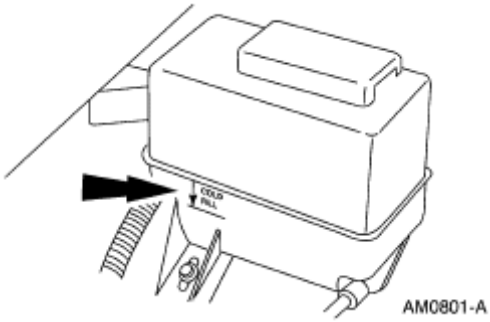
	INSTALL a new vacuum control motor (18A318). TEST the system for normal operation.
H10 CHECK THE MODE DOOR LINKAGE AND MOVEMENT	
	1 Inspect the mode door linkage and verify correct movement of the mode door. • **Is the mode door or mode door linkage broken, binding or otherwise obstructed?** → **Yes** REPAIR the mode door or mode door linkage as necessary. TEST the system for normal operation. → **No** INSTALL a new EATC module. TEST the system for normal operation.
H11 CHECK THE AIR INLET DOOR VACUUM CONTROL MOTOR LINE FOR BLOCKAGE	
1 3  A0036133	2 Disconnect the air inlet door vacuum control motor vacuum connector. 3 Disconnect the EATC module vacuum connector and attempt to pull a vacuum on the RECIRC vacuum control motor line using the vacuum pump. • **Can a vacuum be pulled on the air inlet door vacuum control motor line?** → **Yes** REPAIR or INSTALL a new plenum vacuum harness (19C827). TEST the system for normal operation. → **No** GO to H12 .
H12 CHECK THE AIR INLET DOOR VACUUM CONTROL MOTOR LINE FOR LEAKS	

2  A0036133	1 Plug the air inlet door vacuum control motor line at the RECIRC vacuum control motor connection. 2 Leak test the air inlet door vacuum control motor line using the vacuum pump. • **Does the air inlet door vacuum control motor line leak?** → **Yes** REPAIR or INSTALL a new vacuum harness (19C827). TEST the system for normal operation. → **No** GO to H13.
H13 CHECK THE AIR INLET DOOR VACUUM CONTROL MOTOR FOR LEAKS AND CORRECT OPERATION	
1  AL0136-A	1 Connect the vacuum pump to the air inlet door vacuum control motor and pull a vacuum. • **Does the air inlet door vacuum control motor operate and hold a vacuum?** → **Yes** GO to H14. → **No** INSTALL a new air inlet door vacuum control motor (18A318). TEST the system for normal operation.
H14 INSPECT THE AIR INLET DOOR LINKAGE AND MOVEMENT	

	1 Inspect the air inlet door linkage and verify correct movement of the door. • **Is the air inlet door or air inlet door linkage broken, binding or otherwise obstructed?** → **Yes** REPAIR the air inlet door or air inlet door linkage as needed. TEST the system for correct operation. → **No** INSTALL a new EATC module (19980). TEST the system for normal operation.

PINPOINT TEST I: INSUFFICIENT, ERRATIC OR NO HEAT

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CHECK FOR CORRECT ENGINE COOLANT LEVEL	
1 2  	2 Check the engine coolant level. • **Is the engine coolant at the correct level in the coolant reservoir?** → **Yes** GO to I3 . → **No** GO to I2 .
I2 CHECK COOLANT SYSTEM INCLUDING RADIATOR CAP FOR LEAKS	
1	1 Fill the coolant system to the specified "COLD FILL" level.



2 Pressure check the engine cooling system. Refer to Section 303-03 .

- **Does the engine cooling system, including the radiator cap, hold pressure?**

→ **Yes**
GO to I3 .

→ **No**
PRESSURE TEST the heater core.

I3 CHECK THE HEATER CORE INLET HOSE FOR HOT WATER

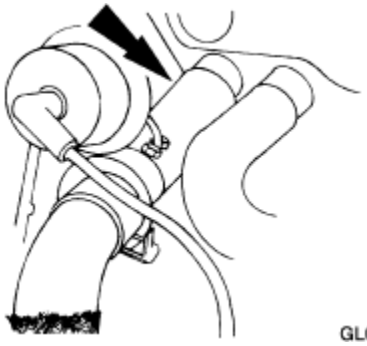
WARNING: The heater core inlet hose will become too hot to handle and can cause serious burns if the system is working correctly.

1

Ignition Start

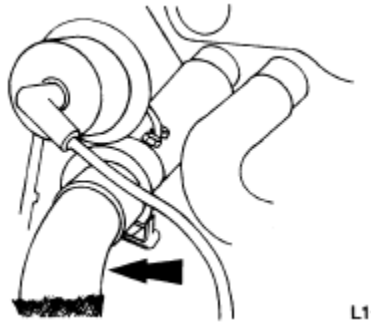
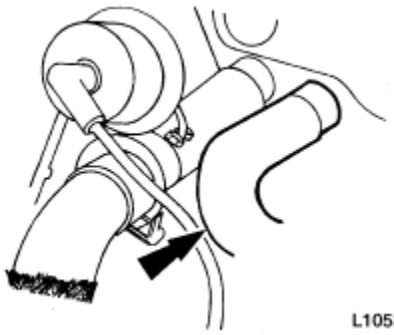
2 Run the engine until it reaches normal operation temperature. Select the FLOOR position on the control assembly. Set the temperature control to full WARM.

3



3 Feel the heater core inlet hose.

- **Is the heater core inlet hose hot?**

	→ **Yes** GO to I5 . → **No** GO to I4 .
I4 CHECK FOR HOT WATER TO THE HEATER CONTROL VALVE INLET HOSE	
1  L10536-A	1 Feel the heater control valve inlet hose. • **Is the heater control valve inlet hose too hot to handle?** → **Yes** GO to I6 . → **No** GO to Section 303-03 .
I5 CHECK THE HEATER CORE OUTLET HOSE	
1  L10537-A	1 Feel the heater core outlet hose. • **Is the heater core outlet hose hot?** → **Yes** GO to Pinpoint Test L (Manual A/C). GO to DTC B1249 (EATC). → **No** TEST the heater core for a plugged or partial-plugged condition.
I6 CHECK VACUUM SUPPLY TO THE HEATER CONTROL VALVE	

	1 Disconnect the heater control valve vacuum supply hose at the heater control valve. 2 Check for presence of vacuum at the heater control valve vacuum supply hose connector. • **Is there vacuum present?** → **Yes** GO to I7 . → **No** INSTALL a new heater control valve. TEST the system for normal operation.
I7 CHECK FOR INCORRECT VACUUM LINE PLACEMENT	
1	2 Inspect the heater control valve and A/C vacuum lines for correct placement. • **Is the vacuum line placement correct?** → **Yes** INSTALL a new climate control assembly. REFER to Section 412-04 . TEST the system for normal operation. → **No** CORRECT the vacuum line placement. TEST the system for normal operation.

PINPOINT TEST J: THE A/C DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY — MANUAL A/C

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK PID WACF WITH A/C OFF	
NOTE: When PCM PID WACF is YES, this is the same fault as DTC P1460.	
1	1 Turn the function selector switch to the OFF position.

AM0577-A

2

3

PCM PID WACF

- **Does the PCM PID WACF read YES?**

→ **Yes**
REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis.

→ **No**
GO to J2 .

J2 CHECK PID WACF WITH A/C ON

NOTE: When PCM PID WACF is YES, this is the same fault as DTC P1460.

2

AM0576-A

3

1 Start the engine and run at idle.

2 Turn the function selector switch to the A/C position.

PCM PID WACF	• **Does the PCM PID WACF read YES?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis. → **No** GO to J3 .
J3 CHECK PID ACCS WITH A/C ON	
2 AM0576-A 3 PCM PID ACCS	1 Make sure the engine is at idle. 2 Turn the function selector switch to the A/C position. • **Does the PCM PID ACCS read ON?** → **Yes** GO to J4 . → **No** GO to J6 .
J4 CHECK PID ACP WITH A/C ON	
NOTE: Diagnosis for vehicles equipped with 4.0L engines do not contain the PCM PID ACP.	
2	1 If equipped with 5.0L engine, make sure the engine is at idle. 2 If equipped with 5.0L engine, turn the function selector switch to the A/C position.

AM0576-A

3

PCM PID ACP 5.0L Engine

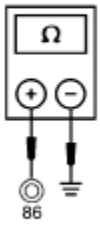
4

4.0L Engine (if equipped)

5 If equipped with 4.0L engine, connect the Rotunda EEC V 104-Pin Breakout Box.

6 If equipped with 4.0L engine, measure the resistance to ground at breakout box pin 86.

6



AM0951-A

- **If equipped with 5.0 engine, does the PCM PID ACP read CLOSED?**

  If equipped with 4.0L engine, is the resistance less than 5 ohms (4.0L)?

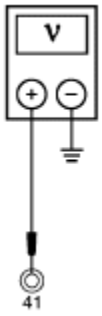
→ **Yes**
GO to J5 .

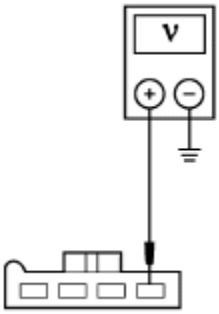
→ **No**
GO to J15 .

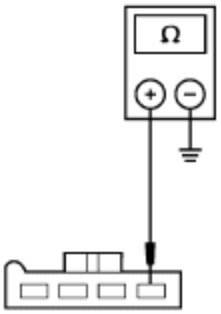
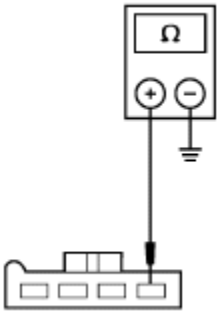
J5 CHECK PID WAC WITH A/C ON

1

 2 AM0576-A 3 PCM PID WAC	2 Turn the function selector switch to the A/C position. • **Does the PID WAC read ON?** → **Yes** GO to J23 . → **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis.
J6 CHECK THE INPUT SIGNAL TO THE PCM	
NOTE: Do not directly probe the PCM wire harness connector.	
1 2 PCM C202 4	3 Connect the Rotunda EEC-V 104-Pin Breakout Box to the wire harness connector C202. Do not connect the breakout box to the PCM.

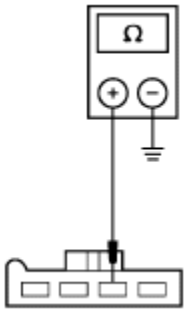
 5	5 Turn the function selector switch to the A/C position.
  AM0576-A	
6  AM0584-A	6 Measure the voltage at the breakout box pin 41, circuit 348 (VT).
	• **Is the voltage reading B+?** → **Yes** INSTALL a new powertrain control module. REFER to Section 303-14 . TEST the system for normal operation. → **No** GO to J7 .
J7 CHECK THE SUPPLY TO THE FUNCTION SELECTOR SWITCH	
1 2 Function Selector Switch C231 3	

 4  AM0585-A	4 Measure the voltage at the function selector switch connector pin C231, circuit 1003 (GY/YE). • **Is the voltage reading B+?** → **Yes** GO to J13 . → **No** GO to J8 .
J8 CHECK FUSE 10 (7.5A)	
1 2 Fuse Junction Panel Fuse 10 (7.5A) 3 Fuse Junction Panel Fuse 10 (7.5A)	• **Is fuse 10 (7.5A) OK?** → **Yes** REPAIR circuit 1003 (GY/YE) for an open. TEST the system for normal operation. → **No** GO to J9 .
J9 CHECK CIRCUIT 1003 (GY/YE) FOR A SHORT TO GROUND	

1  AM0586-A	1 Measure the resistance between the function selector switch connector pin C231, circuit 1003 (GY/YE) and ground. • **Is the resistance reading 10,000 ohms or less?** → **Yes** GO to J10 . → **No** GO to J11 .
J10 CHECK THE BLEND DOOR ACTUATOR	
1 Blend Door Actuator C270 2  AM0586-A	2 Measure the resistance between the function selector switch connector pin C231, circuit 1003 (GY/YE) and ground. • **Is the resistance reading 10,000 ohms or less?** → **Yes** REPAIR circuit 1003 (GY/YE) for a short to ground. TEST the system for normal operation. → **No** INSTALL a new A/C electronic door actuator motor (19E616). REFER to Section 412-04 . TEST the system for normal operation.

J11 CHECK CIRCUIT 348 (VT) FOR A SHORT TO GROUND

1



AM0587-A

1 Measure the resistance between the function selector switch connector pin C231, circuit 348 (VT) and ground.

- **Is the resistance reading 10,000 ohms or less?**

→ **Yes**
REPAIR circuit 348 (VT) for a short to ground. TEST the system for normal operation.

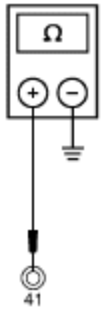
→ **No**
GO to J12 .

J12 CHECK FOR A SHORTED FUNCTION SELECTOR SWITCH

1

Function Selector Switch C231

2



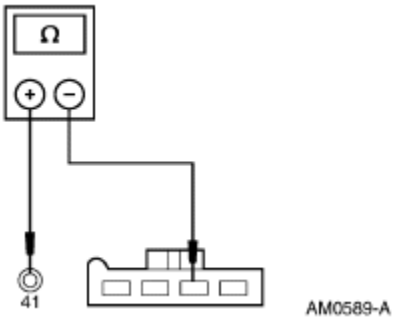
AM0588-A

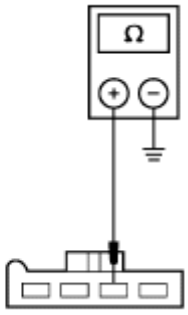
2 **NOTE:** Make sure fuse 10 (7.5A) is still removed.

Measure the resistance between the breakout box pin 41, circuit 348 (VT) and ground.

3 Turn the function selector switch to each of the following positions and note the resistance reading.

- MAX A/C
- A/C
- PNL/FLR
- FLR/DEF
- DEF

	• **Are any of the resistance readings 10,000 ohms or less?** → **Yes** INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation. → **No** INSTALL a new fuse 10 (7.5A). TEST the system for normal operation. If fuse 10 (7.5A) opens again, INSTALL a new powertrain control module. REFER to Section 303-14 . TEST the system for normal operation.
J13 CHECK CIRCUIT 348 (VT) FOR AN OPEN	
1 2 	2 Measure the resistance of circuit 348 (VT) between the PCM breakout box pin 41 and the function selector switch connector pin C231. • **Is the resistance reading 5 ohms or less?** → **Yes** GO to J14 . → **No** REPAIR circuit 348 (VT) for an open. TEST the system for normal operation.
J14 CHECK FOR A SHORTED INPUT	
1	1 Measure the resistance between the function selector switch connector pin C231, circuit 348 (VT) and ground.



- **Is the resistance reading 10,000 ohms or less?**

→ **Yes**
REPAIR circuit 348 (VT) for a short to ground. TEST the system for normal operation.

→ **No**
INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation.

J15 CHECK THE REFRIGERANT SYSTEM PRESSURE

1

2 Connect the manifold set to the service ports. Refer to Manifold Gauge Set Connection in this section.

- **Is the pressure between 345 kPa (50 psi) and 1,724 kPa (250 psi)?**

→ **Yes**
GO to J16 .

→ **No**
CHECK the system for refrigerant system leaks. REFER to Leak Detection—Using Refrigerant Leak Detector or Leak Detection—Using Tracer Dye in this section.

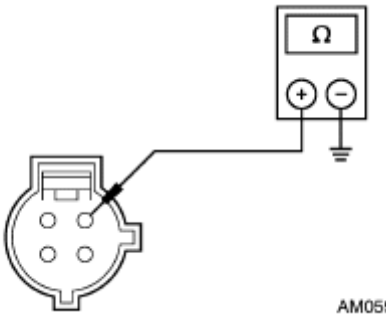
J16 CHECK CIRCUIT 570 (BK/WH)

1

A/C Pressure Cut-Off Switch C195

2

2 Measure the resistance between the A/C



pressure cut-off switch connector C195, circuit 570 (BK/WH) and ground.

- **Is the resistance reading 5 ohms or less?**

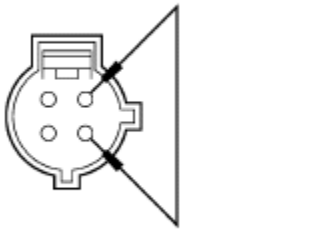
→ **Yes**
GO to J17 .

→ **No**
REPAIR circuit 570 (BK/WH) for an open.
TEST the system for normal operation.

J17 CHECK THE A/C PRESSURE CUT-OFF SWITCH

NOTE: Diagnostics for vehicles with 4.0L engines do not contain the PCM PID ACP.

1



2

5.0L Engine

3

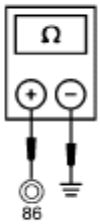
PCM PID ACP 5.0L Engine

5

1 Connect a jumper wire across the A/C pressure switch connector C195, circuit 570 (BK/WH) and circuit 441 (RD/YE).

4 If equipped with 4.0L engine, connect the Rotunda EEC-V 104-Pin Breakout Box.

5 If equipped with 4.0L engine, measure the resistance to ground of breakout box pin 86.



AM0951-A

- **If equipped with 5.0L engine, does the PID ACP read CLOSED?**

  If equipped with 4.0L engine, is the resistance less than 5 ohms?

→ **Yes**
INSTALL a new A/C pressure cut-off switch (19D594). REFER to Section 412-03 . TEST the system for normal operation.

→ **No**
GO to J18 .

J18 CHECK THE A/C CYCLING SWITCH

NOTE: Diagnostics for vehicles with 4.0L engines do not contain the PCM PID ACP.

1

2

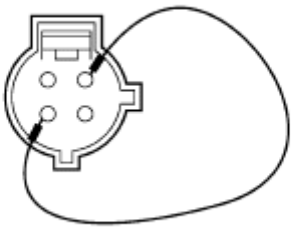
A/C Pressure Cut-Off Switch C195

3

A/C Cycling Switch C151

4

4 Connect a jumper wire across the A/C cycling switch connector C151, circuit 347 (BK/YE) and circuit 441 (RD/YE).



AL0112-A

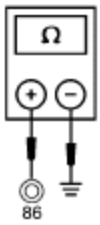
5

5.0L Engine

6

PCM PID ACP 5.0L Engine

7



AM0951-A

7 If equipped with 4.0L engine, measure the resistance to ground of breakout box pin 86.

- **If equipped with 5.0L engine, does the PID ACP read CLOSED?**

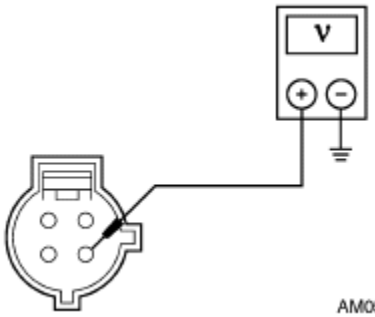
  If equipped with 4.0L engine, is the resistance less than 5 ohms?

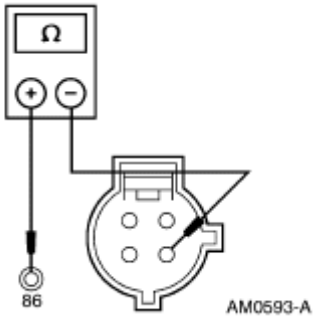
→ **Yes**
INSTALL a new A/C cycling switch (19E561). REFER to Section 412-03 . TEST the system for normal operation.

→ **No**
GO to J19 .

J19 CHECK CIRCUIT 347 (BK/YE) FOR A SHORT TO B+

1

 2 PCM C202 3 4  AM0592-A	4 Measure for voltage at the A/C cycling switch connector C151, circuit 347 (BK/YE). • **Is voltage present?** → **Yes** REPAIR circuit 347 (BK/YE) for a short to B+. TEST the system for normal operation. → **No** GO to J20 .
J20 CHECK CIRCUIT 347 (BK/YE) FOR AN OPEN	
NOTE: Do not directly probe the PCM wire harness connector.	
1 3	2 Connect the Rotunda EEC-V 104-Pin Breakout Box. 3 Measure the resistance of circuit 347 (BK/YE) between the breakout box pin 86 and the A/C cycling switch Connector C151.



- **Is the resistance reading 5 ohms or less?**

→ **Yes**
GO to J21 .

→ **No**
REPAIR circuit 347 (BK/YE) for an open. TEST the system for normal operation.

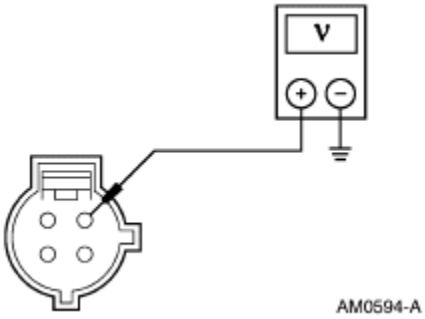
J21 CHECK CIRCUITY 441 (RD/YE) FOR A SHORT TO B+

1

A/C Pressure Cut-Off Switch C195

2

3

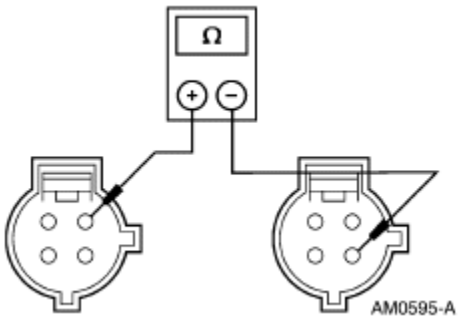


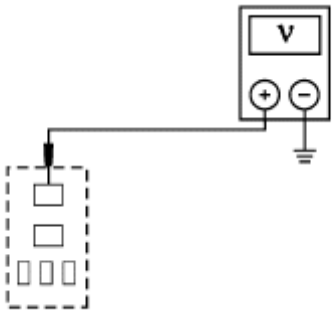
3 Measure for voltage at the A/C cycling switch connector C151, circuit 441 (RD/YE).

- **Is voltage present?**

→ **Yes**
REPAIR circuit 441 (RD/YE) for a short to B+. TEST the system for normal operation.

→ **No**

	GO to J22 .
J22 CHECK CIRCUIT 441 (RD/YE) FOR AN OPEN	
1 2  	2 Measure the resistance of circuit 441 (RD/YE) between the A/C cycling switch connector C151 and the A/C pressure cut-off switch connector C195. • **Is the resistance reading 5 ohms or less?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. → **No** REPAIR circuit 441 (RD/YE) for an open. TEST the system for normal operation.
J23 CHECK THE INPUT TO THE A/C CLUTCH RELAY	
1 3 4	2 Remove the A/C clutch relay from the power distribution box. 4 Measure the voltage at the A/C clutch relay connector pin 3, circuit 883 (PK/LB).



- **Is the voltage reading B+?**

→ **Yes**
GO to J27.

→ **No**
GO to J24.

J24 CHECK THE A/C FUSE

1

2

Power Distribution Box A/C Fuse (10A)

3

Power Distribution Box A/C Fuse (10A)

- **Is the A/C fuse (10A) OK?**

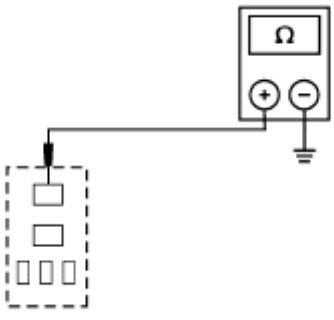
→ **Yes**
REPAIR circuit 883 (PK/LB) for an open. TEST the system for normal operation.

→ **No**
GO to J25.

J25 CHECK CIRCUIT 883 (PK/LB) FOR A SHORT TO GROUND

1

1 Measure the resistance between the A/C clutch relay connector pin 3, circuit 883 (PK/LB) and ground.



- **Is the resistance reading 10,000 ohms or less?**

→ **Yes**
REPAIR circuit 883 (PK/LB) for a short to ground. TEST the system for normal operation.

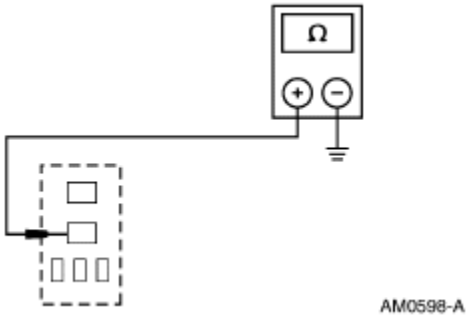
→ **No**
GO to J26 .

J26 CHECK CIRCUIT 321 (GY/WH) FOR A SHORT TO GROUND

1

A/C Clutch C152

2



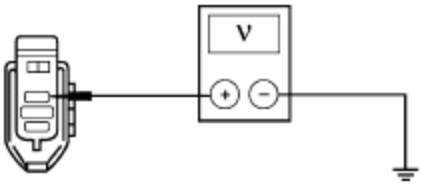
2 Measure the resistance between the A/C clutch relay connector pin 5, circuit 321 (GY/WH) and ground.

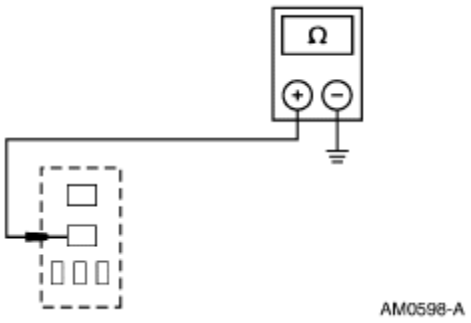
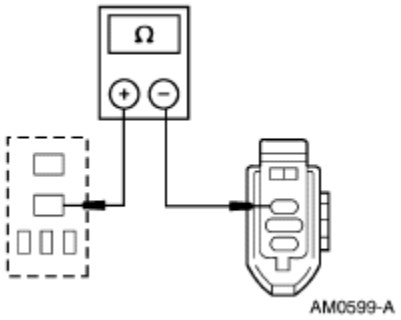
- **Is the resistance reading 10,000 ohms or less?**

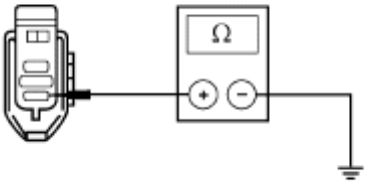
→ **Yes**
REPAIR circuit 321 (GY/WH) for a short to ground. TEST the system for normal operation.

→ **No**
INSTALL a new A/C clutch field coil (2987). REFER to Section 412-03 . TEST the system for normal operation.

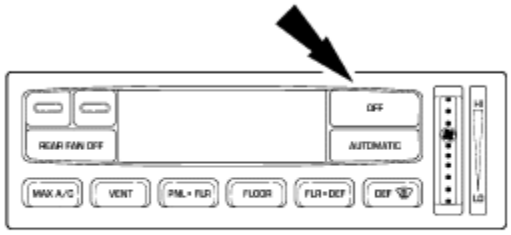
J27 CHECK THE A/C CLUTCH INPUT

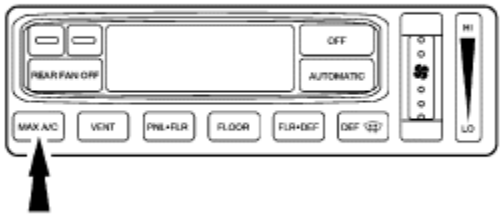
1   2 Install the A/C clutch relay in the power distribution box. 3   A/C Clutch C152 4   5   5 In Active Command Mode, command the PCM outputs ON. 6  GL0225-A 6 Measure for voltage at the A/C clutch connector C152, circuit 321 (GY/WH). 7 Command the PCM outputs OFF. • **Is the voltage reading B+?** → **Yes** GO to J30 . → **No** GO to J28 .
J28 CHECK FOR A SHORTED OUTPUT	
1 2 Remove the A/C clutch relay from the power distribution box.	

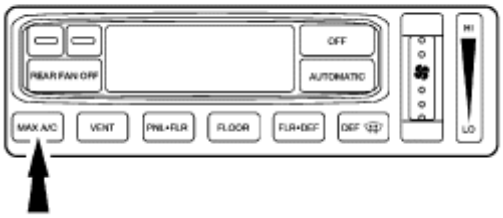
3  	3 Measure the resistance between the A/C clutch relay connector pin 5, circuit 321 (GY/WH) and ground. • **Is the resistance reading 10,000 ohms or less?** → **Yes** REPAIR circuit 321 (GY/WH) for a short to ground. TEST the system for normal operation. → **No** GO to J29 .
J29 CHECK CIRCUIT 321 (GY/WH) FOR AN OPEN	
1  	1 Measure the resistance of circuit 321 (GY/WH) between the A/C clutch relay connector pin 5 and the A/C clutch connector C152. • **Is the resistance reading 5 ohms or less?** → **Yes** INSTALL a new A/C clutch relay. TEST the system for normal operation. → **No** REPAIR circuit 321 (GY/WH) for an open. TEST the system for normal operation.
J30 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1	1 Measure the resistance between the A/C clutch connector C152, circuit 57 (BK) and ground.

 GL0227-A	• **Is the resistance reading 5 ohms or less?** → **Yes** INSTALL a new A/C clutch field coil. REFER to Section 412-03 . TEST the system for normal operation. → **No** REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.

PINPOINT TEST K: THE A/C DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY — EATC

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK PID WACF WITH A/C OFF	
NOTE: When PCM PID WACF is YES, this is the same fault as DTC P1460.	
1 2  AM0852-B 3 PCM PID WACF	2 Press the OFF button on the electronic automatic temperature control module.

	• **Does the PCM PID WACF read YES?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis. → **No** GO to K2 .
K2 CHECK PID WACF WITH A/C ON	
NOTE: When PCM PID WACF is YES, this is the same fault as DTC P1460.	
2  GL1257-B 3 PCM PID WACF	1 Start the engine and run at idle. 2 Press the EATC MAX A/C button. • **Does the PCM PID WACF read YES?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis. → **No** GO to K3 .
K3 CHECK PID ACCS WITH A/C ON	
2	1 Make sure the engine is at idle. 2 Press the EATC MAX A/C button.



GL1257-B

3

PCM PID ACCS

- **Does the PCM PID ACCS read ON?**

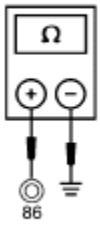
→ **Yes**
GO to K4 .

→ **No**
GO to K6 .

K4 CHECK A/C PRESSURE SWITCH CIRCUIT

1

3



AM0951-A

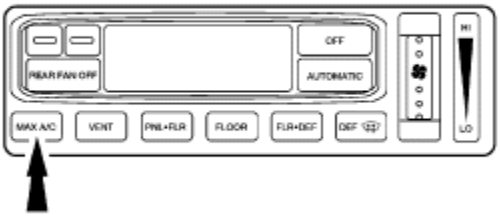
2 Connect the Rotunda EEC-V 104-Pin Breakout Box.

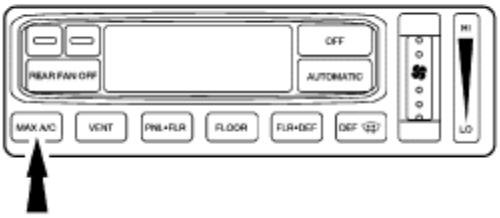
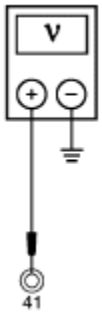
3 Measure the resistance to ground of breakout box pin 86.

- **Is the resistance less than 5 ohms?**

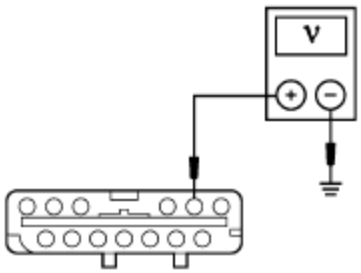
→ **Yes**
GO to K5 .

→ **No**

	GO to K13 .
K5 CHECK PID WAC WITH A/C ON	
1 2  GL1257-B 3 PCM PID WAC	2 Press the EATC MAX A/C button. • **Does the PID WAC read ON?** → **Yes** GO to K21 . → **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis.
K6 CHECK THE INPUT SIGNAL TO THE PCM	
NOTE: Do not directly probe the PCM wire harness connector.	
1 2 PCM C202	3 Connect the Rotunda EEC-V 104-Pin Breakout Box to the wire harness connector C202. Do not connect the breakout box to the PCM.

4 5  GL1257-B 6  AM0584-A	5 Press the EATC MAX A/C button. 6 Measure the voltage at the breakout box pin 41, circuit 348 (VT). • **Is the voltage reading B+?** → **Yes** INSTALL a new powertrain control module. REFER to Section 303-14 . TEST the system for normal operation. → **No** GO to K7 .
K7 CHECK THE SUPPLY TO THE EATC MODULE	
1 2 EATC Module C298 3	

4



AM0857-A

4 Measure the voltage at the EATC module connector C298 pin 16, circuit 364 (BK/LG).

- **Is the voltage reading B+?**

→ **Yes**
GO to K11 .

→ **No**
GO to K8 .

K8 CHECK FUSE 2 (7.5A)

1

2

Fuse Junction Panel Fuse 2 (7.5A)

3

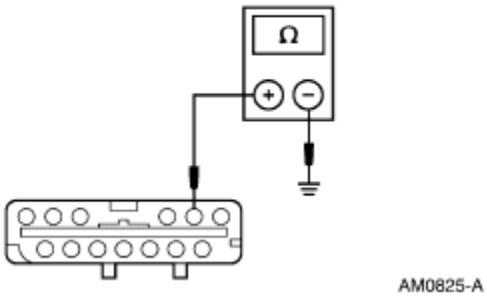
Fuse Junction Panel Fuse 2 (7.5A)

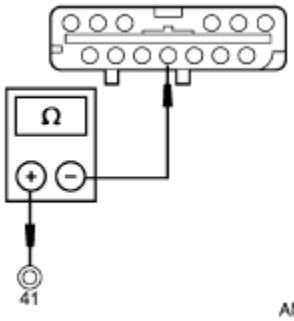
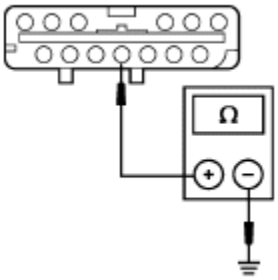
- **Is fuse 2 (7.5A) OK?**

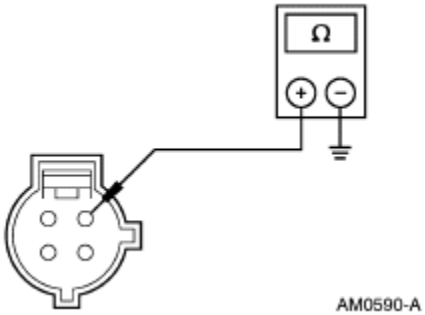
→ **Yes**
REPAIR circuit 364 (BK/LG) for an open. TEST the system for normal operation.

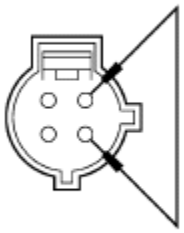
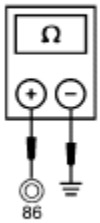
→ **No**
GO to K9 .

K9 CHECK CIRCUIT 364 (BK/LG) FOR A SHORT TO GROUND

1  	1 Measure the resistance between the EATC module connector C298 pin 16, circuit 364 (BK/LG) and ground. • **Is the resistance reading 100 ohms or less?** → **Yes** REPAIR circuit 364 (BK/LG) for a short to ground. TEST the system for normal operation. → **No** GO to K10 .
K10 CHECK THE AIR BAG DIAGNOSTIC MODULE	
1 Fuse Junction Panel Fuse 2 (7.5A) 2 3 4 Fuse Junction Panel Fuse 2 (7.5A) 5 Fuse Junction Panel Fuse 2 (7.5A)	• **Is fuse 2 (7.5A) OK?**

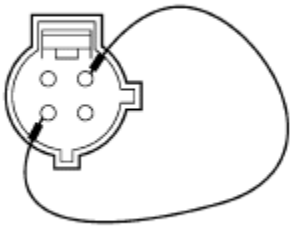
	→ **Yes** INSTALL a new EATC module. TEST the system for normal operation. → **No** GO to Section 501-20B .
K11 CHECK CIRCUIT 348 (VT) FOR AN OPEN	
1 2  AM0826-A	2 Measure the resistance of circuit 348 (VT) between the breakout box pin 41 and the EATC module connector C297 pin 11. • **Is the resistance reading 5 ohms or less?** → **Yes** GO to K12 . → **No** REPAIR circuit 348 (VT) for an open. TEST the system for normal operation.
K12 CHECK FOR A SHORTED INPUT	
1  AM0824-A	1 Measure the resistance between the EATC module connector C297 pin 11, circuit 348 (VT) and ground. • **Is the resistance reading 10,000 ohms or less?**

	→ **Yes** REPAIR circuit 348 (VT) for a short to ground. TEST the system for normal operation. → **No** INSTALL a new EATC module. REFER to Control Assembly — Electronic Automatic Temperature Control in Section 412-04. TEST the system for normal operation.
K13 CHECK THE REFRIGERANT SYSTEM PRESSURE	
1 	2 Connect the manifold set to the service ports. Refer to Manifold Gauge Set Connection in this section. • **Is the pressure between 345 kPa (50 psi) and 1,724 kPa (250 psi)?** → **Yes** GO to K14. → **No** CHECK the system for refrigerant leaks. REFER to Leak Detection—Using Refrigerant Leak Detector or Leak Detection—Using Tracer Dye in this section.
K14 CHECK CIRCUIT 570 (BK/WH)	
1 A/C Pressure Cut-Off Switch C195 2  	2 Measure the resistance between the A/C pressure cut-off switch connector C195, circuit 570 (BK/WH) and ground. • **Is the resistance reading 5 ohms or less?**

	→ **Yes** GO to K15 . → **No** REPAIR circuit 570 (BK/WH) for an open. TEST the system for normal operation.
K15 CHECK THE A/C PRESSURE CUT-OFF SWITCH	
1  AM0591-A	1 Connect a jumper wire across the A/C pressure switch connector C195, circuit 570 (BK/WH) and circuit 441 (RD/YE).
	2 Connect the Rotunda EEC-V 104-Pin Breakout Box.
3  AM0951-A	3 Measure the resistance to ground of breakout box pin 86.
	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new A/C pressure cut-off switch. REFER to Section 412-03 . TEST the system for normal operation. → **No** GO to K16 .
K16 CHECK THE A/C CYCLING SWITCH	
1 A/C Pressure Cut-Off Switch C195 2	

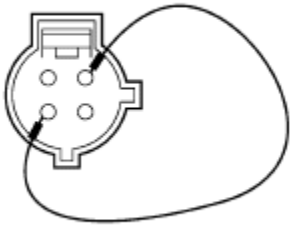
A/C Cycling Switch C151

3



AL0112-A

4



AL0112-A

3 Connect a jumper wire across the A/C cycling switch connector C151, circuit 347 (BK/YE) and circuit 441 (RD/YE).

4 Measure the resistance to ground of breakout box pin 86.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new A/C cycling switch. REFER to Section 412-03 . TEST the system for normal operation.

→ **No**
GO to K17 .

K17 CHECK CIRCUIT 347 (BK/YE) FOR A SHORT TO B+

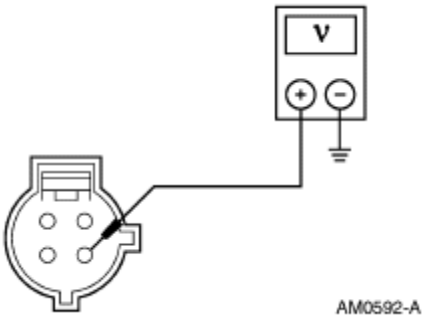
1

2

PCM C202

3

4



4 Measure for voltage at the A/C cycling switch connector C151, circuit 347 (BK/YE).

- **Is voltage present?**

→ **Yes**
REPAIR circuit 347 (BK/YE) for a short to B+.
TEST the system for normal operation.

→ **No**
GO to K18 .

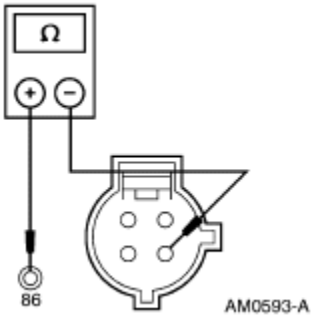
K18 CHECK CIRCUIT 347 (BK/YE) FOR AN OPEN

NOTE: Do not directly probe the PCM wire harness connector.

1

2 Connect the Rotunda EEC-V 104-Pin Breakout Box.

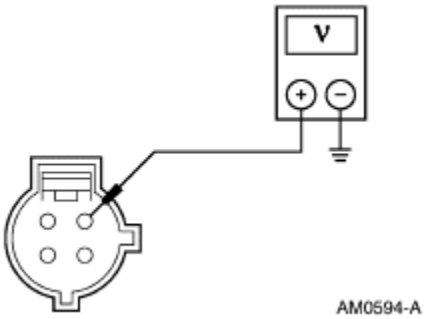
3

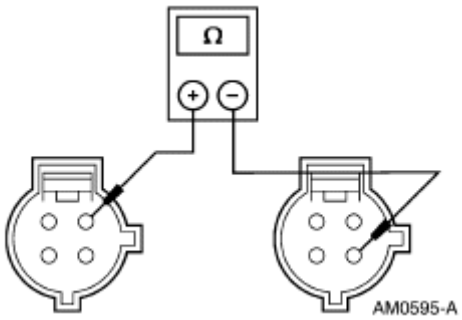


3 Measure the resistance of circuit 347 (BK/YE) between the breakout box pin 86 and the A/C cycling switch connector C151.

- **Is the resistance reading 5 ohms or less?**

→ **Yes**
GO to K19 .

	→ **No** REPAIR circuit 347 (BK/YE) for an open. TEST the system for normal operation.
K19 CHECK CIRCUITY 441 (RD/YE) FOR A SHORT TO B+	
1 A/C Pressure Cut-Off Switch C195 2 3  AM0594-A	3 Measure for voltage at the A/C cycling switch connector C151, circuit 441 (RD/YE). • **Is voltage present?** → **Yes** REPAIR circuit 441 (RD/YE) for a short to B+. TEST the system for normal operation. → **No** GO to K20 .
K20 CHECK CIRCUIT 441 (RD/YE) FOR AN OPEN	
1 2	2 Measure the resistance of circuit 441 (RD/YE) between the A/C cycling switch connector C151 and the A/C pressure cut-off switch connector C195.



- **Is the resistance reading 5 ohms or less?**

→ **Yes**
REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis.

→ **No**
REPAIR circuit 441 (RD/YE) for an open. TEST the system for normal operation.

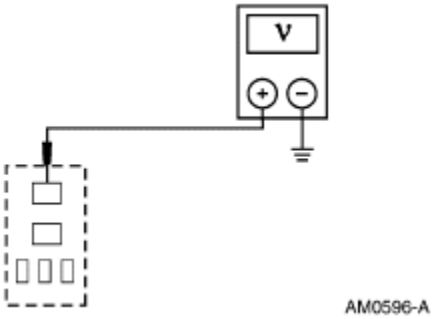
K21 CHECK THE INPUT TO THE A/C CLUTCH RELAY

1

2 Remove the A/C clutch relay from the power distribution box.

3

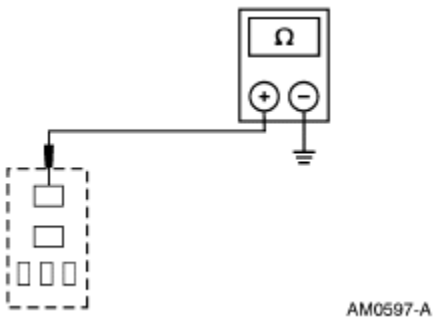
4

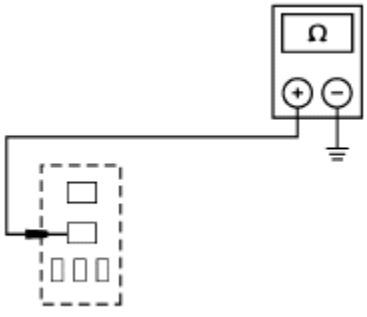


4 Measure the voltage at the A/C clutch relay connector pin 3, circuit 883 (PK/LB).

- **Is the voltage reading B+?**

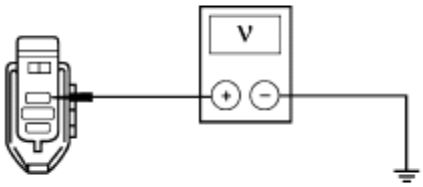
→ **Yes**

	GO to K25 . → **No** GO to K22 .
K22 CHECK THE A/C FUSE	
1 2 Power Distribution Box A/C Fuse (10A) 3 Power Distribution Box A/C Fuse (10A)	• **Is the A/C fuse (10A) OK?** → **Yes** REPAIR circuit 883 (PK/LB) for an open. TEST the system for normal operation. → **No** GO to K23 .
K23 CHECK CIRCUIT 883 (PK/LB) FOR A SHORT TO GROUND	
1  AM0597-A	1 Measure the resistance between the A/C clutch relay connector pin 3, circuit 883 (PK/LB) and ground. • **Is the resistance reading 10,000 ohms or less?** → **Yes** REPAIR circuit 883 (PK/LB) for a short to ground. TEST the system for normal operation.

	→ **No** GO to K24 .
K24 CHECK CIRCUIT 321 (GY/WH) FOR A SHORT TO GROUND	
1 A/C Clutch C152 2  AM0598-A	2 Measure the resistance between the A/C clutch relay connector pin 5, circuit 321 (GY/WH) and ground. • **Is the resistance reading 10,000 ohms or less?** → **Yes** REPAIR circuit 321 (GY/WH) for a short to ground. TEST the system for normal operation. → **No** INSTALL a new A/C clutch field coil. REFER to Section 412-03 . TEST the system for normal operation.
K25 CHECK THE A/C CLUTCH INPUT	
1 3 A/C Clutch C152 4 	2 Install the A/C clutch relay in the power distribution box.

5

6



GL0225-A

5 In Active Command Mode, command the PCM outputs ON.

6 Measure for voltage at the A/C clutch connector C152, circuit 321 (GY/WH).

7 Command the PCM outputs OFF.

- **Is the voltage reading B+?**

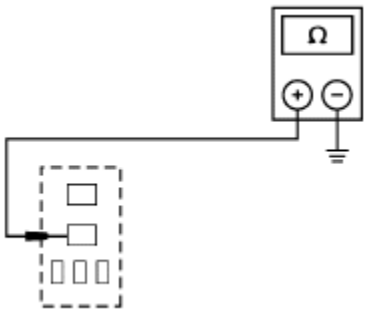
→ **Yes**
GO to K28 .

→ **No**
GO to K26 .

K26 CHECK FOR A SHORTED OUTPUT

1

3



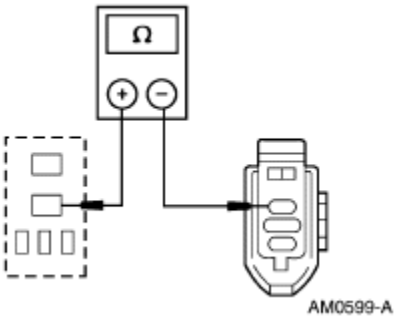
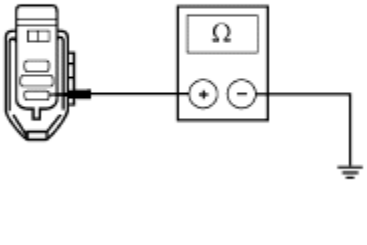
AM0598-A

2 Remove the A/C clutch relay from the power distribution box.

3 Measure the resistance between the A/C clutch relay connector pin 5, circuit 321 (GY/WH) and ground.

- **Is the resistance reading 10,000 ohms or less?**

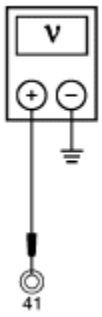
→ **Yes**
REPAIR circuit 321 (GY/WH) for a short to

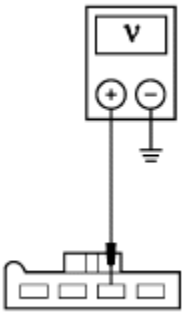
	ground. TEST the system for normal operation. → **No** GO to K27 .
K27 CHECK CIRCUIT 321 (GY/WH) FOR AN OPEN	
1  AM0599-A	1 Measure the resistance of circuit 321 (GY/WH) between the A/C clutch relay connector pin 5 and the A/C clutch connector C152. • **Is the resistance reading 5 ohms or less?** → **Yes** INSTALL a new A/C clutch relay. TEST the system for normal operation. → **No** REPAIR circuit 321 (GY/WH) for an open. TEST the system for normal operation.
K28 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  GL0227-A	1 Measure the resistance between the A/C clutch connector C152, circuit 57 (BK) and ground. • **Is the resistance reading 5 ohms or less?** → **Yes** INSTALL a new A/C clutch field coil. REFER to Section 412-03 . TEST the system for normal operation. → **No** REPAIR circuit 57 (BK) for an open. TEST the

	system for normal operation.

PINPOINT TEST L: THE A/C IS ALWAYS ON — MANUAL A/C

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK PID WACF WITH THE A/C OFF	
1 AM0577-A 2 3 PCM PID WACF	1 Turn the function selector switch to the OFF position. • **Does the PCM PID WACF read YES?** → **Yes** REPAIR circuit 331 (PK/YE) for a short to ground. TEST the system for normal operation. → **No** GO to L2.
L2 CHECK PID ACCS WITH A/C OFF	
1 PCM PID ACCS	• **Does the PCM PID ACCS read ON?** → **Yes** GO to L3.

	→ **No** GO to L5 .
L3 CHECK FOR A FALSE INPUT SIGNAL TO THE PCM	
NOTE: Do not directly probe the PCM wire harness connector.	
1 	
2 PCM C111	
	3 Connect the Rotunda EEC-V 104-Pin Breakout Box to the wire harness connector C111. Do not connect the breakout box to the PCM.
4 	
5	5 Turn the function selector switch to the OFF position.
 AM0577-A	
6  41 AM0584-A	6 Measure the voltage at the breakout box pin 41, circuit 348 (VT). • **Is the voltage reading B+?**

	→ **Yes** GO to L4 . → **No** INSTALL a new powertrain control module. REFER to Section 303-14 . TEST the system for normal operation.
L4 CHECK CIRCUIT 348 (VT) FOR A SHORT TO B+	
1 2 Function Selector Switch C234 3 PCM C111 4 5  AM0582-A	5 Measure the voltage at the function selector switch connector C234 pin 3, circuit 348 (VT). • **Is voltage present?** → **Yes** REPAIR circuit 348 (VT) for a short to B+. TEST the system for normal operation. → **No** INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation.

L5 CHECK FOR A SHORTED CLUTCH INPUT

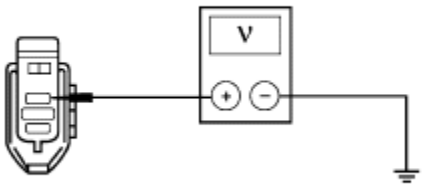
1

2

A/C Clutch Connector C166

3

4



GL0225-A

4 Measure for voltage at the A/C clutch connector C166, circuit 321 (GY/WH).

- **Is voltage present?**

→ **Yes**
GO to L6 .

→ **No**
CHECK the clutch air gap. REFER to A/C Clutch Air Gap Adjustment in this section.

L6 CHECK FOR A SHORTED A/C CLUTCH RELAY

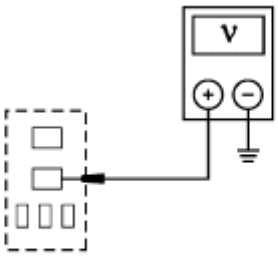
1

2 Remove the A/C clutch relay from the power distribution box.

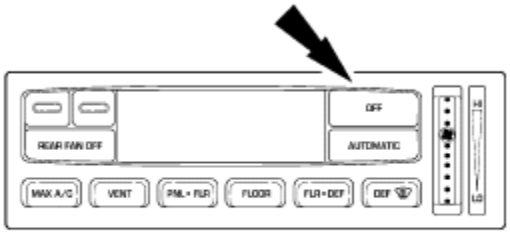
3

4

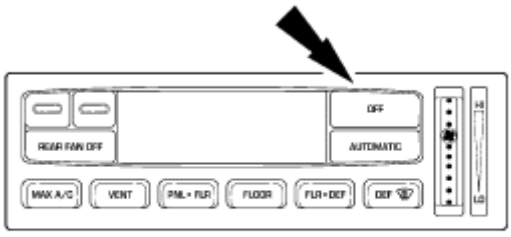
4 Measure the voltage at the A/C clutch relay

 AM0600-A	connector pin 5, circuit 321 (GY/WH). • **Is voltage present?** → **Yes** REPAIR circuit 321 (GY/WH) for a short to B+. TEST the system for normal operation. → **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.

PINPOINT TEST M: THE A/C IS ALWAYS ON — EATC

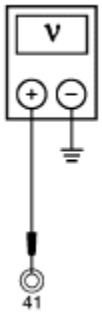
CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK PID WACF WITH THE A/C OFF	
1 	
2  AM0852-B	2 Push the EATC off button.
3 PCM PID WACF	• **Does the PCM PID WACF read YES?**

	→ **Yes** REPAIR circuit 331 (PK/YE) for a short to ground. TEST the system for normal operation. → **No** GO to M2.
M2 CHECK PID ACCS WITH A/C OFF	
1 PCM PID ACCS	• **Does the PCM PID ACCS read ON?** → **Yes** GO to M3. → **No** GO to M5.
M3 CHECK FOR A FALSE INPUT SIGNAL TO THE PCM	
NOTE: Do not directly probe the PCM wire harness connector.	
1 2 PCM C111 4 5	3 Connect the Rotunda EEC-V 104-Pin Breakout Box to the wire harness connector C111. Do not connect the breakout box to the PCM. 5 Push the EATC off button.



AM0852-B

6



AM0584-A

6 Measure the voltage at the breakout box pin 41, circuit 348 (VT).

- **Is the voltage reading B+?**

→ **Yes**
GO to M4 .

→ **No**
INSTALL a new powertrain control module. REFER to Section 303-14 . TEST the system for normal operation.

M4 CHECK CIRCUIT 348 (VT) FOR A SHORT TO B+

1

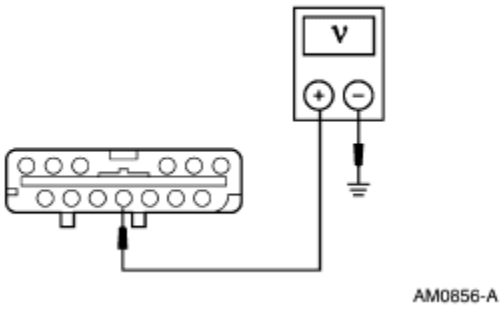
2

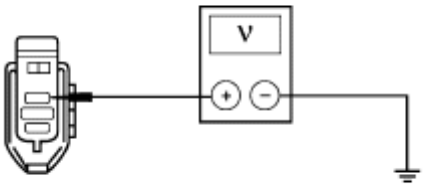
EATC Module C297

3

PCM C111

4

 5  AM0856-A	5 Measure the voltage at the EATC module connector C297 pin 11, circuit 348 (VT). • **Is voltage present?** → **Yes** REPAIR circuit 348 (VT) for a short to B+. TEST the system for normal operation. → **No** INSTALL a new EATC module. REFER to Section 412-04 . TEST the system for normal operation.
M5 CHECK FOR A SHORTED CLUTCH INPUT	
1 2 A/C Clutch Connector C166 3 4	4 Measure for voltage at the A/C clutch connector C166, circuit 321 (GY/WH).



GL0225-A

- **Is voltage present?**

→ **Yes**
GO to M6 .

→ **No**
CHECK the clutch air gap. REFER to A/C Clutch Air Gap Adjustment in this section.

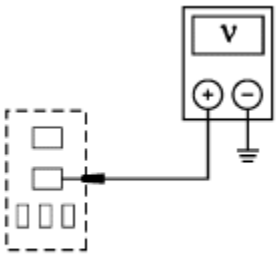
M6 CHECK FOR A SHORTED A/C CLUTCH RELAY

1

2 Remove the A/C clutch relay from the power distribution box.

3

4



AM0600-A

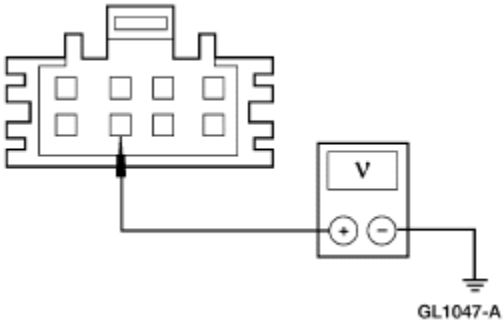
4 Measure the voltage at the A/C clutch relay connector pin 5, circuit 321 (GY/WH).

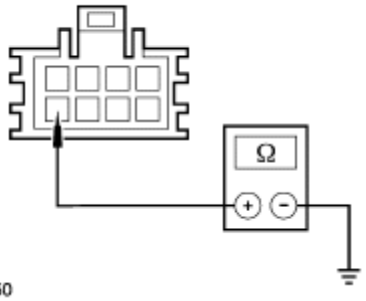
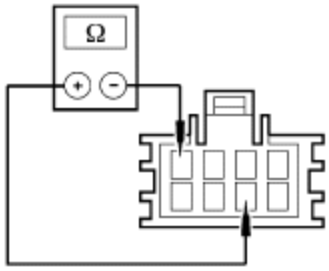
- **Is voltage present?**

→ **Yes**
REPAIR circuit 321 (GY/WH) for a short to B+. TEST the system for normal operation.

	→ **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.

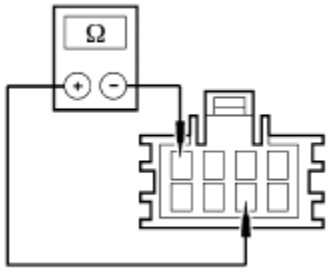
PINPOINT TEST N: NO OPERATION IN ALL TEMPERATURE SETTINGS—MANUAL CLIMATE CONTROL

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK THE VOLTAGE TO THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR	
1 2 Temperature Blend Door Actuator Motor C270 3 4  GL1047-A	4 Measure the voltage between the temperature blend door actuator C270 pin 7, circuit 1003 (GY/YE) and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to N2 . → **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation.
N2 CHECK THE GROUND TO THE BLEND DOOR ACTUATOR	
1	

 2  A0013850	2 Measure the resistance between the blend door actuator C270 pin 8, circuit 57 (BK) and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to N3 . → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
N3 CHECK THE TEMPERATURE CONTROL POTENTIOMETER TOTAL RESISTANCE	
1  A0042533	1 Measure the resistance between temperature blend door actuator C270 pin 4, circuit 660 (YE/LG) and pin 6, circuit 359 (GY/RD). • **Is the resistance between 4,500 and 5,500 ohms?** → **Yes** GO to N6 . → **No** If the resistance is less than 4,500 ohms, GO to N4 . If the resistance is greater than 5,500 ohms, GO to N5 .
N4 CHECK CIRCUIT 660 (YE/LG) AND CIRCUIT 359 (GY/RD) FOR A SHORT TOGETHER	
1	

Temperature Control Potentiometer C277

2



A0042533

2 Measure the resistance between temperature blend door actuator C270 pin 4, circuit 660 (YE/LG) and pin 6, circuit 359 (GY/RD).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 660 (YE/LG) and circuit 359 (GY/RD) for a short together. TEST the system for normal operation.

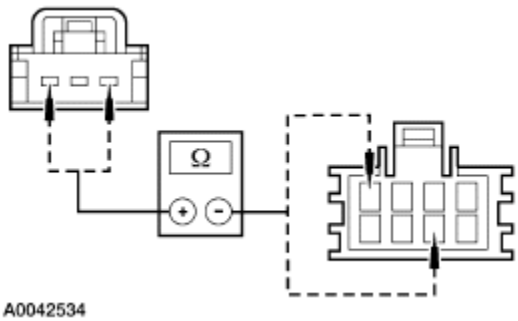
→ **No**
INSTALL a new temperature control potentiometer. REFER to Section 412-04 . TEST the system for normal operation.

N5 CHECK CIRCUIT 660 (YE/LG) AND CIRCUIT 359 (GY/RD) FOR AN OPEN

1

Temperature Control Potentiometer C277

2

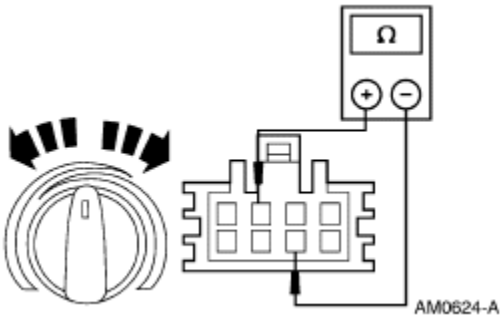
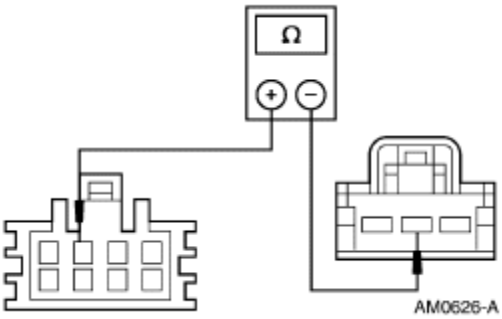


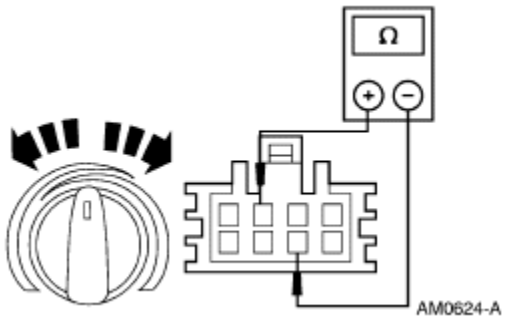
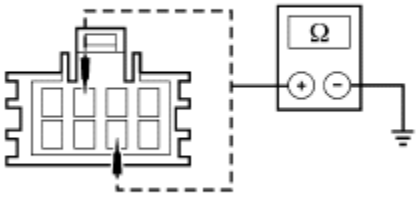
A0042534

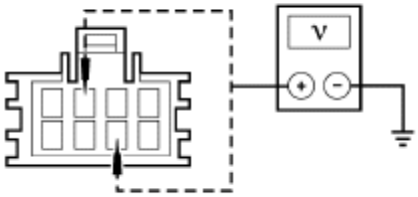
2 Measure the resistance between temperature blend door actuator C270 pin 4, circuit 660 (YE/LG) and temperature control potentiometer C277, circuit 660 (YE/LG); and between temperature blend door actuator C270 pin 6, circuit 359 (GY/RD) and temperature control potentiometer C277, circuit 359 (GY/RD).

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new temperature control

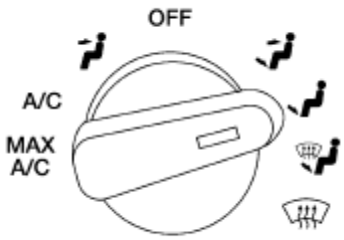
	potentiometer. REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR the affected circuit. TEST the system for normal operation.
N6 CHECK THE TEMPERATURE CONTROL POTENTIOMETER OPERATION	
1  	1 Measure the resistance between temperature blend door actuator C270 pin 3, circuit 773 (DG/OG) and pin 6, circuit 359 (GY/RD) while rotating the temperature control potentiometer from full WARM to full COOL. • **Does the resistance vary between 150 and 4,800 ohms?** → **Yes** GO to N9 . → **No** GO to N7 .
N7 CHECK CIRCUIT 773 (DG/OG) FOR AN OPEN	
1 Temperature Control Potentiometer C277	
2  	2 Measure the resistances between actuator C270 pin 3, circuit 773 (DG/OG) and temperature control potentiometer C277, circuit 773 (DG/OG). • **Is the resistance less than 5 ohms?** → **Yes** GO to N8 .

	→ **No** REPAIR circuit 773 (DG/OG) for an open. TEST the system for normal operation.
N8 CHECK CIRCUIT 773 (DG/OG) AND CIRCUIT 359 (GY/RD) FOR A SHORT TOGETHER	
1  	1 Measure the resistance between temperature blend door actuator C270 pin 3, circuit 773 (DG/OG) and pin 6, circuit 359 (GY/RD). • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 773 (DG/OG) and circuit 359 (GY/RD) for a short together. TEST the system for normal operation. → **No** INSTALL a new temperature control potentiometer. REFER to Section 412-04 . TEST the system for normal operation.
N9 CHECK CIRCUIT 773 (DG/OG) AND CIRCUIT 359 (GY/RD) FOR A SHORT TO GROUND	
1 Temperature Control Potentiometer C277	
2  	2 Measure the resistances between temperature blend door actuator C270 pin 3, circuit 773 (DG/OG) and ground, and between temperature blend door actuator C270 pin 6, circuit 359 (GY/RD) and ground. • **Are the resistances less than 5 ohms?** → **Yes**

	REPAIR the affected circuit for a short to ground. TEST the system for normal operation. → **No** GO to N10 .
N10 CHECK CIRCUIT 773 (DG/OG) AND CIRCUIT 359 (GY/RD) FOR A SHORT TO GROUND	
1 Temperature Control Potentiometer C277 2 3  A0042536	3 Measure the voltages between temperature blend door actuator C270 pin 6, circuit 660 (YE/LG) and ground, and between temperature blend door actuator C270 pin 3, circuit 773 (DG/OG) and ground. • **Is voltage present?** → **Yes** REPAIR the affected circuit for a short to power. TEST the system for normal operation. → **No** GO to N11 .
N11 CHECK FOR BINDING, STUCK OR BROKEN DOOR AND LINKAGE	
1 	2 Remove the actuator. Refer to Section 412-04 . 3 Inspect for a binding, stuck or broken blend door or linkage. • **Is there a binding, stuck or broken blend door or linkage condition?**

	→ **Yes** REPAIR the blend door/linkage. REFER to Section 412-04 . TEST the system for normal operation. → **No** INSTALL a new temperature blend door actuator. REFER to Section 412-04 . TEST the system for normal operation.

PINPOINT TEST O: THE BLOWER MOTOR DOES NOT OPERATE — MANUAL A/C

CONDITIONS	DETAILS/RESULTS/ACTIONS
O1 CHECK BLOWER MOTOR OPERATION	
1 	
2  L10572-A	2 Turn the A/C function switch to the FLOOR position.
3 L10527-A	3 Turn the blower motor switch to the high position.
4	4 Turn the blower motor switch to the low position.

GL0437-A

- **Does the blower motor operate?**

→ **Yes**
WIGGLE the wires and CHECK for intermittent operation. REPAIR as necessary. TEST the system for normal operation.

→ **No**
If the blower motor operates in some speeds, Go To Pinpoint Test Q .

If the blower motor operates in all settings except high, Go To Pinpoint Test S .

If the blower motor does not operate at all, GO to O2 .

O2 CHECK I/P FUSE 6 (7.5A)

1

I/P Fuse 6 (7.5A)

- **Is fuse 6 (7.5A) OK?**

→ **Yes**
GO to O4 .

→ **No**
INSTALL a new fuse 6 (7.5A). TEST the system for normal operation. If the fuse fails again, GO to O3 .

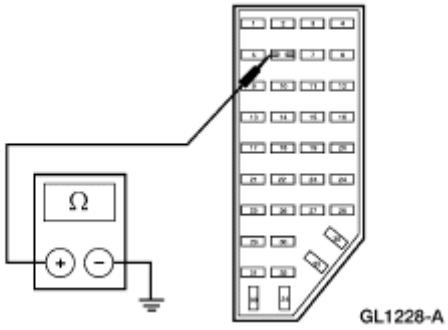
O3 CHECK CIRCUIT 364 (BK/LG) FOR SHORT TO GROUND

1

Blower Motor Relay

2

2 Measure the resistance between I/P fuse



panel fuse 6 (7.5A), pin 1, and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new blower motor relay. TEST the system for normal operation.

→ **No**
REPAIR circuit 364 (BK/LG). TEST the system for normal operation.

O4 CHECK MAXI-FUSE 9 (50A)

1

maxi-fuse 9 (50A)

- **Is the maxi-fuse 9 (50A) OK?**

→ **Yes**
GO to O7 .

→ **No**
INSTALL a new maxi-fuse 9 (50A). TEST the system for normal operation. If the fuse fails again, GO to O5 .

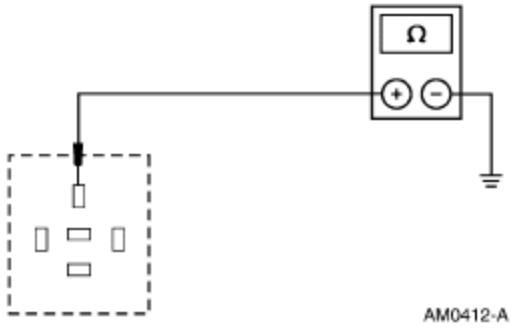
O5 CHECK BLOWER MOTOR FOR SHORT TO GROUND

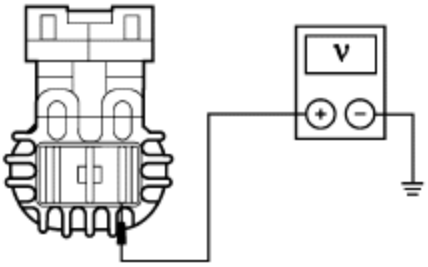
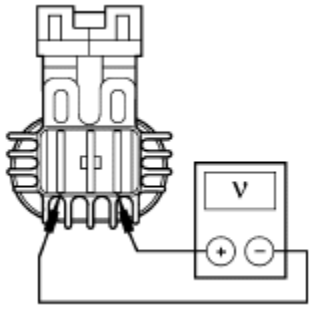
1

2

Blower Motor C154

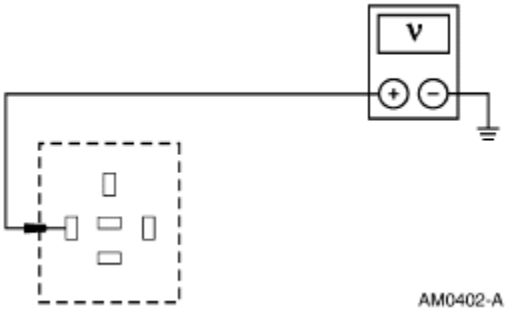
3 Install a new maxi-fuse 9 (50A).

4 5 L10527-A	5 Rotate the blower motor switch to the high position. • **Is the maxi-fuse 9 (50A) OK?** → **Yes** INSTALL a new blower motor. TEST the system for normal operation. → **No** GO to O6 .
O6 CHECK CIRCUIT 371 (PK/WH) FOR SHORT TO GROUND	
1  AM0412-A	1 Measure the resistance between blower motor relay connector pin 30, circuit 371 (PK/WH), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPAIR circuit 364 (BK/LG) between the power distribution box and blower motor relay. TEST the system for normal operation. → **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.
O7 CHECK CIRCUIT 371 (PK/WH) FOR VOLTAGE	

1  AM0416-A	1 Measure the voltage between blower motor C154, circuit 371 (PK/WH), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to O8 . → **No** GO to O9 .
O8 CHECK CIRCUIT 181 (BN/OG)	
1  GL0438-A	1 Measure the voltage between blower motor C154, circuit 371 (PK/WH), and blower motor C154, circuit 181 (BN/OG). • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new blower motor. TEST the system for normal operation. → **No** GO to O15 .
O9 CHECK CIRCUIT 364 (BK/LG) FOR OPEN	
1 2	

Blower Motor Relay

3



3 Measure the voltage between blower motor relay connector pin 86, circuit 364 (BK/LG), and ground.

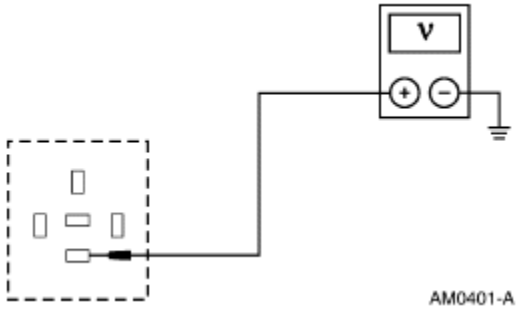
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to O10 .

→ **No**
REPAIR circuit 364 (BK/LG) between the I/P fuse panel and blower motor relay. TEST the system for the normal operation.

O10 CHECK VOLTAGE AT THE BLOWER MOTOR RELAY

1



1 Measure the voltage between blower motor relay connector pin 87, circuit 364 (BK/LG), and ground.

- **Is the voltage greater than 10 volts?**

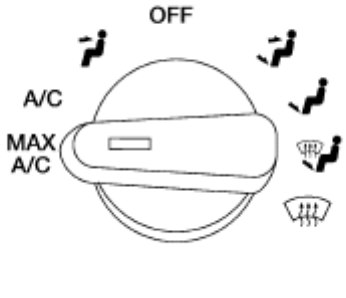
→ **Yes**
GO to O11 .

→ **No**
REPAIR circuit 364 (BK/LG) between the power distribution box and the blower motor relay. TEST the system for normal operation.

O11 CHECK CIRCUIT 260 (RD/OG) FOR OPEN

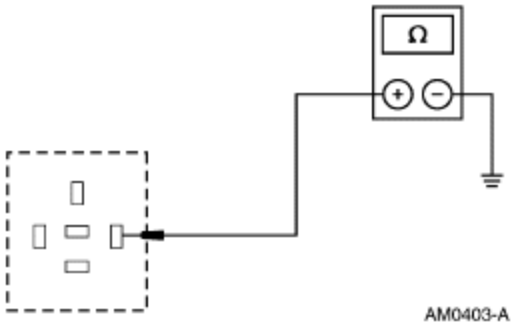
1

1 Turn the A/C function switch to MAX A/C.



L10562-A

2



AM0403-A

2 Measure the resistance between blower motor relay connector pin 85, circuit 260 (RD/OG), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to O14 .

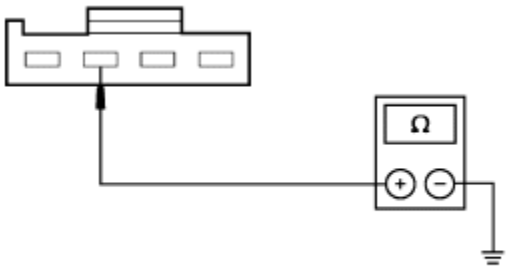
→ **No**
GO to O12 .

O12 CHECK CIRCUIT 57 (BK) FOR OPEN

1

A/C Function Switch C231

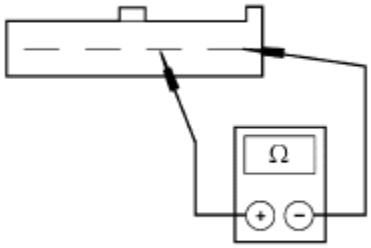
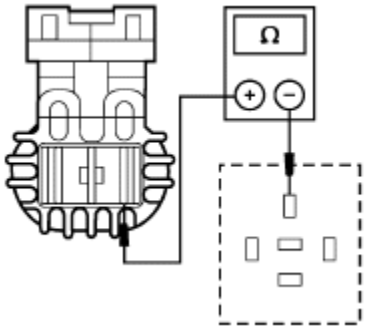
2

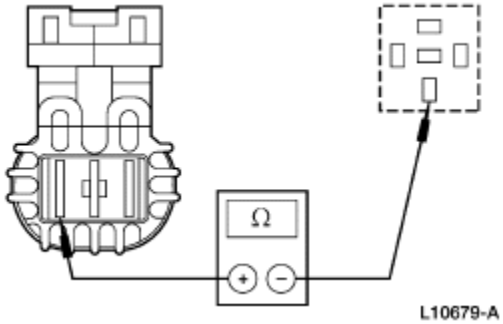


AM0413-A

2 Measure the resistance between A/C function switch C231 pin 3, circuit 57 (BK), and ground.

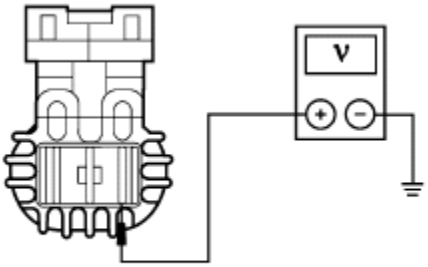
- **Is the resistance less than 5 ohms?**

	→ **Yes** GO to O13 . → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
O13 CHECK A/C FUNCTION SWITCH	
1  GL1229-A	1 Measure the resistance between A/C function switch terminal 1 and terminal 2, in all A/C function switch positions, except OFF. • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 260 (RD/OG). TEST the system for normal operation. → **No** INSTALL a new A/C function switch. TEST the system for normal operation.
O14 CHECK CIRCUIT 371 (PK/WH) FOR OPEN	
1 Blower Motor C154 2  AM0404-A	2 Measure the resistance between blower motor relay connector pin 30, circuit 371 (PK/WH), and blower motor C154, circuit 371 (PK/WH). • **Is the resistance less than 5 ohms?** → **Yes**

	INSTALL a new blower motor relay. TEST the system for normal operation. → **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.
O15 CHECK CIRCUIT 181 (BN/OG) FOR OPEN	
1 High Speed Blower Motor Relay 2  	2 Measure the resistance between blower motor C154, circuit 181 (BN/OG), and high speed blower motor relay connector pin 30, circuit 181 (BN/OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new high speed blower motor relay. TEST the system for normal operation. → **No** REPAIR circuit 181 (BN/OG) for open. TEST the system for normal operation.

PINPOINT TEST P: THE BLOWER MOTOR IS INOPERATIVE — EATC

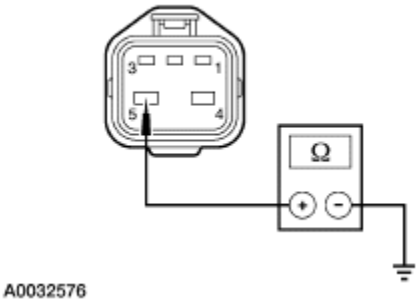
CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 VERIFY THE BLOWER MOTOR OPERATION	
1 	2 Press the VENT button on the EATC module. Adjust the blower motor setting to LO and then to HI. • **Is the blower motor inoperative in all**

	settings? → **Yes** GO to P2 . → **No** Go To Pinpoint Test R .
P2 CHECK FOR VOLTAGE TO THE BLOWER MOTOR	
1 2 Blower Motor C154 3 4  AM0416-A	4 Measure the voltage between the blower motor C154, circuit 371 (PK/WH) and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to P3 . → **No** GO to P8 .
P3 CHECK CIRCUIT 57 (BK)	
1 2	

Blower Motor Speed Control C179

3

4



A0032576

4 Measure the resistance between the blower motor speed control C179 pin 5, circuit 57 (BK) and ground.

- **Is the resistance less than 5 ohms?**

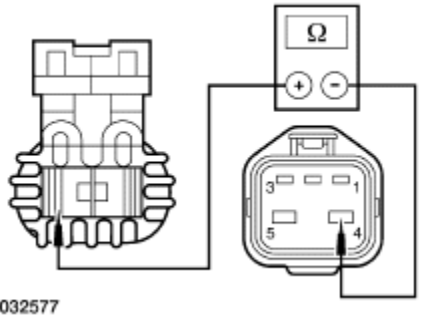
→ **Yes**
GO to P4 .

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

P4 CHECK CIRCUIT 261 (OG/BK)

1

2

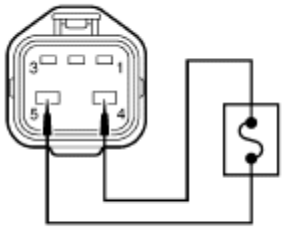


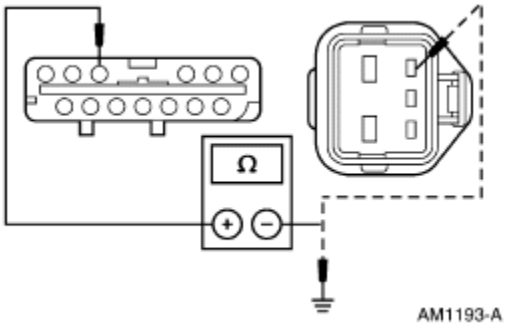
A0032577

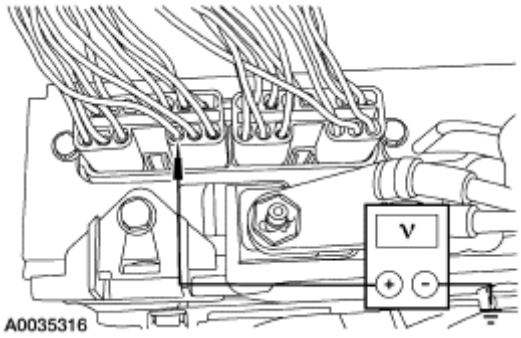
2 Measure the resistance between the blower motor C154, circuit 261 (OG/BK) and the blower motor speed control C179 pin 4, cicuit 261 (OG/BK).

- **Is the resistance less than 5 ohms?**

→ **Yes**

	GO to P5 . → **No** REPAIR circuit 261 (OG/BK). TEST the system for normal operation.
P5 CHECK THE BLOWER MOTOR	
1 Blower Motor C154 2  A0032579 3 	2 Connect a fused jumper lead between the blower motor speed control C179 pin 4, circuit 261 (OG/BK) and ground. • **Does the blower motor operate?** → **Yes** GO to P6 . → **No** INSTALL a new blower motor. TEST the system for normal operation.
P6 CHECK CIRCUIT 775 (BN/OG)	
1 3 EATC Module C298	2 Remove the fused jumper lead from the blower motor speed control C179.

4  	4 Measure the resistance between the EATC module C298 pin 24, circuit 775 (BN/OG) and the blower motor speed control C179 pin 3, circuit 775 (BN/OG), and measure the resistance between the EATC module C298 pin 24, circuit 775 (BN/OG) and ground. • **Is the resistance less than 5 ohms between the EATC module and the blower motor speed control and greater than 10,000 ohms between the EATC module and ground?** → **Yes** GO to P7 . → **No** REPAIR circuit 775 (BN/OG). TEST the system for normal operation.
P7 CHECK THE EATC MODULE OUTPUT	
1 EATC Module C298 2 Blower Motor Speed Control C179 3 5	4 Adjust the blower motor speed to HI (7 bars). 5 Measure the voltage between the EATC module C298 pin 24, circuit 775 (BN/OG) and ground by back-probing the EATC module C298.



- **Is the voltage within 2 volts of battery voltage?**

→ **Yes**
INSTALL a new blower motor speed control. TEST the system for normal operation.

→ **No**
INSTALL a new EATC module. TEST the system for normal operation.

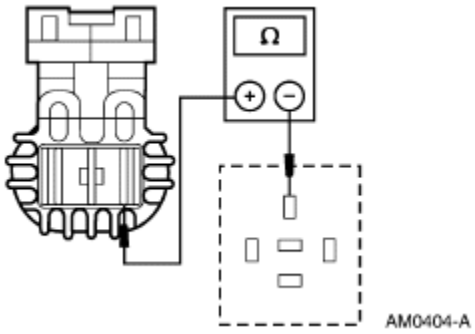
P8 CHECK CIRCUIT 371 (PK/WH)

1

2

Blower Motor Relay

3

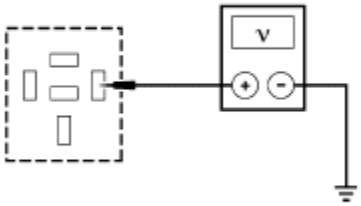
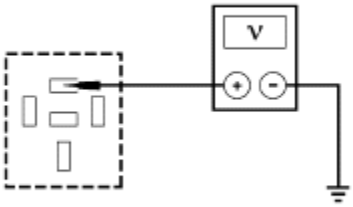


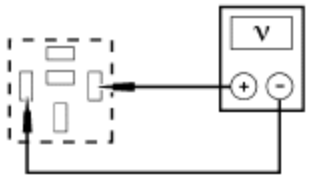
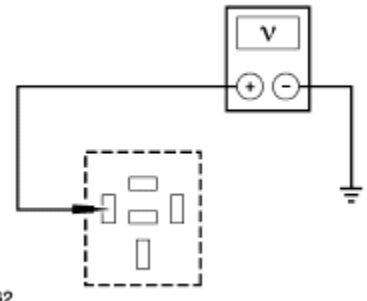
3 Measure the resistance between the blower motor C154, circuit 371 (PK/WH) and the blower motor relay socket pin 30, circuit 371 (PK/WH).

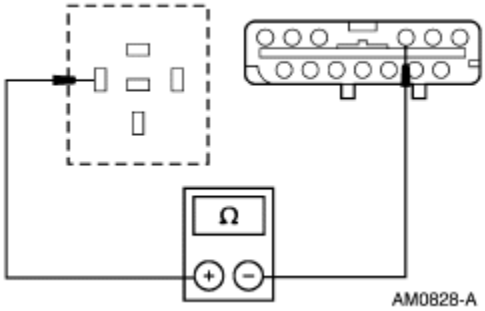
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to P9 .

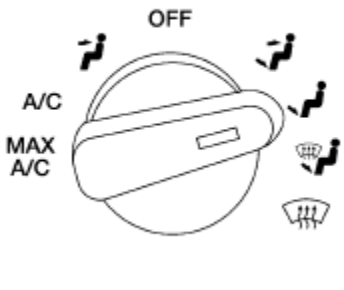
→ **No**

	REPAIR circuit 371 (PK/WH). TEST the system for normal operation.
P9 CHECK CIRCUIT 364 (BK/LG), COIL SIDE	
1 2  A0020210	2 Measure the voltage between the blower motor relay socket pin 86, circuit 364 (BK/LG) and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to P10 . → **No** REPAIR circuit 364 (BK/LG). TEST the system for normal operation.
P10 CHECK CIRCUIT 364 (BK/LG), SWITCH SIDE	
1  A0013861	1 Measure the voltage between the blower motor relay socket pin 87, circuit 364 (BK/LG) and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to P11 . → **No** REPAIR circuit 364 (BK/LG). TEST the system for normal operation.
P11 CHECK THE EATC MODULE OUTPUT	

1  A0034149	1 Measure the voltage between the blower motor relay socket pin 86, circuit 364 (BK/LG) and socket pin 85, circuit 575 (VT/BK). • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new blower motor relay. TEST the system for normal operation. → **No** GO to P12 .
P12 CHECK CIRCUIT 575 (VT/BK) FOR A SHORT TO VOLTAGE	
1 EATC Module C297 2 3  A0013862	3 Measure the voltage between the blower motor relay socket pin 85, circuit 575 (VT/BK) and ground. • **Is voltage present?** → **Yes** REPAIR circuit 575 (VT/BK). TEST the system for normal operation. → **No**

	GO to P13 .
P13 CHECK CIRCUIT 575 (VT/BK)	
1 2  	2 Measure the resistance between the EATC module C297 pin 17, circuit 575 (VT/BK) and the blower motor relay socket pin 85, circuit 575 (VT/BK). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new EATC module. TEST the system for normal operation. → **No** REPAIR circuit 575 (VT/BK). TEST the system for normal operation.

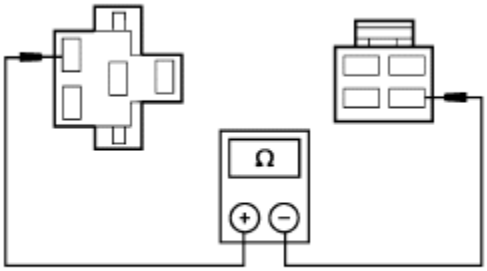
PINPOINT TEST Q: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY — MANUAL A/C

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK BLOWER LOW SPEED OPERATION	
1 2  	2 Turn the A/C function switch to the FLOOR position.

3 GL0437-A	3 Turn the blower motor switch to low. • **Does the blower motor operate?** → **Yes** GO to Q5 . → **No** GO to Q2 .
Q2 CHECK BLOWER MEDIUM/LOW OPERATION	
1 GL1231-A	1 Turn the blower motor switch to medium/low. • **Does the blower motor operate?** → **Yes** GO to Q4 . → **No** GO to Q3 .
Q3 CHECK CIRCUIT 752 (YE/RD) FOR OPEN	
1 Blower Motor Switch C230 2	

Blower Motor Resistor C153

3



AM0376-B

3 Measure the resistance between blower motor switch C230 pin 4, circuit 752 (YE/RD), and blower motor resistor C153 pin 3, circuit 752 (YE/RD).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to Q4 .

→ **No**
REPAIR circuit 752 (YE/RD). TEST the system for normal operation.

Q4 CHECK BLOWER MEDIUM/HIGH OPERATION

1

GL1234-A

1 Turn the blower motor switch to medium/high.

- **Does the blower motor operate?**

→ **Yes**
GO to Q6 .

→ **No**
GO to Q5 .

Q5 CHECK CIRCUIT 754 (LG/WH) FOR OPEN

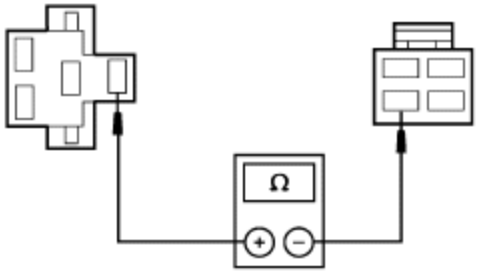
1

Blower Motor Switch C230

2

Blower Motor Resistor C153

3



AM0378-B

3 Measure the resistance between blower motor switch C230 pin 3, circuit 754 (LG/WH), and blower motor resistor C153 pin 1, circuit 754 (LG/WH).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to Q6 .

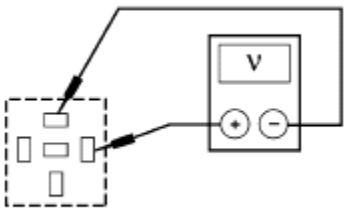
→ **No**
REPAIR circuit 754 (LG/WH). TEST the system for normal operation.

Q6 CHECK THE HIGH SPEED BLOWER MOTOR RELAY FOR VOLTAGE

1

High Speed Blower Motor Relay

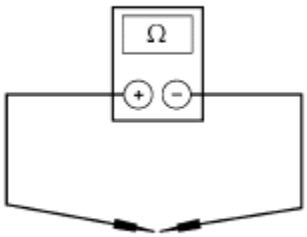
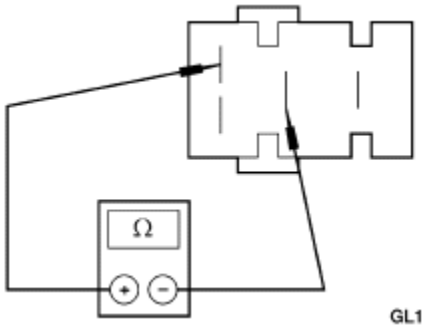
2

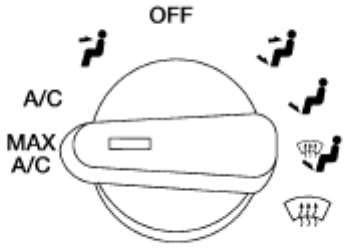


GL1513-A

2 Measure the voltage between high speed blower motor relay connector pin 87, circuit 261 (OG/BK), and high speed blower motor relay connector pin 86, circuit 371 (PK/WH).

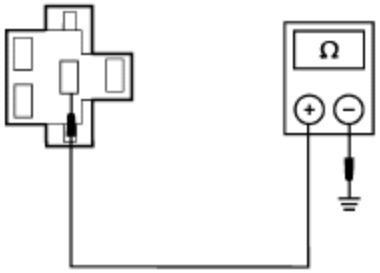
- **Is the voltage greater than 10 volts?**

	→ **Yes** INSTALL a new high speed blower motor relay. TEST the system for normal operation. → **No** GO to Q7 .
Q7 CHECK A/C BLOWER MOTOR RESISTOR	
1  L10681-A	1 Zero the multimeter by touching the leads together and recording the resistance value.
2  GL1232-A	2 Measure the resistance between A/C blower motor resistor terminal 2 and A/C blower motor resistor terminal 4. Subtract the resistance value found when zeroing the multimeter. • **Is the resistance between 3.375 and 4.125 ohms?** → **Yes** GO to Q8 . → **No** INSTALL a new A/C blower motor resistor. TEST the system for normal operation.
Q8 CHECK CIRCUIT 260 (RD/OG) FOR OPEN	
1	1 Turn the A/C function switch to MAX A/C.



L10562-A

2



AM0374-B

2 Measure the resistance between blower motor resistor C153 pin 2, circuit 260 (RD/OG), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to Q9 .

→ **No**
REPAIR circuit 260 (RD/OG). TEST the system for normal operation.

Q9 CHECK BLOWER MOTOR SWITCH

1

2

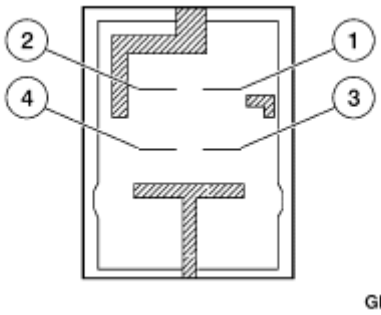
Blower Motor Switch

3

3 Measure the resistance of the blower motor switch. Refer to the chart shown.

Blower Switch Resistance Test

Switch Position	Resistance Between Terminals
Low	None



Medium/Low	2 and 3 only
Medium/High	2, 3 and 4 only
High	1, 2 and 4 only

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 261 (OG/BK). TEST the system for normal operation.

→ **No**
INSTALL a new blower motor switch. TEST the system for normal operation.

PINPOINT TEST R: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY — EATC

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 VERIFY THE BLOWER MOTOR OPERATION	
1	2 Press the VENT button on the EATC module. Adjust the blower motor setting to LO and then to HI. • **Does the blower motor operate at any setting?** → **Yes** GO to R2 . → **No** Go To Pinpoint Test P .
R2 CHECK THE STEERING WHEEL CONTROLS	
1 2	

Clockspring C220

3

4 Adjust the blower motor setting to LO and then to HI.

- **Does the blower motor speed decrease to LO, then increase to HI?**

→ **Yes**
Go To Pinpoint Test T .

→ **No**
GO to R3 .

R3 CHECK CIRCUIT 261 (OG/BK)

1

2

Blower Motor Speed Control C179

3

- **Does the blower motor operate?**

→ **Yes**
REPAIR circuit 261 (OG/BK). TEST the system for normal operation.

→ **No**
GO to R4 .

R4 CHECK BLOWER MOTOR SPEED CONTROL

1

2

Blower Motor Speed Control C176

3

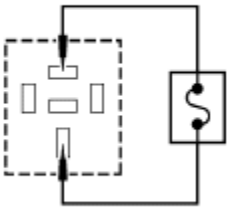
EATC Module C297 and C298

4

Blower Motor Relay

5

6



A0032587

6 Connect a fused jumper lead between the blower motor relay socket pin 30, circuit 371 (PK/WH) and socket pin 87, circuit 364 (BK/LG).

- **Does the blower motor operate?**

→ **Yes**
INSTALL a new blower motor speed control. TEST the system for normal operation.

→ **No**
GO to R5 .

R5 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR AN OPEN

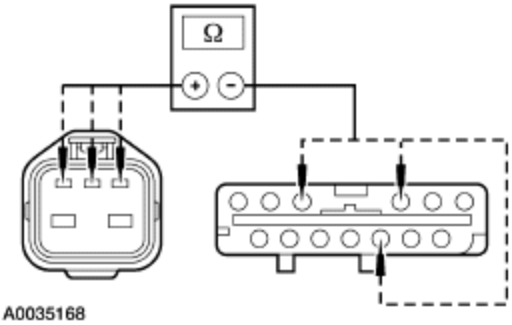
1

Blower Motor Relay

2

Blower Motor Speed Control C179

3



A0035168

3 Measure the resistance between the blower motor speed control C179:

- pin 1, circuit 184 (TN/OG) and the EATC module C298 pin 10, circuit 184 (TN/OG).
- pin 2, circuit 181 (BN/OG) and the EATC module C298 pin 23, circuit 181 (BN/OG).
- pin 3, circuit 775 (WH/PK) and the EATC module C298 pin 24, circuit 775 (WH/PK).

- **Are the resistances less than 5 ohms?**

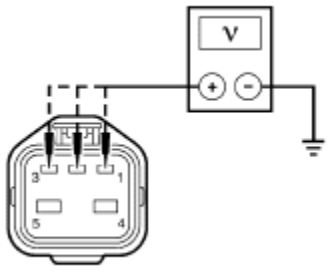
→ **Yes**
GO to R6 .

→ **No**
REPAIR the affected circuit. TEST the system for normal operation.

R6 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE

1

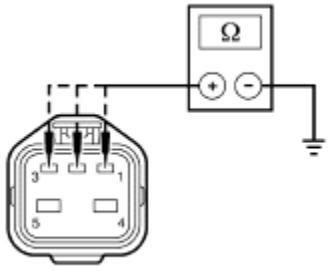
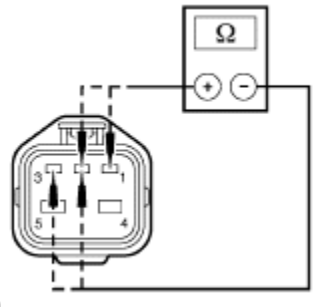
2

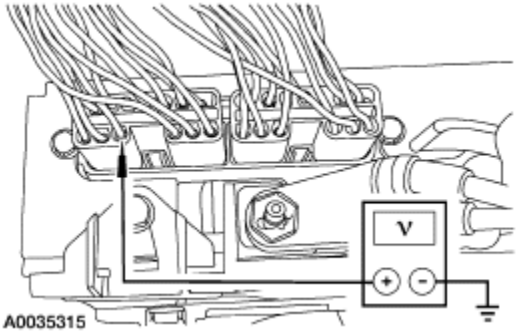


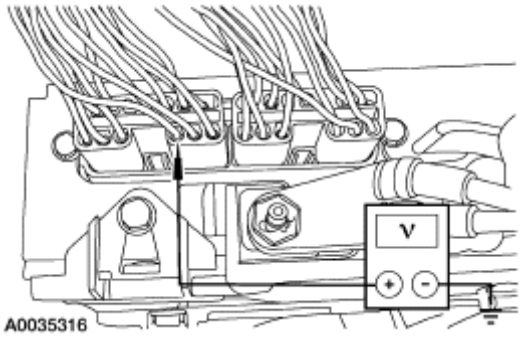
A0033862

2 Measure the voltage between the blower motor speed control C179:

- pin 1, circuit 184 (TN/OG) and ground.
- pin 2, circuit 181 (BN/OG) and ground.
- pin 3, circuit 775 (WH/PK) and ground.

	• **Is voltage present?** → **Yes** REPAIR the affected circuit. TEST the system for normal operation. → **No** GO to R7 .
R7 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	
1 2  A0033863	2 Measure the resistance between the blower motor speed control C179: ■ pin 1, circuit 184 (TN/OG) and ground. ■ pin 2, circuit 181 (BN/OG) and ground. ■ pin 3, circuit 775 (WH/PK) and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** GO to R8 . → **No** REPAIR the affected circuit. TEST the system for normal operation.
R8 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR A SHORT	
1  A0033864	1 Measure the resistance between the blower motor speed control C179: ■ pin 1, circuit 184 (TN/OG) and pin 2, circuit 181 (BN/OG). ■ pin 1, circuit 184 (TN/OG) and pin 3, circuit 775 (WH/PK). ■ pin 2, circuit 181 (BN/OG) and pin 3, circuit 775 (WH/PK). • **Are the resistances greater than 10,000 ohms?**

	→ **Yes** GO to R9 . → **No** REPAIR the affected circuits. TEST the system for normal operation.
R9 CHECK THE EATC MODULE HIGH BLOWER OUTPUT	
1 EATC Module C297 and C298 2 Blower Motor Speed Control C179 3 5  	4 Adjust the blower motor speed to HI (7 bars). 5 Measure the voltage between the EATC module C298 pin 24, circuit 775 (WH/PK) and ground by back-probing the EATC module C298. • **Is the voltage within 2 volts of battery voltage?** → **Yes** GO to R10 . → **No** INSTALL a new EATC module. TEST the system for normal operation.
R10 CHECK THE EATC MODULE BLOWER CONTROL OUTPUT	
2	1 Adjust the blower motor speed to LO (1 bar). 2 Measure the voltage between the EATC module C298 pin 23, circuit 181 (BN/OG) and

	ground by back-probing the EATC module C298. • **Is the voltage greater than 1 volt?** → **Yes** INSTALL a new blower motor speed control. TEST the system for normal operation. → **No** INSTALL a new EATC module. TEST the system for normal operation.

PINPOINT TEST S: NO OPERATION IN HIGH BLOWER SETTING — MANUAL A/C

CONDITIONS	DETAILS/RESULTS/ACTIONS
S1 CHECK BLOWER MOTOR SPEED	
1	
2	2 Turn the A/C function switch to the FLOOR position.
3	3 Turn the blower motor switch to high.

L10527-A

- **Does the blower motor operate in high?**

→ **Yes**
CYCLE blower motor switch from high to low several times. If blower operates each time, advise owner of system operation. If blower does not operate in high each time, INSTALL a new blower motor switch.

→ **No**
GO to S2 .

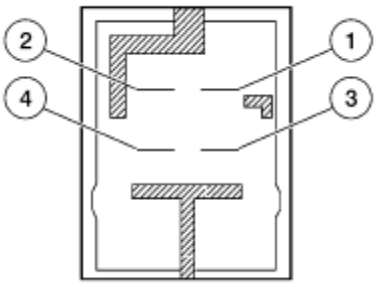
S2 CHECK BLOWER MOTOR SWITCH

1

2

Blower Motor Switch C230

3



GL1230-A

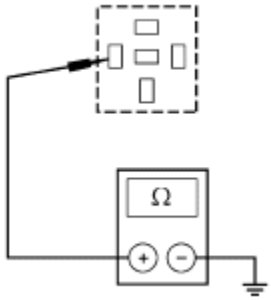
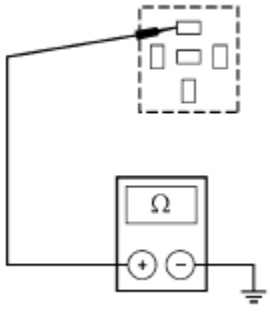
3 Measure the resistance of the blower motor switch. Refer to the chart shown.

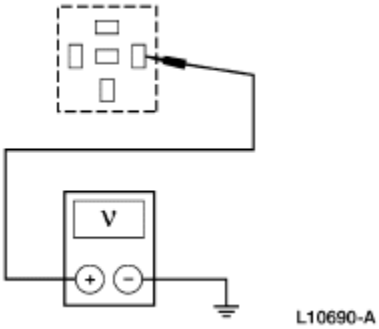
Blower Switch Resistance Test

Switch Position	Resistance Between Terminals
Low	None
Medium/Low	2 and 3 only
Medium/High	2, 3 and 4 only
HIGH	1, 2 and 4 only

- **Is the resistance less than 5 ohms?**

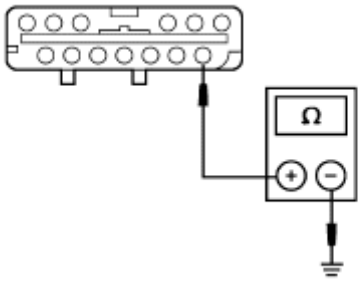
→ **Yes**
GO to S3 .

	→ **No** INSTALL a new blower motor switch. TEST the system for normal operation.
S3 CHECK CIRCUIT 261 (OG/BK) FOR OPEN	
1 High Speed Blower Motor Relay 2  L10691-A	2 Measure the resistance between high speed blower motor relay connector pin 85, circuit 261 (OG/BK), and ground. • **Is the resistance 5 ohms or less?** → **Yes** GO to S4 . → **No** REPAIR circuit 261 (OG/BK). TEST the system for normal operation.
S4 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  L10692-A	1 Measure the resistance between high speed blower motor relay connector pin 87, circuit 57 (BK), and ground. • **Is the resistance 5 ohms or less?** → **Yes** GO to S5 . → **No**

	REPAIR circuit 57 (BK). TEST the system for normal operation.
S5 CHECK CIRCUIT 371 (PK/WH) FOR BATTERY VOLTAGE	
1 2  L10690-A	2 Turn the A/C function switch to any position except OFF. Measure the voltage between the high speed blower motor relay connector pin 86, circuit 371 (PK/WH), and the ground. • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new high speed blower motor relay. TEST the system for normal operation. → **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.

PINPOINT TEST T: ONE OR MORE STEERING WHEEL CONTROL SWITCHES IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
T1 CHECK THE INPUT TO THE ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (EATC)	
1 2 EATC C297 3	3 Measure the resistance between the EATC module connector pin C297 pin 8, circuit 583 (YE) and ground.



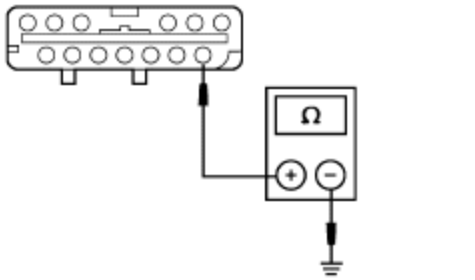
- **Is the resistance reading between 4,500 and 5,000 ohms?**

→ **Yes**
GO to T2 .

→ **No**
GO to T3 .

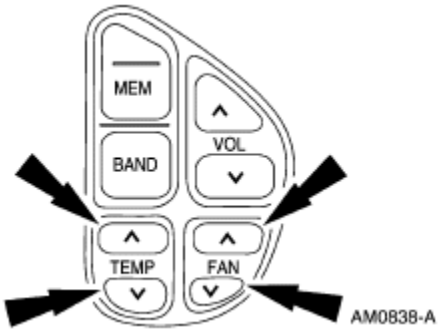
T2 CHECK THE STEERING WHEEL CONTROL SWITCH OUTPUT

1



1 Measure the resistance between the EATC module connector C297 pin 8, circuit 583 (YE) and ground.

2

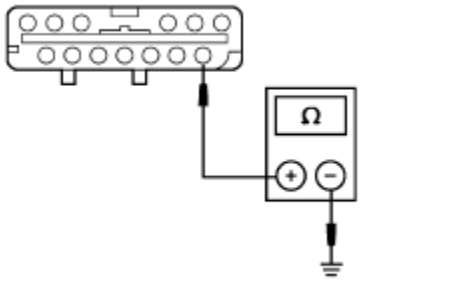
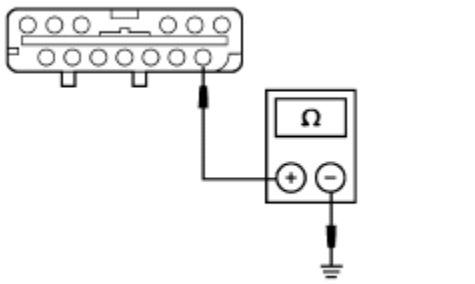


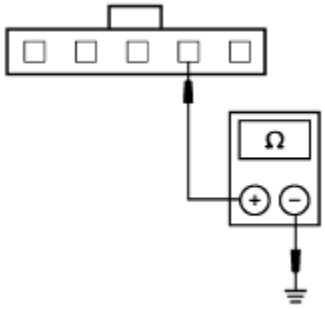
2 Press each steering wheel control switch and compare the resistance reading to the chart below.

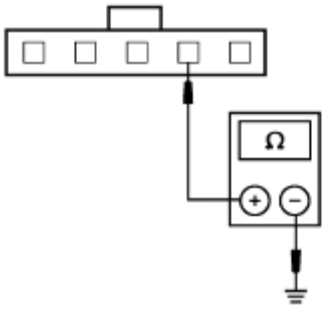
Switch	Resistance
TEMP UP	336-376 ohms
TEMP DOWN	1,620-1,810 ohms
FAN UP	736-821 ohms
FAN DOWN	123-138 ohms

- **Are the resistances within range?**

→ **Yes**
INSTALL a new EATC module. TEST the system for normal operation.

	→ **No** INSTALL a new steering column switch assembly. TEST the system for normal operation.
T3 CHECK THE SYSTEM FOR AN OPEN	
1  AM0837-A	1 Measure the resistance between the EATC module connector C297 pin 8, circuit 583 (YE) and ground. • **Is the resistance reading less than 4,500 ohms?** → **Yes** GO to T4 . → **No** GO to T7 .
T4 CHECK CIRCUIT 583 (YE) FOR A SHORT TO GROUND	
1 Clockspring C220 2  AM0837-A	2 Measure the resistance between the EATC module connector C297 pin 8, circuit 583 (YE) and ground. • **Is the resistance reading less than 10,000 ohms?** → **Yes** REPAIR circuit 583 (YE) for a short to ground. TEST the system for normal operation.

	→ **No** GO to T5 .
T5 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND	
1 Climate Control Steering Wheel Switch 2  AM0840-A	2 Measure the resistance between the climate control steering wheel switch connector circuit (LB/RD) and ground. • **Is the resistance 10,000 ohms or less?** → **Yes** GO to T6 . → **No** INSTALL a new climate control steering wheel switches. TEST the system for normal operation.
T6 CHECK THE STEERING WHEEL SWITCH HARNESS FOR A SHORT TO GROUND	
2 Steering Wheel Switch In-Line Connector 3	1 Remove the driver air bag. Refer to Section 501-20B . 3 Measure the resistance between the climate control steering wheel switch connector, circuit (LB/RD) and ground.



- **Is the resistance 10,000 ohms or less?**

→ **Yes**
REPAIR the steering wheel switch harness. TEST the system for normal operation.

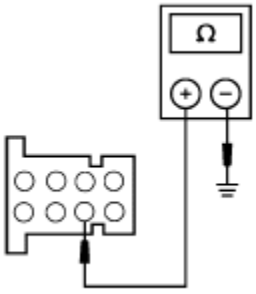
→ **No**
INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.

T7 CHECK THE GROUND SUPPLY TO THE STEERING COLUMN SWITCHES

1

Clockspring C220

2



2 Measure the resistance between the clockspring connector C220 pin 4, circuit 848 (DG/OG) and ground.

- **Is the resistance reading 5 ohms or less?**

→ **Yes**
GO to T9 .

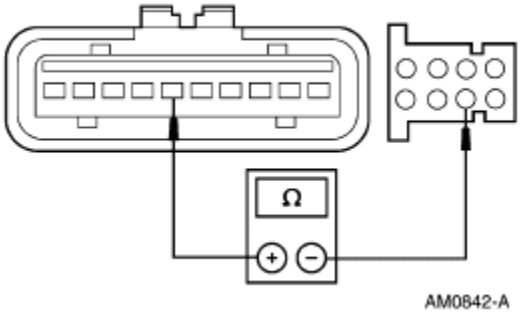
→ **No**
GO to T8 .

T8 CHECK CIRCUIT 848 (DG/OG) FOR AN OPEN

1

Speed Control Module C171

2



2 Measure the resistance of circuit 848 (DG/OG) between the clockspring connector C220 pin 4 and the speed control module connector C171 pin 6.

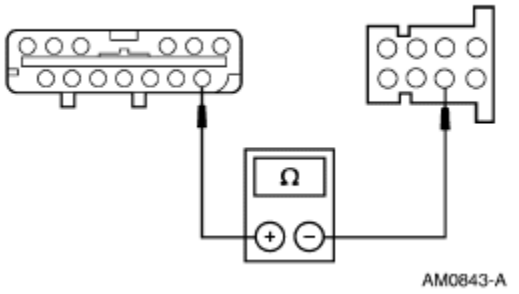
- **Is the resistance 5 ohms or less?**

→ **Yes**
INSTALL a new speed control module. REFER to Section 310-03 .

→ **No**
REPAIR circuit 848 (DG/OG) for an open. TEST the system for normal operation.

T9 CHECK CIRCUIT 583 (YE) FOR AN OPEN

1



1 Measure the resistance of circuit 583 (YE) between the clockspring connector C220 pin 5 and the EATC connector C297 pin 8.

- **Is the resistance reading 5 ohms or less?**

→ **Yes**
GO to T10 .

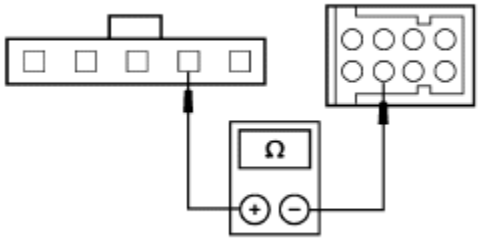
→ **No**
REPAIR circuit 583 (YE) for an open. TEST the system for normal operation.

T10 CHECK THE STEERING COLUMN SWITCH FOR AN OPEN

1

Climate Control Steering Wheel Switch

2



2 Measure the resistance between the clockspring connector terminal C220 pin 5, circuit (WH/LB) and the steering wheel switch connector, circuit (LB/RD).

- **Is the resistance reading 5 ohms or less?**

→ **Yes**
INSTALL a new steering wheel switch assembly. TEST the system for normal operation.

→ **No**
GO to T11 .

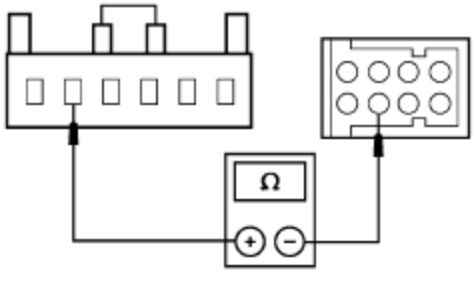
T11 CHECK THE CLOCKSPRING FOR AN OPEN

1 Remove the driver air bag. Refer to Section 501-20B .

2

Steering Wheel Switch In-Line Connector

3

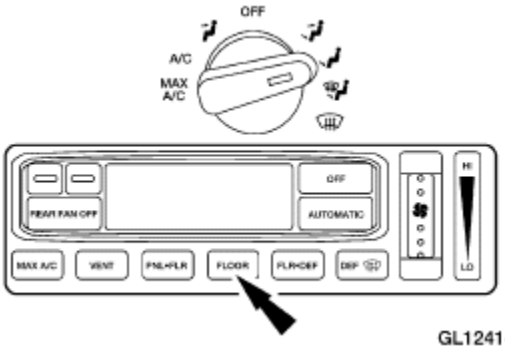


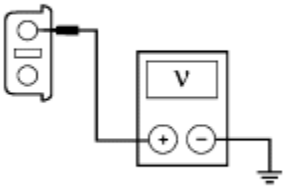
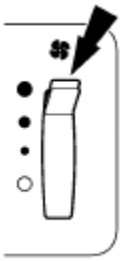
3 Measure the resistance of circuit (WH/LB) between the clockspring connector terminal C220 pin 5 and the clockspring to steering wheel switch in-line harness connector.

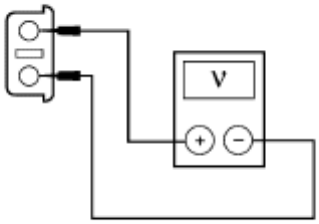
- **Is the resistance reading 5 ohms or less?**

	→ **Yes** REPAIR the steering wheel switch harness. TEST the system for normal operation. → **No** INSTALL a new clockspring. REFER to Section 501-20B .

PINPOINT TEST U: THE CONSOLE BLOWER MOTOR DOES NOT OPERATE

CONDITIONS	DETAILS/RESULTS/ACTIONS
U1 CHECK BLOWER MOTOR OPERATION	
1 2  GL1241-B	2 Place the front A/C function switch to FLR (manual A/C); or select the electronic automatic temperature control (EATC) FLOOR button. 3 Rotate the rear blower switch to MED, and then to HIGH. • **Does the rear blower operate?** → **Yes** If the blower operates in all speeds, WIGGLE the wires and CHECK for an intermittent condition. If the rear blower operates in one speed only, GO to U6 . → **No** GO to U2 .
U2 CHECK I/P FUSE 31 (7.5A)	
1 I/P Fuse 31 (7.5A)	

	• **Is fuse 31 (7.5A) OK?** → **Yes** GO to U3 . → **No** INSTALL a new fuse 31 (7.5A). TEST the system for normal operation. If the fuse fails again, GO to U14 .
U3 CHECK CIRCUIT 371 (PK/WH) FOR VOLTAGE	
1 Rear Blower Motor C2012 2  GL1069-A	2 Measure the voltage between rear blower motor C2012, circuit 371 (PK/WH), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to U4 . → **No** GO to U10 .
U4 CHECK REAR BLOWER MOTOR OPERATION	
1  GL1238-A 2	1 Place the rear blower switch to HIGH. 2 Measure the voltage between rear blower motor C2012, circuit 371 (PK/WH), and rear



blower motor C2012, circuit 515 (OG/RD).

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new rear blower motor. TEST the system for normal operation.

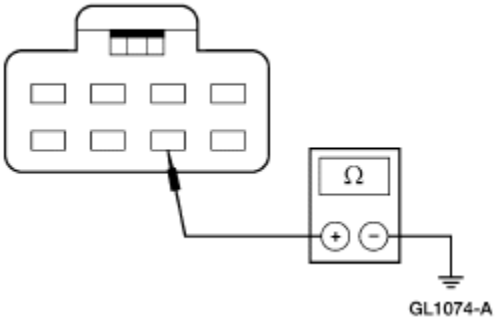
→ **No**
GO to U5 .

U5 CHECK CIRCUIT 57 (BK) FOR OPEN

1

Rear Blower Switch C2004

2



2 Measure the resistance between rear blower switch C2004 pin 7, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

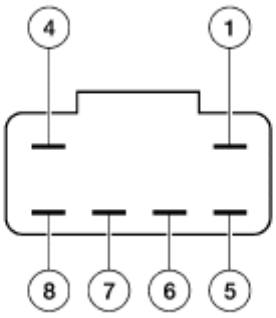
→ **Yes**
GO to U6 .

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

U6 CHECK REAR BLOWER SWITCH

1

1 Measure the resistance of the rear blower switch. Refer to the chart shown.



GL0448-B

Blower Switch Resistance Test

Switch Position	Resistance Between Terminals
OFF	None
LOW	None
MED	6 and 7
HIGH	5 and 7

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to U7 .

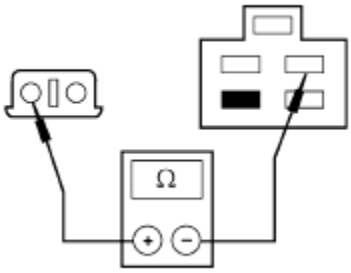
→ **No**
INSTALL a new rear blower switch. TEST the system for normal operation.

U7 CHECK CIRCUIT 515 (OG/RD) FOR OPEN

1

Rear Blower Motor Resistor C2014

2



GL0449-A

2 Measure the resistance between rear blower motor C2012, circuit 515 (OG/RD), and rear blower motor resistor C2014 pin 2, circuit 515 (OG/RD).

- **Is the resistance less than 5 ohms?**

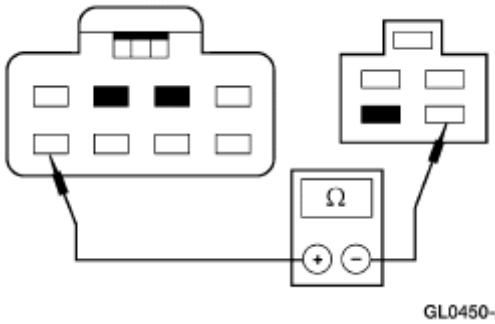
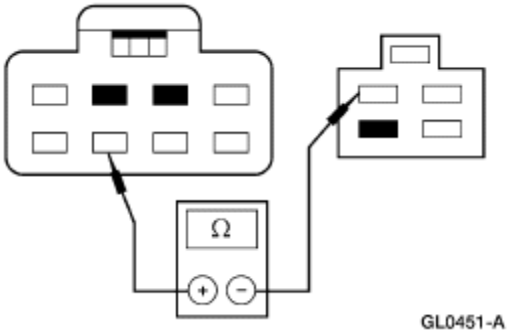
→ **Yes**
GO to U8 .

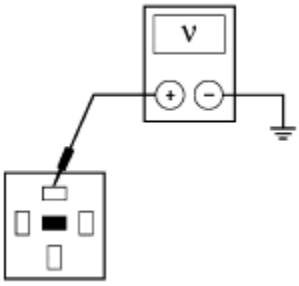
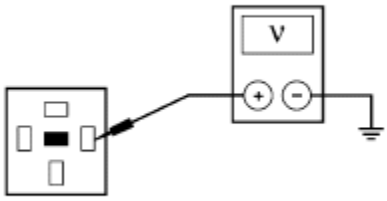
→ **No**
REPAIR circuit 515 (OG/RD). TEST the system for normal operation.

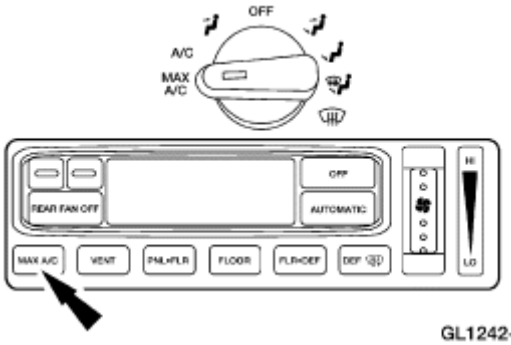
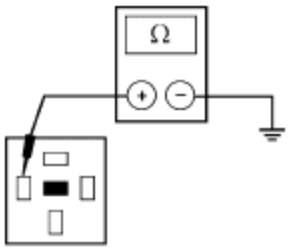
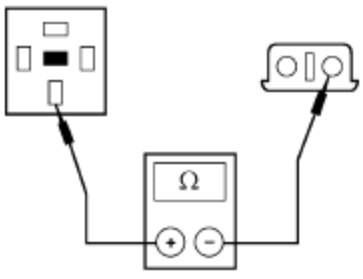
U8 CHECK CIRCUIT 261 (OG/BK) FOR OPEN

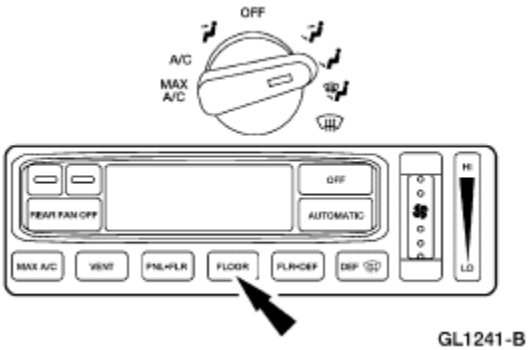
1

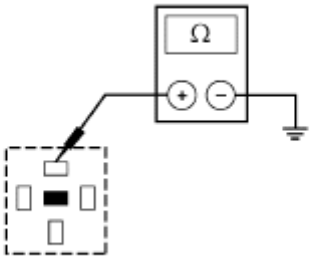
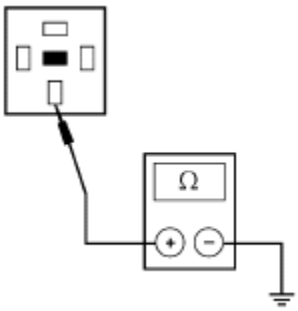
1 Measure the resistance between rear blower motor resistor C2014-4, circuit 261 (OG/BK), and rear blower switch C2014 pin 5, circuit

	261 (OG/BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to U9 . → **No** REPAIR circuit 261 (OG/BK). TEST the system for normal operation.
U9 CHECK CIRCUIT 269 (LB/OG) FOR OPEN	
1 	1 Measure the resistance between rear blower motor resistor C2014 pin 1, circuit 269 (LB/OG), and rear blower switch C2014 pin 6, circuit 269 (LB/OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new rear blower motor resistor. TEST the system for normal operation. → **No** REPAIR circuit 269 (LB/OG) for open. TEST the system for normal operation.
U10 CHECK CIRCUIT 181 (BN/OG) FOR OPEN	
1 Rear Blower Relay 2	

 3  GL0452-A	3 Measure the voltage between rear blower relay pin 87, circuit 181 (BN/OG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to U11 . → **No** REPAIR circuit 181 (BN/OG). TEST the system for normal operation.
U11 CHECK CIRCUIT 1003 (GY/YE) FOR OPEN	
1  GL0453-A	1 Measure the voltage between rear blower relay connector pin 85, circuit 1003 (GY/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to U12 . → **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation.
U12 CHECK CIRCUIT 260 (RD/OG) FOR OPEN	
1	1 Turn the A/C function switch to MAX A/C (manual A/C); or select the electronic automatic temperature control (EATC) MAX A/C button.

 GL1242-B 2  GL0454-A	2 Measure the resistance between the rear blower relay connector pin 86, circuit 260 (RD/OG), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to U13 . → **No** REPAIR circuit 260 (RD/OG). TEST the system for normal operation.
U13 CHECK CIRCUIT 371 (PK/WH) FOR OPEN	
1  GL0455-A	1 Measure the resistance between the rear blower relay connector pin 30, circuit 371 (PK/WH), and rear blower motor C2012, circuit 371 (PK/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new rear blower relay. TEST the system for normal operation. → **No**

	REPAIR circuit 371 (PK/WH). TEST the system for normal operation.
U14 CHECK FOR SHORTED REAR BLOWER MOTOR	
1 Rear Blower Motor C2012	
	2 Install a new I/P fuse 31 (7.5A).
3 	
4  GL1241-B	4 Turn the A/C function switch to the FLR (manual A/C) position; or select the electronic automatic temperature control (EATC) FLOOR button.
5 Fuse 31 (7.5A)	
	• **Is fuse 31 (7.5A) OK?** → **Yes** INSTALL a new rear blower motor. TEST the system for normal operation. → **No** GO to U15 .
U15 CHECK CIRCUIT 181 (BN/OG) FOR SHORT TO GROUND	
1 Rear Blower Relay	
2	2 Measure the resistance between rear blower relay connector pin 87, circuit 181 (BN/OG), and ground.

 GL0440-A	• **Is the resistance greater than 10,000 ohms?** → **Yes** GO to U16 . → **No** REPAIR circuit 181 (BN/OG). TEST the system for normal operation.
U16 CHECK CIRCUIT 371 (PK/WH) FOR SHORT TO GROUND	
1  GL1225-A	1 Measure the resistance between rear blower relay connector pin 30, circuit 371 (PK/WH), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new rear blower relay. TEST the system for normal operation. → **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.

Component Tests

Heater Core

WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate

the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

1. **NOTE:** Testing of returned heater cores reveals that a large percentage of heater cores are good and did not require installation of a new heater core. If a heater core leak is suspected, the heater core must be tested by following the plugged heater core component test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

   Inspect for evidence of coolant leakage at the heater water hose to heater core attachments. A coolant leak in the heater water hose could follow the heater core tube to the heater core and appear as a leak in the heater core.

2. **NOTE:** Spring-type clamps are installed as original equipment. Installation and overtightening of non-specification clamps can cause leakage at the heater water hose connection and damage the heater core.

   Check the integrity of the heater water hose clamps.

Heater Core—Plugged

WARNING: The heater core inlet hose will become too hot to handle if the system is working correctly.

1. Check to see that the engine coolant is at the correct level.

2. Start the engine and turn on the heater.

3. When the engine coolant reaches operating temperature, feel the heater core outlet hose to see if it is hot.

If it is not hot:

- the heater core may have an air pocket
- the heater core may be plugged
- the thermostat is not working correctly.

Heater Core—Pressure Test

Use Radiator/Heater Core Pressure Tester to carry out the pressure test.

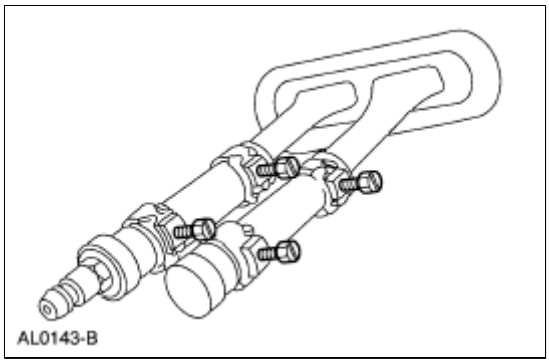
1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

   Drain the coolant from the cooling system. For additional information, refer to Section 303-03 .

2. Disconnect the heater water hoses from the heater core. For additional information, refer to Section 412-02 .

3. Install a short piece of heater water hose, approximately 101 mm (4 inches) long on each heater core tube.

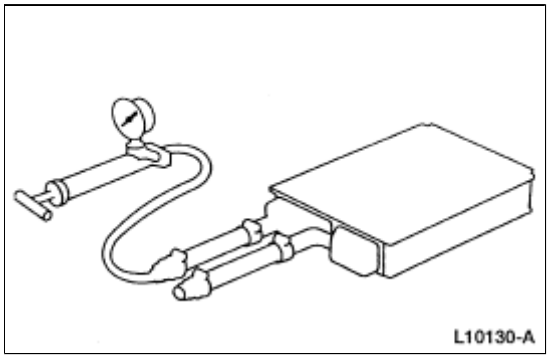
4. Fill the heater core and heater water hoses with water and install Plug BT-7422-B and adapter BT-7422-A from the radiator/heater core pressure tester in the heater water hose ends. Secure the heater water hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the Radiator/Heater Core Pressure Tester to the adapter.
6. Close the bleed valve at the base of the gauge. Pump 241 kPa (35 psi) of air pressure into the heater core.
7. Observe the pressure gauge for a minimum of three minutes.
8. If the pressure drops, check the heater water hose connections to the core tubes for leaks. If the heater water hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

Heater Core—Bench Test

1. Remove the heater core from the vehicle. For additional information, refer to Section 412-02 .
2. Drain all of the coolant from the heater core.
3. Connect the 101 mm (4 inch) test heater water hoses with plug and adapter to the core tubes. Then connect the radiator/heater core pressure tester to the adapter.
4. Apply 241 kPa (35 psi) of air pressure to the heater core. Submerge the heater core in water.
5. If a leak is observed, install a new heater core.



A/C Evaporator/Condenser Core—On-Vehicle Leak Test

1. Discharge and recover the refrigerant. For additional information, refer to Discharging and Recovery in this section.
2. **NOTE:** DO NOT leak test an A/C evaporator core with the suction accumulator/drier (19C836) attached to the core tubes.

Disconnect the suspect A/C evaporator core or A/C condenser core from the A/C system. For additional information, refer to Section 412-03 .

3. Clean the spring lock couplings. For additional information, refer to Spring Lock Coupling in this section.

4. Connect the appropriate test fittings from the R-12/R-134a Air Conditioning Test Fitting Set to the evaporator or condenser tube connections.

5. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter which will activate the valve. The test is not valid if the shut-off valve does not open.

   Connect the red and blue hoses from the R-134a Manifold Gauge Set to the test fittings on the A/C evaporator core or A/C condenser core. Connect the yellow hose to a known good vacuum pump.

6. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low pressure gauge indicates 101 kPa (30 in-Hg). The 45 minute evacuation is necessary to remove any refrigerant from oil left in the A/C evaporator core or A/C condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.

7. If the low pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before installing a new A/C evaporator core or A/C condenser core.

8. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
   - If the low pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
   - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
   - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the A/C evaporator core or A/C condenser core. Then recheck for loss of vacuum.
   - If a very small leak is suspected, allow the system to set overnight with vacuum applied and check for vacuum loss.

9. If the A/C evaporator core or A/C condenser core does leak, as verified by the above procedure, install a new A/C evaporator core or A/C condenser core. For additional information, refer to Section 412-03 .

A/C Compressor—External Leak Test

1. Install the A/C pressure test adapter on the rear head of the A/C compressor using the existing manifold retaining bolt.

2. Connect the high and low pressure lines of a manifold gauge set or a refrigerant recovery/recycling station such as R-134a A/C Service Center to the corresponding fittings on the A/C pressure test adapter.

3. Attach the center hose of the manifold gauge set to a refrigerant container standing in an upright position.

4. Hand-rotate the compressor shaft 10 complete revolutions to distribute the oil inside the A/C compressor.

5. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.

6. Using the Refrigerant Leak Detector, check for leaks at the compressor shaft seal and the compressor center seal.

7. If a shaft seal leak is found, install a new shaft seal. For additional information, refer to Section 412-03 . If an external leak is found at the center joint of the A/C compressor, install a new A/C compressor.

8. When the leak test is complete, recover the refrigerant from the compressor.

Air Conditioning (A/C) System Check — Retail Procedure

NOTE: This Retail Procedure is not eligible for claiming on Ford paid repairs (warranty and ESP).

NOTE: The engine should be run at idle for 10 minutes with the air conditioning on and set to MAX A/C before carrying out this retail procedure.

NOTE: Read and follow all of the Warnings, Cautions and Notes at the beginning of this section before continuing.

1. **Visual inspection**
   Open the hood and visually inspect the heating and air conditioning systems for the following:
   - Coolant reservoir for correct coolant level
   - Heater hoses for deterioration or loose connections
   - Radiator and condenser for debris or damaged fins restricting airflow, loose mounting or connections
   - Accessory drive belt(s) and cooling fan(s) for wear or physical damage
   - Refrigerant lines and connections for physical damage or loose connections
   - Compressor for physical damage or loose connections
   - Suction accumulator/drier for physical damage or loose connections
   - Wiring and connectors for excessive wear, loose or damaged connections, or incorrect routing

2. **A/C refrigerant analysis**
   - Carry out air conditioning refrigerant analysis. For additional information, refer to Refrigerant Identification Testing in this section.
   - If the refrigerant fails the analysis, discontinue diagnosis and make recommendations for repairs.
   - If the refrigerant passes the analysis, carry out the air conditioning system check.

3. **Air conditioning system check**
   - Connect manifold gauge set or charging station with gauges to refrigerant system.
   - With the vehicle in park, parking brake set, thermometer installed in center panel vent, and air conditioning system on and set to MAX A/C, start the engine.
   - Record air refrigerant system pressures while running the engine at 1,500 rpm and allow engine to return to idle.
   - Operate the blower motor in all control positions and check for correct blower speed changes.
   - With the blower motor on HI, operate air discharge mode selector in all positions and check for correct airflow in each position.
   - Operate the temperature blend selector in all positions and check for correct change in discharge temperature. Check the air discharge temperature with the selector in the coolest position and the air conditioning on and set to MAX A/C to determine if the air discharge temperature is acceptable for the current ambient air temperature.
   - Carry out the EATC self-test (if applicable).
     If the refrigerant system pressures were low, carry out the refrigerant system leak test.

4. **Refrigerant system leak test**
   - Use either an ultraviolet (UV) or an electronic leak detector to check for leaks at all refrigerant lines, connections, and components.
     After all tests have been completed, report all findings and recommended repairs to your

service advisor before carrying out further diagnostic procedures.

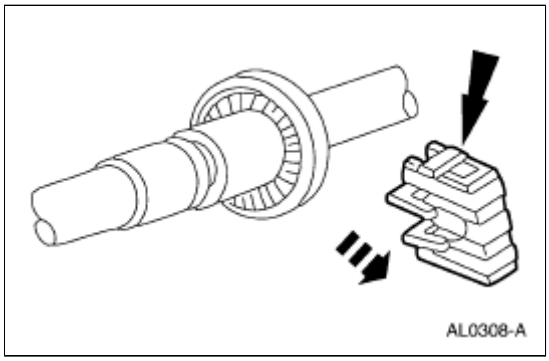
Spring Lock Coupling

Special Tool(s)

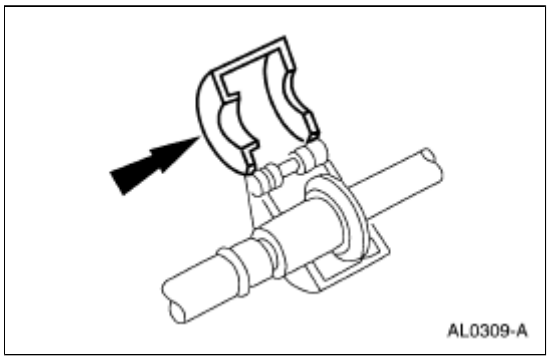
ST2352-A	Spring Lock Coupling Disconnect Tool Set 412-039 (T84L-19623-B)

Disconnect

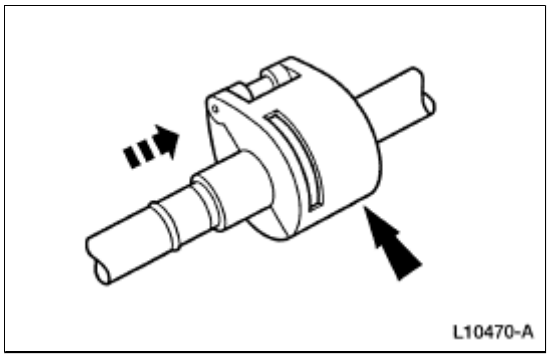
1. Remove the A/C tube lock coupling clip (19E746).



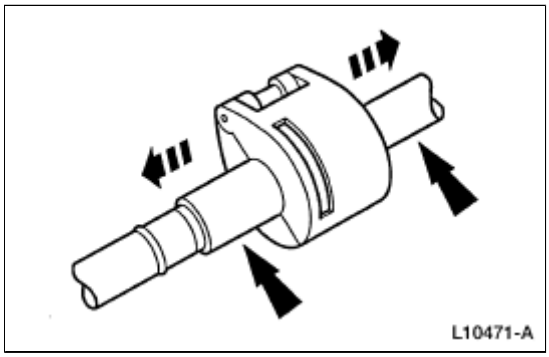
2. Fit the spring lock coupling disconnect tool to the spring lock coupling.



3. Push the tool into the cage opening to release the female fitting from the A/C tube lock coupling spring (19E576).

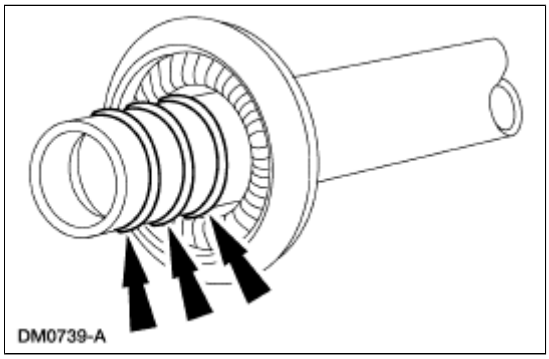


4. Pull the spring lock coupling fittings apart.



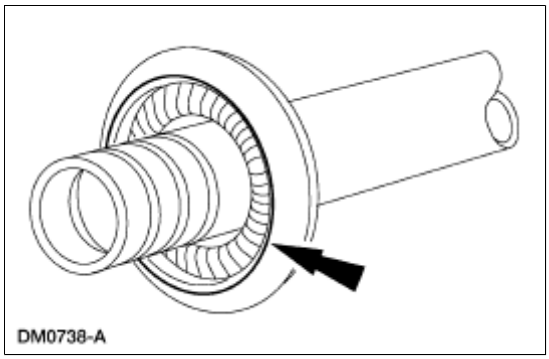
5. **CAUTION: Do not use metal tools to remove the O-ring seals. They can cause axial scratches across the O-ring seal grooves resulting in refrigerant leaks.**

   Remove the O-ring seals with a non-metallic tool.
   - There are three O-ring seals required for the A/C condenser core couplings.
   - There are two O-ring seals for all other refrigerant tube couplings.



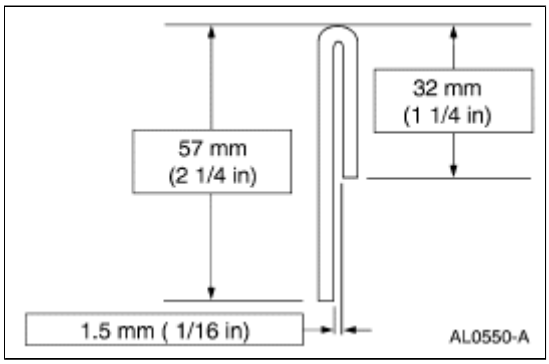
6. **CAUTION: Do not use a screwdriver or similar tool to remove the A/C tube lock coupling spring; this can cause axial scratches across the O-ring seal grooves resulting in refrigerant leaks.**

   Remove the A/C tube lock coupling spring with a small hooked wire.



Cleaning

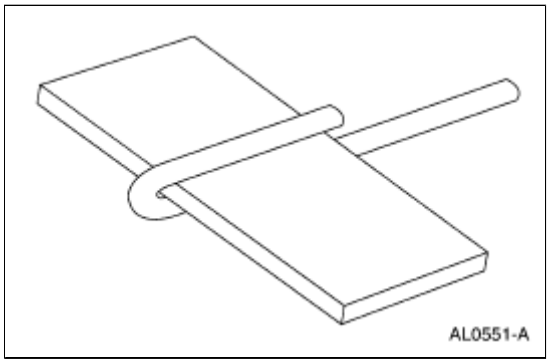
1. Fabricate a cleaning tool from a 1/8 inch diameter brazing rod.



2. Cut an abrasive pad from maroon colored 3M Scotch Brite® with the dimensions corresponding to the coupling size.

Coupling Size	Pad Size
3/8 inch	25 X 50 mm (1 X 2 inch)
1/2 inch	25 X 50 mm (1 X 2 inch)
5/8 inch	25 X 76 mm (1 X 3 inch)
3/4 inch	25 X 102 mm (1 X 4 inch)

3. Assemble the pad to the tool.



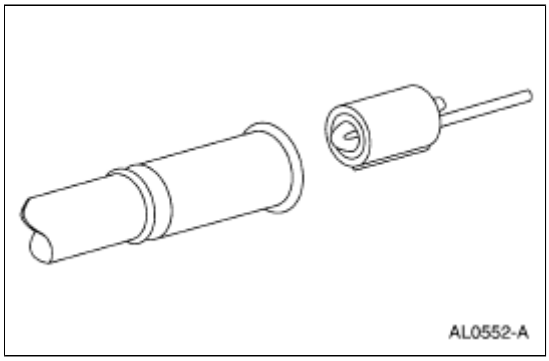
4. Coat the abrasive pad with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA

(Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

5. Roll the pad on the tool and install it in a variable speed drill motor.

6. **CAUTION: Maintain low speed drill rotation when inserting or removing the cleaning tool to prevent axial scratches which may cause future leaks.**

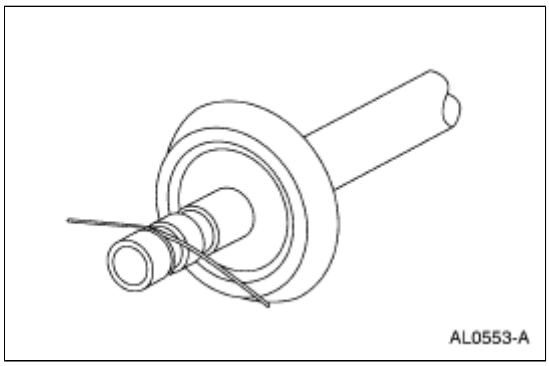
   Polish for one minute at moderate speed (less than 1,500 rpm) or until the surface is clean and free of scratches or foreign material.



7. Clean the fitting with a lint-free cloth.

8. Inspect the surface for grooves or scratches. If grooves and scratches are still present, install a new component.

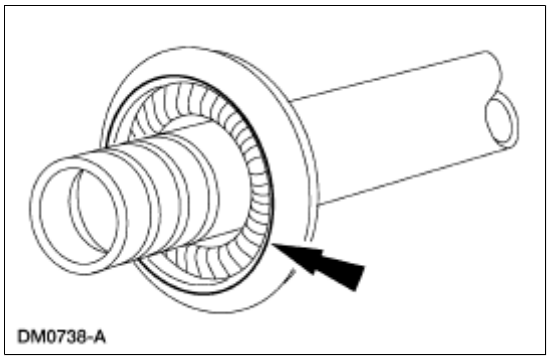
9. Clean the O-ring seal grooves with a 300 mm (12 inch) length of natural fiber string.
   - Loop the string around the grooves and pull the string back and forth.



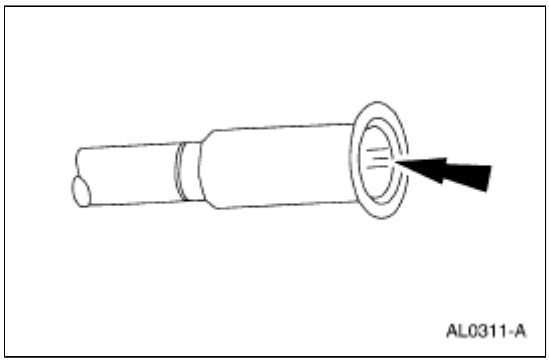
10. Remove any foreign material from the grooves with a lint-free cloth.

Connect

1. Install the A/C tube lock coupling spring.

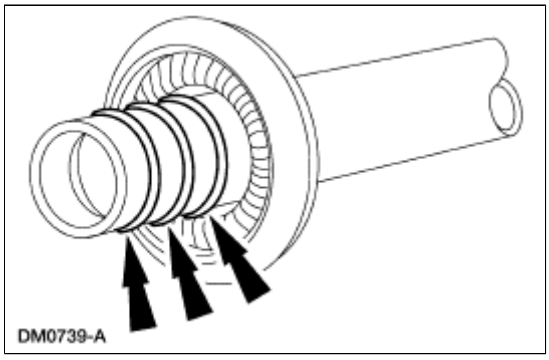


2. Lubricate the inside of the coupling with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

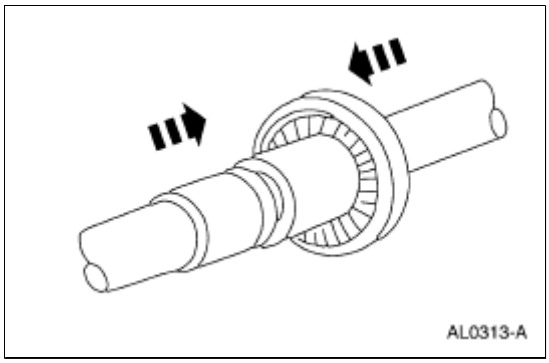


3. **CAUTION: Use only new green O-ring seals. The use of any O-ring seals other than specified may result in intermittent leakage during vehicle operation.**

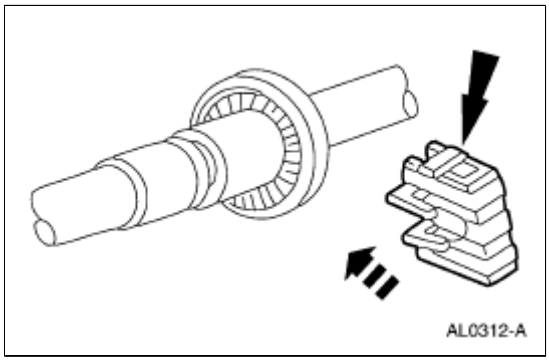
   Install the O-ring seals.
   - Lubricate the O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



4. Connect the spring lock coupling fittings with a twisting motion until the A/C tube lock coupling spring snaps over the flared end of the female fitting.



5. Install the A/C tube lock coupling clip.

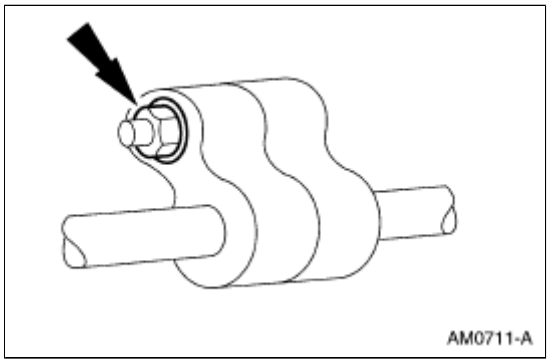


Fitting —Peanut

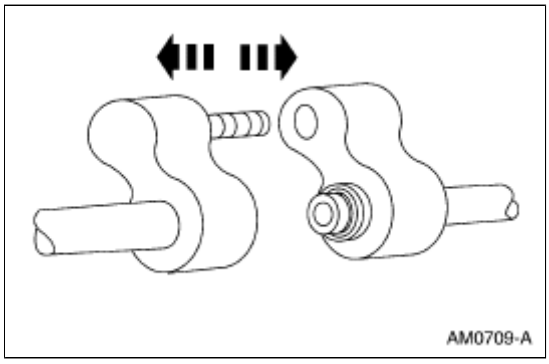
Disconnect

1. **CAUTION: Support the female fitting with a wrench to prevent the tubes from twisting.**

   Remove the nut from the peanut fitting.

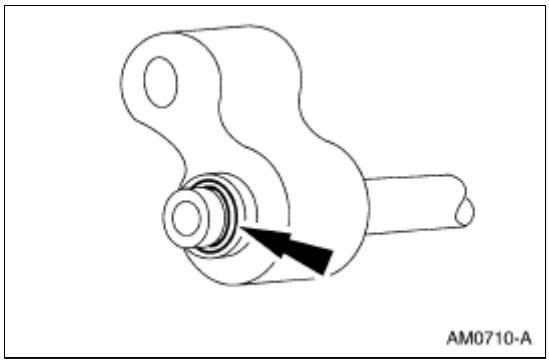


2. Pull the peanut fitting apart.



3. **CAUTION: Do not use metal tools to remove the O-ring seal. They can cause axial scratches across the O-ring seal groove resulting in refrigerant leaks.**

   Remove the O-ring seal with a non-metallic tool.

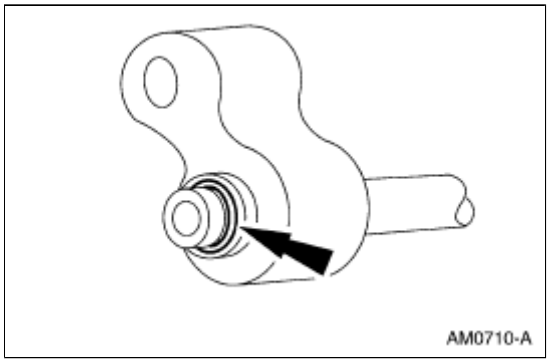


Connect

1. Clean all dirt or foreign material from the fittings.

2. **CAUTION: Use only new green O-ring seals. The use of any O-ring seals other than specified may result in intermittent leakage during vehicle operation.**

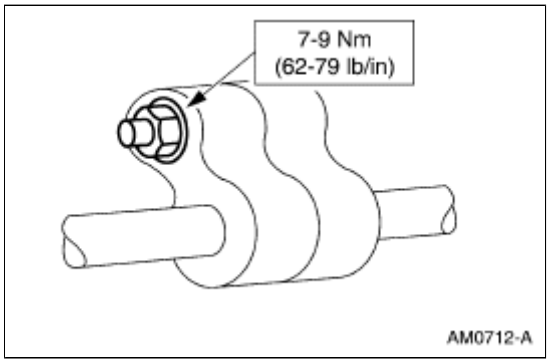
   Install the O-ring seal.
   - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



3. Lubricate the inside of the fittings with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

4. **NOTE:** When correctly assembled the male and female fittings should be flush.

   Assemble the male and female fittings together.



Refrigerant System Tests

Special Tool(s)

ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

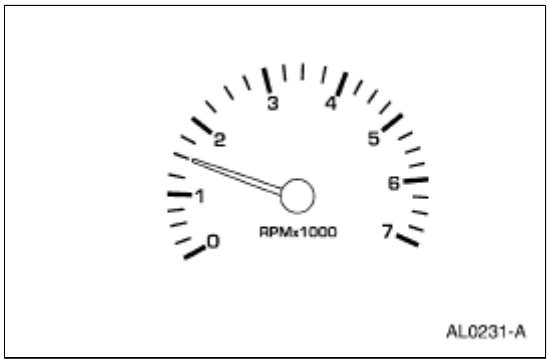
1. Connect the R-134a Manifold Gauge Set. For additional information, refer to Manifold Gauge Set Connection in this section.

2. Adjust the climate control for maximum cooling.
   - Start the engine.
   - Select MAX A/C operation.
   - Set the blower motor speed to maximum.

3. Stabilize the in-vehicle temperature at 21°C-27°C (70°F-80°F).

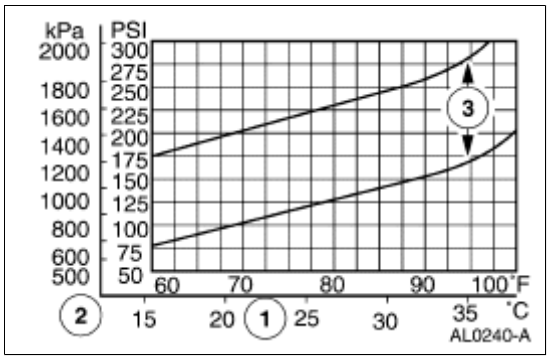
4. **NOTE:** When the ambient temperatures exceed 38°C (100°F), do not run the engine above normal idle speed.

   Maintain the engine speed at 1,500 rpm.



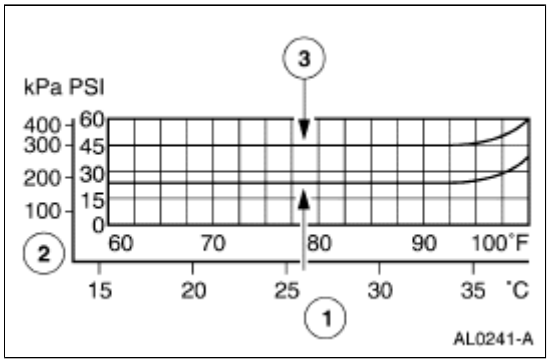
5. Determine the compressor discharge (high) pressure.
   1. Record the ambient temperature.
   2. Record the discharge (high) pressure.
   3. **NOTE:** In ambient temperatures between 38°C-43°C (100°F-110°F), the system performance pressures will be the same as those for ambient temperatures shown on the chart in the 32°C-38°C (90°F-100°F) range.

      The system performance is acceptable when the pressure reading falls between the upper and lower limits shown.



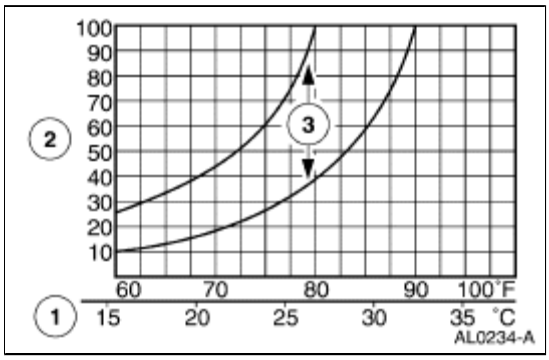
6. Determine the compressor suction (low) pressure.
    1. Record the ambient temperature.
    2. Record the suction (low) pressure.
    3. **NOTE:** In ambient temperatures between 38°C-43°C (100°F-110°F), the system performance pressures will be the same as those for ambient temperatures shown on the chart in the 32°C-38°C (90°F-100°F) range.

       The system performance is acceptable when the pressure reading falls between the upper and lower limits shown.



7. Determine the A/C clutch ON time.
    1. Record the ambient temperature.
    2. Record the A/C clutch ON time in seconds.
    3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

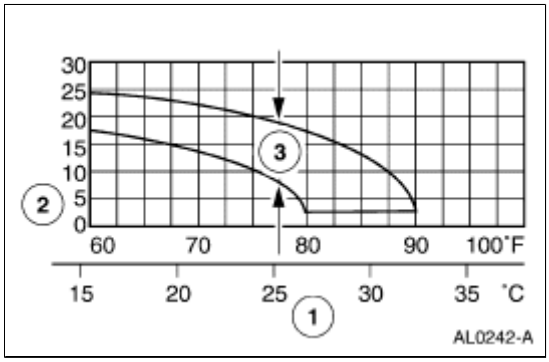
       The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



8. Determine the A/C clutch OFF time.

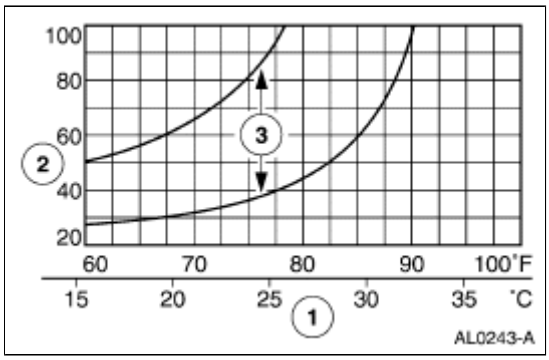
1. Record the ambient temperature.
2. Record the A/C clutch OFF time in seconds.
3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

   The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



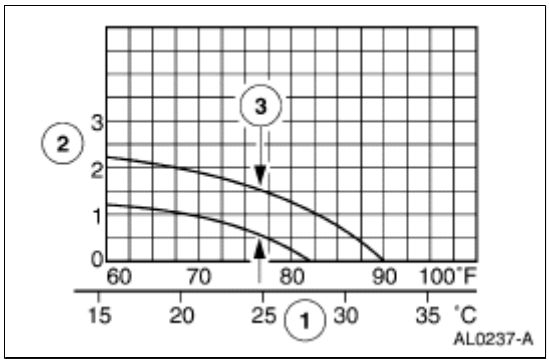
9. Determine the total A/C clutch cycle time.
   1. Record the ambient temperature.
   2. Record the time the A/C clutch is engaged plus the time it is disengaged (time ON plus time OFF).
   3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

      The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



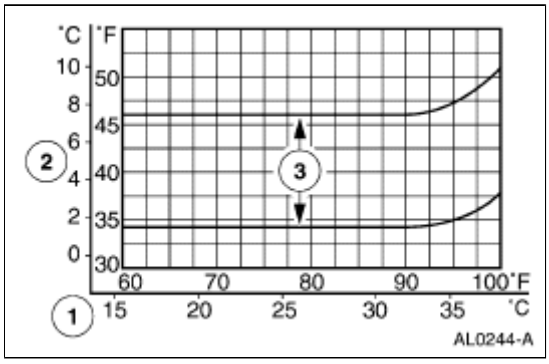
10. Determine the A/C clutch cycle rate per minute.
    1. Record the ambient temperature.
    2. Record the number of A/C clutch cycles occurring in one minute.
    3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

       The system performance is acceptable when the recorded number of cycles fall between the upper and lower limits shown.



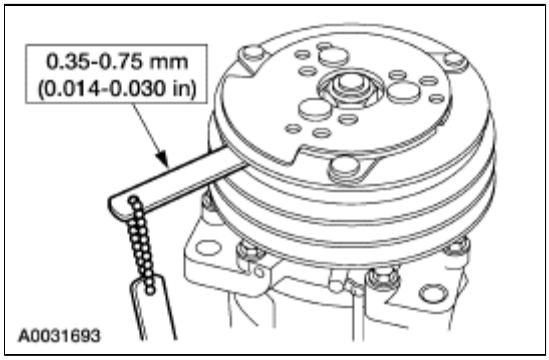
11. Determine the center A/C register discharge temperature.
    1. Record the ambient temperature.
    2. Record the center A/C register discharge temperature.
    3. **NOTE:** In ambient temperatures between 38°C-43°C (100°F-110°F), the A/C register discharge temperatures will be the same as those for ambient temperatures shown on the chart in the 32°C-38°C (90°F-100°F) range.

       The system performance is acceptable when the center A/C register discharge temperature falls between the upper and lower limits shown.



A/C Clutch Air Gap Adjustment

1. Check the A/C clutch air gap at three equally spaced places between the clutch hub and the A/C clutch pulley.



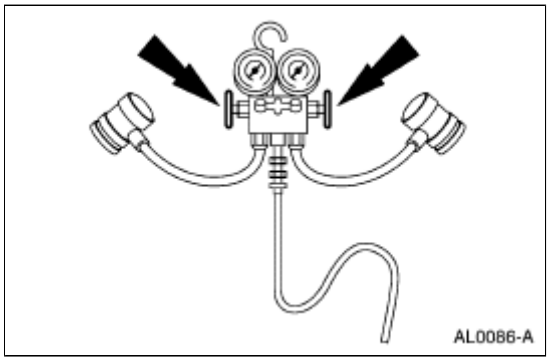
2. Remove the A/C clutch. Add or remove spacers between the A/C clutch and the compressor shaft until clearance is within specification. For additional information, refer to Section 412-03 .

Manifold Gauge Set Connection

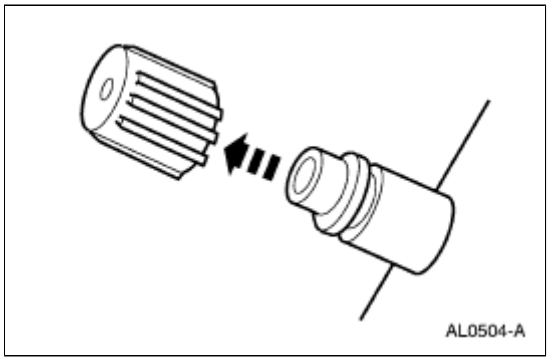
Special Tool(s)

ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

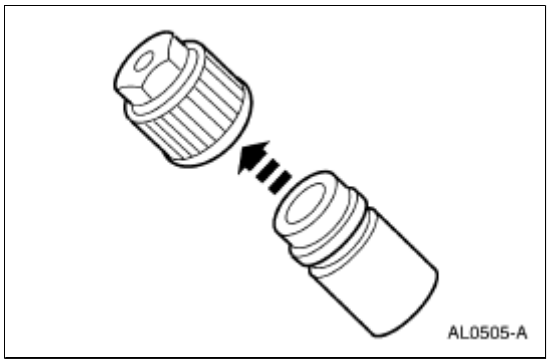
1. Turn both valves on the R-134a Manifold Gauge Set all the way to the left to close the low- and high-pressure hoses to the center manifold and center hose.



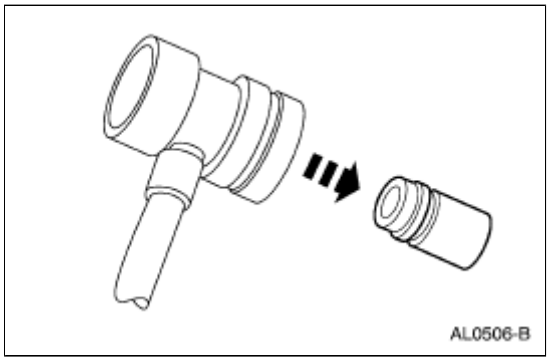
2. Remove the A/C charging valve cap (19D702) from the low-pressure service gauge port valve.



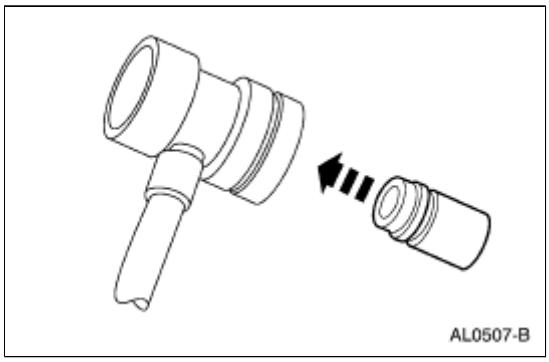
3. Remove the A/C charging valve cap from the high-pressure service gauge port valve.



4. Connect the R-134a Manifold Gauge Set low-pressure hose and the R-134a low side quick disconnect to the low-pressure service gauge port valve.



5. Connect the R-134a Manifold Gauge Set high-pressure hose and the R-134a high side quick disconnect to the high-pressure service gauge port valve.



Leak Detection —Using Refrigerant Leak Detector

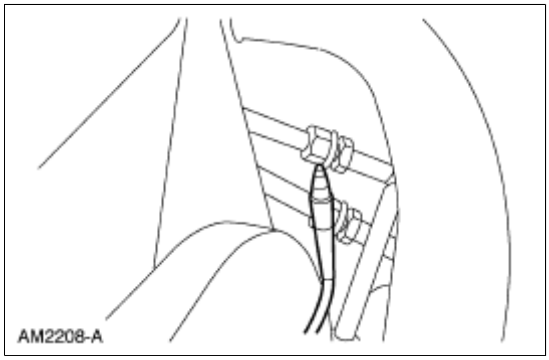
Special Tool(s)

ST2351-A	Refrigerant Leak Detector 216-00001 or equivalent

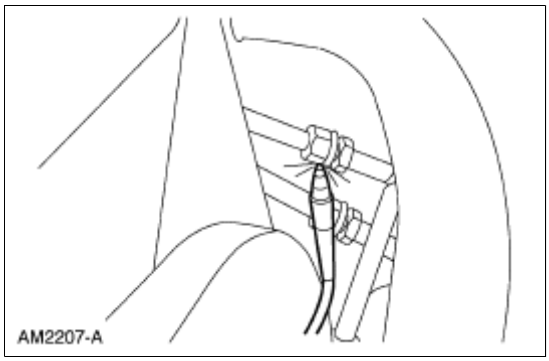
CAUTION: Good ventilation is necessary in the area where electronic A/C leak testing is to be performed. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as anti-freeze, diesel fuel, disc brake cleaner, or other cleaning solvents can cause the same problem. A fan, even in a well-ventilated area, is very helpful in removing small traces of contamination from the air that might affect the leak detector.

1. **NOTE:** System pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

   Leak test the refrigerant system using the Refrigerant Leak Detector. Follow the instructions included with the leak detector for handling and operation techniques.

   
   AM2208-A

2. If a leak is found, discharge and recover the refrigerant. For additional information, refer to Discharging and Recovery in this section.
   - Repair the system.
   - Test the system for normal operation.


AM2207-A

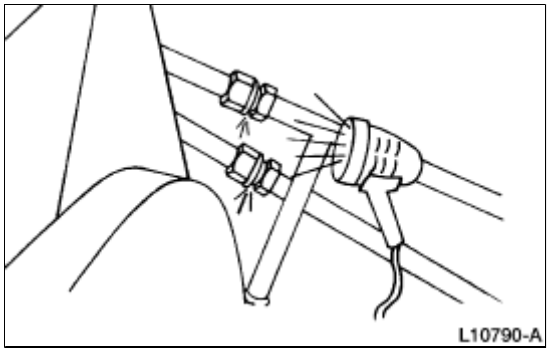
Leak Detection —Using Tracer Dye

Special Tool(s)

ST1261-A	120 Watt UV Spot Lamp 164-R0721 or equivalent

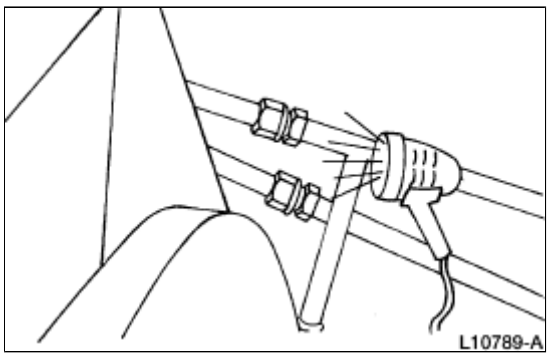
NOTE: Ford Motor Company vehicles are produced with a permanent leak tracer dye incorporated into the A/C system. The location of leaks can be pinpointed by the bright yellow-green glow of the tracer dye. Since more than one leak can exist, always inspect each component.

1. Check for leaks using a 120 Watt UV spot lamp.
   - Scan all components, fittings and lines of the A/C system.


L10790-A

2. After the leak is repaired, remove any traces of leak dye with a general purpose oil solvent.

3. Verify the repair by operating the system for a short time and inspecting with the UV spot lamp.


L10789-A

Discharging and Recovery

Special Tool(s)

ST1834-A	R-134a A/C Refrigerant Center 023-00153 or equivalent
ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

1. Prior to recovering the refrigerant system, you must verify the purity of the refrigerant. For additional information, refer to Refrigerant Identification Testing in this section.

2. **NOTE:** Some R-134a service centers require the use of an A/C manifold gauge set. For additional information, refer to Manifold Gauge Set Connection in this section.

   Connect the R-134a A/C refrigerant center to the low- and high-pressure service gauge port valves.

3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer.

4. Once the refrigerant center has recovered the vehicle A/C system refrigerant, close the refrigerant center inlet valve (if so equipped). Then switch off the power supply.

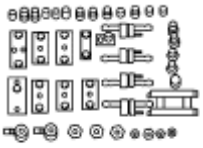
5. Allow the vehicle A/C system to remain closed for about two minutes. Observe the system vacuum level as shown on the gauge. If the pressure does not rise, disconnect the recovery station hose(s).

6. If the system pressure rises, repeat steps 2 through 5 until the vacuum level remains stable for two minutes.

7. Carry out the required repairs, then evacuate and recharge the A/C system. For additional information, refer to Evacuation and Charging in this section.

Air Conditioning (A/C) System Flushing

Special Tool(s)

ST2466-A	A/C Flush and Purge Machine 219-00022 (part of 219-00023) or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 (part of 219-00023) or equivalent

WARNING: Use extreme care and observe all safety and service precautions related to the use of refrigerants.

WARNING: Due to refrigerant hazards, always wear safety goggles and non-penetrable gloves when working on or flushing A/C systems.

CAUTION: An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer's procedures and instructions.

CAUTION: Suction accumulator/drier, muffler, hoses, thermal expansion valve, and fixed orifice tube should be removed when flushing the A/C system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. Except for the hoses, these components are typically discarded after A/C system contamination. Hoses can normally be reused unless they are clogged with foreign material. The 3.785 liters (1 gallon) of A/C Systems Flushing Solvent F4AZ-19579-A and FL1-A filter used in A/C Flush and Purge Machine 219-00022 are intended for use on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.

1. **NOTE:** Prior to using the A/C Flush and Purge Machine 219-00022 for the first time, review the operating instructions.

   NOTE: Only the A/C Flush and Purge Machine kit 219-00023, which includes A/C Flush and Purge Machine 219-00022, A/C Flush and Purge Fitting Kit 219-00024, and the Ford Part number F4AZ-

19579-A A/C Systems Flushing Solvent, is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers. Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.

Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers, A/C evaporator core, and A/C condenser core. The procedure allows the specific components to be cleaned and flushed while installed in their normal in-vehicle location. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure within the suction accumulator/drier and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a two-step procedure that involves the use of an A/C Flush and Purge Machine 219-00022 to:

- Circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
- Remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.

2. Discharge the A/C system. Observe all safety precautions. For additional information, refer to the procedure in this section.

3. Disconnect the refrigerant lines from the heat exchanger(s) to be flushed.

4. Connect the A/C Flush and Purge Machine 219-00022 and A/C Flush and Purge Fitting Kit 219-00024 to the heat exchanger to be flushed. Do not flush through the A/C evaporator core orifice, mufflers or hoses. Internal plumbing and material make-up of these components make it impossible to correctly remove foreign material or residual flushing solvent.

5. Use 3.785 liters (one gallon) of A/C Systems Flushing Solvent part number F4AZ-19579-A to flush the heat exchanger for a minimum of 15 minutes. The flush solvent may be used for one or both heat exchangers in the A/C system. However, the flush solvent is intended for one vehicle only. The filter used on the flushing unit is also intended for use on one vehicle only.

6. Flush the component for a minimum of 15 minutes.

7. Apply 621-862 kPa (90-125 psi) pressurized air to the component for a minimum of 30 minutes. The 30-minute purge time is required to force and evaporate all residual solvent from the A/C system component. Failure to successfully remove all residual solvent within the component can result in system damage when reconnected and operated. Dispose of the used flush solvent and filter in accordance with local, state and federal emissions.

8. **NOTE:** A/C system filtering as described in this section is optional if system flushing is carried out. However, the filter kit use is recommended after flushing if the A/C system contamination is extensive.

   Install a new A/C evaporator core orifice in any vehicle being serviced for A/C compressor or desiccant failure.

9. Install new refrigerant hoses if clogged with foreign material.

10. Reconnect the heat exchanger being serviced.

11. Add additional refrigerant oil as required. For additional information, refer to the procedure in this section.

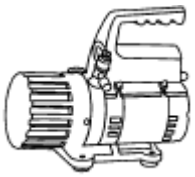
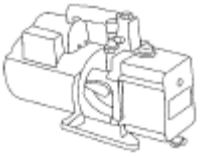
12. Evacuate, leak test and charge the A/C system. For additional information, refer to the procedure in

this section.

13. Check the system for normal operation.

Evacuation and Charging

Special Tool(s)

ST1834-A	R-134a A/C Refrigerant Center 023-00153 or equivalent
ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1685-A	1.2 CFM Vacuum Pump 023-R0162 or equivalent
 ST1686-A	4.0 CFM Vacuum Pump 023-R0163 or equivalent

1. Prior to charging the refrigerant system, you must verify the purity of the refrigerant. For additional information, refer to Refrigerant Identification Testing in this section.

2. **NOTE:** Ford Motor Company recommends use of a charging station to Carry out evacuation and charging of the refrigerant system. If a charging station is not available, system charging may be accomplished using a separate vacuum pump, charging cylinder, and manifold gauge set. For additional information, refer to Manifold Gauge Set Connection in this section.

   Connect the R-134a A/C Refrigerant Center to the low- and high-pressure service gauge port valves.

3. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) (vacuum) and as close as 101.1 kPa (30 in-Hg) as possible. Continue to operate the vacuum pump for a minimum of 45 minutes.

4. Turn off the evacuation pump. Observe the low-pressure gauge for five minutes to make sure that the system vacuum is held. If vacuum is not held for five minutes, leak-test the system, service the leaks, and evacuate the system again.

5. Correctly oil match the system to verify that the correct amount of refrigerant oil is present in the system. For additional information, refer to Refrigerant Oil Adding in this section.

6. Charge the system with the specified weight of refrigerant and refrigerant oil.

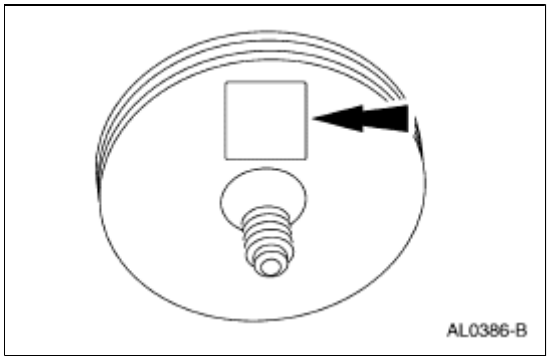
7. When no more refrigerant is being drawn into the system, start the engine and select MAX A/C operation. Set the blower motor speed to maximum and allow the remaining refrigerant to be drawn into the system. Continue to add refrigerant into the system until the specified weight of R-134a has been added. Close the charging cylinder valve and allow the system to pull any remaining refrigerant from the hose. When the suction pressure drops to approximately 207 kPa (30 psi), close the charging hose valve.

Refrigerant System Filtering After A/C Component Replacement

Special Tool(s)

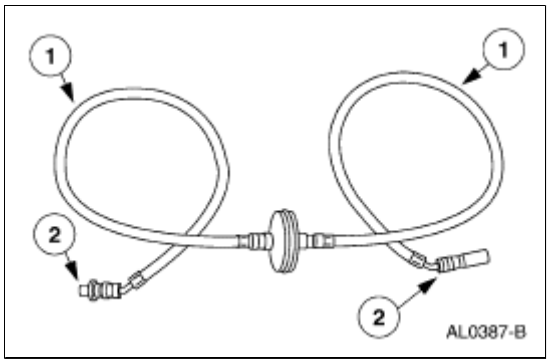
ST1252-A	R-12/R-134a Air Conditioning Test Fitting Set 412-DS028 (014-00333, D93L-19703-B) or equivalent

1. Install the new A/C compressor. For additional information, refer to Section 412-03 .
2. Install the new suction accumulator/drier. For additional information, refer to Section 412-03 .
3. Install the new A/C evaporator core orifice. For additional information, refer to Section 412-03 .
4. Orient the filter inlet toward the A/C condenser core.



5. **NOTE:** The pancake filter is not permanently installed and will be removed at the end of this procedure.

   Temporarily install the pancake filter between the A/C condenser core and the condenser to evaporator tube (19835).
   1. Use flexible refrigerant hose of 17,238 kPa (2500 psi) burst rating.
   2. Make the connections using the A/C Test Fitting Set. For additional information, refer to the Spring Lock Couplings procedure in this section.



6. Correctly oil match the system. For additional information, refer to Refrigerant Oil Adding in this section.

7. Evacuate and charge the system. For additional information, refer to the procedure in this section.

8. Check all refrigerant system hoses, lines and the positioning of the newly installed filters to be sure they do not interfere with other engine compartment components. If necessary, use tie straps to make adjustments.

9. Provide adequate airflow to the front of the vehicle (with a fan, if necessary). Select MAX A/C operation and set the blower motor speed to maximum. Start the engine and let it idle briefly. Make sure the A/C system is operating correctly.

10. Gradually bring the engine up to 1,200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1,000 rpm). Set the engine at 1,200 rpm and run it for one hour with the A/C system operating.

11. Stop the engine.

12. Recover the refrigerant from the system. For additional information, refer to the procedure in this section.

13. Remove the fittings, flexible hoses and pancake filter from between the A/C condenser core and the condenser to evaporator tube.

14. Discard the pancake filter. It can be used one time only.

15. Reconnect the condenser to evaporator tube to the A/C condenser core. For additional information, refer to Spring Lock Coupling in this section.

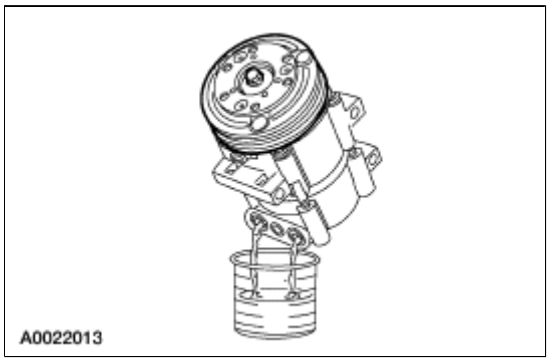
16. Evacuate and charge the system. For additional information, refer to the procedure in this section.

Refrigerant Oil Adding

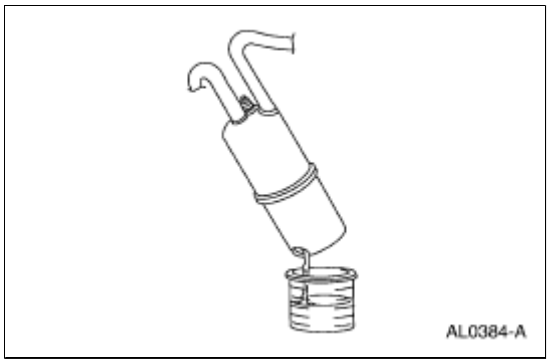
CAUTION: During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

1. **NOTE:** Service A/C compressors (19703) are shipped without compressor oil.

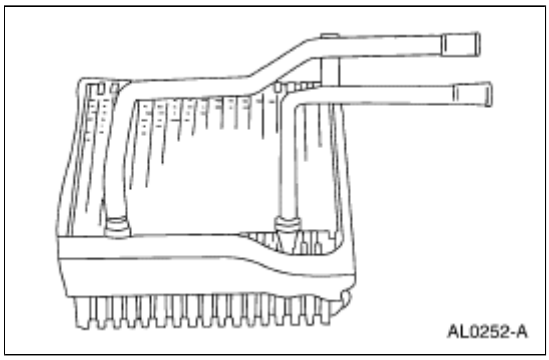
   Rotate the A/C compressor shaft six to eight revolutions while collecting oil in a clean measuring device.
   - If the amount of oil drained from the old A/C compressor is between 85-142 ml (3-5 ounces), pour the same amount plus 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is greater than 142 ml (5 ounces), pour the same amount drained of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is less than 85 ml (3 ounces), pour 85 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.



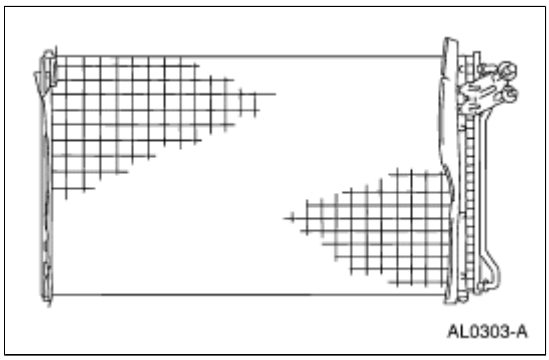
2. For the suction accumulator/drier (19C836), drill two 1/2 inch holes in the suction accumulator/drier cylinder and drain the oil into a calibrated container.
   - Add a quantity of new oil to match that drained from the old suction accumulator/drier plus 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



3. For the A/C evaporator core (19860), add 89 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the suction accumulator/drier inlet tube.



4. For the A/C condenser core (19712), add 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the A/C condenser core or the suction accumulator/drier inlet tube.



5. Add 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the suction accumulator/drier inlet tube when carrying out each of the following repairs:
    - installation of a new A/C evaporator core orifice (19D990)
    - installation of a new A/C compressor pressure relief valve (19D644)
    - installation of a new refrigerant line
    - repair of an O-ring seal leak
    - repair of a charge port leak

6. Installation of new components that do not require discharge of refrigerant and resulting oil loss, such as the A/C cycling switch (19E561) and the A/C pressure transducer, do not require additional oil.

Inspection and Assembly Requirements —Following An A/C Compressor Failure

CAUTION: To prevent refrigerant system contamination and possible failure of the new component, carry out the following procedures.

1. **NOTE:** The suction accumulator/drier and A/C evaporator core orifice cannot be cleaned and new components must be installed.

   When an A/C compressor fails due to internal causes, clean the refrigerant system by flushing or filtering. This will remove any foreign material or contaminants that may be present and prevent damage to the new A/C compressor.

2. **NOTE:** A dirty A/C evaporator core orifice or a condenser to evaporator tube containing black refrigerant oil and particles indicates that the A/C compressor has failed and a new compressor must be installed.

   Remove and discard the A/C evaporator core orifice. For additional information, refer to Section 412-03 .

3. **NOTE:** Residual refrigerant oil in the A/C compressor must be drained and measured for correct system oil matching. For additional information, refer to the Refrigerant Oil Addition procedure in this section.

   Remove the A/C compressor. For additional information, refer to Section 412-03 .

4. **NOTE:** Residual refrigerant oil in the suction accumulator/drier must be drained and measured for correct oil system matching. For additional information, refer to the Refrigerant Oil Addition procedure in this section.

   Remove the suction accumulator/drier. For additional information, refer to Section 412-03 .

5. **NOTE:** System flushing is the preferred method of cleaning. However, if flushing equipment is not available, system filtering may be carried out as an alternative.

   Clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to the Flushing procedure in this section.

6. Install the new A/C compressor. For additional information, refer to Section 412-03 .

7. Install the new suction accumulator/drier. For additional information, refer to Section 412-03 .

8. Install the new A/C evaporator core orifice. For additional information, refer to Section 412-03 .

9. Correctly oil match the system. For additional information, refer to the Refrigerant Oil Addition procedure in this section.

10. Evacuate and charge the system. For additional information, refer to the procedure in this section.

Refrigerant Identification Testing

Special Tool(s)

ST1457-A	Deluxe A/C Refrigerant Analyzer 198-00003 or equivalent

1. **NOTE:** Prior to recovering or charging the refrigerant system, you must use an A/C refrigerant analyzer to identify gas samples taken directly from the refrigeration system or storage containers.

   Follow the instructions included with the Refrigerant Analyzer to obtain the sample for testing.

2. The analyzer will display one of the following:
   - R-12 or R-134a if the purity is better than 98 % by weight.
   - FAIL if neither of the two gases have been identified or if they are not at least 98% pure.
   - HC and a horn will sound if the gas detected contains a hydrocarbon (flammable material).

3. **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into your recovery/recycling equipment.**

   Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant. For additional information, refer to Contaminated Refrigerant Handling in this section.

Contaminated Refrigerant Handling

1. **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into your recovery/recycling equipment.**

   Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant.
   - This equipment must only be used to recover contaminated refrigerant to prevent the spread to other vehicles.
   - If this equipment is not available, contact an A/C service facility in your area with the correct equipment to carry out this service.

2. Determine and correct the cause of the customer's initial concern.

3. **NOTE:** Residual refrigerant oil in the suction accumulator/drier must be drained and measured for correct oil system matching. For additional information, refer to the Refrigerant Oil Addition procedure in this section.

   The suction accumulator/drier cannot be cleaned and a new component must be installed. Remove the suction accumulator/drier. For additional information, refer to Section 412-03 .

4. Clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to the Flushing procedure in this section.

5. Install the new suction accumulator/drier. For additional information, refer to Section 412-03 .

6. Correctly oil match the system. For additional information, refer to the Refrigerant Oil Addition procedure in this section.

7. Evacuate and charge the system. For additional information, refer to the procedures in this section.

8. Dispose of contaminated refrigerant according to all federal, state and local regulations.

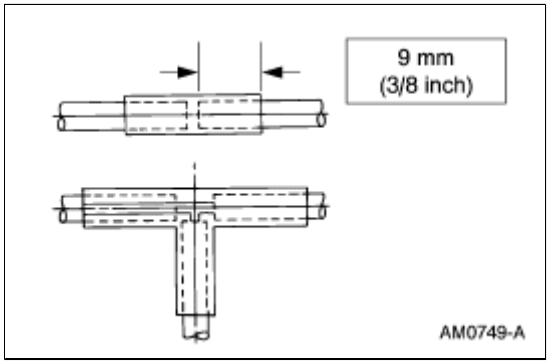
Vacuum Hose Repair —Mini-Tube

Special Tool(s)

ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

1. Measure the length of the damaged area of the mini-tube vacuum hose.
2. Cut a piece of standard 1/8 inch inner diameter vacuum hose approximately 25 mm (1 inch) longer than the damaged area of the mini-tube vacuum hose.
3. Cut off the mini-tube vacuum hose on each side of the damaged area.
4. **WARNING: Read the warning information on the product label to prevent possible injury.**

   Dip the mini-tube hose ends in commercially available paint thinner containing methyl ethyl ketone (MEK). This solvent will seal the mini-tube in the vacuum hose.
5. Insert the ends of the mini-tube vacuum hose approximately 9 mm (3/8 inch) into the ends of the standard 1/8 inch service vacuum hose section.



6. Shake the service joint after assembly to make sure the solvent is dispersed and the vacuum line is not plugged.
7. Test the system for a vacuum leak in the repair area.
   - Use the Vacuum Tester or equivalent.

General Specifications

Item	Specification
Rubber Suspension Insulator Lube E25Y-19553-A	ESF-M99B112-A

Torque Specifications

Description	Nm	lb-in
Side Window Demister Hose and Nozzle Screws	2-3	18-26
Instrument Panel Finish Panel Screws	2-3	18-26
LH Instrument Panel Register Screws	2-3	18-26
Plenum Chamber Nuts	3.4-4.8	31-42
Windshield Defroster Hose Nozzle Screws	2-3	18-26
Rear Floor Duct Screws	2-3	17-26

Air Distribution

There are two sources of air available to the air distribution system:

- outside air
- recirculated air

Recirculated air is only used during MAX A/C, AUTOMATIC (if equipped with EATC) and OFF modes.

Air distribution within the vehicle is determined by the function selector switch position, if equipped with manual A/C, or is controlled by the electronic automatic temperature control system in the AUTOMATIC mode but can be overridden by the driver if desired. Airflow control doors are used to direct airflow within the heater air plenum chamber (18471). Vacuum control motors (18A318) are used to position these airflow control doors.

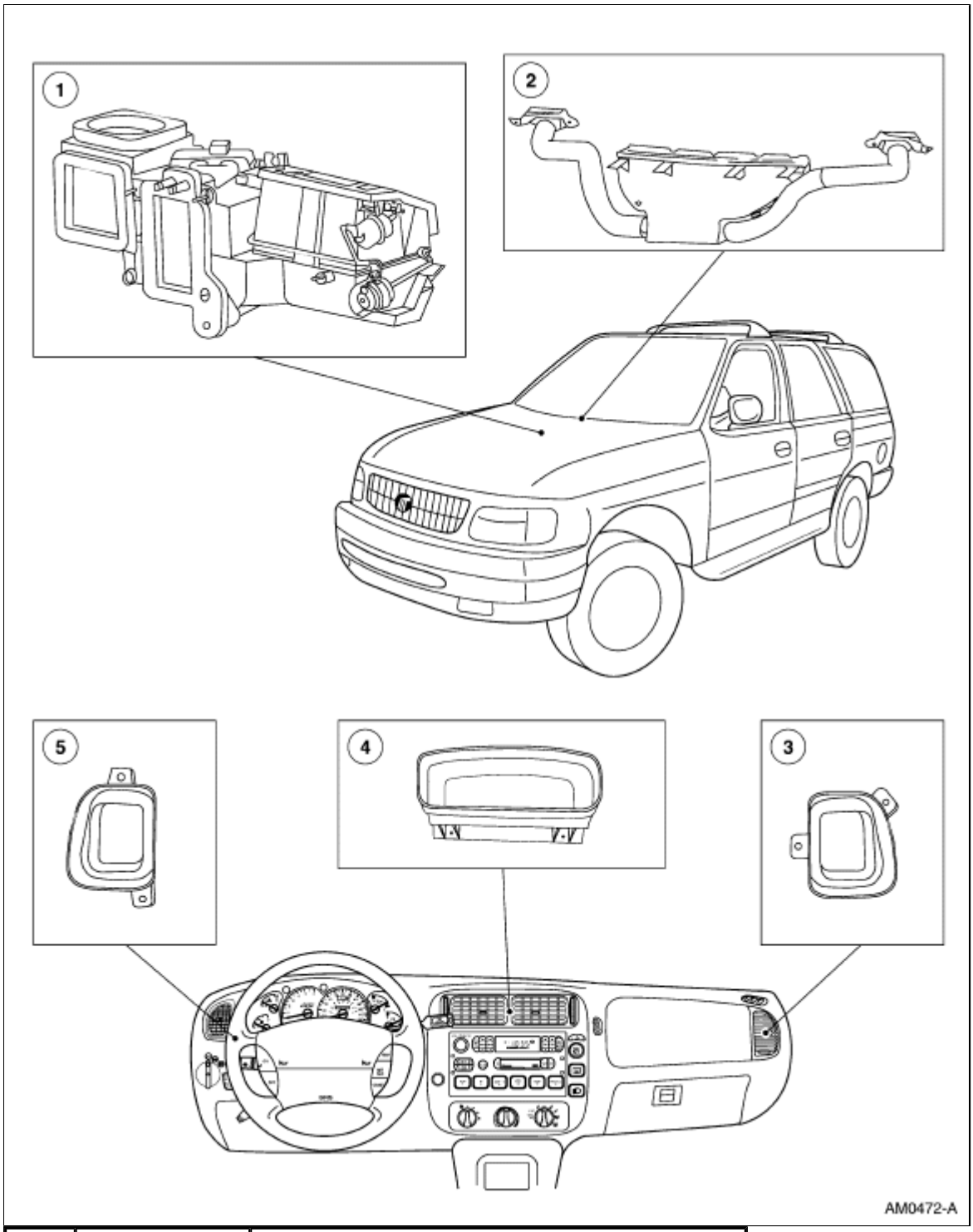
The air distribution system is designed to provide airflow from the defrost nozzle when no vacuum is applied to any of the vacuum control motors. This is done to prevent a situation where defrost cannot be obtained due to a system vacuum leak.

Air enters the passenger compartment from the:

- instrument panel A/C registers (19893).
- heater outlet floor duct (18C433).
- windshield defroster hose nozzle (18490).
- side window demisters.
- rear seat airflow duct (if equipped).

Passenger compartment air is exhausted from the vehicle through open windows or cab air vents.

Component Locations



Item	Part Number	Description
1	18471	Heater Air Plenum Chamber
2	18490	Windshield Defroster Hose Nozzle
3	19B680	A/C Evaporator Register Duct— (RH)
4	19B680	A/C Evaporator Register Duct— (Center)
5	19B680	A/C Evaporator Register Duct— (LH)

Air Distribution

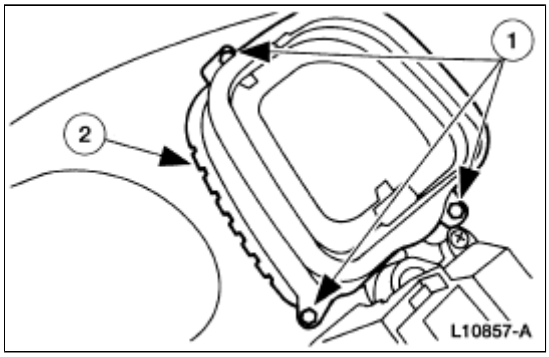
Refer to Section 412-00 .

Register — LH

Removal

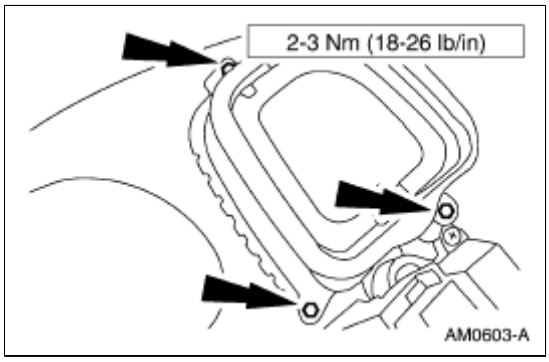
1. Remove the LH instrument panel finish panel (04338); refer to Section 501-12 .

2. Remove the LH instrument panel register.
    1. Remove the screws.
    2. Remove the LH instrument panel register.



Installation

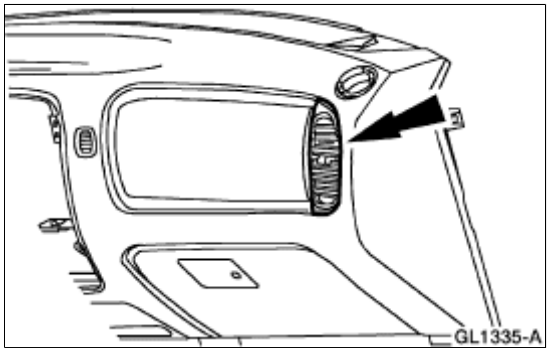
1. Follow the removal procedure in reverse order.



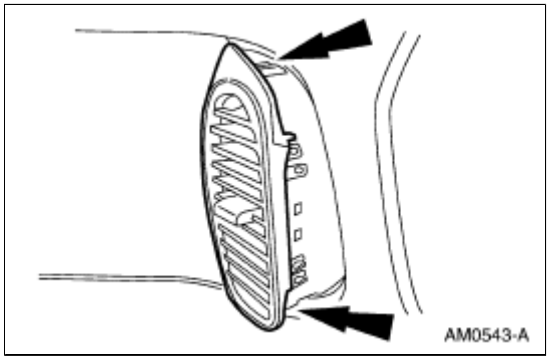
Register — RH

Removal

1. Lift the edge of the RH instrument panel register to expose the retainers.



2. Release the retainers and remove the RH instrument panel register.



Installation

1. Follow the removal procedure in reverse order.

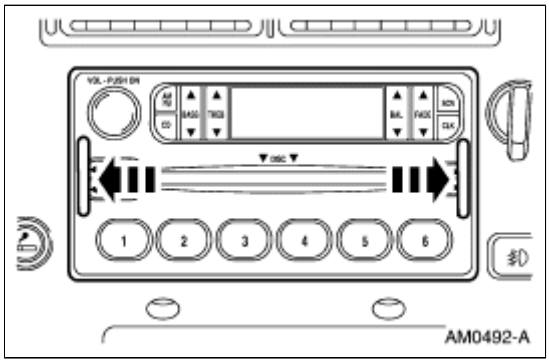
Register — Center

Special Tool(s)

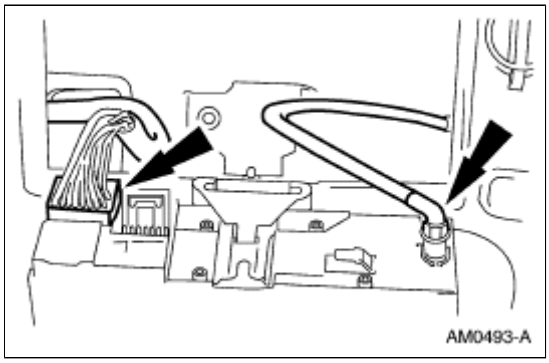
ST1445-A	Radio Removing Tool 415-001 (T87P-19061-A)

Removal

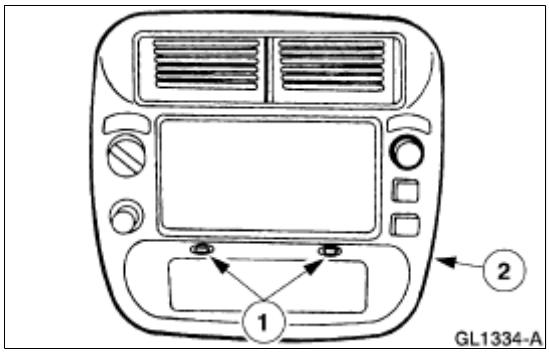
1. Use the Radio Removing Tool to remove the radio chassis (18806).



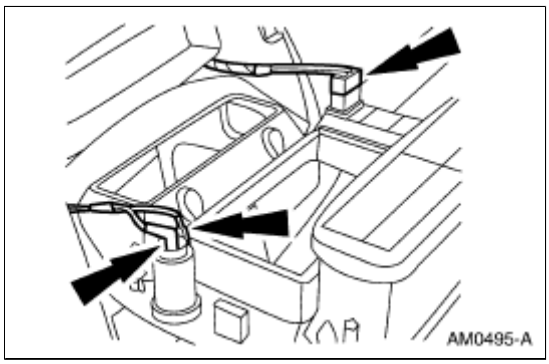
2. Disconnect the antenna lead and the wire harness connectors.



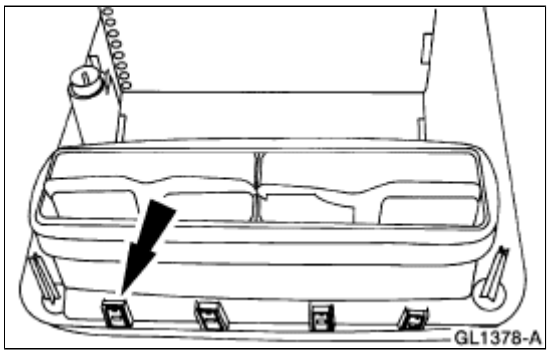
3. Remove the instrument panel finish panel (044D70).
    1. Remove the screws.
    2. Disengage the spring clips and remove the instrument panel finish panel.



4. Disconnect the wire harness connector.

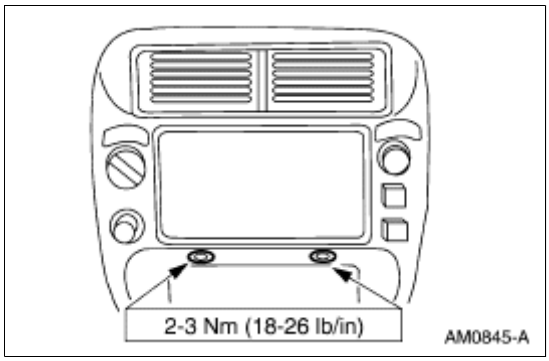


5. Release the eight clips and remove the center instrument panel register from the instrument panel finish panel.



Installation

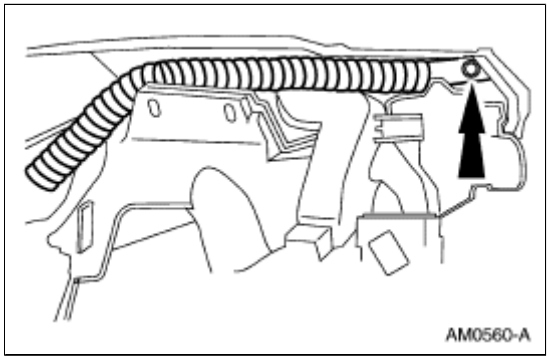
1. Follow the removal procedure in reverse order.


2-3 Nm (18-26 lb/in)
AM0845-A

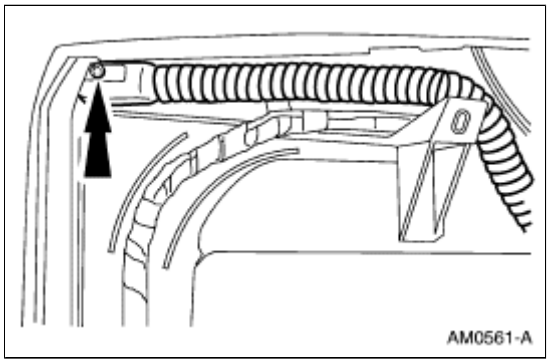
Nozzle —Windshield Defroster and Side Window Demister

Removal

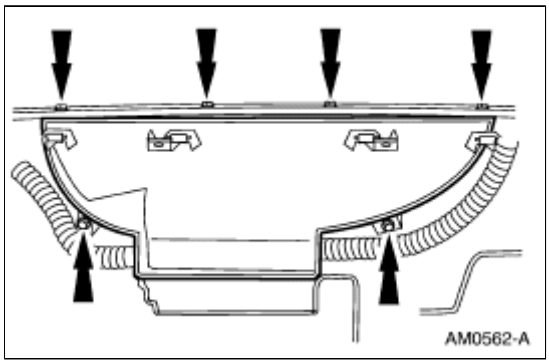
1. Remove the instrument panel (04320); refer to Section 501-12 .
2. Remove the two screws and remove the LH demister nozzle and duct (18D453).



3. Remove the two screws and remove the RH demister nozzle and duct.

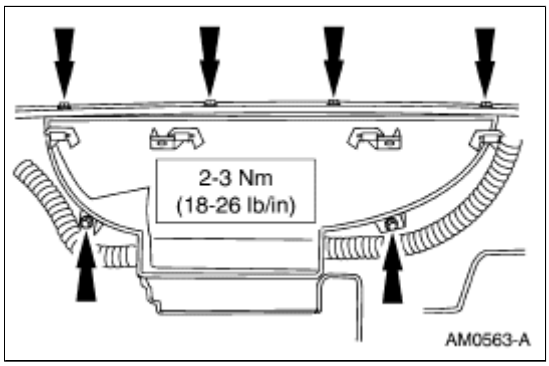


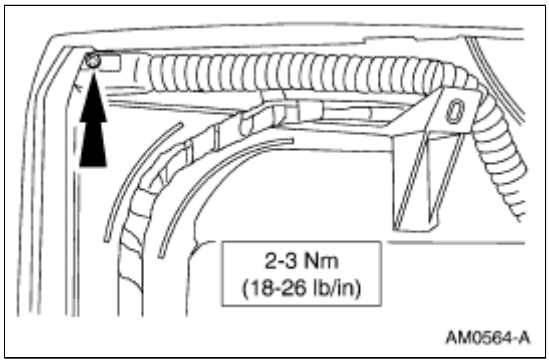
4. Remove the screws and remove the windshield defroster hose nozzle (18490).

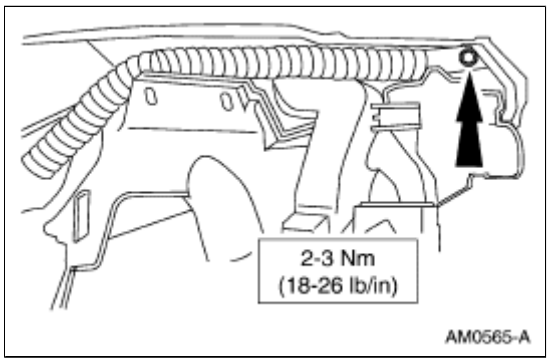


Installation

1. Follow the removal procedure in reverse order.





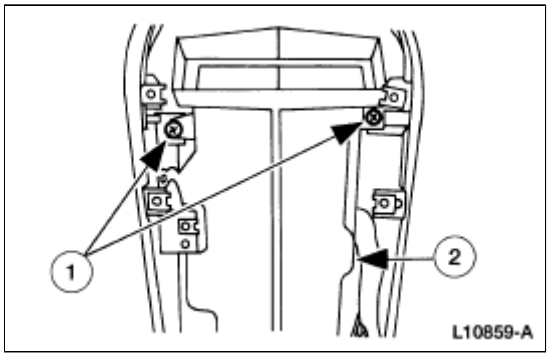


Duct —Floor

Removal

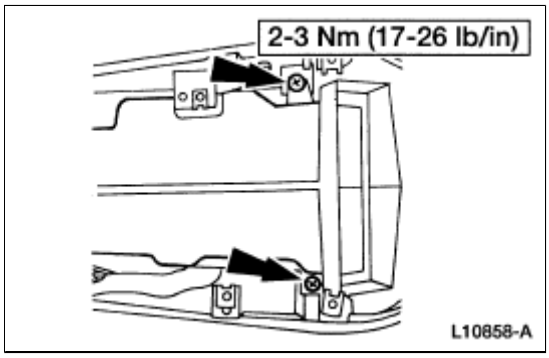
1. Remove the console rear controls; refer to Section 412-04 .

2. Remove the rear floor duct.
    1. Remove the screws.
    2. Remove the rear floor duct.



Installation

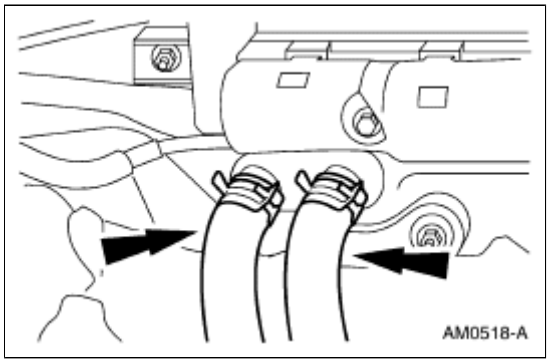
1. Follow the removal procedure in reverse order.



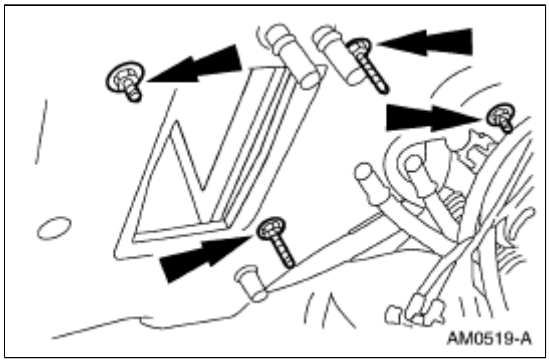
Plenum Chamber

Removal

1. Remove the instrument panel; refer to Section 501-12 .
2. Drain the radiator; refer to Section 303-03 .
3. Disconnect the heater hoses from the heater core (18476).
4. Remove the evaporator core housing; refer to Section 412-02 .

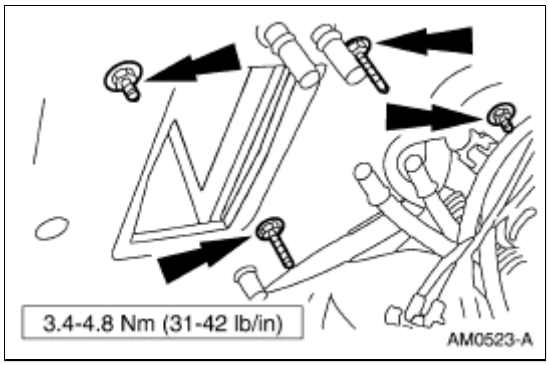


5. Remove the nuts and remove the plenum chamber.



Installation

1. Follow the removal procedure in reverse order.
   - Lubricate the hoses and fittings with Rubber Suspension Insulator Lube E25Y-19553-A or equivalent meeting Ford specification ESF-M99B112-A.


3.4-4.8 Nm (31-42 lb/in)
AM0523-A

Torque Specifications

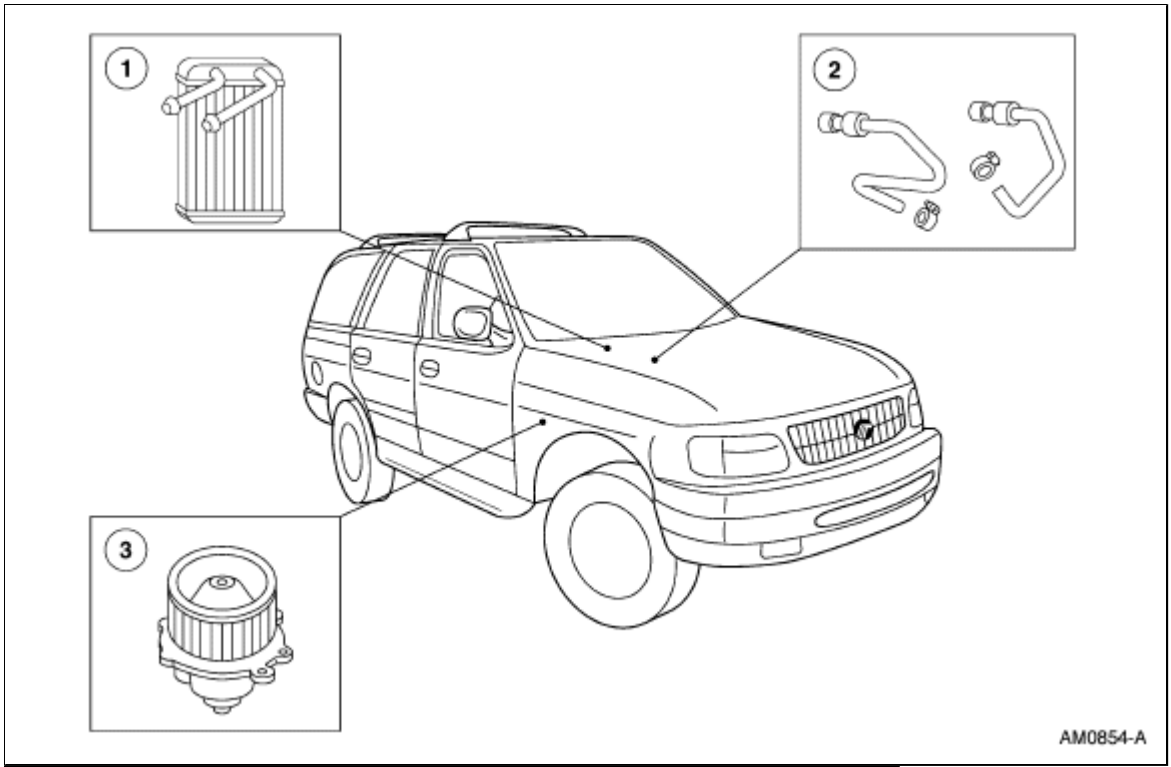
Description	Nm	lb-in
Cruise control servo mounting bolt	9-12	80-106
Coolant/washer reservoir screws and nuts	6-8	52-71

Heating/Defrosting

The heating and defrosting system has the following features:

- Controls the temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle.
- Delivers heated or cooled air to maintain the vehicle interior temperature and comfort level.
- Controls the blower motor speed.
- Cooling or heating can be adjusted to maintain the desired temperature.
- System uses a reheat method to provide conditioned air to the passenger compartment.
- The blower motor (18527) draws outside air through the air inlet duct from just below the windshield during all system operations except for MAX A/C, cooling (when recirculated air is used).
- All airflow from the blower motor passes through the A/C evaporator core (19860).
- The temperature is then regulated by reheating a portion of the air and blending it with the remaining cool air to the desired temperature.
- The temperature blending is varied by the air temperature control door, which regulates the amount of air that flows through and around the heater core (18476), where it is then mixed and distributed.

Component Locations



Item	Part Number	Description
1	18476	Heater core
2	18472	Heater water hoses
3	18527	Blower motor

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer it to air passing through the heater core.

Blower Motor

The A/C blower motor (19805) pulls air from the air inlet and forces it into the plenum assembly where it is mixed and distributed.

Heating/Defrosting

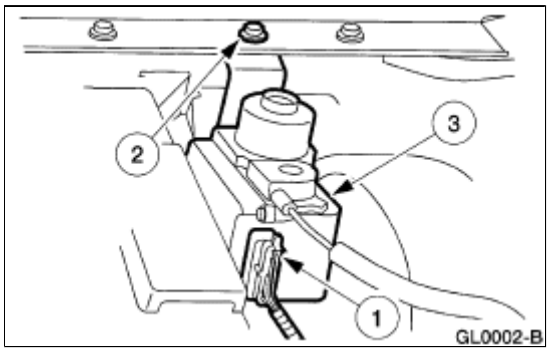
Refer to Section 412-00 .

Blower Motor

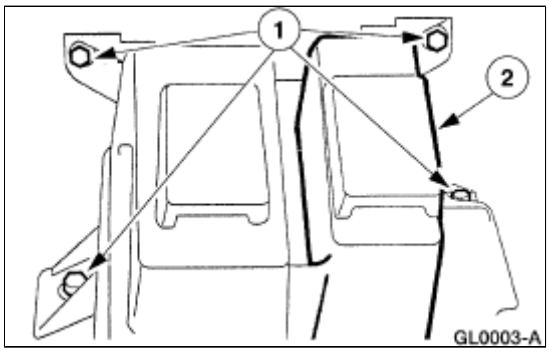
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

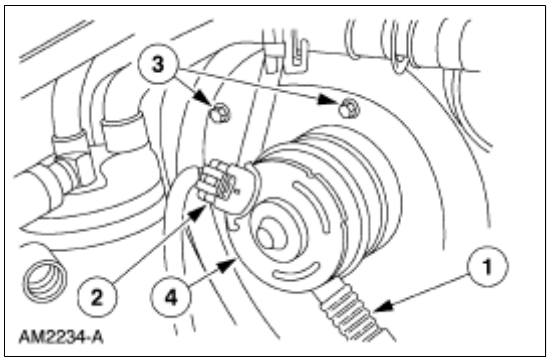
2. Remove the speed control servo.
    1. Disconnect the electrical connector.
    2. Remove the bolt.
    3. Position the speed control servo aside.



3. Position the coolant/washer reservoir.
    1. Remove the screws and the nuts.
    2. Move the coolant/washer reservoir aside.

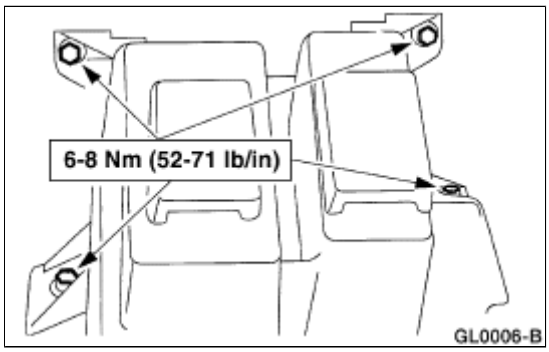


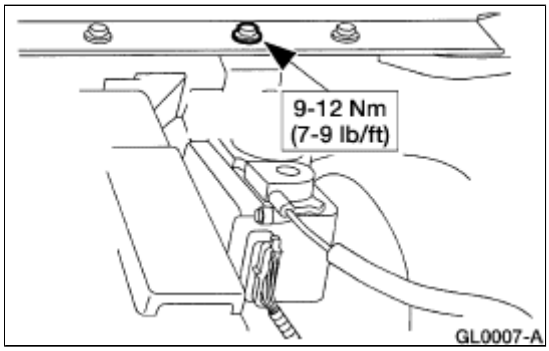
4. Remove the blower motor.
    1. Disconnect the vent hose.
    2. Disconnect the electrical connector.
    3. Remove the four screws.
    4. Remove the blower motor.



Installation

1. To install, reverse the removal procedure.





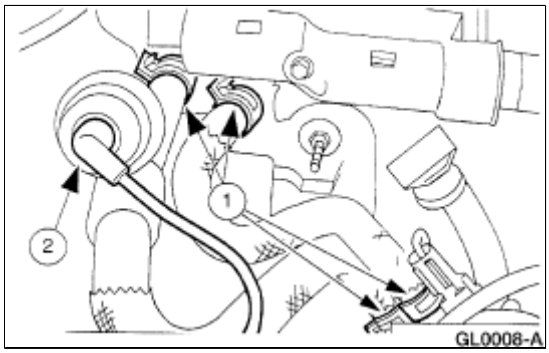
Heater Core

Removal

1. **NOTE:** If a heater core leak is suspected, the heater core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

   Drain the radiator. For additional information, refer to Section 303-03 .

2. Remove the heater water hoses.
   1. Squeeze the clamps and pull the hoses off.
   2. Disconnect the vacuum hose from the water control valve.



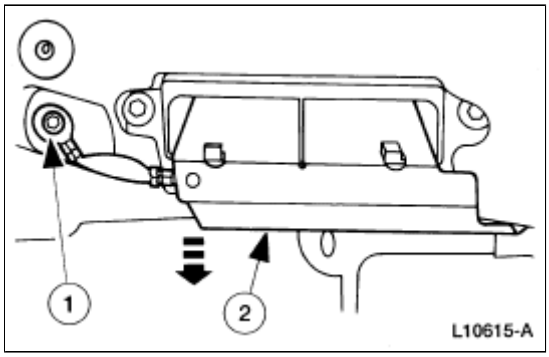
3. Remove the instrument panel. For additional information, refer to Section 501-12 .

4. Remove the A/C evaporator core housing. For additional information, refer to Section 412-03 .

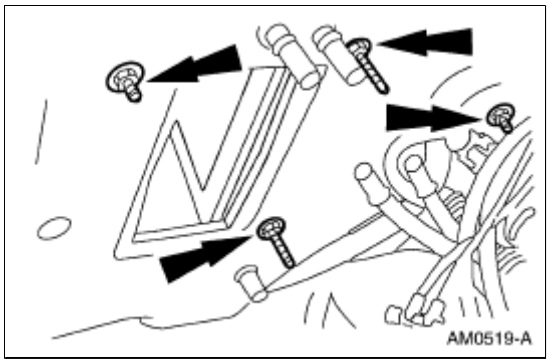
5. Remove the A/C evaporator core housing. For additional information, refer to Section 412-03 .

6. Remove the powertrain control module (PCM). For additional information, refer to Section 303-14 .

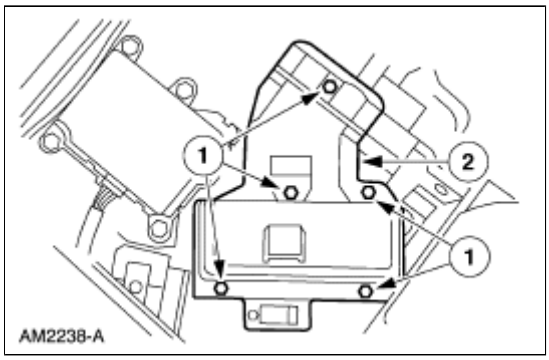
7. Remove the PCM heat sink.
   1. Remove the ground strap screw.
   2. Remove the heat sink.



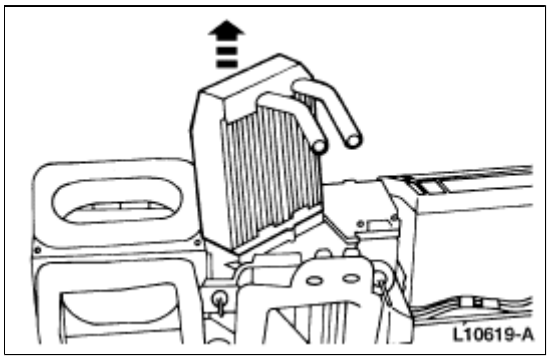
8. Remove the heater air plenum nuts from the engine side of the dash panel.



9. Remove the heater core.
    1. Remove the heater core cover to air plenum screws.
    2. Lift off the cover.



10. Remove the heater core (18476).



Installation

1. **NOTE:** Be sure to install a new oval foam seal around the heater core inlet and outlet tubes.

    To install, reverse the removal procedure.

General Specifications

Item	Specification
A/C cycling switch kPa (psi)	Close maximum 324 (47) Open minimum 152 (22)
A/C compressor pressure relief valve kPa (psi)	Opens at 3103 (470-600)
Lubricant	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Capacity ml (ounce)	266 (9)
A/C Compressor	
A/C clutch air gap mm (inch)	0.35-0.75 (0.014-0.030)

Torque Specifications

Description	Nm	lb-ft	lb-in
Accumulator to evaporator core fitting	35-42	26-31	—
A/C condenser core bolt	8.4-11.2	—	75-99
A/C compressor heat shield bolts	5.5-8	—	50-71
A/C compressor mounting bolts	21-29	15-21	—
A/C manifold tube bolt	17-23	12.5-17	—
A/C manifold to generator clamp nut	15-22	11-16	—
A/C line to condenser nut	6.8-9.2	—	60.6-82
Power steering reservoir bolts	7.6-10.4	—	67-92
Power steering hose clamp nut	7.6-10.4	—	67-92
Speed control servo bolt	9-12	7-9	—
Suction/accumulator bracket screw	6-8	—	53-71
Windshield washer/coolant reservoir bolts and nuts	6-8	—	52-71
A/C clutch bolt	11-14	—	98-123
Peanut fittings	7-9	—	62-79

Air Conditioning

The A/C refrigerant system is a clutch cycling orifice tube type. The system components are:

- A/C compressor (19703).
- A/C clutch (2884).
- A/C condenser core (19712).
- A/C evaporator core (19860).
- suction accumulator/drier (19C836).
- connecting refrigerant lines.

The refrigeration system operation is controlled by the:

- A/C evaporator core orifice (19D990).
- A/C cycling switch (19E561).
- A/C compressor pressure relief valve (19D644).
- A/C pressure cut-off switch (19D594).

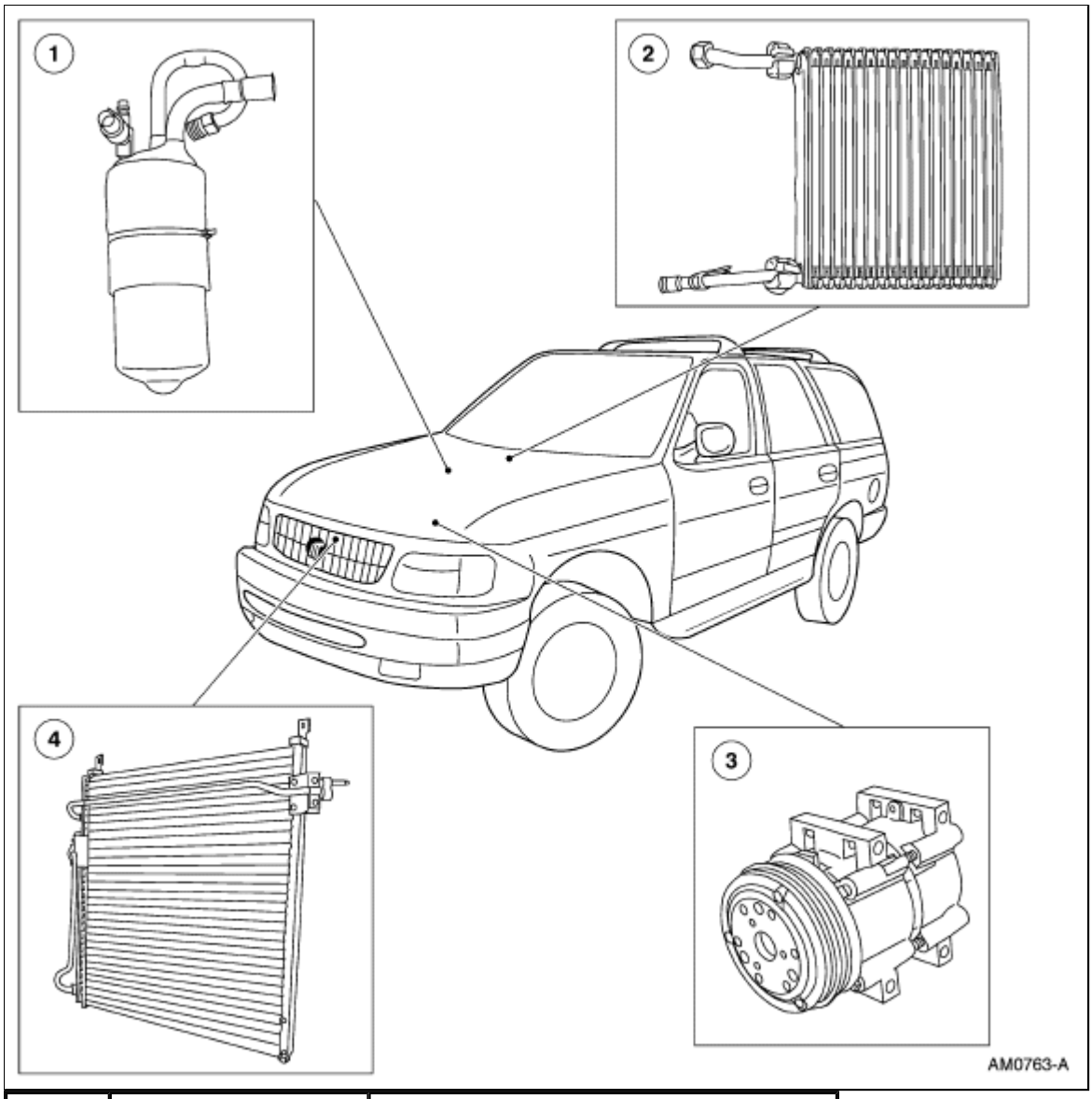
The refrigerant system incorporates an A/C compressor controlled by an A/C cycling switch.

The A/C cycling switch senses A/C evaporator core pressure to control A/C compressor operation.

An A/C compressor pressure relief valve is installed in the A/C manifold and tube (19D734) to protect the refrigerant system against excessively high refrigerant pressures.

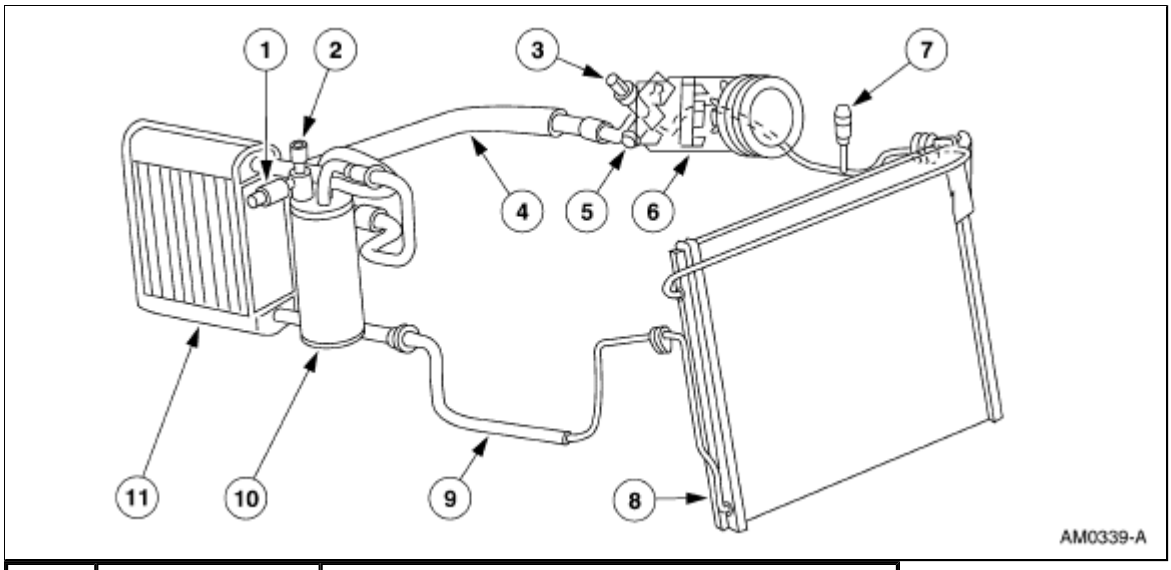
An A/C evaporator core orifice is installed in the condenser to evaporator tube (19835) to meter the liquid refrigerant into the A/C evaporator core.

Component Locations



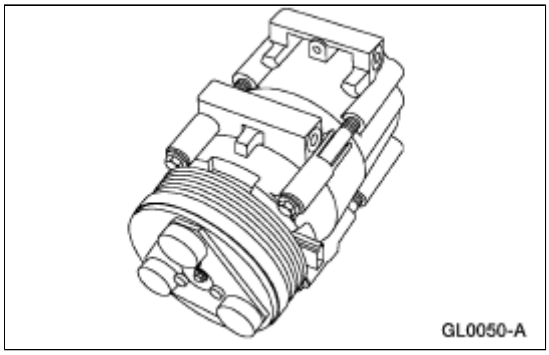
Item	Part Number	Description
1	19C836	Suction accumulator/drier
2	19860	A/C evaporator core
3	19D629	A/C compressor
4	19712	A/C condenser core

Refrigeration System Components — 4.0L (5.0L Similar)



Item	Part Number	Description
1	19E561	A/C cycling switch
2	19E762	A/C charge port valve (low side)
3	19D594	A/C pressure cut-off switch
4	19D734	A/C manifold and tube
5	19D644	A/C compressor pressure relief valve
6	19D629	A/C compressor
7	19E762	A/C charge port valve (high side)
8	19712	A/C condenser core
9	19835	Condenser to evaporator tube
10	19C836	Suction accumulator/drier
11	19860	A/C evaporator core

A/C Compressor and Clutch Assembly



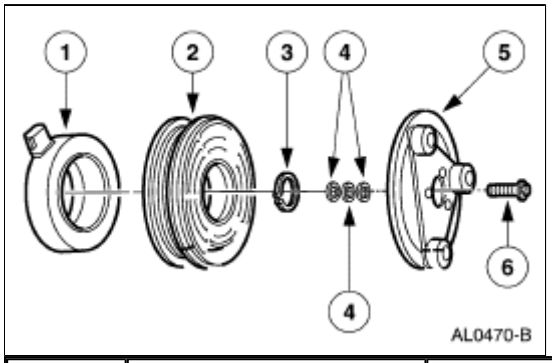
NOTE: Internal A/C compressor components are not serviced separately. The FS-10 A/C compressor is serviced only as an assembly. The A/C clutch, A/C clutch pulley (2E884), A/C clutch field coil (2987) and the shaft seal are serviceable.

NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning

system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

The FS-10 A/C compressor has the following characteristics:

- A ten-cylinder swashplate design utilizing the tangential design mount.
- Displacement of 170 cc (10.4 cubic inches).
- A one-piece lip-type seal (replaceable from the front of the A/C compressor) is used to seal it at the shaft opening in the assembly.
- Five double-acting pistons operate within the cylinder assembly. The pistons are actuated by a swashplate that changes the rotating action of the shaft to a reciprocating force.
- Reed-type discharge valves are located between the cylinder assembly and the head at each end of the A/C compressor.
- The A/C compressor uses PAG compressor oil, YN-12-C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B. This oil contains special additives required for the A/C compressor.
- The A/C compressor oil from vehicles equipped with an FS-10 A/C compressor may have a dark color while maintaining a normal oil viscosity. This is normal for this A/C compressor because carbon from the piston rings will discolor the oil.



Item	Part Number	Description
1	2987	A/C clutch field coil
2	2E884	A/C clutch pulley
3	N805388-S2	Pulley snap ring
4	19D648	A/C clutch hub spacer
5	2884	A/C clutch
6	N805332-S2	A/C clutch bolt

The magnetic A/C clutch has the following characteristics:

- It drives the compressor shaft.
- When battery positive voltage (B+) is applied to the A/C clutch field coil, the clutch disc and hub assembly is drawn toward the A/C clutch pulley.
- The magnetic force locks the clutch disc and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate.
- When B+ is removed from the A/C clutch field coil, springs in the clutch disc and hub assembly move the clutch plate away from the A/C clutch pulley.

A/C Compressor Pressure Relief Valve

An A/C compressor pressure relief valve is incorporated in the compressor A/C manifold and tube to:

- relieve unusually high refrigerant system discharge pressure buildups, (3,103 kPa [450 psi] and above).
- prevent damage to the A/C compressor and other system components.
- avoid total refrigerant loss by closing after the excessive pressure has been relieved.

A/C Condenser Core

NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

The A/C condenser core has the following characteristics:

- It is an aluminum fin and tube design heat exchanger located in front of the vehicle radiator (8005).
- It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

Refrigerant Lines

NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

The condenser to evaporator tube contains high pressure liquid refrigerant upstream of the A/C evaporator core orifice.

The A/C manifold and tube is attached to the A/C compressor with O-ring seals and has the following features:

- The upstream side contains low pressure refrigerant gas.
- The downstream side contains high pressure refrigerant gas and a fitting used to mount a serviceable high-pressure A/C charge port valve.
- The downstream side also contains a fitting used to mount the A/C pressure cut-off switch. A long-travel Schrader-type valve stem core is installed in the fitting so that the A/C pressure cut-off switch can be removed without discharging the A/C system.

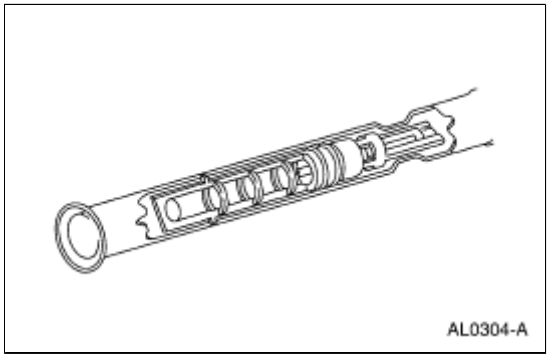
A/C Evaporator Core

NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

The A/C evaporator core is the plate/fin type with a unique refrigerant flow path.

- A mixture of refrigerant and oil enters the bottom of the A/C evaporator core through the A/C evaporator core inlet tube and is routed so it flows through the partitioned first three plate/fin sections.
- The next four plate/fin sections are partitioned to force the refrigerant to flow toward the other end of the A/C evaporator core.
- Refrigerant then continues over to the remaining five plate/fin sections and then moves out of the A/C evaporator core through the A/C evaporator core outlet tube.
- This S-pass flow pattern accelerates the flow of refrigerant and oil through the A/C evaporator core.

A/C Evaporator Core Orifice

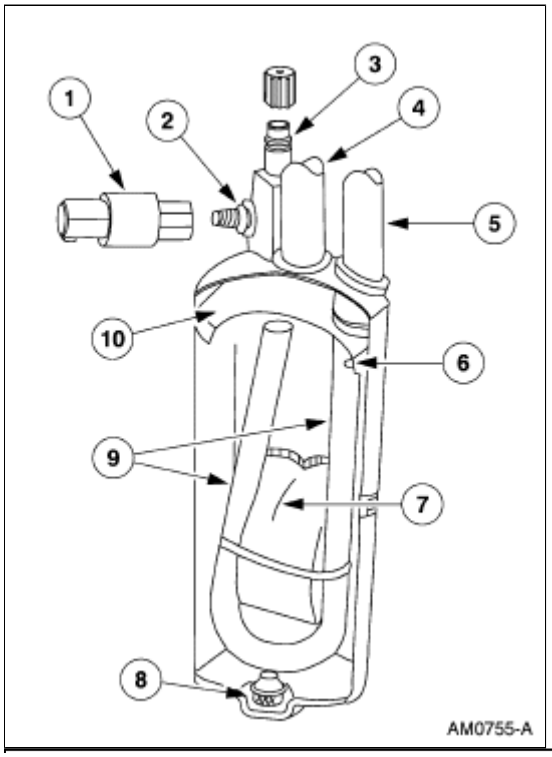


NOTE: A new A/C evaporator core orifice should be installed whenever a new A/C compressor is installed.

The A/C evaporator core orifice has the following characteristics:

- It is color-coded red.
- It has an orifice diameter of 1.6 mm (0.062 inch).
- It is located in the A/C evaporator core inlet tube.
- It has filter screens located on the inlet and outlet ends of the tube body.
- The inlet filter screen acts as a strainer for the liquid refrigerant flowing through the A/C evaporator core orifice.
- O-rings on the A/C evaporator core orifice prevent the high-pressure liquid refrigerant from bypassing the A/C evaporator core orifice.
- Adjustment or service cannot be made to the A/C evaporator core orifice assembly. A new evaporator core orifice assembly must be installed.

Suction Accumulator/Drier



Item	Part Number	Description
1	19E561	A/C cycling switch
2	—	O-ring seal (part of 19C836)
3	19E762	Low pressure service gauge port valve
4	—	Inlet from A/C evaporator core (part of 19C836)
5	—	Outlet to A/C compressor (part of 19C836)
6	—	Anti-siphon hole (part of 19C836)
7	—	Desiccant bag (part of 19C836)
8	—	Oil return orifice filter (part of 19C836)
9	—	Vapor return tube (part of 19C836)
10	—	Suction accumulator/drier dome (part of 19C836)

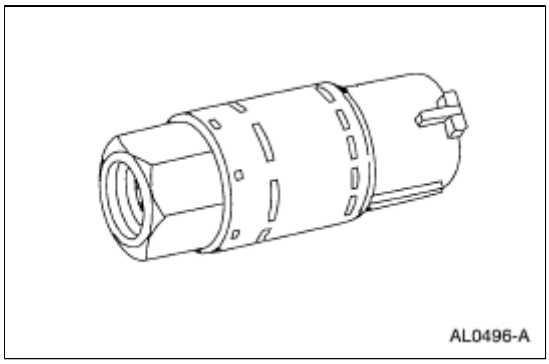
NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

The suction accumulator/drier is mounted to the A/C accumulator bracket (19D606) to the right of the vehicle centerline. The inlet tube of the suction accumulator/drier attaches directly to the A/C evaporator core outlet tube and the outlet tube attaches to the A/C manifold and tube.

After entering the inlet of the suction accumulator/drier, the heavier oil-laden refrigerant contacts an internally mounted dome (which serves as an umbrella) and drips down onto the bottom of the canister.

- A small diameter oil bleed hole, in the bottom of the vapor return tube, allows the accumulated heavier liquid refrigerant and oil mixture to re-enter the compressor suction line at a controlled rate.
- As the heavier mixture passes through the small diameter liquid bleed hole, it has a second chance to vaporize and recirculate through the A/C compressor without causing compressor damage due to slugging.
- A fine mesh screened filter fits tightly around the bottom of the vapor return tube to filter out refrigerant system contaminant particles.
- A desiccant bag is mounted inside the canister to absorb any moisture which may be in the refrigerant system.
- A fitting located on the top of the suction accumulator/drier is used to attach the A/C cycling switch. A long-travel Schrader-type valve stem core is installed in the fitting so that the A/C cycling switch can be removed without discharging the A/C system.

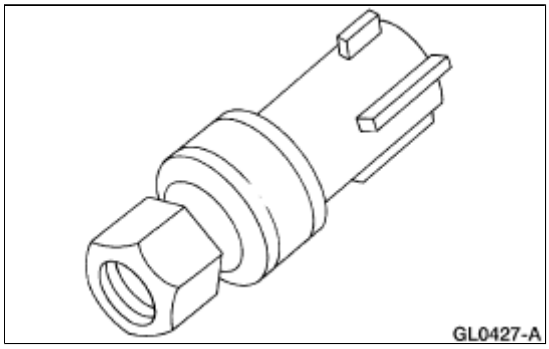
A/C Cycling Switch



The A/C cycling switch is mounted on a Schrader valve-type fitting on the top of the suction accumulator/drier.

- A valve depressor, located inside the threaded end of the A/C cycling switch, presses in on the Schrader valve stem.
- This allows the suction pressure inside the suction accumulator/drier to control the operation of the A/C cycling switch.
- The electrical switch contacts open when the suction pressure drops to 152-193 kPa (22-28 psi).
- The contacts close when the suction pressure rises to 276-324 kPa (40-47 psi).
- When the A/C cycling switch contacts close, the signal to energize the A/C clutch is sent to the wide open throttle A/C cutoff relay.
- When the A/C cycling switch contacts open, the A/C clutch field coil is de-energized and compressor operation stops.
- The A/C cycling switch will control the A/C evaporator core pressure at a point where the plate/fin surface temperature will be maintained slightly above freezing.
- This prevents icing of the A/C evaporator core and blockage of airflow.
- It is not necessary to discharge the refrigerant system to remove the A/C cycling switch.

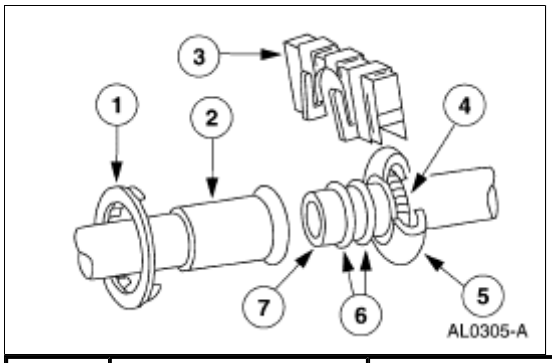
A/C Pressure Cut-Off Switch



The A/C pressure cut-off switch is used to interrupt A/C compressor operation in the event of high system discharge pressures.

- The A/C pressure cut-off switch is mounted on a Schrader valve-type fitting on the high pressure side of the A/C manifold and tube.
- A valve depressor, located inside the threaded end of the A/C pressure cut-off switch, presses on the Schrader valve stem.
- This allows the A/C pressure cut-off switch to monitor the compressor discharge pressure.
- When the compressor discharge pressure rises to approximately 2,896 kPa (420 psi), the switch contacts open, disengaging the A/C compressor,
- When the pressure drops to approximately 1,724 kPa (250 psi), the contacts close to allow operation of the A/C compressor.
- It is not necessary to discharge the refrigerant system to remove the A/C pressure cut-off switch.

Spring Lock Coupling



Item	Part Number	Description
1	—	Plastic indicator ring
2	—	Female fitting
3	19E746	A/C tube lock coupling clip
4	19E576	A/C tube lock coupling spring
5	—	Cage
6	—	O-ring seals (2 req'd)
7	—	Male fitting

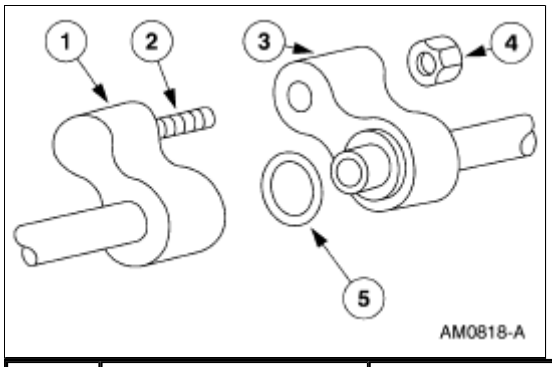
The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage.

- When the coupling is connected together, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting.
- The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.
- Three O-ring seals are used to seal between the two halves of the A/C condenser core couplings, all other couplings have two O-ring seals.
- These O-ring seals are green in color and are made of special material.
- Use only the green O-ring seals listed in the Ford Master Parts Catalog for the spring lock coupling.
- A plastic indicator ring is used on the spring lock couplings of the A/C evaporator core to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.
- The indicator ring may also be used during service operations to indicate connection of the coupling.
- An A/C tube lock coupling clip (19E746) may be used to secure the coupling but is not required.

Peanut Fitting

The A/C condenser core uses the peanut shaped refrigerant fittings instead of spring lock couplings.

- The male and female blocks of the peanut fitting are retained with a nut.
- An O-ring seal is installed around the tube on the male block.
- The female block is welded to the tube and is not adjustable.
- Support the female fitting with a wrench to prevent twisting of the tubes.
- The male block will pivot around the tube to allow for alignment with the female block during assembly.
- When correctly assembled the male and female fittings should be flush.

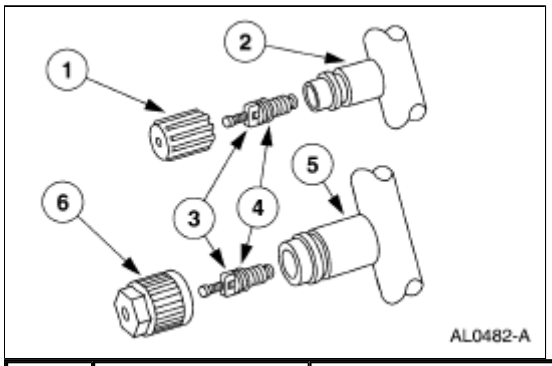


Item	Part Number	Description
1	—	Female block (part of tube assy)
2	W701890-S426	Stud (part of female block)
3	—	Male block (part of 19712)
4	W520413-S301	Nut
5	—	O-ring seal

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the front A/C manifold and tube.

The low pressure service gauge port valve is located on the suction accumulator/drier.



Item	Part Number	Description
1	19D702	A/C charging valve cap
2	—	Low pressure service gauge port valve
3	—	Schrader-type valve
4	—	O-ring seal
5	—	High pressure service gauge port valve
6	19D702	A/C charging valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high-side and low-side service gauge ports.
- A new Schrader-type valve core can be installed if the seal leaks.
- Always install the A/C charging valve cap (19D702) on the service gauge port valves after repairing

the refrigerant system.

Air Conditioning

Refer to Section 412-00 .

Air Conditioning (A/C) Compressor —4.0L OHV

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA	WSH-M1C231-B

Removal and Installation

CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

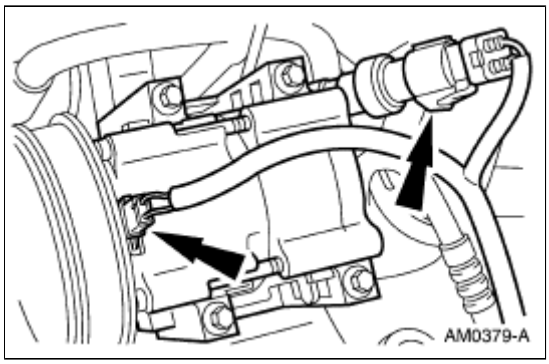
- **If A/C flushing equipment is available, carry out flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to Section 412-00 .**
- **If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to Section 412-00 .**
- **Install a new evaporator core orifice (19D990) as directed by the A/C flushing or filtering procedure.**
- **Install a new suction accumulator (19C836) as directed by the A/C flushing or filtering procedure.**

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

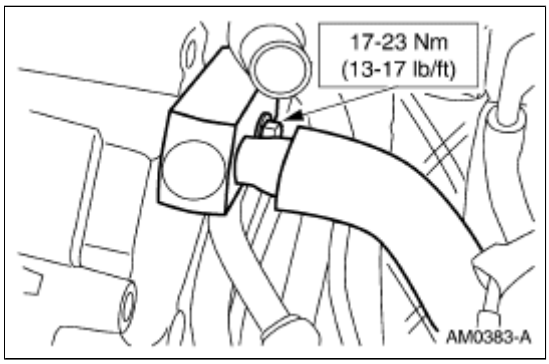
1. If flushing of the air conditioning system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00 .

2. Remove the drive belt (8620) from the air conditioning compressor pulley.

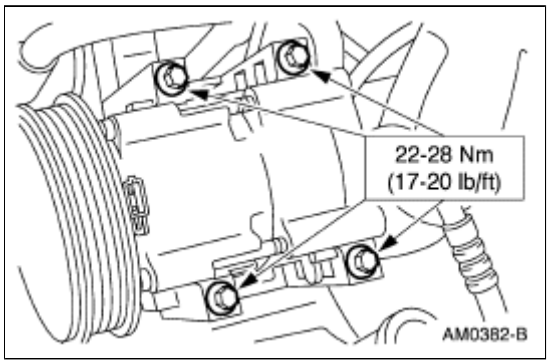
3. Disconnect the field coil and pressure cutoff switch electrical connectors.



4. Remove the bolt and detach the manifold and tube from the A/C compressor.
    - Discard the O-ring seals.



5. Remove the bolts and remove the A/C compressor.



6. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - If filtering of the air conditioning system is not to be carried out, correctly oil match the system with clean PAG oil. For additional information, refer to Section 412-00 .

7. If filtering of the refrigerant system is not to be carried out, evacuate, leak-test, and charge the refrigerant system. For additional information, refer to Section 412-00

Air Conditioning (A/C) Compressor —4.0L SOHC

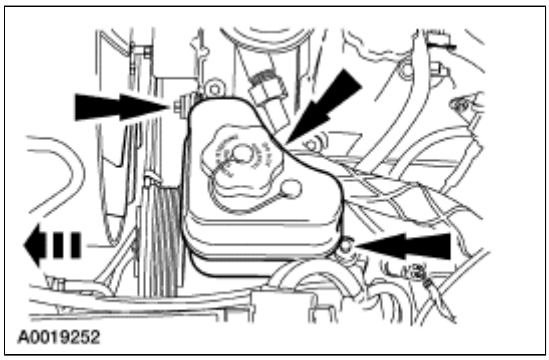
Removal and Installation

CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

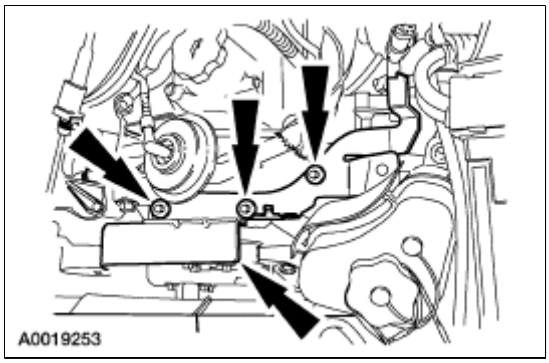
- **If A/C flushing equipment is available, carry out flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to Section 412-00 .**
- **If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to Section 412-00 .**
- **Install a new evaporator core orifice (19D990) as directed by the A/C flushing or filtering procedure.**
- **Install a new suction accumulator (19C836) as directed by the A/C flushing or filtering procedure.**

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

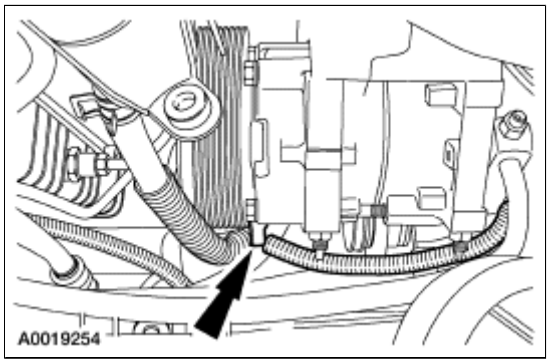
1. If flushing of the air conditioning system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the drive belt from the A/C compressor pulley.
4. Remove the bolts and position aside the power steering reservoir.



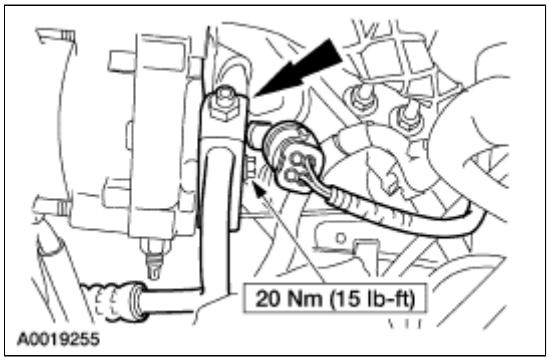
5. Remove the bolts and remove the power steering bracket.



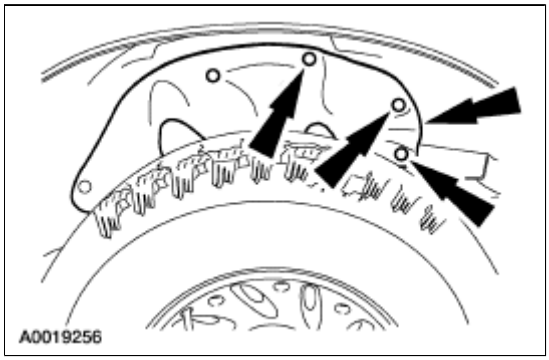
6. Disconnect the field coil electrical connector.



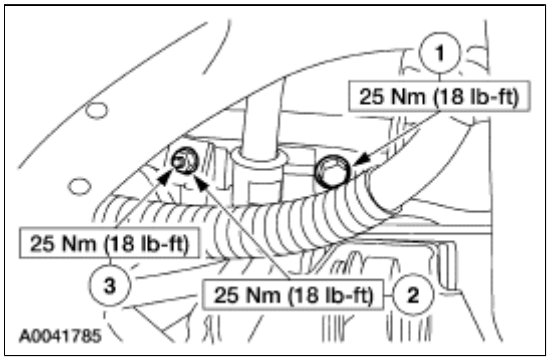
7. Remove the bolt and detach the manifold and tube from the A/C compressor.
   - Discard the O-ring seals.



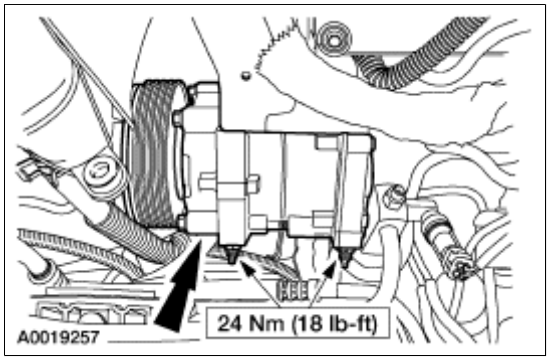
8. Remove the retaining pins and position aside the inner fender well splash shield.



9. Remove the lower A/C compressor bolt and stud.
    1. Remove the bolt.
    2. Remove the nut and detach the bracket from the stud.
    3. Remove the stud.



10. Remove the two A/C compressor nuts and studs, and remove the A/C compressor.



11. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - If filtering of the air conditioning system is not to be carried out, correctly oil match the system with clean PAG oil. For additional information, refer to Section 412-00 .

12. If filtering of the refrigerant system is not to be carried out, evacuate, leak-test, and charge the refrigerant system. For additional information, refer to Section 412-00 .

Air Conditioning (A/C) Compressor —5.0L

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA	WSH-M1C231-B

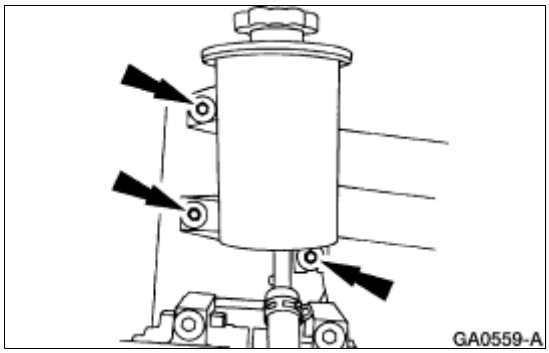
Removal and Installation

CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

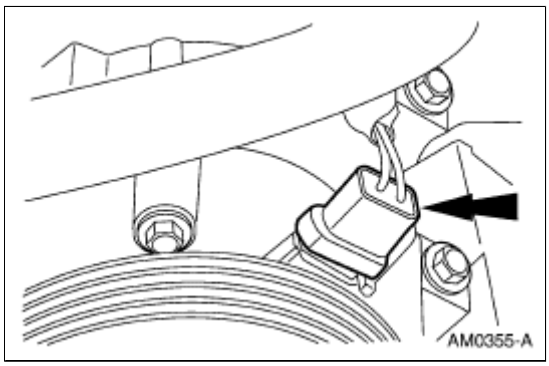
- **If A/C flushing equipment is available, carry out flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to Section 412-00 .**
- **If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed, For additional information, refer to Section 412-00 .**
- **Install a new evaporator core orifice (19D990) as directed by the A/C flushing or filtering procedure.**
- **Install a new suction accumulator (19C836) as directed by the A/C flushing or filtering procedure.**

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

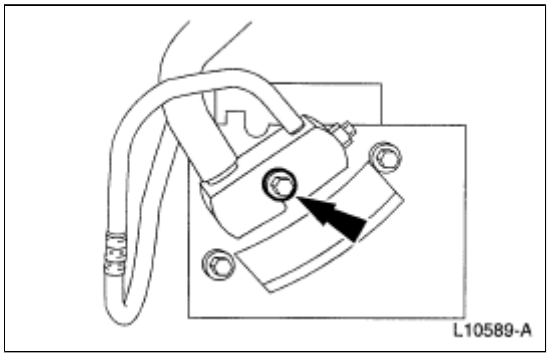
1. If flushing of the air conditioning system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Remove the drive belt from the A/C compressor pulley.
4. Remove the bolts and position aside the power steering reservoir.



5. Disconnect the field coil electrical connector.

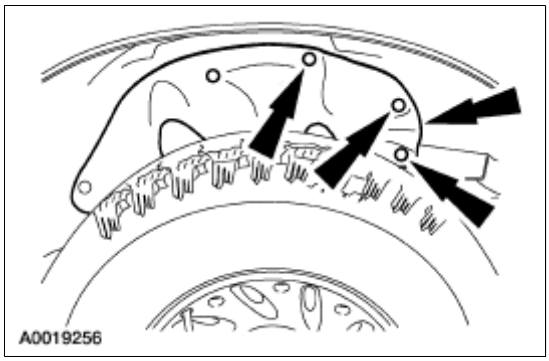


6. Remove the bolt and detach the compressor manifold and tube assembly from the A/C compressor.
   - Discard the O-ring seals.

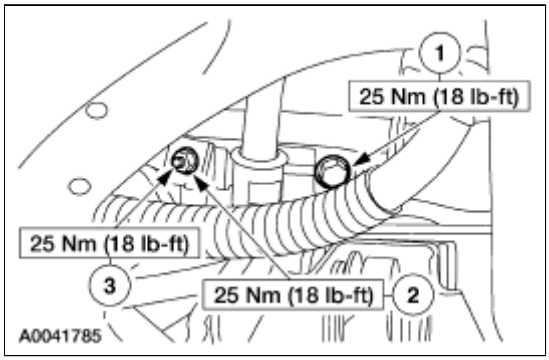


7. Partially raise the vehicle. For additional information, refer to Section 100-02 .

8. Remove the retaining pins and position the inner fender well access panel out of the way.

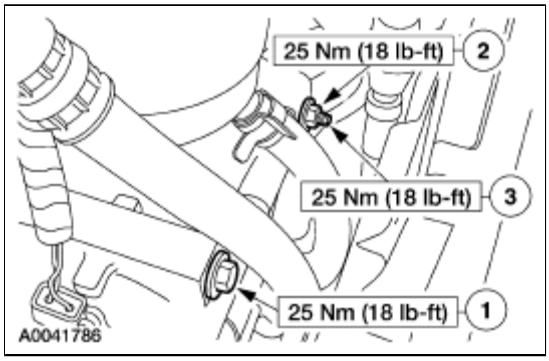


9. Remove the lower A/C compressor bolt and stud.
    1. Remove the bolt.
    2. Remove the nut and detach the bracket from the stud.
    3. Remove the stud.



10. Lower the vehicle.

11. Remove the upper A/C compressor bolt and stud.
    1. Remove the bolt.
    2. Remove the nut and detach the bracket from the stud.
    3. Remove the stud.



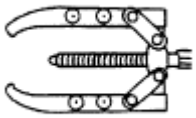
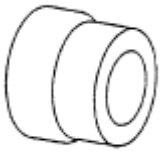
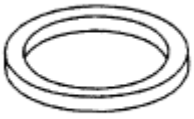
12. Remove the A/C Compressor.

13. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - If filtering of the air conditioning system is not to be carried out, correctly oil match the system with clean PAG oil. For additional information, refer to Section 412-00 .

14. If filtering of the refrigerant system is not to be carried out, evacuate, leak-test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Clutch And Clutch Field Coil

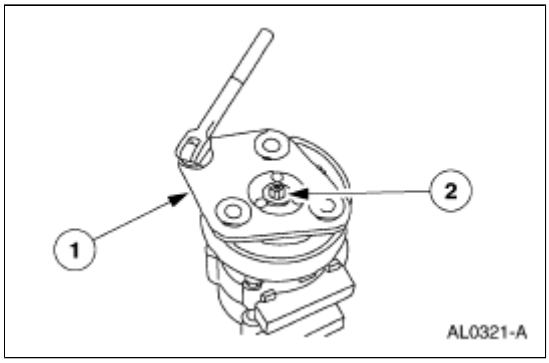
Special Tool(s)

 ST1260-A	2-Jaw Puller 205-D026 (D80L-1002-L) or equivalent
 ST1232-A	Coil Replacer 412-065 (T89P-19623-EH)
ST1235-A	Compressor Clutch Holding Tool 412-098 (T94P-19703-AH)
ST1220-A	Differential Bearing Cone Remover 205-116 (T77F-4220-B1)
 ST1234-A	Field Coil Replacer 412-078 (T91L-19623-CH)
ST1233-A	Field Coil Remover 412-067 (T89P-19623-FH)

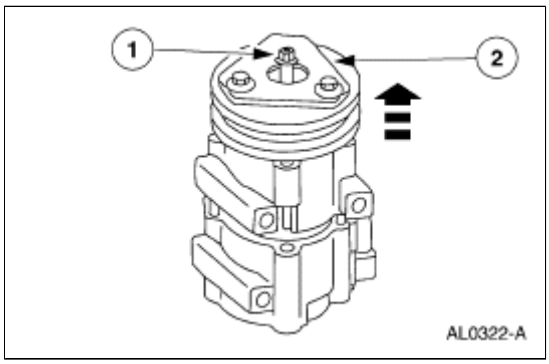
Removal

1. Remove the A/C compressor (19703). For additional information, refer to Air Conditioning (A/C) Compressor—4.0L OHV , Air Conditioning (A/C) Compressor—4.0L SOHC or Air Conditioning (A/C) Compressor—5.0L in this section.

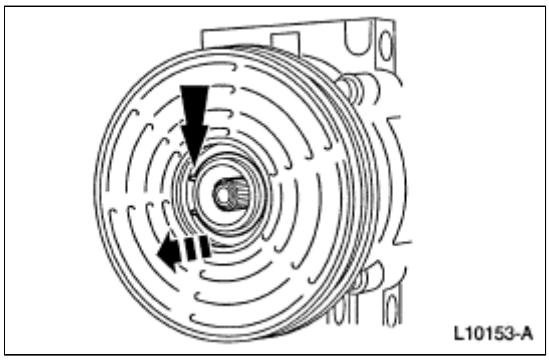
2. Remove the bolt.
    1. Hold the A/C clutch hub with the Compressor Clutch Holding Tool.
    2. Remove the bolt.



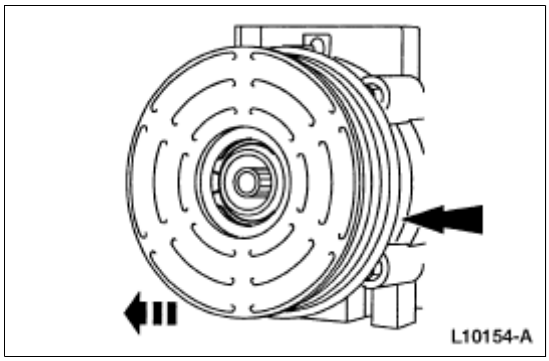
3. Remove the A/C clutch (2884) and the A/C clutch hub spacer (19D648).
    1. Thread an 8 x 1.25 mm bolt into the A/C clutch to force it from the compressor shaft.
    2. Lift the A/C clutch and the A/C clutch hub spacer from the compressor shaft.



4. Remove the pulley snap ring.

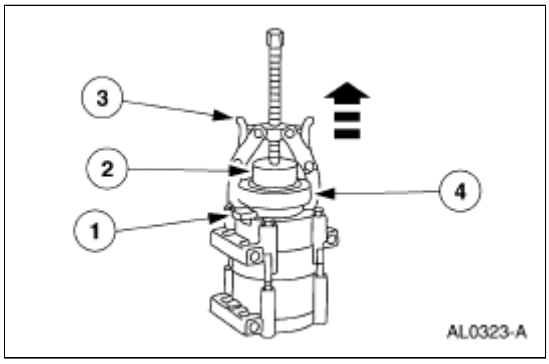


5. Remove the A/C clutch pulley (2E884).



6. **CAUTION: Do not use air tools. The A/C clutch field coil (2987) can be easily damaged.**

   Remove the A/C clutch field coil.
   1. Note the location of the A/C clutch field coil electrical connector.
   2. Install the Field Coil Remover on the nose opening of the A/C compressor.
   3. Install the Puller-Differential Side Bearing.
   4. Remove the A/C clutch field coil.

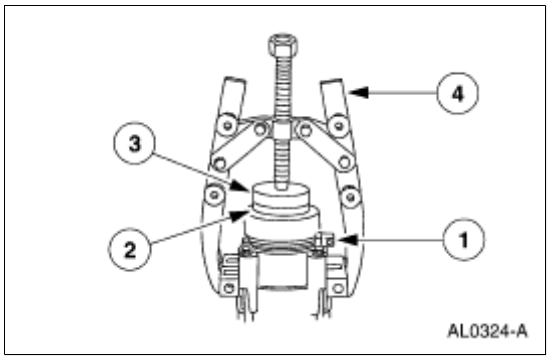


Installation

1. Clean the A/C clutch field coil and pulley bearing mounting surfaces.

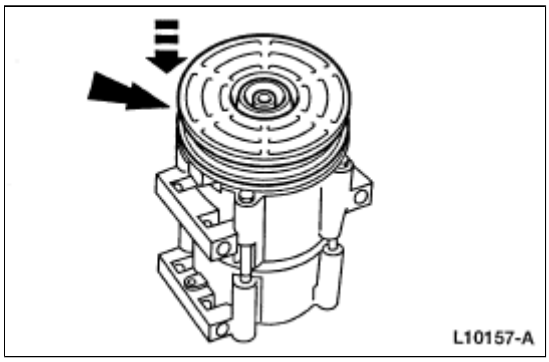
2. **CAUTION: Do not use air tools. The A/C clutch field coil can be easily damaged.**

   Install the A/C clutch field coil.
   1. Place the A/C clutch field coil on the A/C compressor with the A/C clutch field coil electrical connector correctly positioned.
   2. Place the Field Coil Replacer on the A/C clutch field coil.
   3. Place the Coil Replacer on the Field Coil Replacer.
   4. Use the 2-Jaw Puller to install the A/C clutch field coil until bottomed completely against the A/C compressor.

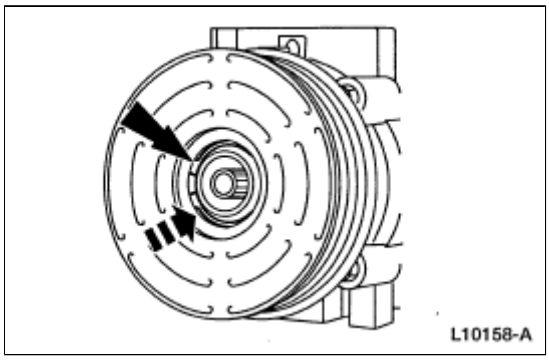


3. **NOTE:** The A/C clutch pulley is a tight fit on the A/C compressor head; it must be correctly aligned during installation.

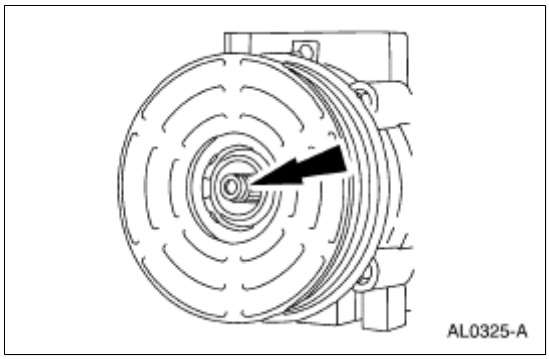
   Install the A/C clutch pulley.



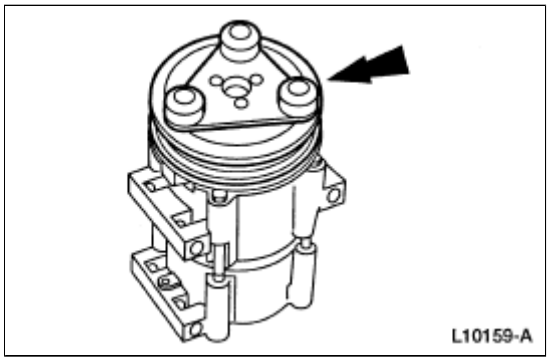
4. Install the pulley snap ring with the bevel side out.



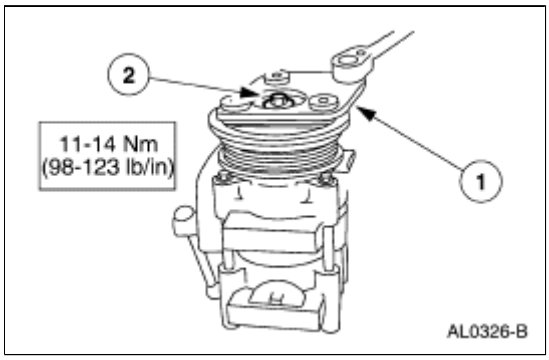
5. Place one nominal thickness A/C clutch hub spacer inside the clutch hub spline opening.



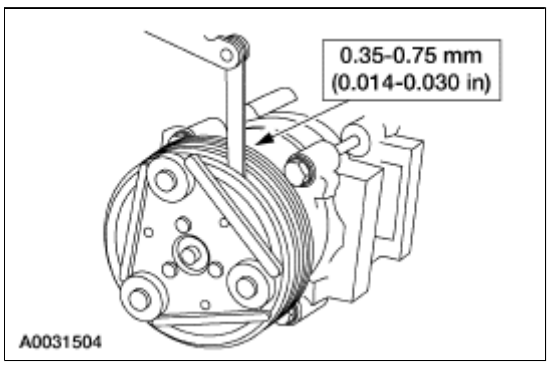
6. Install the A/C clutch.



7. Install the bolt.
    1. Hold the A/C clutch hub with the Compressor Clutch Holding Tool.
    2. Tighten the bolt.



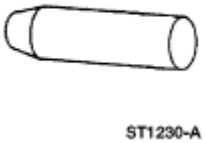
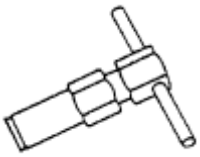
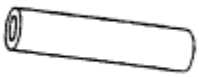
8. Measure and adjust the clutch air gap by removing or adding A/C clutch hub spacers.



9. Install the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor—4.0L OHV , Air Conditioning (A/C) Compressor—4.0L SOHC or Air Conditioning (A/C) Compressor—5.0L in this section.

Shaft Seal

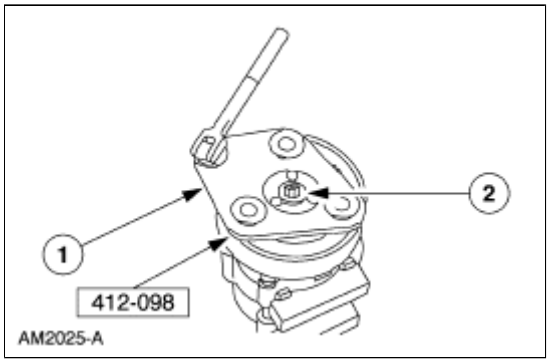
Special Tool(s)

 ST1230-A	Seal Protector 412-061 (T89P-19623-CH)
 ST1229-A	Compressor Seal Remover 412-059 (T89P-19623-BH)
 ST1228-A	Shaft Seal Replacer 412-058 (T89P-19623-AH)
ST1231-A	Snap Ring Remover 412-063 (T89P-19623-DH)
ST1219-A	O-Ring Removal Pick 100-010 (T71P-19703-C)
ST1235-A	Compressor Clutch Holding Tool 412-098 (T94P-19703-AH)

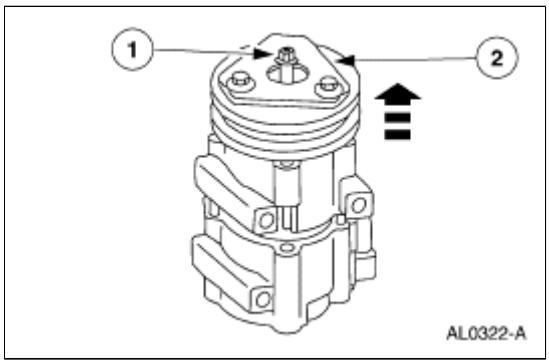
Removal

1. Remove the air conditioning (A/C) compressor. For additional information, refer to Air Conditioning (A/C) Compressor—4.0L OHV , Air Conditioning (A/C) Compressor—4.0L SOHC or Air Conditioning (A/C) Compressor—5.0L in this section.

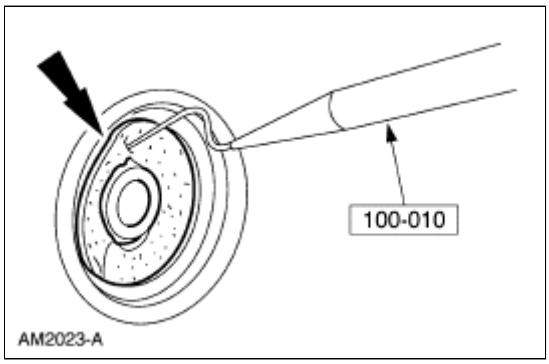
2. Remove the bolt.
    1. Hold the A/C clutch hub with the special tool.
    2. Remove the bolt.



3. Remove the A/C clutch and spacer.
    1. Thread an 8 x 1.25 mm (0.05 in) bolt into the A/C clutch to force it from the compressor shaft.
    2. Lift the A/C clutch and the A/C clutch hub spacer from the compressor shaft.

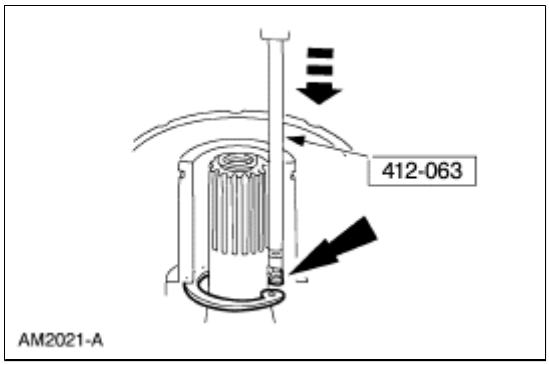


4. Remove the shaft seal felt from the nose of the A/C compressor with the special tool.

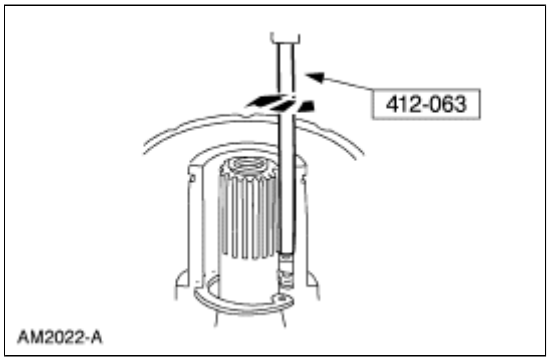


5. Clean the compressor nose area.

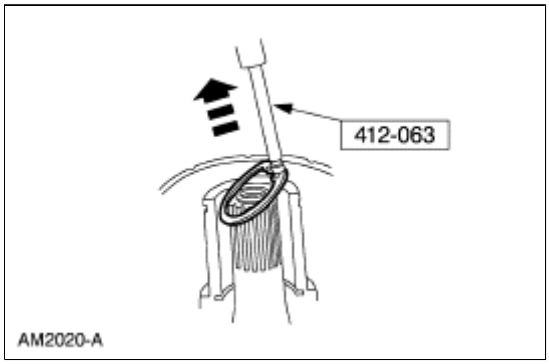
6. Insert the tip of the special tool into one of the snap ring eyes.



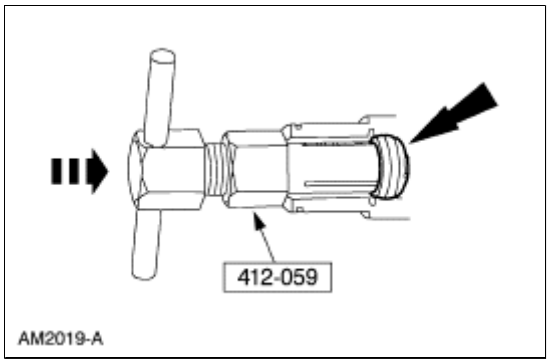
7. Rotate the special tool to position the tool tip and the snap ring eye closest to the A/C compressor shaft.



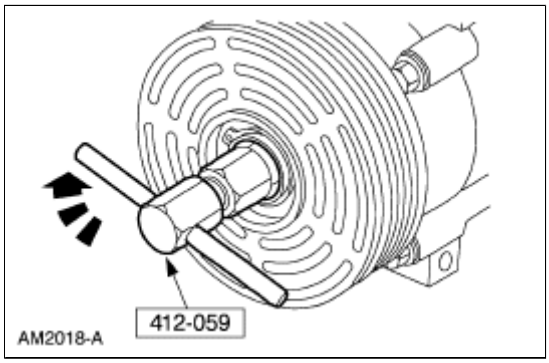
8. Pull the special tool up quickly while keeping the tool shaft against the side of the nose opening and remove the snap ring.



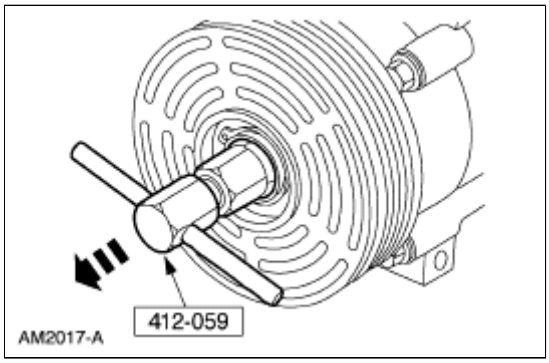
9. Engage the special tool into the inside diameter of the shaft seal.



10. Turn the tool handle clockwise to expand the tool tip inside of the shaft seal.



11. Pull the seal from the A/C compressor.

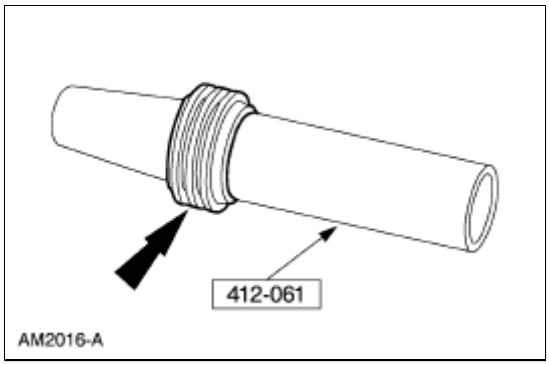


Installation

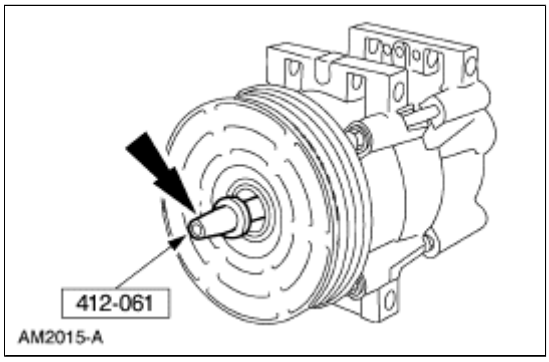
1. **CAUTION: Do not allow dirt or other foreign materials to enter the A/C compressor.**

   Clean the A/C compressor nose area.

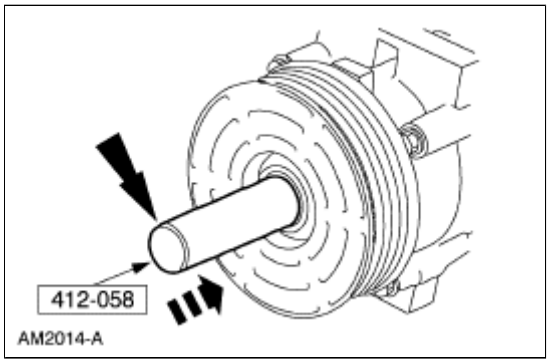
2. Place the shaft seal on the special tool. Lubricate the shaft seal and protector with PAG Refrigerant Compressor Oil, YN-12-C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B.



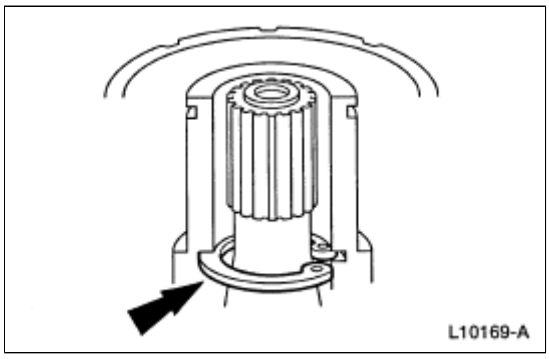
3. Position the shaft seal and the special tool over the A/C compressor shaft.



4. Push the shaft seal onto the A/C compressor shaft with the special tool until seated.

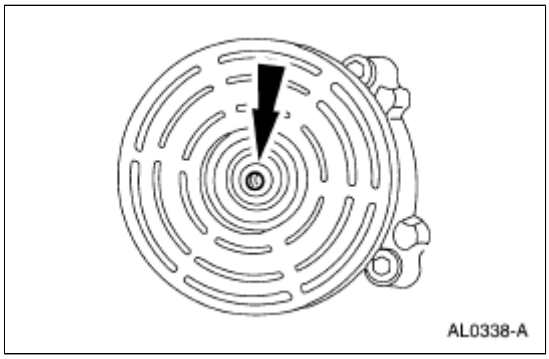


5. Install the shaft seal snap ring.

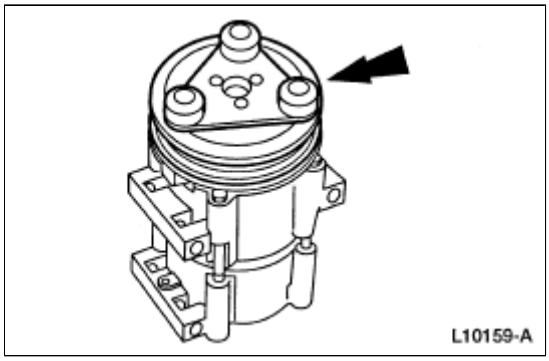


6. Conduct the A/C compressor external leak test. For additional information, refer to Section 412-00 .

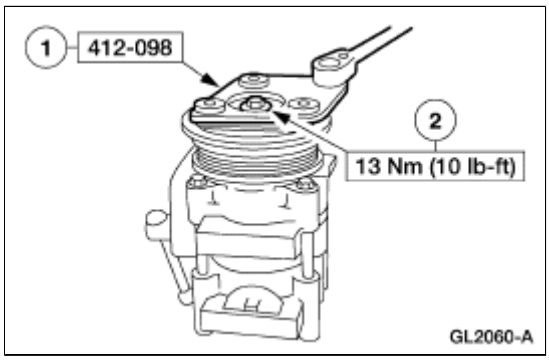
7. Install the shaft seal felt.



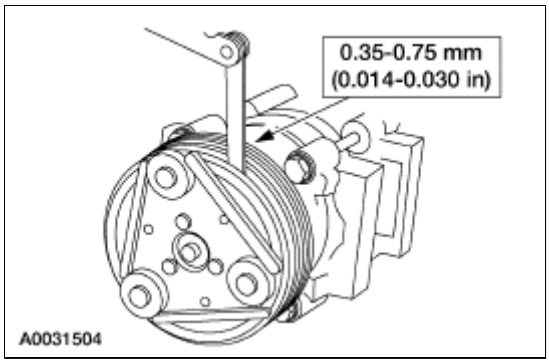
8. Install the A/C clutch hub spacer and the A/C clutch hub.



9. Install the bolt.
    1. Hold the A/C clutch hub with the special tool.
    2. Tighten the bolt.



10. Measure and adjust the clutch air gap by adding or removing A/C clutch hub spacers.



11. Install the Air Conditioning (A/C) compressor. For additional information, refer to Air Conditioning (A/C) Compressor—4.0L OHV , Air Conditioning (A/C) Compressor—4.0L SOHC or Air Conditioning (A/C) Compressor—5.0L in this section.

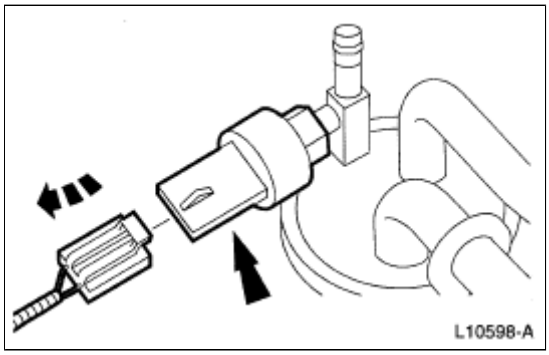
Evaporator Core

Removal

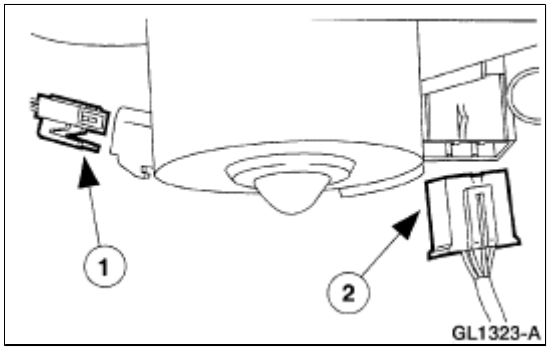
NOTE: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

NOTE: If an A/C evaporator core leak is suspected, the A/C evaporator core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

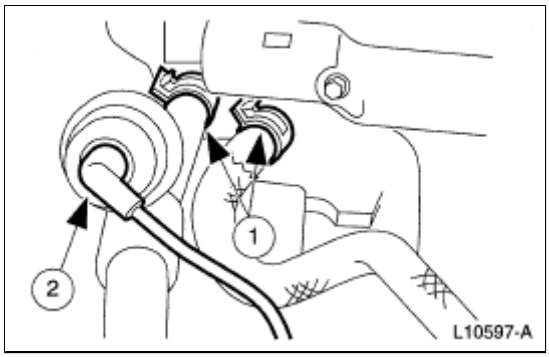
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Disconnect the A/C cycling switch (19E561).



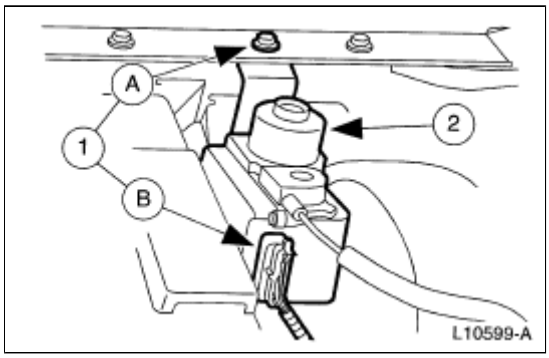
4. Disconnect the electrical connectors.
    1. Disconnect the A/C blower motor electrical connector.
    2. Disconnect the A/C blower motor resistor electrical connector.



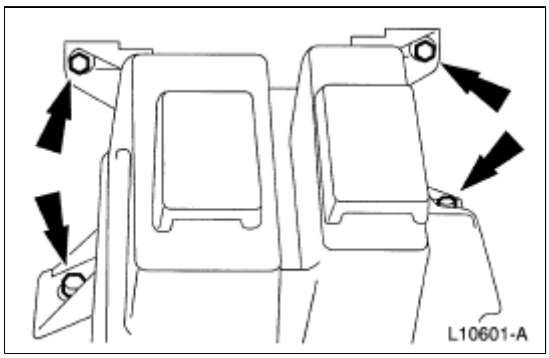
5. Disconnect the heater core (18476).
    1. Disconnect the heater water hoses (18472).
    2. Disconnect the heater water control valve vacuum hose.



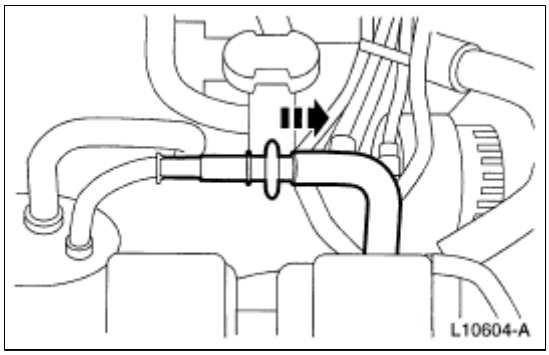
6. Position the speed control servo (9C735) aside.
    1. Remove the (A) bolt and disconnect the (B) servo electrical connector.
    2. Position the speed control servo aside.



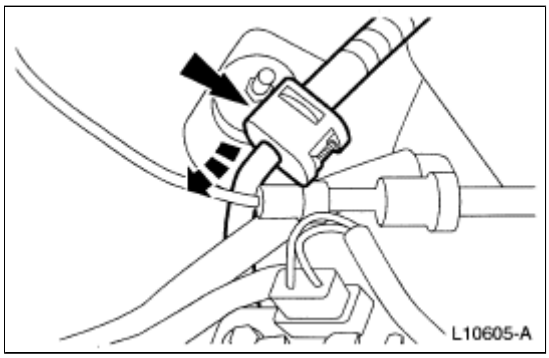
7. Remove the nuts and the screws from the windshield washer reservoir/coolant recovery reservoir. Set the reservoir aside.



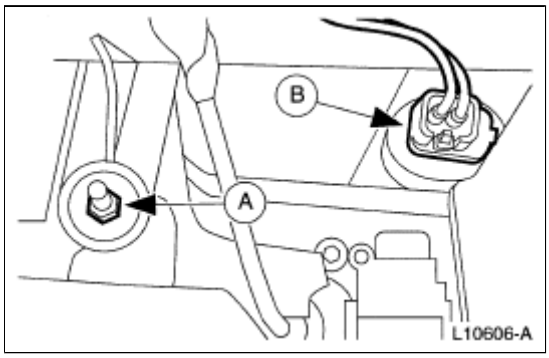
8. Disconnect the A/C manifold and tube (19D734) from the suction accumulator/drier. For additional information, refer to Section 412-00 .



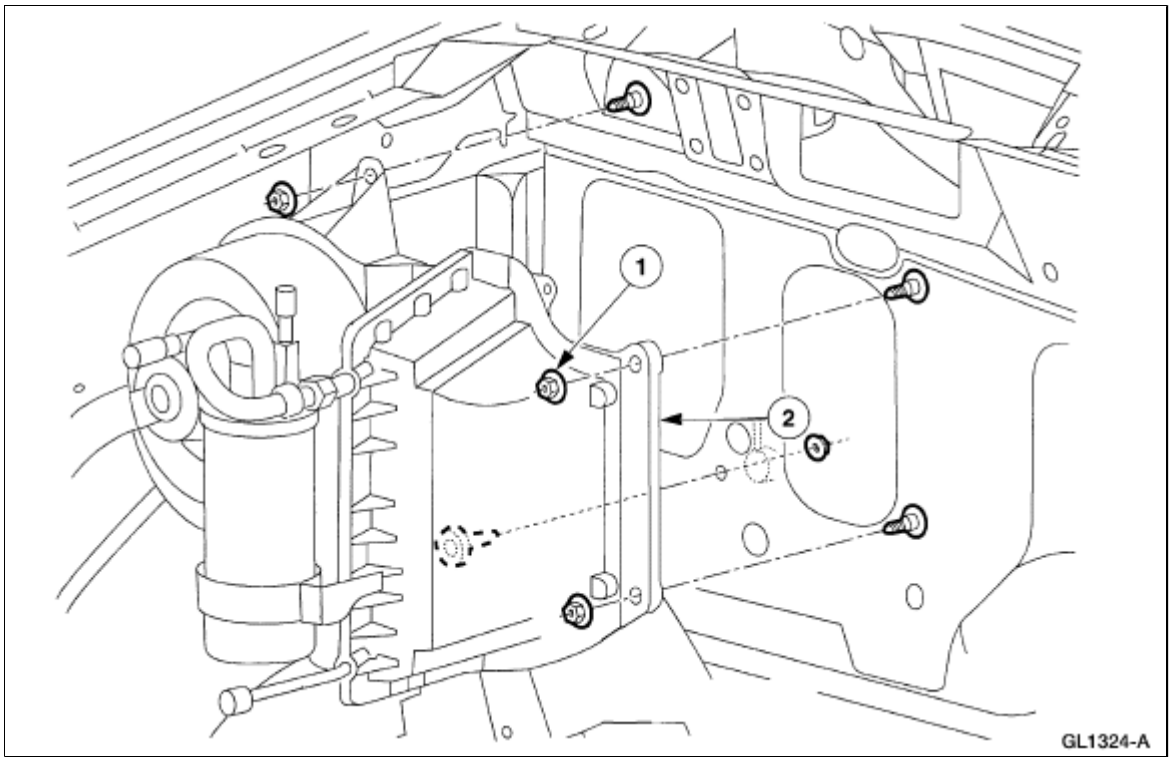
9. Disconnect the condenser to evaporator tube (19835). For additional information, refer to Section 412-00 .



10. Disconnect the (B) A/C system vacuum harness and the (A) A/C evaporator housing mounting nut inside the vehicle.



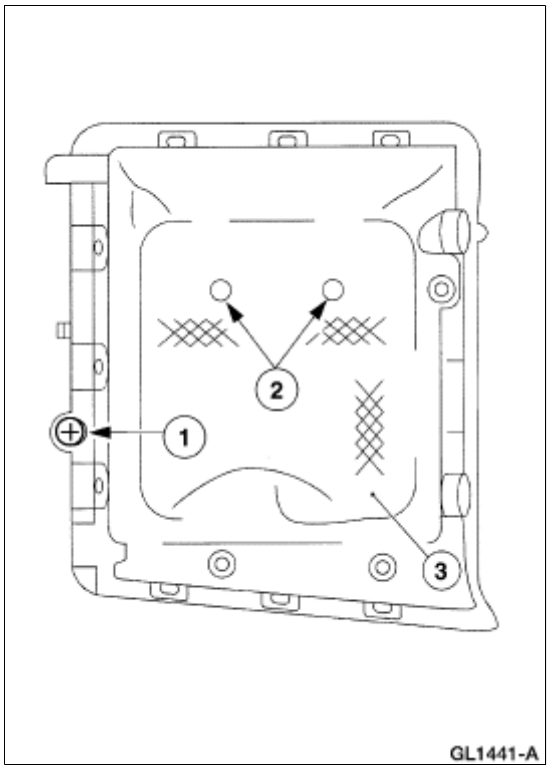
11. Remove the A/C evaporator housing (19850).
    1. Remove the three underhood and one underdash nuts.
    2. Lift the A/C evaporator housing out of the vehicle.



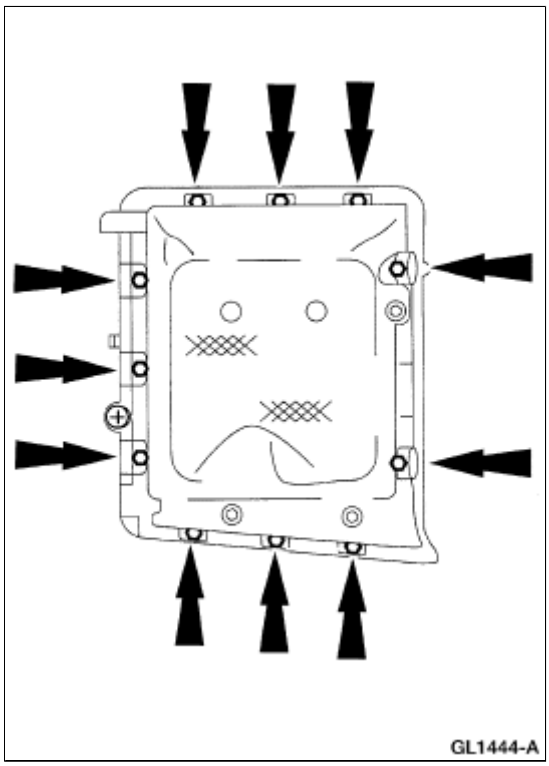
12. Disconnect the suction accumulator/drier from the A/C evaporator core. For additional information, refer to Evaporator Core in this section.

13. **NOTE:** For the 5.0L engine only:

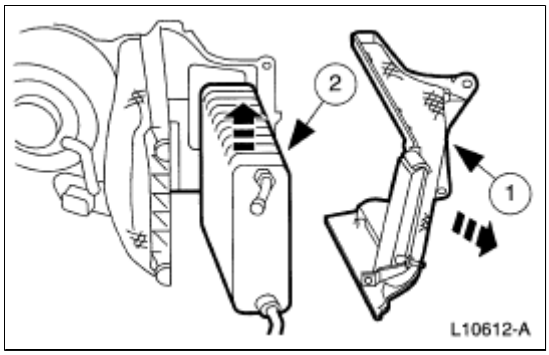
    Remove the evaporator housing heat shield.
    1. Remove the screw.
    2. Remove the clips.
    3. Remove the heat shield.



14. Remove the screws attaching the housing cover.

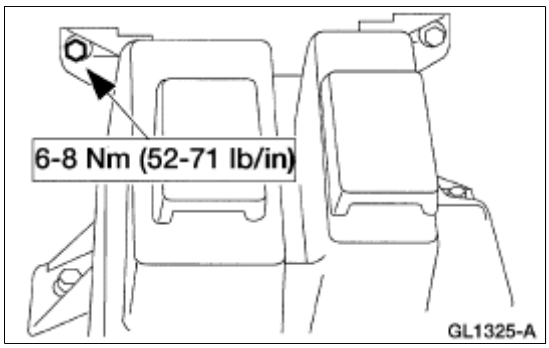


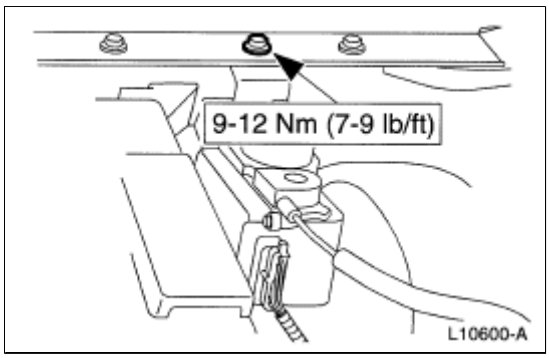
15. Remove the A/C evaporator core.
    1. Separate the evaporator case halves.
    2. Lift the A/C evaporator core out.



Installation

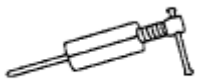
1. To install, reverse the removal procedure.
    - Service the new A/C evaporator core with the correct amount of PAG compressor oil, YN-12-C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B. For additional information, refer to Section 412-00 .





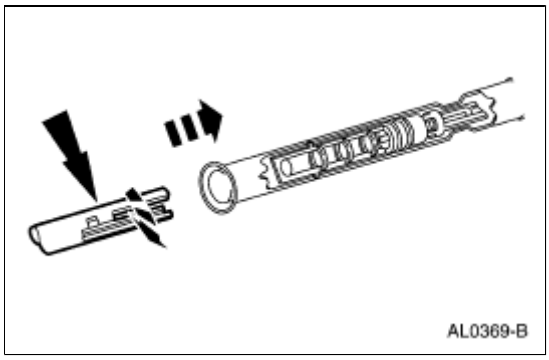
Evaporator Core Orifice

Special Tool(s)

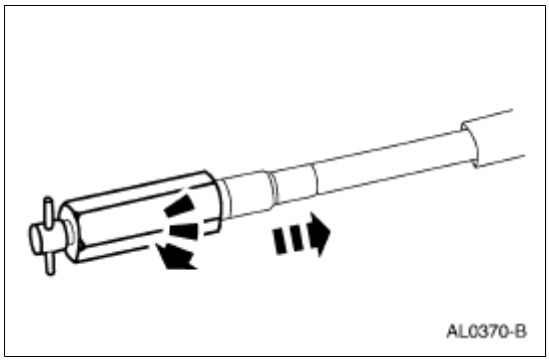
 ST1223-A	Throttle Remover 412-035 (T83L-19990-B)
ST1224-A	Fixed Orifice Tube Tool 412-034 (T83L-19990-A)

Removal

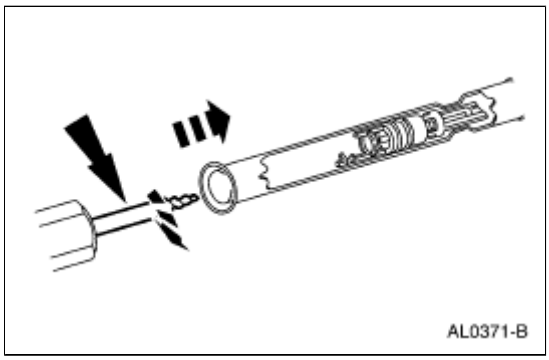
1. Remove the condenser to evaporator tube (19835). For additional information, refer to Line—Condenser to Evaporator in this section.
2. Engage the Fixed Orifice Tube Tool to the A/C evaporator core orifice (19D990).



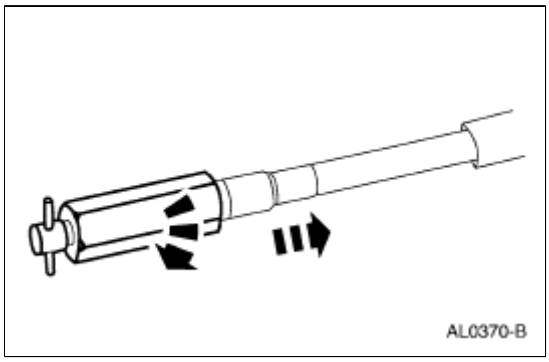
3. Hold the tool T-handle stationary and rotate the tool body to remove the A/C evaporator core orifice.



4. To remove a broken A/C evaporator core orifice, screw the end of the Throttle Remover into the broken A/C evaporator core orifice.



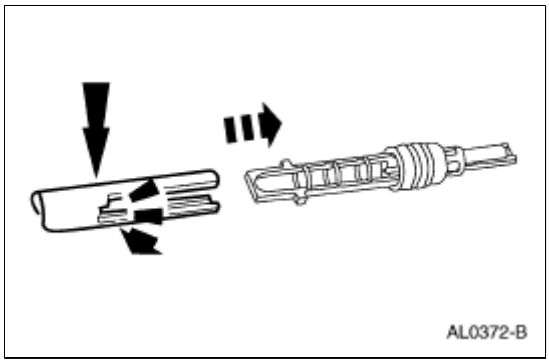
5. Hold the tool T-handle stationary and rotate the tool body to remove the broken A/C evaporator core orifice.



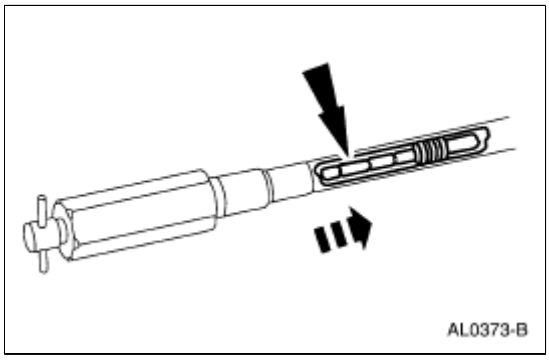
Installation

1. Lubricate and install the O-ring seals on the A/C evaporator core orifice.
    - Use PAG compressor oil, YN-12-C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B.

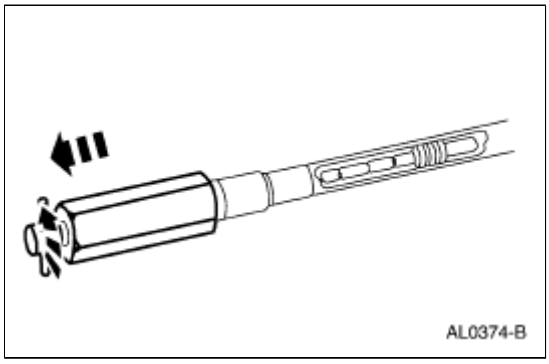
2. Place the A/C evaporator core orifice into the Fixed Orifice Tube Tool.



3. Insert the A/C evaporator core orifice into the condenser to evaporator tube until seated.



4. Remove the Fixed Orifice Tube Tool.

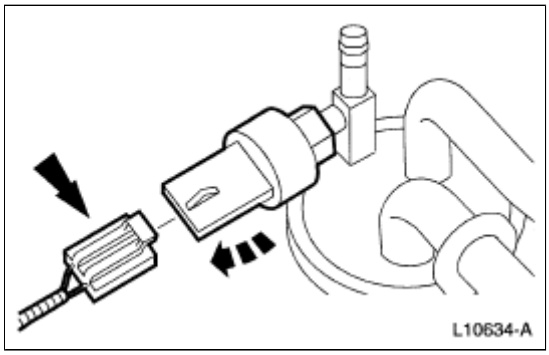


5. Install the condenser to evaporator tube. For additional information, refer to Line—Condenser to Evaporator in this section.

Suction Accumulator

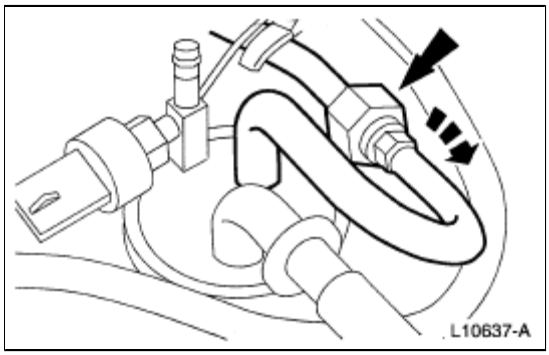
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Disconnect the A/C cycling switch electrical connector.

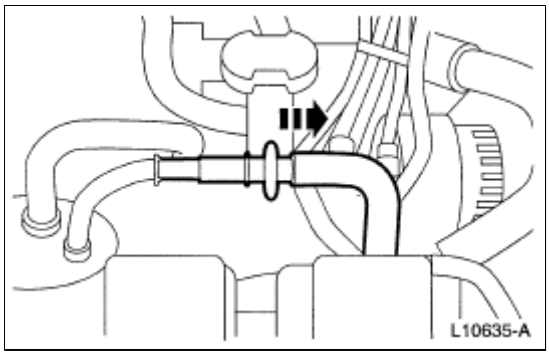


4. **CAUTION: Use a back-up wrench to prevent damage to the tubes.**

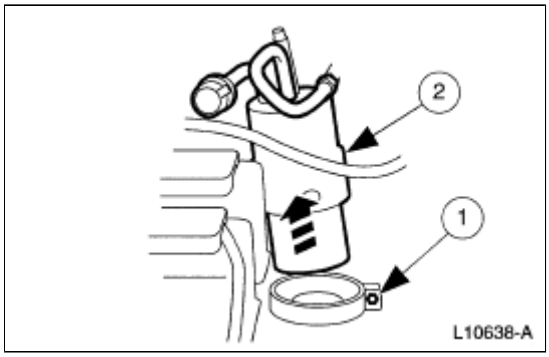
   Disconnect the suction accumulator/drier to A/C evaporator core fitting.



5. Disconnect the A/C manifold and tube spring lock coupling from the suction accumulator/drier (19C836) suction accumulator/drier. For additional information, refer to Section 412-00 .



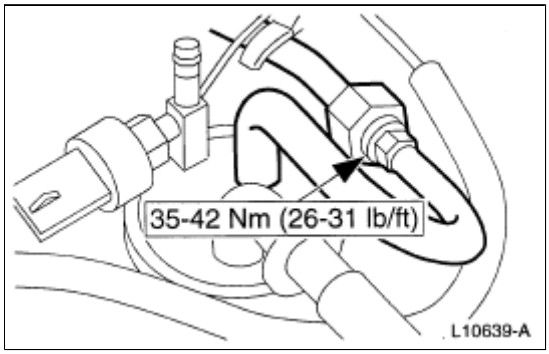
6. Remove the suction accumulator/drier.
    1. Remove the screw from the mounting bracket.
    2. Lift the suction accumulator/drier out.

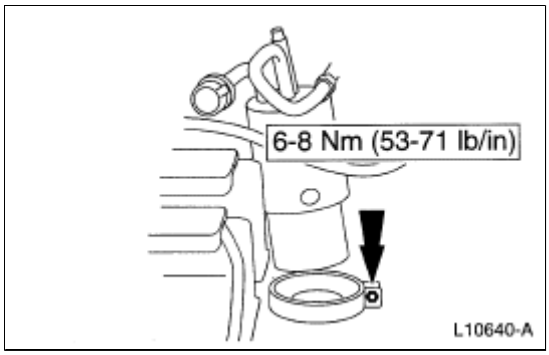


7. Transfer the A/C cycling switch (19E561) to the new suction accumulator/drier.

Installation

1. To install, reverse the removal procedure.
    - Service the new suction accumulator/drier with the correct amount of PAG compressor oil, YN-12-C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B. For additional information, refer to Section 412-00 .




6-8 Nm (53-71 lb/in)
L10640-A

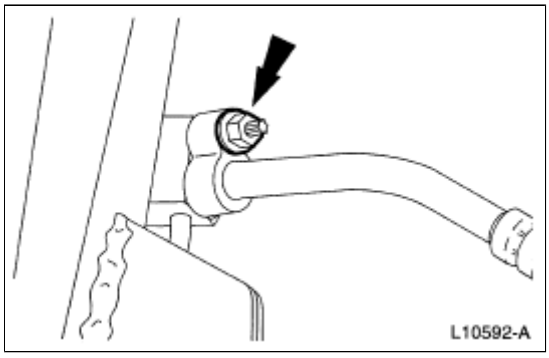
Condenser Core

Removal

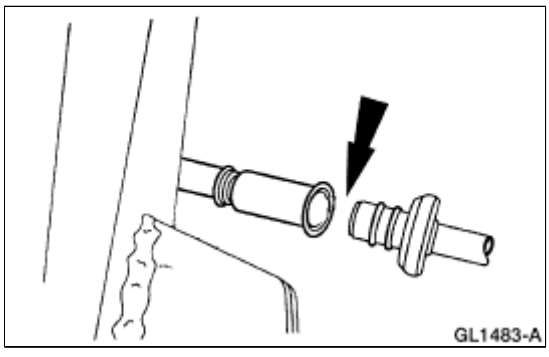
CAUTION: Installation of a new suction accumulator/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator/drier.

NOTE: If an A/C condenser core leak is suspected, the A/C condenser core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. If equipped with 5.0L or 4.0L SOHC engine, disconnect the A/C manifold and tube (19D734) and the condenser to evaporator tube (19835) from the A/C condenser core.



3. If equipped with 4.0L push rod engine, disconnect the A/C manifold and tube and the condenser to evaporator tube spring lock couplings from the A/C condenser core. For additional information, refer to Section 412-00 .

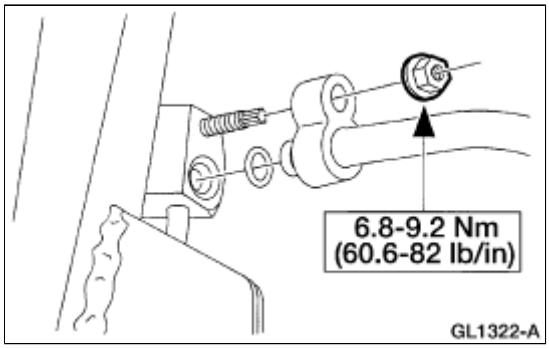


4. Remove the radiator. For additional information, refer to Section 303-03 .
5. Remove the A/C condenser core.

Installation

1. **NOTE:** When a new A/C condenser is installed, a new A/C evaporator core orifice (19D990) should also be installed.

   To install, reverse the removal procedure.
   - Service the new A/C condenser core with the correct amount of PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B. For additional information, refer to Section 412-00 .
   - Lubricate new O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



Compressor Manifold and Tube Assembly —4.0L OHV

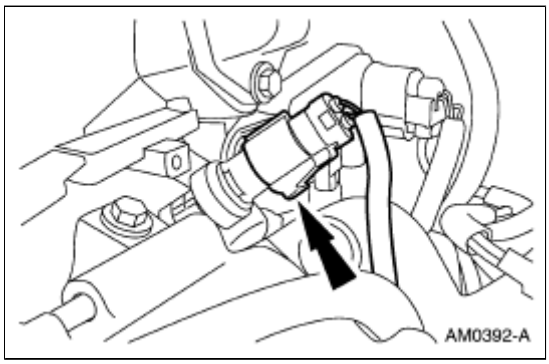
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

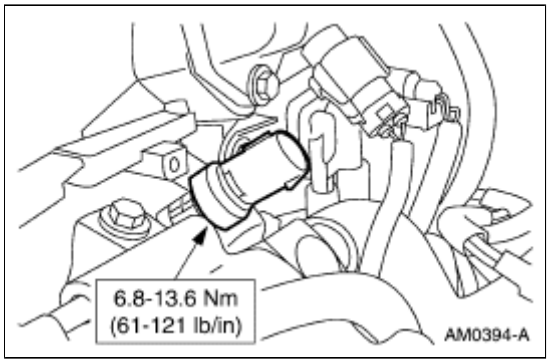
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

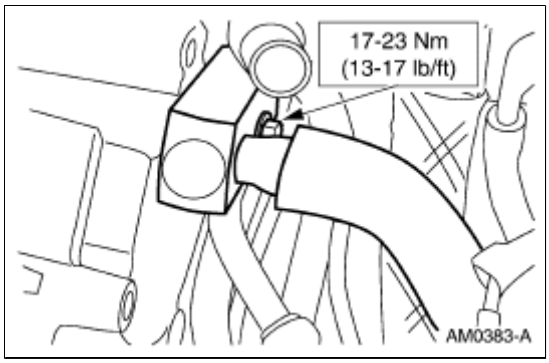
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Disconnect the pressure cutoff switch electrical connector.



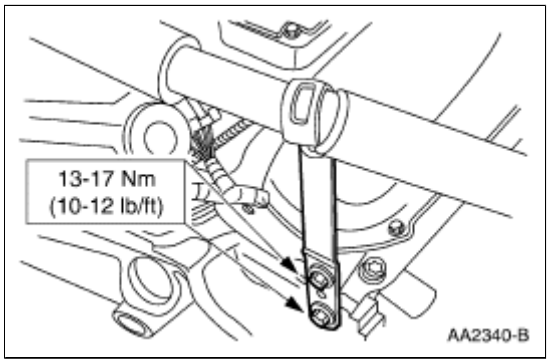
3. Remove the pressure cutoff switch.



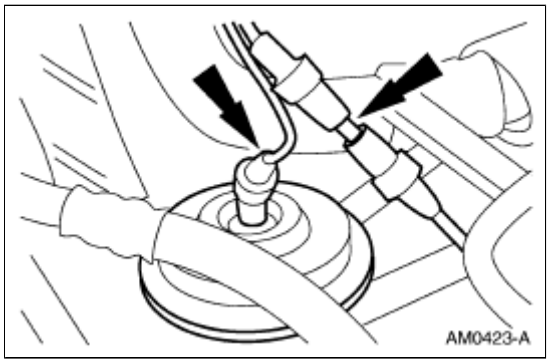
4. Remove the bolt and detach the manifold and tube from the A/C compressor.
   - Discard the O-ring seals.



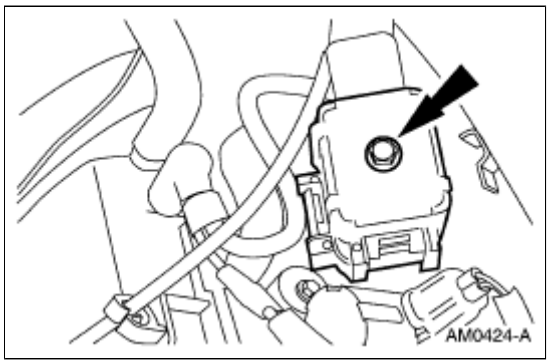
5. Remove the bolts and detach the manifold and tube bracket.



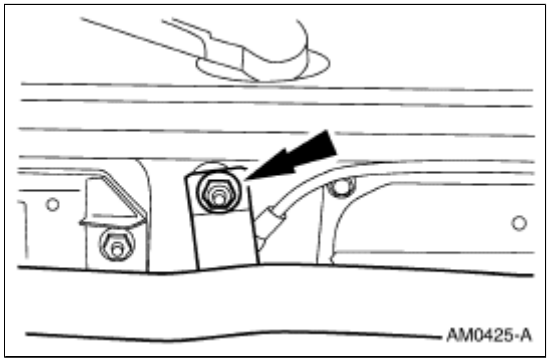
6. Disconnect and position aside the vacuum lines.



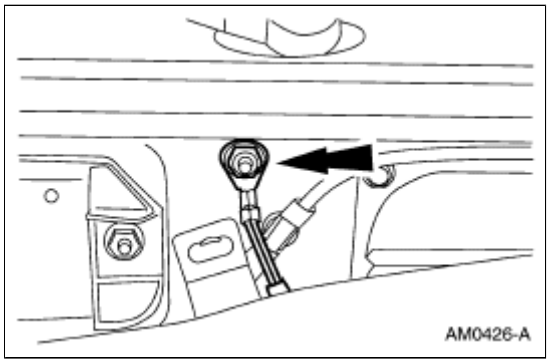
7. Disconnect the electrical connector.



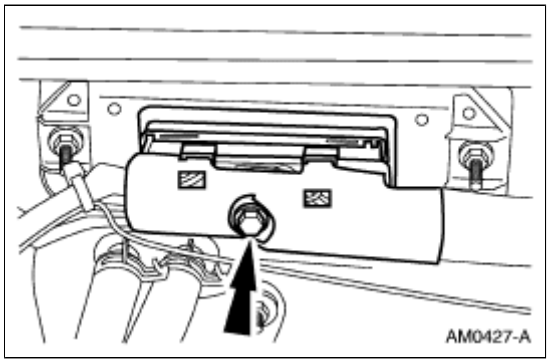
8. Remove the wiring harness retaining nut at the dash panel.



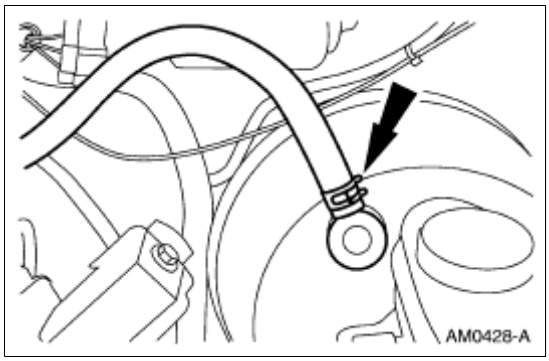
9. Detach the ground wire from the dash panel.



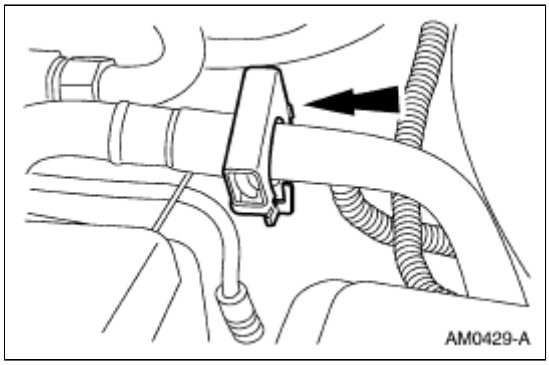
10. Disconnect and position aside the PCM electrical connector.



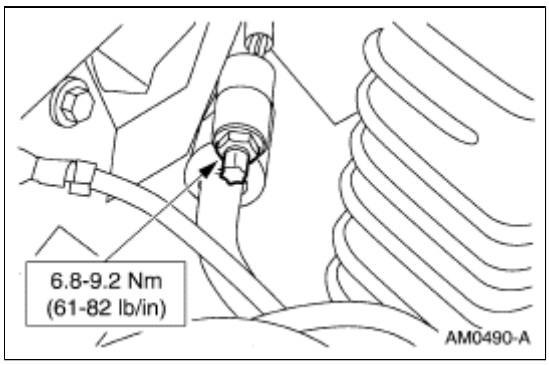
11. Disconnect the brake booster vacuum line.



12. Disconnect the manifold and tube spring lock coupling at the suction accumulator.
    - Discard the O-ring seals.



13. Remove the nut and disconnect the manifold and tube from the condenser core.
    - Discard the O-ring seals.



14. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

15. Evacuate, leak-test, and charge the refrigerant system. For additional information, refer to Section 412-00 .

Compressor Manifold and Tube Assembly —4.0L SOHC

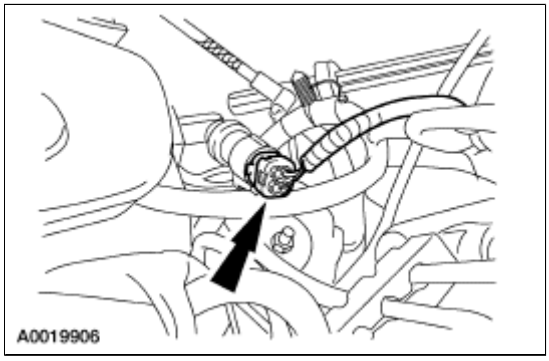
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

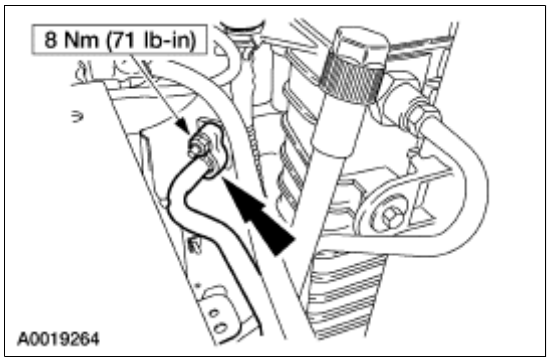
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

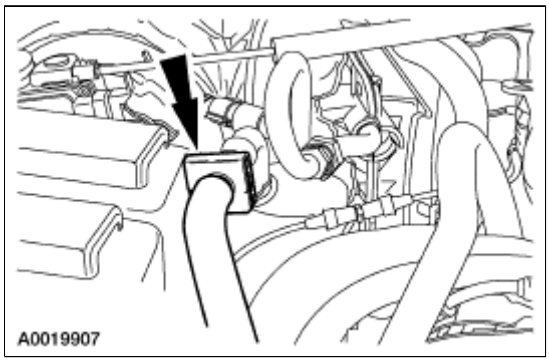
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor—4.0L SOHC in this section.
4. Remove the cooling fan and shroud. For additional information, refer to Section 303-03 .
5. Disconnect the A/C pressure cutoff switch electrical connector.



6. Remove the nut and disconnect the compressor manifold and tube assembly fitting at the condenser core.
   - Discard the O-ring seals.

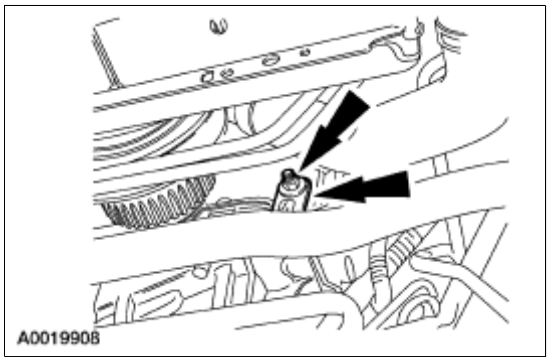


7. Disconnect the compressor manifold and tube assembly spring lock coupling at the suction accumulator.
   - Discard the O-ring seals.



8. Raise the vehicle. For additional information, refer to Section 100-02 .

9. Remove the bolt and detach the compressor manifold and tube assembly.



10. Lower the vehicle.

11. Remove the compressor manifold and tube assembly.

12. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

13. Evacuate, leak-test, and charge the refrigerant system. For additional information, refer to Section

412-00 .

Compressor Manifold and Tube Assembly —5.0L

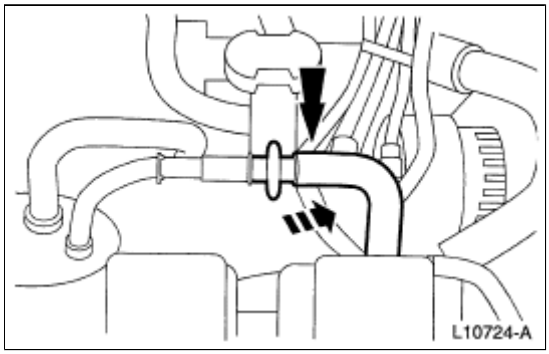
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

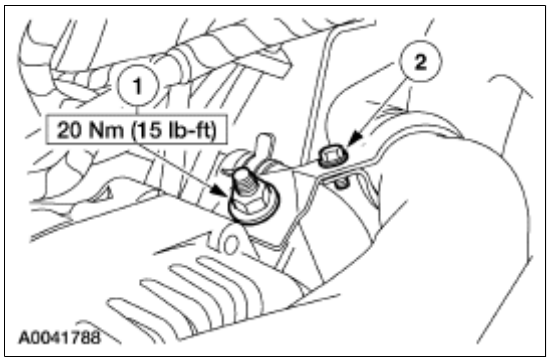
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

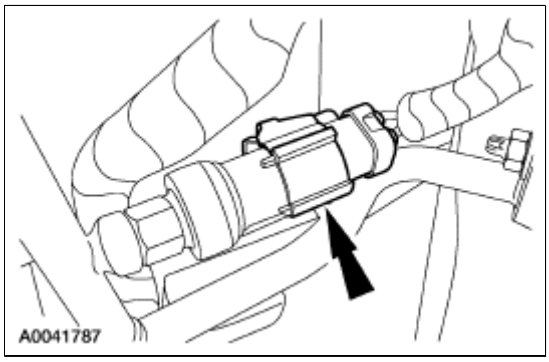
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner assembly. For additional information, refer to Section 303-12 .
3. Disconnect the compressor manifold and tube assembly from the suction accumulator.
   - Discard the O-ring seals.



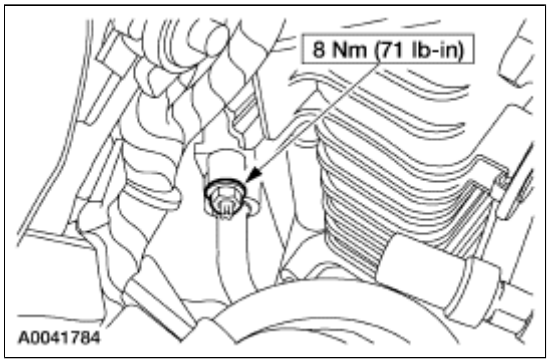
4. Detach the A/C line bracket.
   1. Remove the nut.
   2. Remove the screw and detach the A/C line bracket.



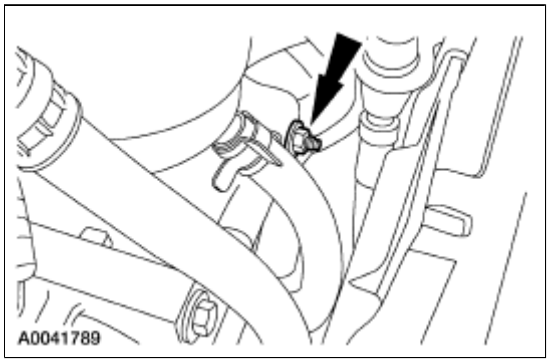
5. Disconnect the pressure cutoff switch electrical connector.



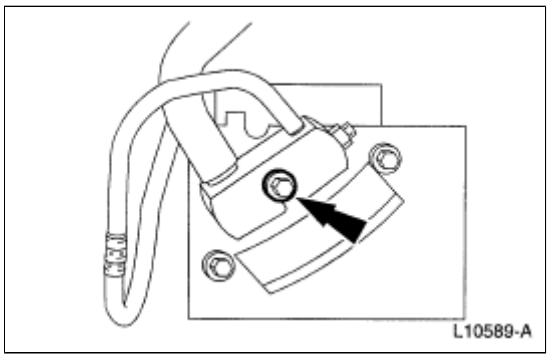
6. Remove the nut and disconnect the compressor manifold and tube fitting from the condenser core.
    - Discard the O-ring seal.



7. Remove the nut and position aside the bracket.



8. Remove the bolt and detach the compressor manifold and tube assembly from the A/C compressor.
    - Discard the O-ring seals.



9. Remove the compressor manifold and tube assembly.

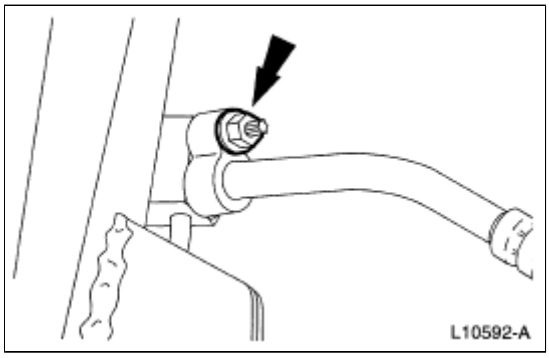
10. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

11. Evacuate, leak-test, and charge the refrigerant system. For additional information, refer to Section 412-00 .

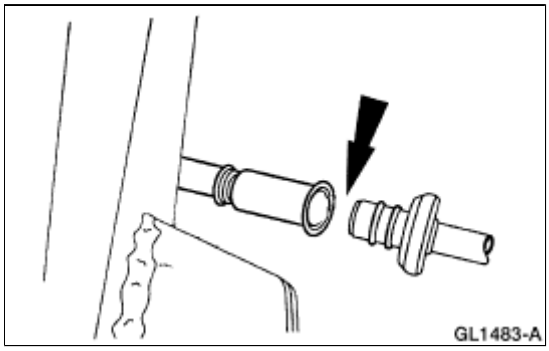
Line —Condenser to Evaporator

Removal

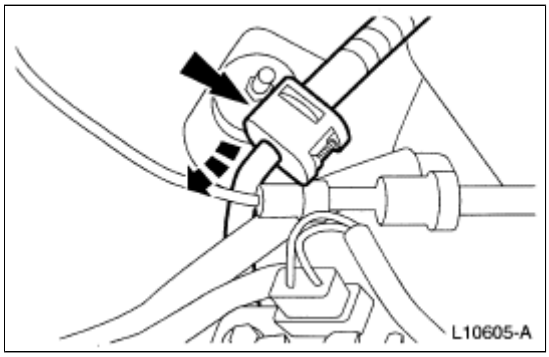
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. If equipped with a 5.0L or 4.0L SOHC engine, disconnect the condenser to evaporator tube (19835) from the A/C condenser core (19712).



3. If equipped with a 4.0L push rod engine, disconnect the condenser to evaporator tube spring lock couplings from the A/C condenser core. For additional information, refer to Section 412-00 .

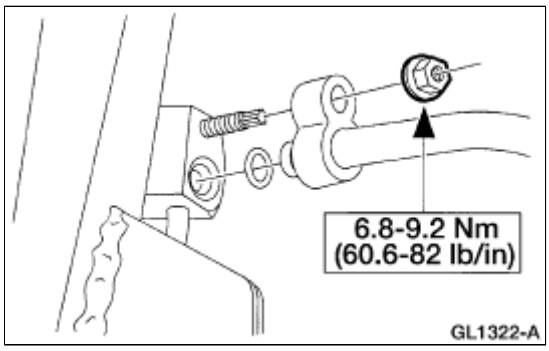


4. Disconnect the condenser to evaporator tube spring lock coupling from the A/C evaporator core (19860) and remove the condenser to evaporator tube. For additional information, refer to Section 412-00 .



Installation

1. To install, reverse the removal procedure.



Control Components

Manual A/C

The manual climate control system heats or cools the vehicle interior depending on the function selector position and the temperature selected. Function selector position determines heating or cooling and air distribution. The temperature blend control setting determines air temperature.

The manual climate control components are used to:

- select air inlet source (outside or recirculated).
- select blower motor speed.
- select discharge air temperature (temperature blend).
- select discharge air location (defrost, panel, floor).
- select A/C compressor clutch operation.

Electronic Automatic Temperature Control

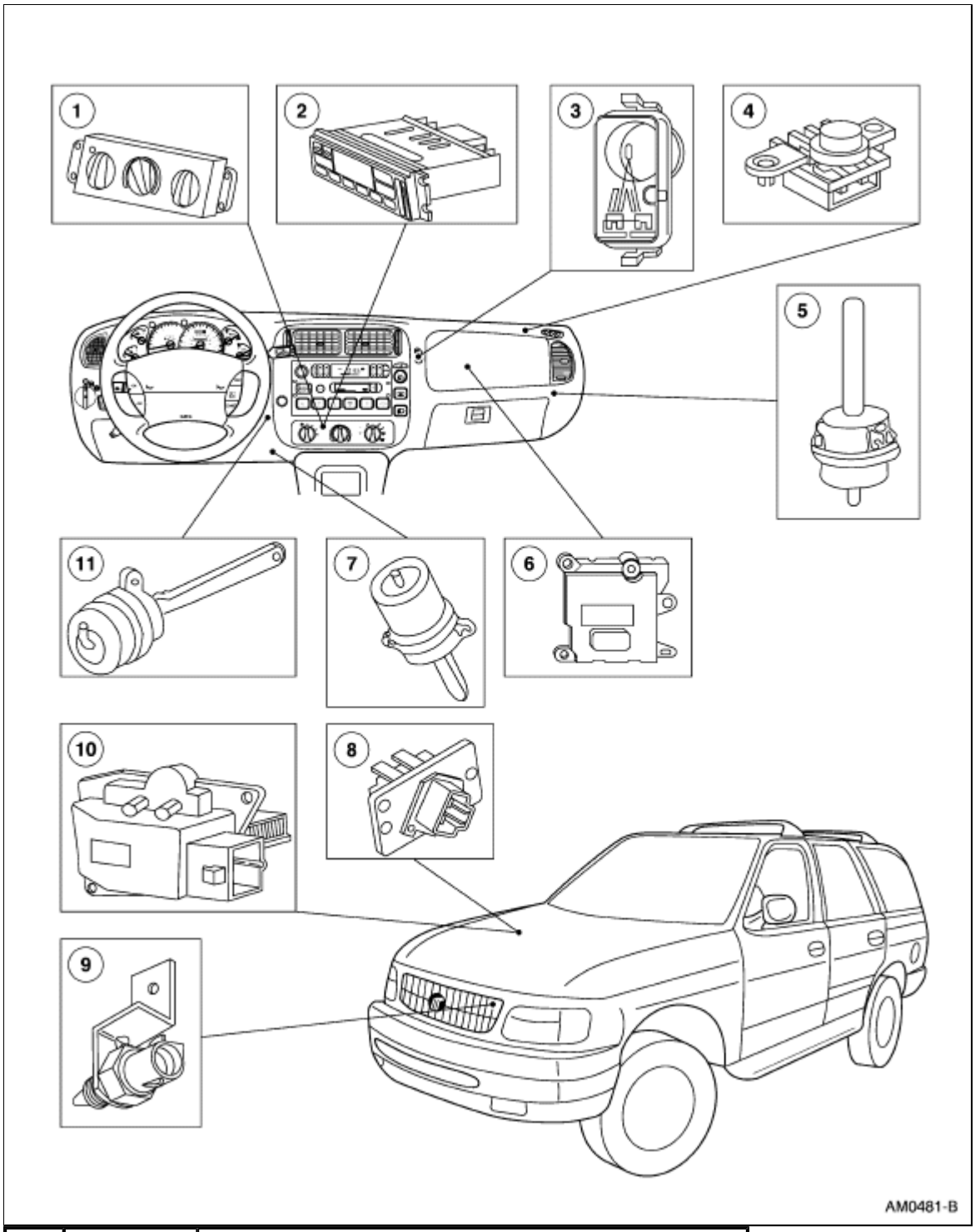
With the use of a microcontroller, the electronic automatic temperature control (EATC) module analyzes input from the following major sources:

- temperature, function and blower selection (made by the vehicle occupants)
- in-vehicle temperature
- ambient temperature
- sunload
- vehicle speed
- engine coolant temperature

Using these inputs, the microcontroller determines the correct conditions for the following outputs:

- A/C clutch engagement
- blower speed
- air temperature blend door position
- panel/floor door position
- panel/defrost door position
- air inlet door position

Component Locations



Item	Part Number	Description
1	19980	Manual A/C control assembly
2	19880	Electronic automatic temperature control module
3	19D888	Automatic temperature control sensor hose and elbow— (EATC only)
4	19E663	A/C sunload sensor— (EATC only)

5	18A318	Vacuum control motor— (air inlet door)
6	19E616	A/C electronic door actuator motor
7	18A318	Vacuum control motor— (panel/defrost door)
8	18591	Heater blower motor switch resistor
9	19E702	A/C ambient air temperature sensor and bracket— (EATC only)
10	19E624	A/C blower motor speed control— (EATC only)
11	18A318	Vacuum control motor— (floor/panel door)

Control System Inputs—Manual A/C

Climate Control Assembly

The climate control assembly has three system controls:

- The A/C heater function selector switch combines a vacuum selector valve with two electrical switches to supply battery positive voltage (B+) to the A/C clutch circuit and the blower motor control circuit.
- The temperature selection is accomplished with a potentiometer connected to the electric blend door actuator that controls positioning of the temperature blend door. Movement of the control knob (18519) from COOL (blue) to WARM (red) causes a corresponding movement on the air temperature control door and determines the temperature that the system will maintain.
- The blower motor switch controls blower motor speed by adding or bypassing resistors in the heater blower motor switch resistor (18591).

Control System Inputs—EATC

Climate Control Assembly

The electronic automatic temperature control (EATC) module, located in the instrument panel, has the following features:

- 11 push buttons
- a blower speed override thumbwheel for manual input
- a vacuum fluorescent display for displaying set temperature, function and diagnostic trouble codes (DTCs)
- an on-board diagnostic (OBD) feature to supply the technician with diagnostic trouble codes (DTCs). These DTCs direct the technician to the inoperative component.

A/C Ambient Air Temperature Sensor

The A/C ambient air temperature sensor and bracket (19E702):

- is located in front of the A/C condenser core (19712) near the center of the vehicle.
- contains a thermistor which measures the temperature of outside air as a resistance and sends that reading to the electronic automatic temperature control assembly.

In-Car Temperature Sensor

The in-car temperature sensor operates in the following manner:

- A thermistor in the in-car temperature sensor measures air temperature inside the passenger compartment.
- An automatic temperature control sensor hose and elbow (19D888) is connected between the plenum assembly and the in-car temperature sensor.
- The automatic temperature control sensor hose and elbow takes air from the plenum assembly air stream to create a suction in the in-car temperature sensor.
- The suction draws in-vehicle air into the in-car temperature sensor and across the thermistor.

A/C Sunload Sensor

The A/C sunload sensor (19E663):

- is located on the top of the instrument panel (04320).
- contains a photovoltaic diode that is sensitive to light.
- has some unspecified resistance across the terminals depending upon the amount of light reaching the photovoltaic diode; therefore the only test that can be carried out is for an internal short circuit.

Control System Outputs—Manual A/C

Blower Motor Switch Resistor

The heater blower motor switch resistor has the following features:

- The assembly is located on the evaporator housing in the engine compartment.
- Three resistance elements are mounted on the resistor board to provide four blower motor speeds.
- Depending on the heater blower motor switch position, series resistance is added or bypassed in the blower motor circuit to decrease or increase blower motor speed.
- An overheating protective device (thermal limiter) will open the resistor coil circuit when the temperature reaches 121°C (250°F) interrupting the blower motor operation in all speeds except HI.
- The thermal limiter cannot be reset and is not serviceable.

Control System Outputs—EATC

Blower Motor Speed Control

The blower speed control is located on the evaporator housing in the engine compartment.

- The function of the blower motor speed control is to convert low power signals from the electronic automatic temperature control module to a high current, variable ground feed for the blower motor (18527).
- The blower motor speed is infinitely variable and is controlled by the electronic automatic temperature control module software.
- A delay function provides a gradual increase or decrease in blower motor speed under all conditions.

A/C Electric Blend Door Actuator

The A/C electric blend door actuator is located on the plenum assembly.

- Its function is to move the air temperature blend door on command from the control assembly.
- The A/C electric blend door actuator contains a reversible electric motor and a potentiometer. The potentiometer wiper is connected to the actuator output shaft and moves with the output shaft to indicate the position of the air temperature blend door.

- A 5 volt signal is applied to the ends of the potentiometer. The voltage available at the wiper indicates the position of the potentiometer. The expressed value of the actuator wiper voltage is sent to the electronic automatic temperature control module and is matched with the wiper voltage of the module potentiometer. The control module then drives the actuator motor in whichever direction is necessary to make the actuator wiper voltage agree with the control module wiper voltage.

EATC SYSTEM RESPONSE

Control Assembly Selection	Air Temperature Blend Door Response	Panel/Floor Door Response	Panel/Defrost Door Response	Air Inlet Door Response	Blower Motor Response (Unless Manually Overridden)	A/C Clutch Response
OFF	Remains fixed	Fixed in PANEL	Fixed in DEFROST	Fixed in RECIRC	Blower Motor OFF	A/C Clutch Disabled
AUTO	Varies a ccording to the sensor temperatures and the customer temperature selection. The air temperature blend door is in the heat position when the sensors are cool. The air temperature blend door is in the A/C position when the sensors are hot.	Air to the floor during heating. Air to the panel during cooling. Air to both between heating and cooling.	Air to the windshield defroster hose nozzle during heating. Air to the panel during cooling.	Recirculates air when maximum air conditioning is required. Otherwise outside air.	Variable blower motor speeds when the engine coolant temp. is above 49°C (120°F) or A/C is required. Low blower motor speed when the engine coolant is below 49°C (120°F) and heating is required. [a]	A/C Clutch enabled if outside temp. is above 10° C (50°F).
MAX A/C	Varies according to the sensor temperatures and the customer temperature selection.	Air to the panel.	Fixed in the PANEL position.	Fixed in the RECIRC position.	Variable blower motor speeds.	A/C Clutch enabled if outside temp. is above 10° C (50°F).
VENT	Varies according to the sensor temperatures and the customer temperature selection.	Air to the panel.	Fixed in the PANEL position.	Fixed in the outside air position.	Variable blower motor speeds.	A/C Clutch disabled.
PNL-FLR	Varies according to the sensor temperatures and the customer temperature	Air to the panel and floor.	Fixed in the PANEL position.	Fixed in the outside air position.	Variable blower motor speeds.	A/C Clutch enabled if outside temp. is above 10° C (50°F).

	selection.					
FLOOR	Varies according to the sensor temperatures and the customer temperature selection.	Air to floor.	Fixed in the DEFROST position.	Fixed in the outside air position.	Variable blower motor speeds.	A/C Clutch disabled.
FLR-DEF	Varies according to the sensor temperatures and the customer temperature selection.	Air to the panel and floor.	Fixed in the DEFROST position.	Fixed in the outside air position.	Variable blower motor speeds.	A/C Clutch enabled if outside temp. is above 10° C (50°F).
DEFROST	Varies according to the sensor temperatures and the customer temperature selection.	Air to the panel.	Fixed in the DEFROST position.	Fixed in the outside air position.	Variable blower motor speeds.	A/C Clutch enabled if outside temp. is above 10° C (50°F).

[a] If the engine coolant temperature fails to reach 50°C (122°F) after 3 1/2 minutes of operation, the blower motor speed will increase and the panel/floor door will shift from the defrost position to the floor position.

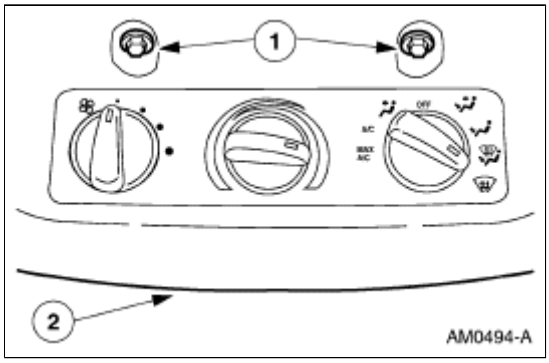
Control Components

Refer to Section 412-00 .

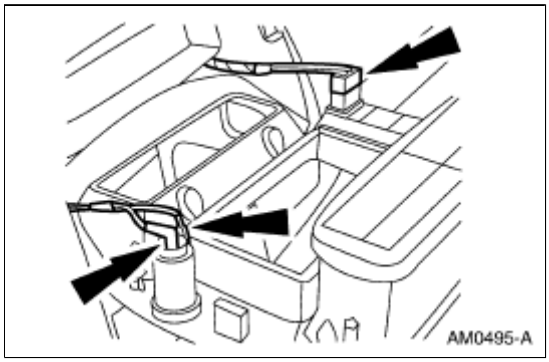
Control Assembly —Manual A/C

Removal

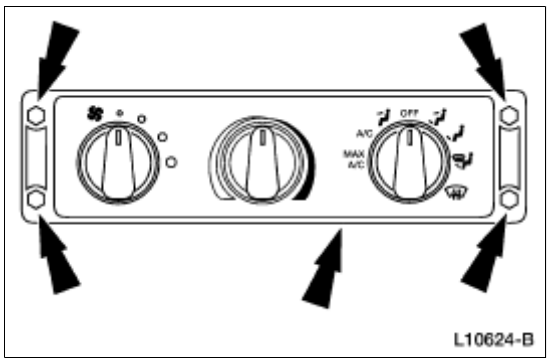
1. Remove the radio chassis (18806). For additional information, refer to Section 415-01 .
2. Remove the instrument panel finish panel (044D70).
    1. Remove the screws.
    2. Disengage the spring clips and remove the instrument panel finish panel.



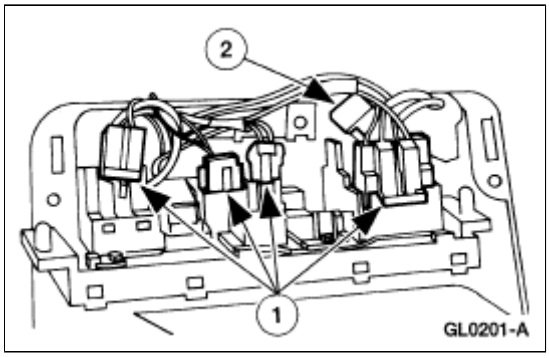
3. Disconnect the connectors.



4. Remove the screws and remove the climate control assembly.



5. Disconnect the climate control assembly.
    1. Disconnect the electrical connectors.
    2. Disconnect the vacuum harness connector.



Installation

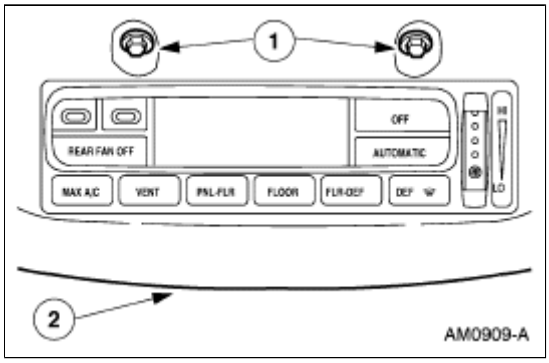
1. To install, reverse the removal procedure.

Control Assembly —Electronic Automatic Temperature Control

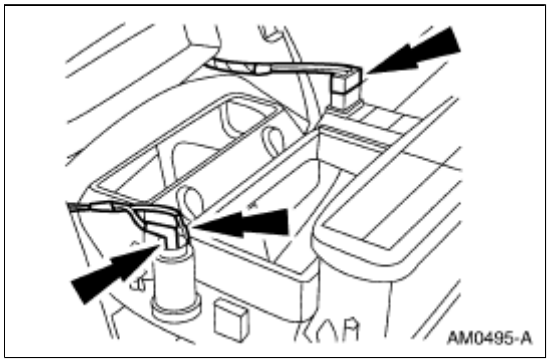
Removal

1. Remove the radio chassis (18806). For additional information, refer to Section 415-01 .

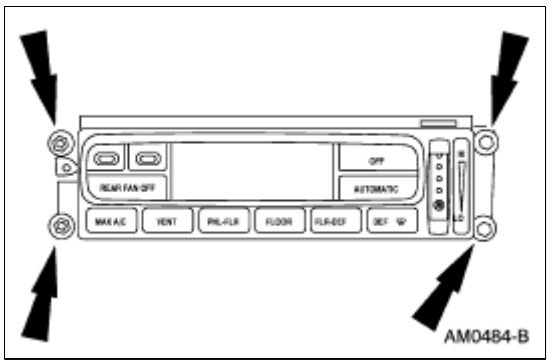
2. Remove the instrument panel finish panel (04338).
    1. Remove the screws.
    2. Disengage the spring clips and remove the instrument panel finish panel.



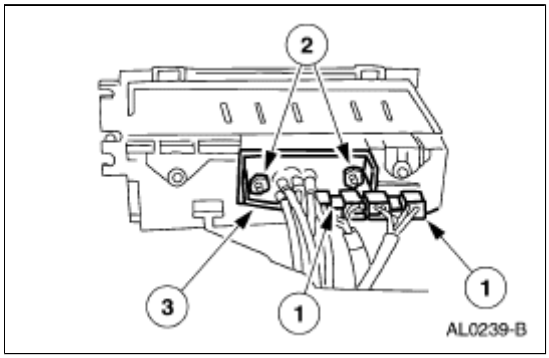
3. Disconnect the connectors.



4. Remove the screws and remove the electronic automatic temperature control module.



5. Remove the electronic automatic temperature control module.
    1. Disconnect the electrical connectors.
    2. Remove the nuts.
    3. Disconnect the vacuum harness connector.



Installation

1. To install, reverse the removal procedure.

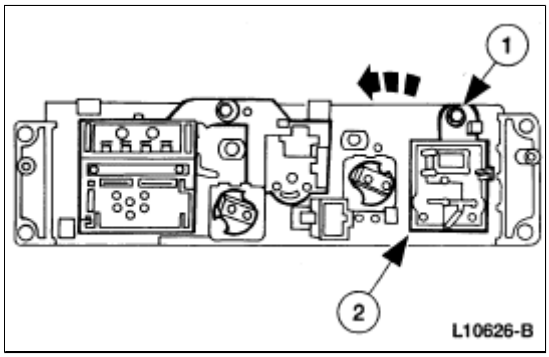
Switch —Manual A/C

Removal

1. Remove the climate control assembly. For additional information, refer to Control Assembly—Manual A/C in this section.

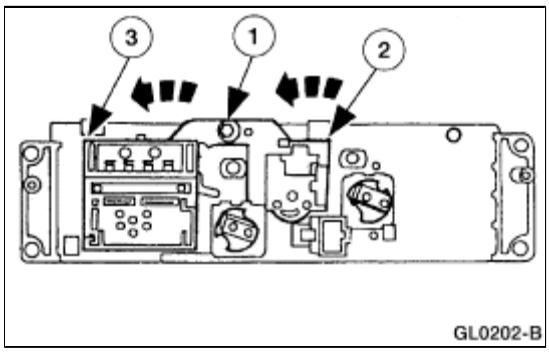
2. **NOTE:** The knob will come off when the switch is removed.

   Remove the heater blower motor switch.
   1. Remove the screw.
   2. Rotate and remove the heater blower motor switch.



3. **NOTE:** The knobs will come off when the switch is removed.

   Remove the temperature control switch and the A/C damper door switch (19B888).
   1. Remove the screw.
   2. Rotate and remove the temperature control switch.
   3. Rotate and remove the A/C damper door switch.



Installation

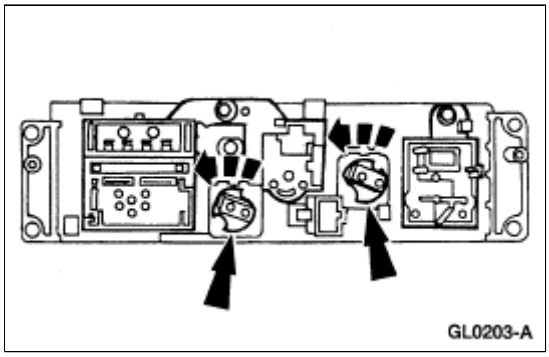
1. To install, reverse the removal procedure.

Bulbs —Manual A/C

Removal

1. Remove the climate control assembly. For additional information, refer to Control Assembly—Manual A/C in this section.

2. Turn and pull the lamp socket.
   - Install a new the bulb in the socket.



Installation

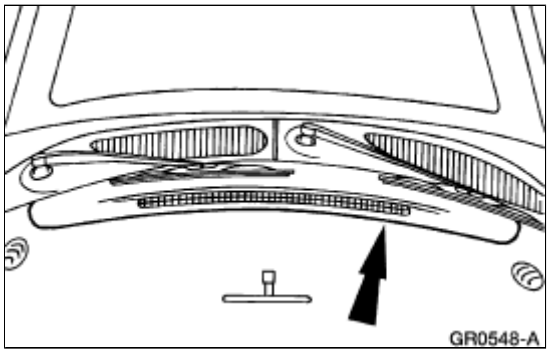
1. To install, reverse the removal procedure.

Temperature Blend Door Actuator

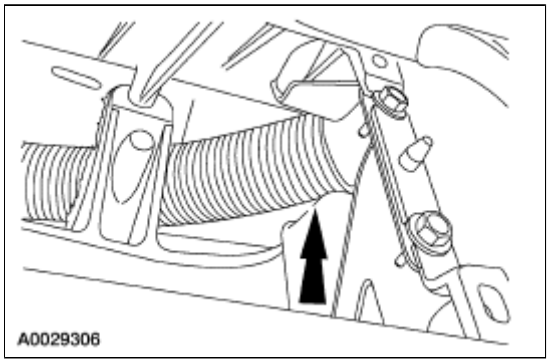
Removal and Installation

All vehicles

1. Remove the passenger air bag module. For additional information, refer to Section 501-20B .
2. Remove the defroster opening grill.

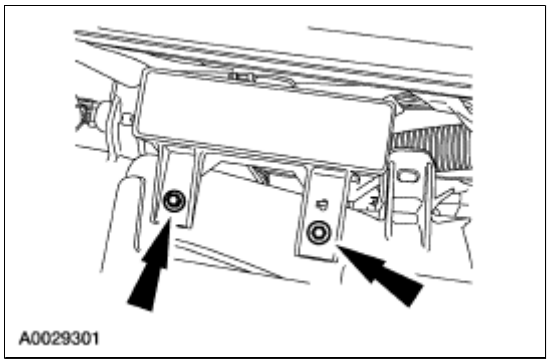


3. Detach and position aside the RH demister hose.



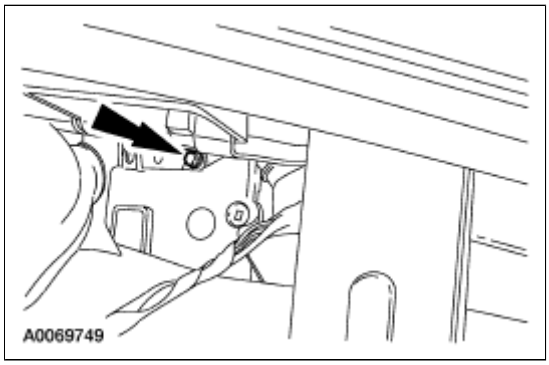
Vehicles with anti-theft/keyless entry

4. Remove the screws and position aside the anti-theft/keyless entry module.

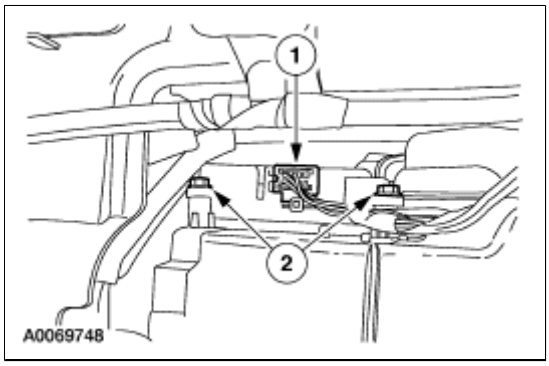


All vehicles

5. Working through the opening near the RH defroster nozzle, remove the screw.



6. Remove the temperature blend door actuator.
    1. Disconnect the electrical connector.
    2. Remove the screws and the temperature blend door actuator.

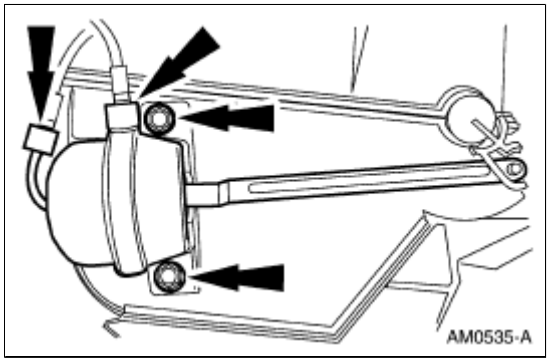


7. To install, reverse the removal procedure.

Vacuum Control Motor —Panel/Floor Door

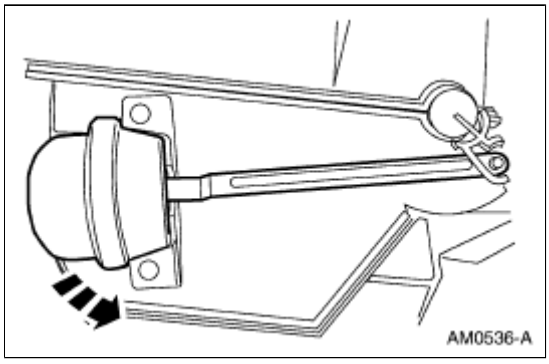
Removal

1. Remove the screws and disconnect the vacuum hose.



2. **CAUTION: Do not attempt to bend any part of the lever. It is brittle and will break.**

   Rotate the vacuum control motor (18A318), disengage the lever, and remove the vacuum control motor.



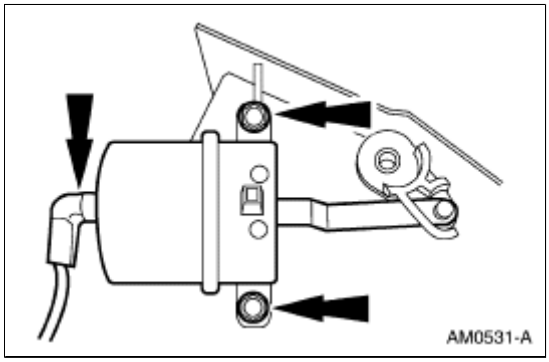
Installation

1. To install, reverse the removal procedure.

Vacuum Control Motor —Panel/Defrost Door

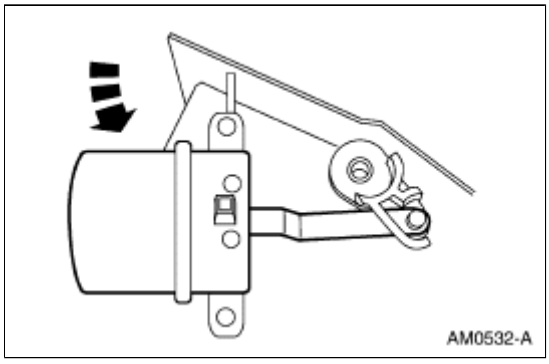
Removal

1. Remove the screws and disconnect the vacuum hose.



2. **CAUTION: Do not attempt to bend any part of the lever. It is brittle and will break.**

   Rotate the vacuum control motor (18A318), disengage the lever, and remove the vacuum control motor.



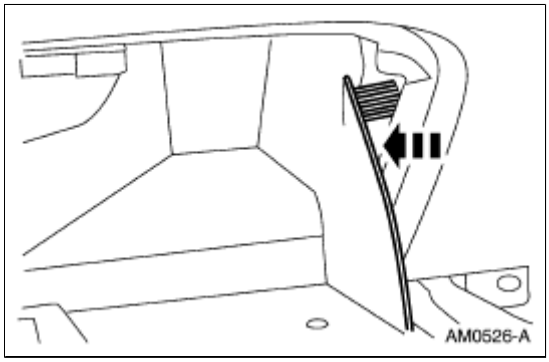
Installation

1. To install, reverse the removal procedure.

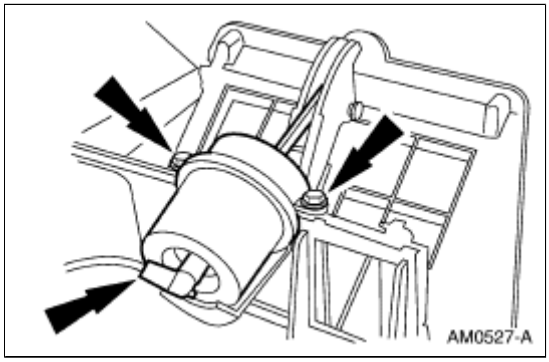
Vacuum Control Motor —Air Inlet Door

Removal

1. Release the stops and lower the glove compartment door to the floor.

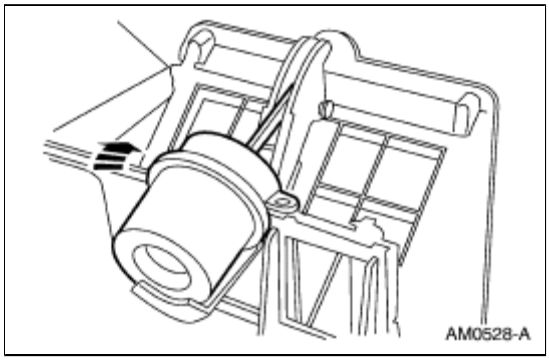


2. Remove the screws and disconnect the vacuum hose.



3. **CAUTION: Do not attempt to bend any part of the lever. It is brittle and will break.**

   Rotate the vacuum control motor (18A318), disengage the lever, and remove the vacuum control motor.



Installation

1. To install, reverse the removal procedure.

Instrument Cluster and Panel Illumination

The instrument cluster (10849) and panel lighting system is powered through the headlamp switch and the panel dimmer switch. The instrument cluster illumination is controlled by the output of the panel dimmer switch. The instrument panel lighting circuit provides illumination for the:

- Climate control panel.
- Instrument cluster.
- Instrument panel ash receptacle (04810).
- Radio chassis (18806).
- Steering wheel control switch(es).
- Rear window defrost (heated backlite) switch.
- Window regulator control switch.
- Power door lock switch.
- Headlamp switch.
- Wiper/washer switch, rear window.
- 4WD mode/ride control (5.0L AWD) switch.
- Message center.
- Fog lamp switch.
- Overhead console.
- Liftgate wiper/washer switch.

Instrument Cluster and Panel Illumination

Refer to Wiring Diagrams Cell 71 , Instrument Illumination for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the headlamp switch (11654). To duplicate the condition, place the headlamp switch in the PARK position and rotate the panel dimmer switch fully up without turning on the courtesy lamps.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged headlamp switch. • Damaged panel dimmer switch.	▪ Blown fuse(s). ▪ Blown bulb(s). ▪ Loose or corroded connections. ▪ Damaged wiring harness.

3. If the fault is not visually evident, verify the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Control Illumination is Inoperative	• Circuitry. • Panel dimmer switch.	• GO to Pinpoint Test A .
• The Instrument Cluster Illumination is Inoperative	• Circuitry. • Illumination bulbs. • Instrument	• GO to Pinpoint Test B .

	cluster printed circuit (10K843).	
• The Climate Control Illumination is Inoperative	• Circuitry. • Illumination bulbs.	• GO to Pinpoint Test C .
• The Climate Control Illumination Is Inoperative — One Bulb	• Illumination bulb. • EATC module.	• CHECK the inoperative illumination bulb. If OK, REPLACE the EATC module. TEST the system for normal operation.
• The Audio System Illumination is Inoperative	• Circuitry. • Illumination bulbs.	• GO to Pinpoint Test D .
• A Single Illumination Source is Inoperative	• Circuitry. • Illumination bulbs.	• GO to Pinpoint Test E .
• A Single Illumination Source Is Inoperative — Steering Wheel Controls	• Circuitry. • Air bag sliding contact (14A664). • Steering wheel control switch (es). • Steering wheel control switch harness.	• GO to Pinpoint Test F .

Pinpoint Tests

PINPOINT TEST A: THE CONTROL ILLUMINATION IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK PARKING LAMPS OPERATION	
1 2	2 Turn the headlamp switch to the parking lamps ON position.

GK0182-A

- **Do the parking lamps operate properly?**

→ **Yes**
TURN the headlamp switch to the OFF position. GO to A2 .

→ **No**
REFER to Section 417-01 .

A2 CHECK PANEL DIMMER SWITCH INPUT VOLTAGE — CIRCUIT 14 (BR)

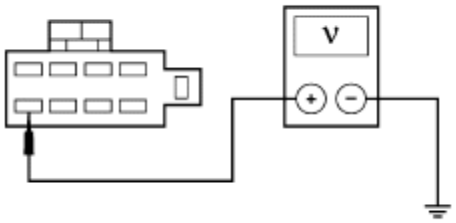
1

Panel Dimmer Switch C219

2 Turn the headlamp switch to the parking lamps ON position.

3

3 Measure the voltage between panel dimmer switch C219-5, circuit 14 (BR), and ground.



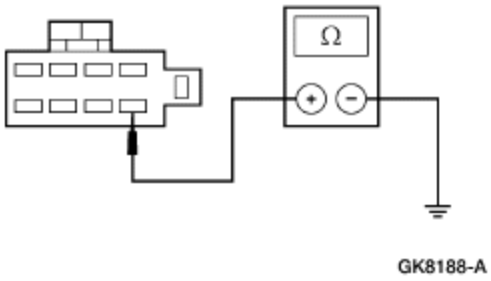
GK8187-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
TURN the headlamp switch to the OFF position. GO to A3 .

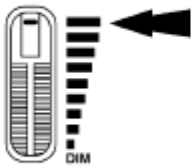
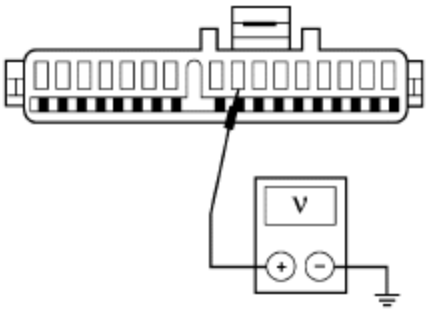
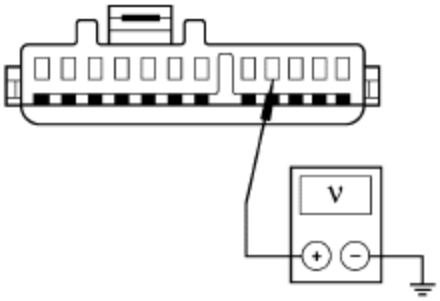
→ **No**
REPAIR circuit 14 (BR). TEST the system for normal operation.

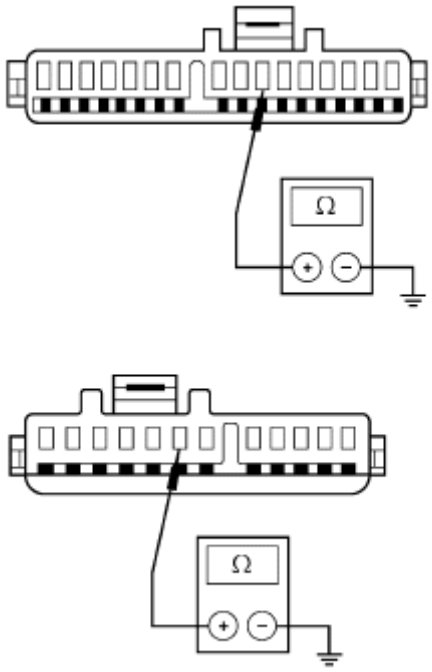
A3 CHECK PANEL DIMMER SWITCH GROUND — CIRCUIT 57 (BK)

1  GK8188-A	1 Measure the resistance between panel dimmer switch C219-8, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the panel dimmer switch. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST B: THE INSTRUMENT CLUSTER ILLUMINATION IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 TEST THE PANEL DIMMER SWITCH	
1 	
2 Instrument Cluster	
3 GK0182-A	3 Turn the headlamp switch to the parking lamps ON position.
4	4 Rotate the panel dimmer switch to the full

	illumination position.
 GK0112-A	
5   GK4044-A	5 Measure the voltage between instrument cluster C287-4, circuit 235 (R/BK), and ground; and between instrument cluster C286-8, circuit 235 (R/BK), and ground.
	• **Are the voltages greater than 10 volts?** → **Yes** TURN the headlamp switch to the OFF position.GO to B2 . → **No** REPAIR the circuit in question. TEST the system for normal operation.
B2 CHECK THE CONTINUITY OF CIRCUIT 57 (BK)	
1	1 Measure the resistance between instrument cluster C287-7, circuit 57 (BK), and ground; and between instrument cluster C286-7, circuit 57 (BK), and ground.



GK4046-A

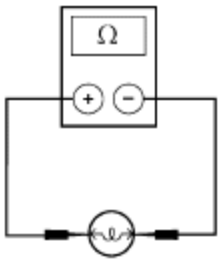
- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to B3 .

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

B3 CHECK THE ILLUMINATION LAMPS

1



GK4131-A

1 Measure for continuity between the terminals of the instrument cluster illumination lamps.

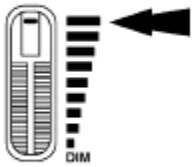
- **Does continuity exist?**

→ **Yes**
REPLACE the instrument cluster printed circuit. TEST the system for normal operation.

→ **No**

	REPLACE the lamps. TEST the system for normal operation.

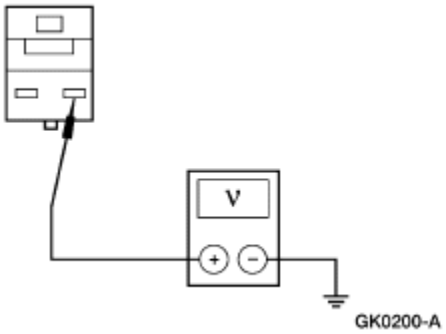
PINPOINT TEST C: THE CLIMATE CONTROL ILLUMINATION IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 VERIFY THE CLIMATE CONTROL ILLUMINATION	
1 GK0182-A	1 Place the headlamp switch in the PARK position.
2  GK0112-A	2 Rotate the panel dimmer switch to the full illumination position. • **Do the electronic automatic temperature control (EATC), front climate control, and/or rear integrated climate control (RICP) illuminations operate properly?** → **Yes** System is OK. → **No** If the front climate control illumination does not operate properly, GO to C2. If the RICP climate control does not operate properly, GO to C4. If the EATC illumination does not operate properly, GO to C7.
C2 CHECK FOR VOLTAGE ON CIRCUIT 235 (R/BK)	
1	

2

A/C Control C276

3



3 Measure the voltage between A/C control C276, circuit 235 (R/BK), and ground.

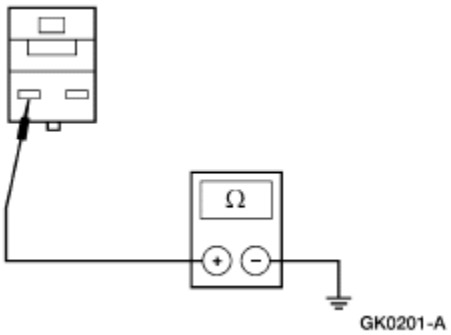
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to C3 .

→ **No**
REPAIR circuit 235 (R/BK). TEST the system for normal operation.

C3 CHECK THE GROUND

1

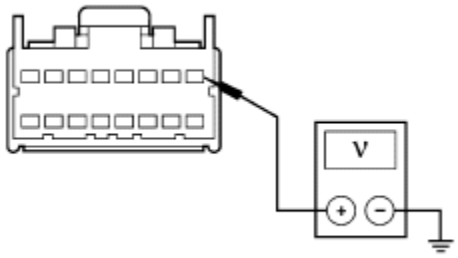
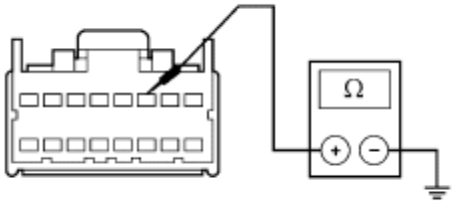


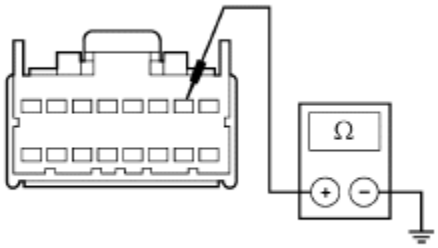
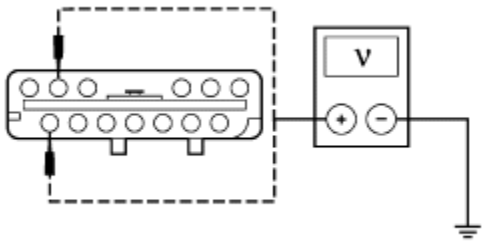
1 Measure the resistance between A/C control C276, circuit 57 (BK), and ground.

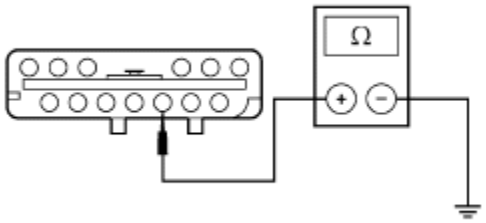
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSPECT the A/C control illumination bulbs. REPLACE as necessary. TEST the system for normal operation.

→ **No**

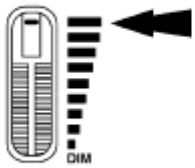
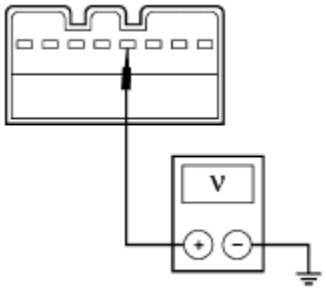
	REPAIR circuit 57 (BK). TEST the system for normal operation.
C4 CHECK FOR VOLTAGE ON CIRCUIT 235 (R/BK)	
1 2 RICP C2003 3  GK3108-A	3 Measure the voltage between RICP C2003-8, circuit 235 (R/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to C5 . → **No** REPAIR circuit 235 (R/BK). TEST the system for normal operation.
C5 CHECK THE CONTINUITY OF CIRCUIT 694 (BK/LG)	
1  GK3109-A	1 Measure the resistance between RICP C2003-6, circuit 694 (BK/LG), and ground. • **Is the resistance less than 5 ohms?** → **Yes**

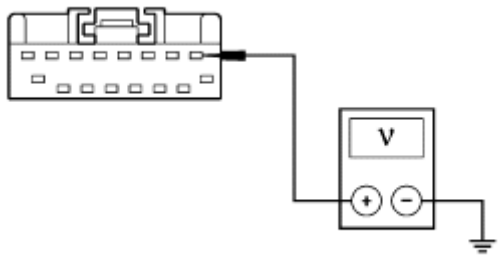
	GO to C6 . → **No** REPAIR circuit 694 (BK/LG). TEST the system for normal operation.
C6 CHECK CONTINUITY OF CIRCUIT 57 (BK)	
1  GK3110-A	1 Measure the resistance between RICP C2003-7, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** INSPECT the RICP assembly miniature bulbs. REPLACE as necessary. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
C7 CHECK VOLTAGE TO THE EATC ILLUMINATION	
1 EATC 2  GK8189-A	2 Measure the voltage between EATC C298-14, circuit 235 (R/BK), and ground; and between EATC C297-19, circuit 19 (LB/R), and ground. • **Are the voltages greater than 10 volts?** → **Yes**

	GO to C8 . → **No** REPAIR the circuit in question. TEST the system for normal operation.
C8 CHECK EATC GROUND	
1  GK8190-A	1 Measure the resistance between EATC C297-3, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** CHECK the EATC illumination lamp(s). REPLACE if necessary. If OK, REPLACE the EATC; REFER to Section 412-04 . TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST D: THE AUDIO SYSTEM ILLUMINATION IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 VERIFY THE AUDIO CONTROL ILLUMINATION	
NOTE: If equipped with T100iDM, the radio chassis will only illuminate the controls available for the mode selected.	
1 GK0182-A	1 Place the headlamp switch in the PARK position.
2	2 Rotate the panel dimmer switch to the full

 GK0112-A	illumination position. • **Do the rear integrated control panel (RICP) and radio chassis (18806) illuminate?** → **Yes** System is OK. → **No** If the RICP does not illuminate, GO to Pinpoint Test C . If the radio chassis does not illuminate, GO to D2 .
D2 CHECK FOR VOLTAGE ON CIRCUIT 235 (R/BK)	
1 Radio Chassis	
2  GK3111-A	2 Measure the voltage between radio chassis C228-5, circuit 235 (R/BK), and ground (M100LLCD).
3	3 Measure the voltage between radio chassis C256-1, circuit 235 (R/BK), and ground (all others).



GK7269-A

- **Is the voltage greater than 10 volts?**

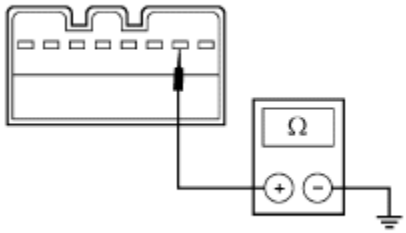
→ **Yes**
GO to D3 .

→ **No**
REPAIR circuit 235 (R/BK). TEST the system for normal operation.

D3 CHECK THE CONTINUITY OF CIRCUIT 57 (BK)

1

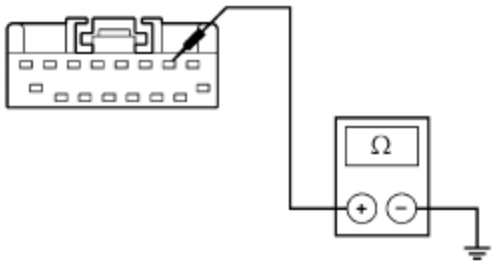
2



GK3112-A

2 Measure the resistance between radio chassis C228-7, circuit 57 (BK), and ground (M100LLCD).

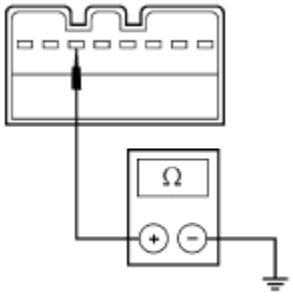
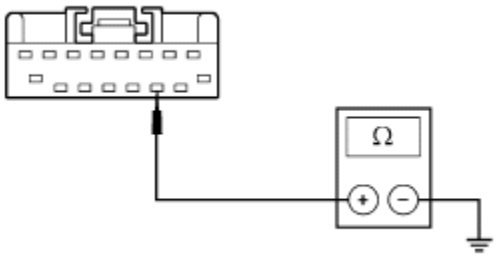
3



GK7270-A

3 Measure the resistance between radio chassis C256-2, circuit 57 (BK), and ground (all others).

- **Is the resistance less than 5 ohms?**

	→ **Yes** GO to D4 . → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
D4 CHECK CONTINUITY OF CIRCUIT 694 (BK/LG)	
1  GK3113-A	1 Measure the resistance between radio chassis C228-3, circuit 694 (BK/LG), and ground (M100LLCD).
2  GK7271-A	2 Measure the resistance between radio chassis C256-11, circuit 694 (BK/LG), and ground (all others). • **Is the resistance less than 5 ohms?** → **Yes** REMOVE the radio chassis and SEND it to an authorized Ford Audio Service Center for repair. After repair, TEST the system for normal operation. → **No** REPAIR circuit 694 (BK/LG). TEST the system for normal operation.

PINPOINT TEST E: A SINGLE ILLUMINATION SOURCE IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK VOLTAGE TO THE INOPERATIVE ILLUMINATION SOURCE	
1	

2

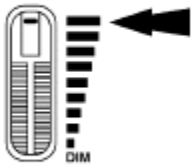
Inoperative Illumination Source

3

GK0182-A

3 Place the headlamp switch in the PARK position.

4



GK0112-A

4 Rotate the panel dimmer switch to the full illumination position.

5 Measure the voltage between inoperative illumination source and ground as follows.

Inoperative Illumination Source	Connector/Pin	Circuit
4WD Mode/Ride Control Switch	C279-4	235 (R/BK)
Ash Receptacle	C208	235 (R/BK)
LF Window Regulator Control/Door Lock Switch (4-Door)	C501-5 and C501-12	235 (R/BK)
RF Window Regulator Control Switch	C615-3	235 (R/BK)

LR Window Regulator Control Switch	C702-3	235 (R/BK)
RR Window Regulator Control Switch	C802-3	235 (R/BK)
RH Door Lock Switch	C614-3	235 (R/BK)
LF Window Regulator Control Switch (2-Door)	C515-7 and C515-14	235 (R/BK)
LF Door Lock Switch	C514-3	235 (R/BK)
Headlamp Switch	C216-9	235 (R/BK)
Heated Backlite Switch	C248-5	235 (R/BK)
Compass/Outside Air Temperature Module	C902-4	19 (LB/R)
Message Center	C2008-2	19 (LB/R)
Message Center Switch	C2007-6	235 (R/BK)
Fog Lamp Switch	C268-5	235 (R/BK)
Liftgate Wiper/Washer Switch	C249-6	235 (R/BK)

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E2 .

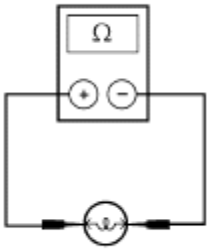
→ **No**
REPAIR the circuit in question. TEST the system for normal operation.

E2 CHECK GROUND TO INOPERATIVE ILLUMINATION SOURCE

1 Measure the resistance between the inoperative illumination source, circuit 57 (BK), and ground.

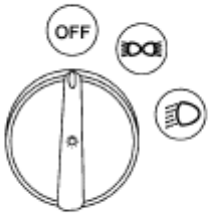
- **Is the resistance less than 5 ohms?**

→ **Yes**
If the inoperative illumination source has replaceable bulbs, GO to E3 . Otherwise, REPLACE the inoperative illumination source.

	TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
E3 CHECK THE SINGLE ILLUMINATION SOURCE BULB	
1 Single Illumination Source Bulb 2  GK3487-A	2 Measure for continuity between the terminals of the single illumination source bulb. • **Does continuity exist?** → **Yes** REPLACE the single illumination source in question. TEST the system for normal operation. → **No** REPLACE the single illumination source bulb in question. TEST the system for normal operation.

PINPOINT TEST F: A SINGLE ILLUMINATION SOURCE IS INOPERATIVE — STEERING WHEEL CONTROL SWITCHES

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK VOLTAGE TO THE AIR BAG SLIDING CONTACT CONNECTOR	
1	1 Place the headlamp switch in the OFF position.



GK0183-A

2

Air Bag Sliding Contact C220

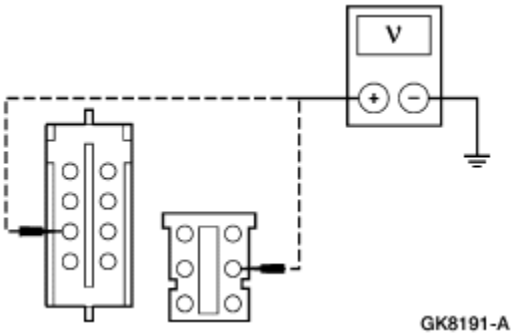
3

3 Place the headlamp switch in the PARK position.

GK0182-A

4

4 Measure the voltage between air bag sliding contact C220-3, circuit 235 (R/BK), and ground.



GK8191-A

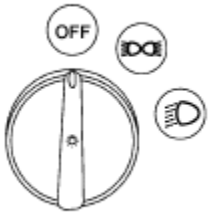
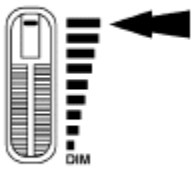
- **Is the voltage greater than 10 volts?**

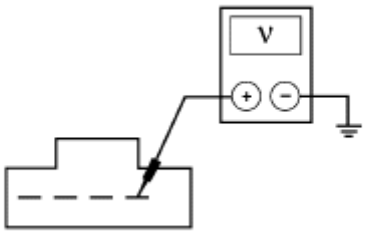
→ **Yes**
RECONNECT air bag sliding contact C220.
GO to F2 .

→ **No**
REPAIR circuit 235 (R/BK). TEST the system for normal operation.

F2 CHECK AIR BAG SLIDING CONTACT FOR VOLTAGE

1 Deactivate the air bag system. Refer to

	Section 501-20B .
2  GK0183-A	2 Place the headlamp switch in the OFF position.
3 Speed Control Actuator Switch	
4 GK0182-A	4 Place the headlamp switch in the PARK position.
5  GK0112-A	5 Rotate the panel dimmer switch to the full illumination position.
6	6 Measure the voltage between speed control actuator switch terminal 4 and ground.



GK3123-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to F3 .

→ **No**
REPLACE the air bag sliding contact. TEST the system for normal operation.

F3 CHECK STEERING WHEEL CONTROL SWITCH HARNESS

1 Inspect the steering wheel control switch harness for shorts, opens or any damage.

- **Is the steering wheel control switch harness OK?**

→ **Yes**
REPLACE the steering wheel control switch (es). TEST the system for normal operation.

→ **No**
REPLACE the steering wheel control switch harness. TEST the system for normal operation.

Bulb —Instrument Cluster

Removal and Installation

For additional information, refer to Section 413-01 .

Bulb —Climate Control

Removal and Installation

For additional information, refer to Section 412-04 .

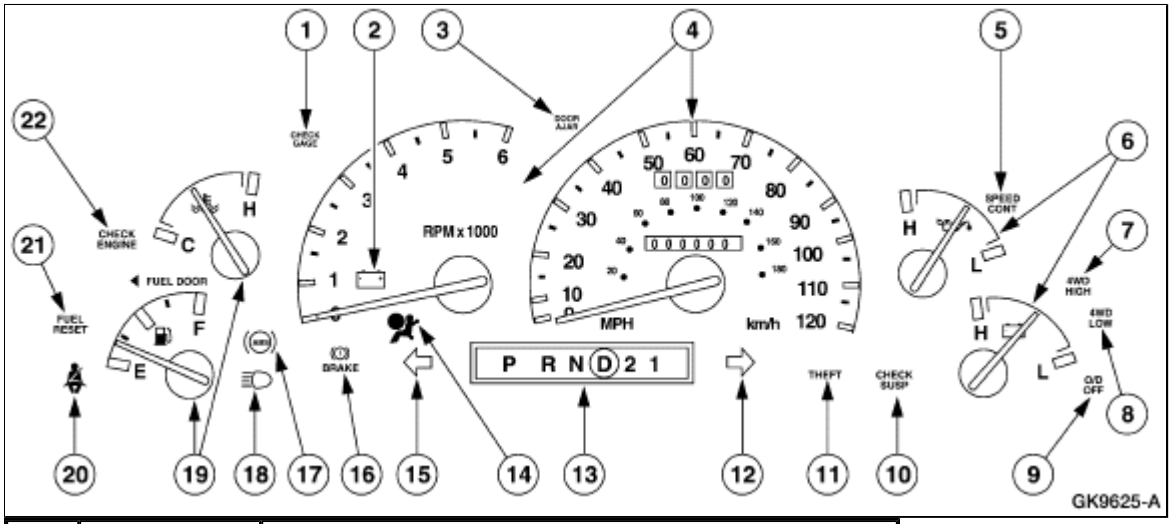
Torque Specifications

Description	Nm	lb-in
Battery Cable Bolt	7-10	62-89
Hood Latch Release Handle	2.7-3.7	25-33
Instrument Cluster Lens Screws	1.4-1.8	12-16
Instrument Cluster Screws	2-3	18-26
Instrument Panel Steering Column Cover Screws	2-3	18-26
Parking Brake Release Handle	2.7-3.7	25-33
Steering Column Opening Cover Reinforcement Screws	10-14	89-124

Instrument Cluster

The instrument cluster (10849) consists of the following:

Instrument Cluster Display



Item	Part Number	Description
1	—	CHECK GAGE Indicator
2	—	Charge System Warning Indicator
3	—	DOOR AJAR Indicator
4	17C290	Tachometer/Speedometer
5	—	Speed Control Indicator (SPEED CONT)
6	—	Oil Pressure/Voltage Gauge
7	—	4 Wheel Drive HIGH Indicator (4WD HIGH)
8	—	4 Wheel Drive LOW Indicator (4WD LOW)
9	—	Overdrive Off Indicator (O/D OFF)
10	—	Rear Load Leveling Indicator (CHECK SUSP)
11	—	Anti-Theft Indicator (THEFT)
12	—	Right Turn Indicator
13	—	Transmission Range Indicator
14	—	Air Bag Indicator
15	—	Left Turn Indicator
16	—	BRAKE Warning Indicator
17	—	Anti-Lock Brake Warning Indicator (ABS)
18	—	High Beam Indicator
19	—	Coolant Temperature/Fuel Level Gauge

20	—	Safety Belt Warning Indicator
21	—	FUEL RESET Indicator
22	—	CHECK ENGINE/Malfunction Indicator Lamp (MIL)

The instrument cluster performs a display prove-out to verify that all warning/indicator lamps and monitored systems are functioning properly. When the ignition switch (11572) is in the ON position with the engine (6007) off, the following indicators will illuminate:

- CHECK ENGINE/malfunction indicator lamp (MIL).
- CHECK GAGE warning indicator.
- Charge system indicator.
- Anti-lock brake (ABS) warning indicator.
- Safety belt warning indicator (60 second prove out).
- Air bag indicator.

Printed Circuit

The instrument cluster printed circuit (10K843) is a flexible circuit that supplies power and ground to the instrument cluster indicators and gauges. It is constructed of copper foil bonded to a polyester base film (usually referred to as Mylar).

The flexible circuit is mounted to the instrument cluster housing and, due to its location, cannot be easily tested or inspected in the vehicle. This makes the flexible circuit vulnerable to damage when a probe is used for in-vehicle testing because the probe can pierce the printed circuit or, in some cases, burn the copper conductor.

Since there is no approved procedure for in-vehicle testing of the flexible circuit, the instrument cluster must be removed from the vehicle for visual inspection. If no damage is evident, each circuit should be checked with an ohmmeter. If an open circuit or a short is detected, the flexible circuit must be replaced.

Gauge Indication Systems

The indication systems use magnetic gauges mounted in the instrument cluster. All the gauges are constructed with windings that form coils. Typically one coil is wound at a 90° angle to the other two. The coils form a magnetic field which varies in direction according to the resistance of the sender, except the battery voltage gauge, that is connected between two of them. The battery voltage gauge varies in direction according to the battery voltage. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. No instrument voltage regulator is used with this system. There is no adjustment, calibration or maintenance required for any gauges.

Instrument Cluster Gauge Amplifier/Check Gauge Module

NOTE: The fuel gauge and instrument cluster gauge amplifier must be replaced as a set. The fuel gauge and instrument cluster gauge amplifier are calibrated together.

NOTE: If the ignition key is left in the ON position during fueling, a slow to respond fuel gauge indication may result. The ignition key must be placed in the OFF position during or after refueling for accurate fuel gauge indication.

The instrument cluster gauge amplifier (10E849) electrically averages the fuel sender readings so the gauge displays the actual fuel level and not the fluctuations due to fuel sloshing. The amplifier also supplies the signal to illuminate the CHECK GAGE indicator to indicate low fuel, high engine coolant temperature, or low engine oil pressure. The gauge amplifier is a small printed circuit board located in a pocket on the back of the instrument cluster. The electrical connections are made with a spring-type connector. There are no provisions for calibration or adjustment. The fuel gauge and the instrument cluster gauge amplifier must be replaced as a unit.

Fuel Sending Unit

The fuel sending unit is a variable resistor made up of a ceramic substrate. It is controlled by the action of a float arm. When the fuel level is low, resistance in the unit is low. When the fuel level is high, the resistance is high.

Water Temperature Indicator Sender Unit

When the engine temperature is low, the resistance of the water temperature indicator sender unit is high, thus restricting the flow of current through the gauge and moving the pointer only a short distance. As the temperature of the coolant increases, the resistance decreases, allowing more current to flow through the gauge and results in a corresponding movement of the pointer.

Oil Pressure Indicator Switch

The oil pressure switch is installed in the engine block and consists of a diaphragm and contact points. The contact points are closed with oil pressure causing the gauge to indicate NORMAL oil pressure. With no oil pressure, the contacts open and the gauge indicates low oil pressure.

Charge Indicator System

The battery voltage gauge measures the voltage potential at the battery.

Vehicle Speed Signal

The vehicle speed signal is generated by the rear anti-lock brake sensor and sent to the 4-wheel anti-lock brake system (4WABS) module. The 4WABS module sends the vehicle speed signal via circuit 679 (GY/BK) to all systems which require a vehicle speed signal input.

Speedometer

The electronic speedometer receives a speed signal from the 4WABS module.

Odometer

A million-mile tamper-resistant odometer is standard. Replacement speedometers have an odometer that can be reset to indicate correct vehicle mileage.

NOTE: Some state laws require that the odometer in any replacement speedometer must register the same as on the removed odometer. Replacement speedometers and odometer modules with the mileage preset are available through Ford electronic repair centers.

If the actual vehicle mileage cannot be determined, the repair centers are able to supply odometers set to "0" miles. An odometer mileage sticker is supplied with the replacement odometer. This sticker must display the estimated vehicle mileage and be affixed to the driver door jamb.

Trip Odometer

The trip odometer indicates how many miles the vehicle has been driven since the last reset.

Tachometer

The tachometer is a 6000 rpm tachometer. It has four terminals: one labeled B (12 to 14.5V), one labeled S (EDIS tach signal in), and two labeled G (cylinder selection grounds). The bottom ground (G) terminal is grounded. The top ground (G) terminal is grounded through a 4.32 kohm resistor in a 6-cylinder engine vehicle and is connected directly to ground for an 8-cylinder engine vehicle.

Warning Indicators

Brake System

The red brake warning light (BRAKE) is used to indicate a low fluid level, brake malfunction or a parking brake that is not fully released. The brake fluid level switch is located in the brake fluid reservoir.

The yellow brake warning indicator is used to indicate a malfunction or deactivation of the anti-lock brake system (ABS). It illuminates when triggered by the ABS control module and stays illuminated as long as the malfunction remains in the system.

Charge System Warning Indicator

The charge system warning indicator illuminates when there is no generator (GEN) (10346) output.

When the ignition switch contacts are closed, battery current flows through the charge indicator and the parallel resistor (390 ohm) to the voltage indicator, and the indicator illuminates.

When the generator builds up enough voltage to energize a circuit in the voltage regulator, the indicator goes out.

Check Engine Light

The CHECK ENGINE/malfunction indicator lamp (MIL) is illuminated when a diagnostic trouble code (DTC) or malfunction is sensed in the closed loop by the powertrain control module (PCM) (12A650).

Air Bag

If an air bag system DTC or malfunction is detected, the air bag indicator is illuminated.

Safety Belt

The safety belt warning indicator is powered through the GEM/CTM module. When the ignition key is turned on, the indicator illuminates for four to eight seconds even if the safety belt is buckled.

Low Fuel

When the fuel level drops to a predetermined level, the CHECK GAGE indicator will illuminate.

Door Ajar

The DOOR AJAR indicator illuminates when any of the vehicle doors are open.

High Beam

The high beam indicator is illuminated when the high beams are on.

Overdrive (O/D) Off

The O/D OFF indicator illuminates when the transmission is locked out of O/D. This dual function indicator will also flash off and on if a transmission malfunction is detected.

Anti-Theft

Once triggered, the anti-theft system flashes the low beam headlamps, the parking lamps, the THEFT indicator and sounds the horns.

Speed Control

The speed control indicator (SPEED CONT) lamp will illuminate when the speed control is engaged.

Fuel Reset

The FUEL RESET indicator is grounded through the inertia switch whenever the vehicle is subjected to a high force situation. The inertia fuel shutoff switch (IFS switch) (9341) cuts off the fuel pump motor. The FUEL RESET indicator illuminates when the IFS switch has been tripped.

Check Gage

The CHECK GAGE indicator will illuminate if any of the following occur:

- Engine oil pressure drops below approximately 42 kPa (6 psi).
- Fuel level drops below approximately 4-8L (1-2 gal).
- Engine temperature exceeds approximately 121°C (250°F).

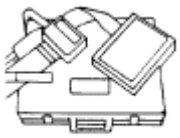
Rear Load Leveling (CHECK SUSP)

The CHECK SUSP indicator illuminates when there is a malfunction of the rear load leveling system or if the air suspension switch is in the OFF position.

Instrument Cluster

Refer to Wiring Diagrams Cell 62 , Instrument Cluster (Analog) for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST1449-A	EEC-IV 60-Pin Breakout Box or equivalent 418-005 (014-00322)
ST1450-A	Anti-Lock Brake Adapter 418-063 (T97P-50-ALA)
 ST1391-A	EEC-V 104-Pin Breakout Box or equivalent 418-049 (014-00950)
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1473-A	Instrument Gauge System Tester or equivalent 014-R1063

Inspection and Verification

NOTE: The generic electronic module (GEM)/central timer module (CTM) must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the system in question.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged engine oil filter • Damaged oil pump • Low engine oil level • Stuck oil pressure gauge needle • Stuck coolant temperature gauge • Door adjustment • Tripped inertia fuel shutoff (IFS) switch • Low engine coolant level • Damaged water thermostat	• Blown central junction box (CJB) fuse(s): ▪ Fuse 11 (7.5A) ▪ Fuse 15 (7.5A) ▪ Fuse 25 (7.5A) • Blown battery junction box (BJB) Maxi-Fuse 1 (60A) • Damaged miniature bulbs • Damaged wiring harness • Loose or corroded connectors • Damaged instrument cluster (10849) • Damaged instrument cluster printed circuit (10K843)

3. Verify the following systems are working correctly:

- Charging.
- Fuel.
- Cooling.
- Safety belt warning chime (GEM/CTM).
- Turn signals.
- Headlamps.
- Anti-theft.
- Rear load leveling.

If the system(s) is/are not working correctly, refer to the appropriate section of the workshop manual.

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

6. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for generic electronic module (GEM), go to Pinpoint Test U.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM/CTM.

7. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	GO to Pinpoint Test V .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	GO to Pinpoint Test V .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated Backlight Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .

B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window Driver One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window Driver One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window Driver Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window Driver Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	GO to Pinpoint Test W .
B1428	Safety Belt Lamp Output Failure	GEM/CTM	GO to Pinpoint Test W .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Washer Interval	GEM/CTM	REFER to Section 501-16 .

	Delay Switch Input Short to Ground		
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delayed Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp/Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up	GEM	REFER to Section 501-16 .

	Relay Circuit Short to Battery		
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size and axle ratio. TEST the system for normal operation. If DTC B2141 is still present, INSTALL a new GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral In Tow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral In Tow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	GO to Pinpoint Test X .
P1806	4WD High Indicator Short Circuit to Battery	GEM	GO to Pinpoint Test X .
P1808	4WD Low Indicator Circuit Failure	GEM	GO to Pinpoint Test X .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	GO to Pinpoint Test X .
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .

P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD Low Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Left Front Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Right Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, ON-B-, OFFO-G
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	FWD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G

PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF

WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage LOW	GEM/CTM
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Power Window LF Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Lamp/Park Input Short Circuit to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Incorrect Fuel Gauge Indication	• Circuitry. • Fuel level sender. • Fuel gauge. • Fuel tank. • Instrument cluster gauge amplifier. • Instrument cluster printed circuit.	• GO to Pinpoint Test A .
• Incorrect Temperature Gauge Indication	• Water temperature indicator sender unit. • Circuitry. • Engine Coolant Temperature Gauge. • Instrument cluster printed circuit.	• GO to Pinpoint Test B .
• Incorrect Oil Pressure Gauge Indication	• Oil pressure switch. • Circuitry. • Instrument cluster printed circuit. • Gauge.	• GO to Pinpoint Test C .
• Incorrect Voltage Gauge Indication	• Circuitry. • Gauge. • Instrument cluster printed circuit.	• REFER to Section 414-00 .
• A Gauge Is Inaccurate — Speedometer	• Speedometer.	• GO to Pinpoint Test D .
• The Speedometer/Odometer Is Inoperative	• Circuitry. • Speedometer.	• GO to Pinpoint Test E .
• The Tachometer Is Inoperative	• Circuitry. • Tachometer. • Instrument cluster printed circuit.	• GO to Pinpoint Test F .
• Incorrect Tachometer Indication	• Circuitry. • Instrument cluster printed circuit. • Tachometer.	• GO to Pinpoint Test G .
• The Charge System Warning Indicator Is Never/Always On	• Fuse. • Bulb. • Circuitry. • Instrument cluster printed circuit.	• GO to Pinpoint Test H .
• Charge System Warning Indicator Stays On Continuously	• Charging system.	• REFER to Section 414-00 .

• An Indicator Is Inoperative — Anti-Lock Brake Warning	• Bulb. • Circuitry. • Instrument cluster printed circuit. • Anti-lock brake system (ABS) module.	• GO to Pinpoint Test J.
• Anti-Lock Brake Warning Indicator Stays On Continuously	• ABS.	• REFER to Section 206-09.
• An Indicator Is Inoperative — Anti-Theft Alarm	• Anti-theft alarm indicator LED. • Circuitry. • Instrument cluster printed circuit. • Remote anti-theft personality (RAP) module. • Passive anti-theft system (PATS) module.	• REFER to Section 419-01.
• Anti-Theft Alarm Indicator Stays On Continuously	• RAP system. • PATS system.	• REFER to Section 419-01.
• An Indicator Is Inoperative — Fuel Reset	• Bulb. • Circuitry.	• GO to Pinpoint Test K.
• Fuel Reset Indicator Stays On Continuously	• Circuitry.	• REPAIR circuit 921 (GY/OG) for short to ground. TEST the system for normal operation.
• An Indicator Is Inoperative — High Beam	• Bulb. • Circuitry. • Instrument cluster printed circuit.	• GO to Pinpoint Test L.
• An Indicator Is Inoperative — CHECK ENGINE/Malfunction Indicator Lamp (MIL)	• Bulb. • Circuitry. • Instrument cluster printed circuit. • Powertrain control module (PCM).	• GO to Pinpoint Test M.
• Check Engine Warning Indicator Stays On Continuously	• Powertrain/emissions concern.	• REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• An Indicator Is Inoperative — LH Turn Signal	• Circuitry. • Bulb. • Instrument cluster printed circuit.	• GO to Pinpoint Test N.
• An Indicator Is Inoperative — RH Turn Signal	• Circuitry. • Bulb. • Instrument cluster printed circuit.	• GO to Pinpoint Test P.
• An Indicator Is Inoperative — O/D Off	• Circuitry. • Dimmer control relay.	• GO to Pinpoint Test Q.

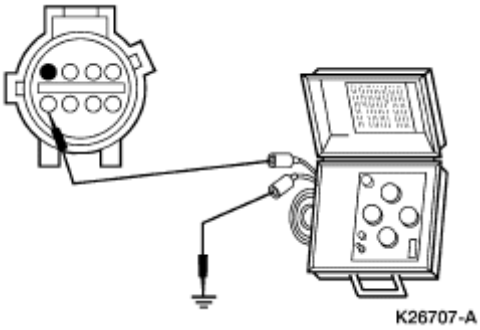
	• Headlamp switch. • Bulb. • Instrument cluster printed circuit.	
• Overdrive Off Indicator Stays On Continuously	• Circuitry. • PCM.	• REFER to Section 307-05 .
• Speed Control Indicator Stays On Continuously	• Circuitry. • Speed control servo.	• REFER to Section 310-03 .
• The Speed Control Indicator Is Never/Always On	• Circuitry. • Dimmer control relay. • Headlamp switch. • Bulb. • Instrument cluster printed circuit.	• GO to Pinpoint Test R .
• An Indicator Is Inoperative — Red Brake Warning	• Circuitry. • Bulb. • Parking brake switch. • Brake fluid level sensor. • Instrument cluster printed circuit.	• GO to Pinpoint Test S .
• Red Brake Warning Indicator Stays On Continuously	• Parking brake. • Brake master cylinder reservoir. • Parking brake switch. • Circuitry. • Instrument cluster printed circuit.	• REFER to Section 206-00 .
• An Indicator Is Inoperative — CHECK GAGE	• Bulb. • Circuitry. • Fuel gauge. • Instrument cluster gauge amplifier. • Instrument cluster printed circuit.	• GO to Pinpoint Test T .
• No Communication with the Module — Generic Electronic Module	• BJB Maxi-Fuse 1 (60A). • CJB Fuse 25 (7.5A). • Circuitry. • GEM/CTM.	• GO to Pinpoint Test U .
• The Door Ajar Indicator Does Not Operate Correctly	• Bulb. • Circuitry. • GEM. • Instrument cluster printed circuit.	• GO to Pinpoint Test V .
• The Safety Belt Warning Indicator Does Not Operate Correctly	• Bulb. • Circuitry. • GEM. • Instrument cluster printed circuit.	• GO to Pinpoint Test W .
• An Indicator Is Inoperative — 4x4 High, 4x4 Low	• Bulb. • Circuitry. • GEM. • Instrument cluster	• GO to Pinpoint Test X .

	printed circuit.	
• An Indicator Is Inoperative — Air Bag	• Bulb. • Circuitry. • Instrument cluster printed circuit.	• GO to Pinpoint Test Y .
• Air Bag Indicator Stays On Continuously	• Circuitry. • Air bag diagnostic monitor.	• REFER to Section 501-20B .
• An Indicator is Inoperative — CHECK SUSP	• Bulb. • Circuitry. • Instrument cluster printed circuit.	• GO to Pinpoint Test Z .
• An Indicator Is Always On — CHECK SUSP	• Circuitry. • Instrument cluster printed circuit. • Air suspension control module. • Air suspension switch. • Rear load leveling system concern.	• GO to Pinpoint Test AA .

Pinpoint Tests

PINPOINT TEST A: INCORRECT FUEL GAUGE INDICATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE FUEL GAUGE READING	
1 2 Fuel Level Sensor and Pump C311 3	3 Connect one lead of Instrument Gauge System Tester to fuel level sensor and pump C311-8, circuit 29 (YE/WH), harness side. Connect the other lead to ground.



4 Set Instrument Gauge System Tester to 160 ohms.

5

6 Set the power switch on Instrument Gauge System Tester to the ON position.

7 Wait one minute.

8 Read the fuel gauge. The fuel gauge should read full or above.

9

10 Set Instrument Gauge System Tester to 15 ohms.

11

12 Wait one minute.

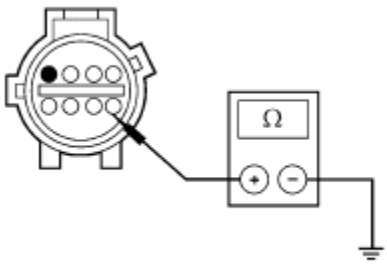
13 Read the fuel gauge. The fuel gauge should read empty or below.

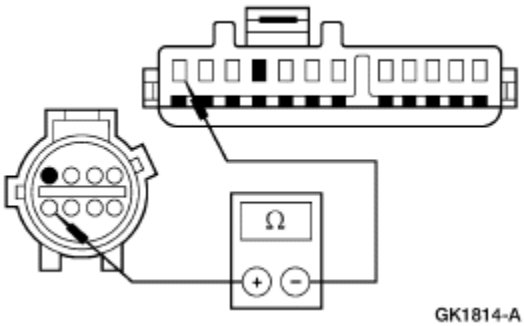
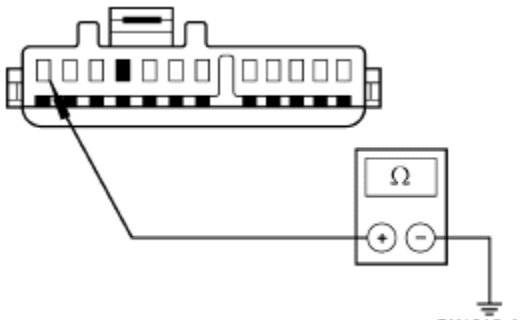
14

- **Does the fuel gauge operate correctly?**

→ **Yes**
GO to A2 .

→ **No**

	GO to A4 .
A2 INSPECT THE FUEL TANK	
	1 Visually inspect the fuel tank for any damage or deformation. • **Is the fuel tank OK?** → **Yes** GO to A3 . → **No** INSTALL a new fuel tank. REFER to Section 310-01 . TEST the system for normal operation.
A3 INSPECT THE FUEL LEVEL SENSOR AND PUMP ASSEMBLY	
	1 Visually inspect the fuel pump assembly for damaged wiring or connectors. 2 Visually inspect the float and float rod for damage or obstruction. • **Are the fuel pump and wiring OK?** → **Yes** INSTALL a new fuel level sender. TEST the system for normal operation. → **No** REPAIR as necessary. TEST the system for normal operation.
A4 CHECK FUEL LEVEL SENSOR AND PUMP GROUND	
1  K26710-A	1 Measure the resistance between fuel level sensor and pump C311-5, circuit 651 (BK/YE), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to A5 . → **No**

	REPAIR circuit 651 (BK/YE). TEST the system for normal operation.
A5 CHECK CIRCUIT 29 (YE/WH) FOR OPEN AND SHORT	
1 2 Instrument Cluster 3  GK1814-A 4  GK1815-A	3 Measure the resistance of circuit 29 (YE/WH) between fuel level sensor and pump C311-8, and instrument cluster C287-12. 4 Measure the resistance between instrument cluster C287-12, circuit 29 (YE/WH), and ground. • **Is the resistance less than 5 ohms between the instrument cluster and fuel level sensor and pump and greater than 10,000 ohms between the instrument cluster and ground?** → **Yes** GO to A6 . → **No** REPAIR circuit 29 (YE/WH). TEST the system for normal operation.
A6 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT	

	1 Measure the resistance of the instrument cluster printed circuit between the following: ■ Fuel gauge S terminal and gauge amplifier Pin 3. ■ Fuel gauge terminal G and instrument cluster printed circuit terminal C287-2. ■ Fuel gauge terminal B and instrument cluster printed circuit terminal C287-8. ■ Fuel gauge ground terminal and gauge amplifier Pin 5. ■ Gauge amplifier and instrument cluster printed circuit terminals C287-2, C287-12, and C288-1. • **Are the resistances less than 1 ohm?** → **Yes** INSTALL a new fuel gauge and instrument cluster gauge amplifier. REFER to Gauges . TEST the system for normal operation. → **No** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

PINPOINT TEST B: INCORRECT TEMPERATURE GAUGE INDICATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CARRY OUT THE COMPONENT TEST	
	1 Carry out the Engine Coolant Temperature Gauge Component Test; refer to Component Tests. • **Is the engine coolant temperature gauge OK?** → **Yes** INSTALL a new water temperature indicator sender unit. TEST the system for normal operation. → **No** GO to B2 .

B2 CHECK WIRE BETWEEN INSTRUMENT CLUSTER AND WATER TEMPERATURE INDICATOR SENDER UNIT

1

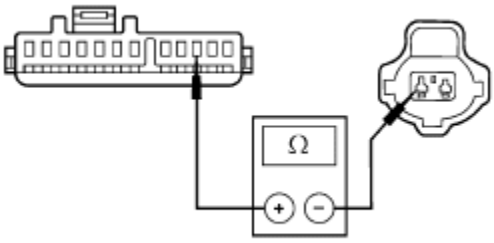
2

Water Temperature Indicator Sender Unit C104

3

Instrument Cluster

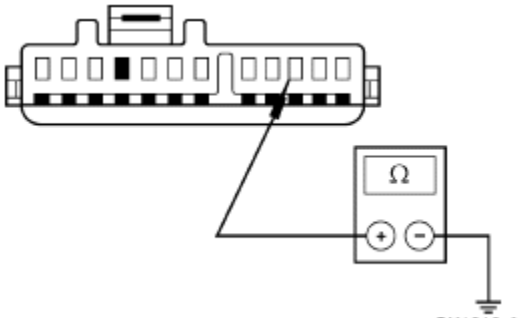
4



GK6906-A

4 Measure the resistance between instrument cluster C287-3, circuit 39 (RD/WH), and water temperature indicator sender unit C104-1, circuit 39 (RD/WH).

5

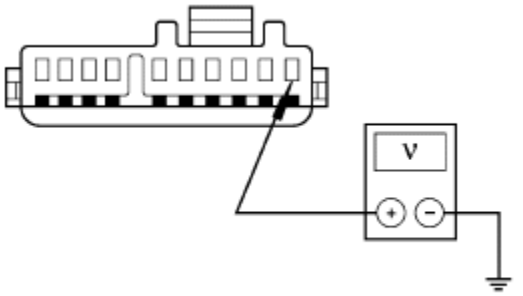


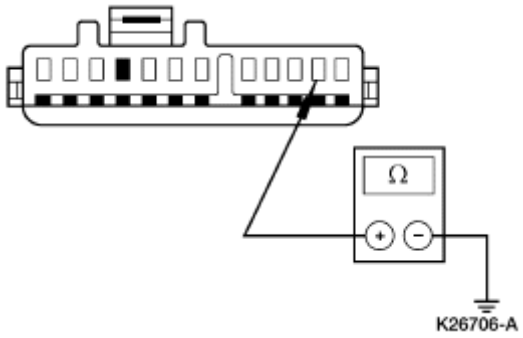
GK1816-A

5 Measure the resistance between instrument cluster C287-3, circuit 39 (RD/WH), and ground.

- **Is the resistance less than 5 ohms between instrument cluster C287 and water temperature indicator sender unit C104; and greater than 10,000 ohms between instrument cluster C287 and ground?**

→ **Yes**
GO to B3 .

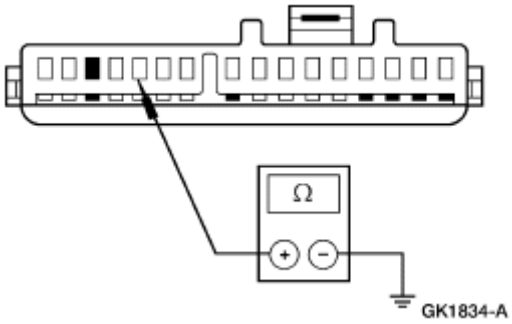
	→ **No** REPAIR circuit 39 (RD/WH). TEST the system for normal operation.
B3 CHECK THE POWER TO THE INSTRUMENT CLUSTER	
1 Instrument Cluster 2 3  GK2025-A	3 Measure the voltage between instrument cluster C288-1, circuit 640 (RD/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B4 . → **No** REPAIR circuit 640 (RD/YE). TEST the system for normal operation.
B4 CHECK THE GROUND TO THE INSTRUMENT CLUSTER	
1 2	2 Check the resistance between instrument cluster C287-2, circuit 570 (BK/WH), and ground.

	• **Is the resistance less than 5 ohms?** → **Yes** GO to B5 . → **No** REPAIR circuit 570 (BK/WH). TEST the system for normal operation.
B5 CHECK INSTRUMENT CLUSTER TEMPERATURE GAUGE	
	1 Measure the resistance between instrument cluster temperature gauge clip "B" and instrument cluster temperature gauge clip "S." 2 Measure the resistance between instrument cluster temperature gauge clip "S" and instrument cluster temperature gauge clip "G." • **Is the resistance 235 +/- 21 ohms between the "B" clip and "S" clip; and 100 +/- 10 ohms between the "S" clip and "G" clip?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new engine coolant temperature gauge. REFER to Gauges . TEST the system for normal operation.

PINPOINT TEST C: INCORRECT OIL PRESSURE GAUGE INDICATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE OIL PRESSURE GAUGE (LOW)	
NOTE: For correct operation of the oil pressure gauge, verify the engine oil is at the correct level and the connector is securely mated to the oil pressure switch. During hard braking, a momentary drop in oil pressure is normal.	

1 	2 Check the oil pressure gauge. • **Does the gauge read L (low) or below?** → **Yes** GO to C5 . → **No** GO to C2 .
C2 CHECK THE OIL PRESSURE GAUGE (KEY ON — ENGINE OFF)	
1 	2 Check the oil pressure gauge. • **Does the gauge indicate oil pressure?** → **Yes** GO to C3 . → **No** System OK.
C3 CHECK THE INPUT SIGNAL TO THE OIL PRESSURE GAUGE	
1 2 Instrument Cluster 3 4	4 Measure the resistance between instrument cluster C286-12, circuit 253 (DG/WH), and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to C4 .

→ **No**
INSTALL a new oil pressure gauge. REFER to Gauges . TEST the system for normal operation.

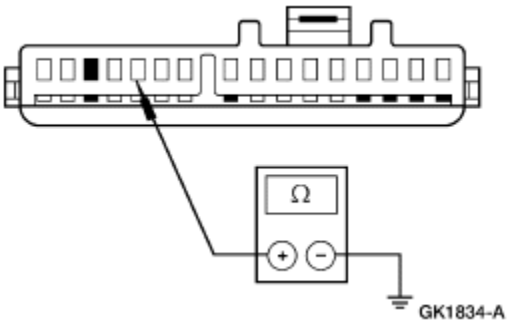
C4 CHECK CIRCUIT 253 (DG/WH) FOR SHORT TO GROUND

1

2

Oil Pressure Switch C175

3

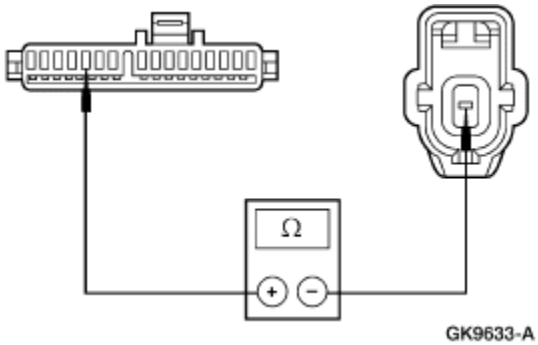


3 Measure the resistance between instrument cluster C286-12, circuit 253 (DG/WH), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new oil pressure switch. TEST the system for normal operation.

	→ **No** REPAIR circuit 253 (DG/WH). TEST the system for normal operation.
C5 CHECK THE OIL PRESSURE GAUGE (NORMAL)	
1 2 Oil Pressure Switch C175 3 4 GK9424-A	4 Connect a 7.5A fused jumper wire between oil pressure switch C175, circuit 253 (DG/WH), and ground. 5 Check the oil pressure gauge. • **Does the gauge read in the normal range?** → **Yes** INSTALL a new oil pressure switch. TEST the system for normal operation. → **No** GO to C6 .
C6 CHECK CIRCUIT 253 (DG/WH) FOR OPEN	
1 2	

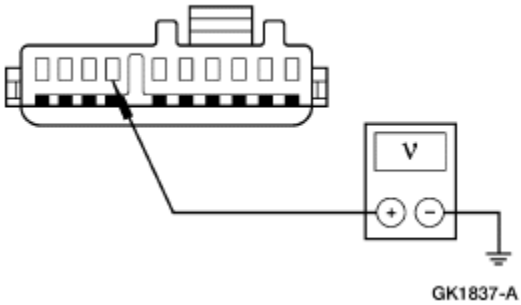
 Instrument Cluster 3  	3 Measure the resistance between instrument cluster C286-12, circuit 253 (DG/WH), and oil pressure switch C175, circuit 253 (DG/WH). • **Is the resistance less than 5 ohms?** → **Yes** GO to C7 . → **No** REPAIR circuit 253 (DG/WH). TEST the system for normal operation.
C7 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT	
	1 Measure the resistance between instrument cluster printed circuit terminal C286-12 and oil pressure gauge contact clip S. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new oil pressure gauge. REFER to Gauges . TEST the system for normal operation. → **No** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

PINPOINT TEST D: A GAUGE IS INACCURATE — SPEEDOMETER

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE TIRES	
	1 Check for factory recommended tire size.

	• **Are the tires the correct size?** → **Yes** GO to D2 . → **No** INSTALL new tires as necessary. TEST the system for normal operation.
D2 CHECK THE ODOMETER	
	1 Check the accuracy of the odometer; refer to Component Tests. • **Is the odometer accurate?** → **Yes** GO to Pinpoint Test E . → **No** INSTALL a new speedometer. REFER to Gauges . TEST the system for normal operation.

PINPOINT TEST E: THE SPEEDOMETER/ODOMETER IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE VOLTAGE TO THE INSTRUMENT CLUSTER	
1 2 Instrument Cluster 3  GK1837-A	3 Measure the voltage between instrument cluster C288-7, circuit 1001 (WH/YE), and ground. • **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E2 .

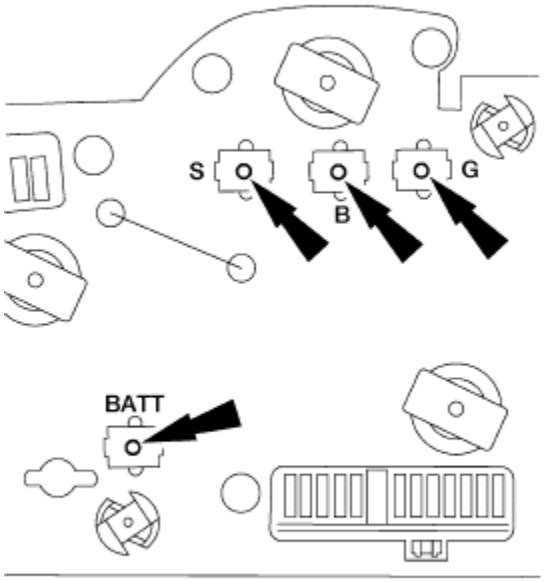
→ **No**
REPAIR circuit 1001 (WH/YE). TEST the system for normal operation.

E2 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT

1

Instrument Cluster

2



GK6907-A

2 **NOTE:** Measurements must be made to the speedometer gauge pins that are inside the instrument cluster printed circuit clips.

Measure the resistance between the speedometer pins (which can be seen in the middle of the instrument cluster printed circuit clips) and the corresponding instrument cluster terminal. Refer to the table for the pin and terminal assignments.

Instrument Cluster Terminal	Speedometer Gauge Pin
C286-13	B
C287-1	S
C287-2	G
C288-7	BATT

- **Are the resistances less than 1 ohm?**

→ **Yes**
GO to E3 .

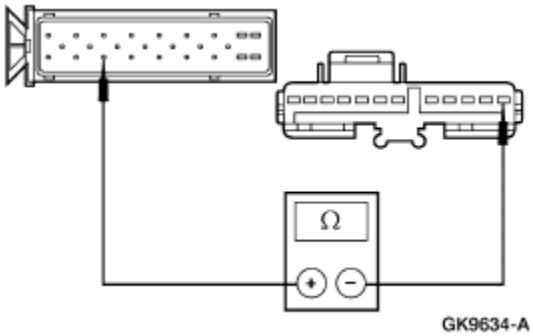
→ **No**
INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

E3 CHECK CIRCUIT 679 (GY/BK)

1

Anti-Lock Brake Control Module C186

2



2 Measure the resistance between anti-lock brake control module C186-19, circuit 679 (GY/BK), and instrument cluster C287-1, circuit 679 (GY/BK).

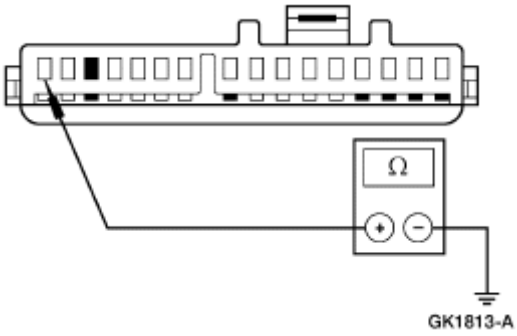
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new speedometer. REFER to Gauges . TEST the system for normal operation.

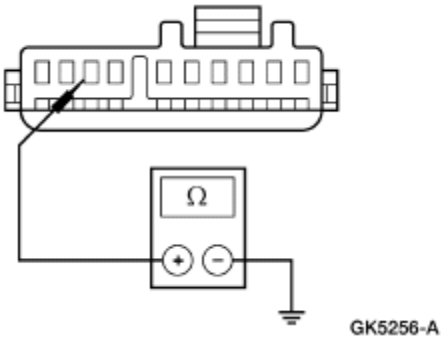
→ **No**
REPAIR circuit 679 (GY/BK). TEST the system for normal operation.

PINPOINT TEST F: THE TACHOMETER IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE GROUND TO THE TACHOMETER	
1 2 Instrument Cluster 3	3 If equipped with 5.0L engine, measure the resistance between instrument cluster C286-16, circuit 397 (BK/WH), and ground.



4



4 If equipped with 4.0L engine, measure the resistance between instrument cluster C288-8, circuit 398 (BK/YE), and ground.

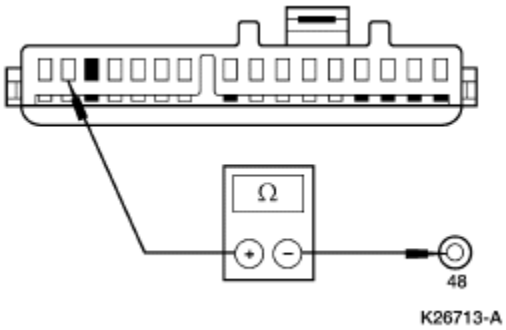
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F2 .

→ **No**
REPAIR circuit 397 (BK/WH) or circuit 398 (BK/YE). TEST the system for normal operation.

F2 CHECK CIRCUIT 11 (TN/YE) FOR OPEN

2

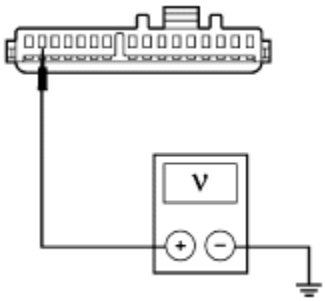


1 Connect the EEC-V 104-Pin Breakout Box.

2 Measure the resistance between instrument cluster C286-15, circuit 11 (TN/YE), and EEC-V 104-Pin Breakout Box pin 48, circuit 11 (TN/YE).

- **Is the resistance less than 5 ohms?**

→ **Yes**
RECONNECT the powertrain control module

	(PCM). GO to F3 . → **No** REPAIR circuit 11 (TN/YE). TEST the system for normal operation.
F3 CHECK CLEAN TACH OUT (CTO) SIGNAL TO TACHOMETER	
1 2  GK9635-A	2 Measure the voltage between instrument cluster C286-15, circuit 11 (TN/YE), and ground. • **Is the voltage between 5 and 8 volts?** → **Yes** GO to F4 . → **No** INSTALL a new PCM. TEST the system for normal operation.
F4 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT	
1 Instrument Cluster	2 Measure the resistance between the tachometer and instrument cluster printed circuit terminals; refer to the following chart:

Instrument Cluster Printed Circuit Terminal	Tachometer Terminal	Expected Values
C286-13	B	Less than 5 ohms
C286-15	S	Less than

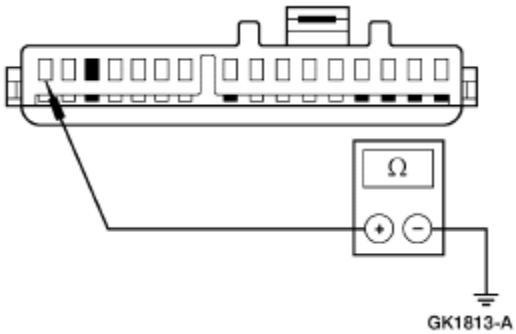
		5 ohms
C286-16	Upper G (8 CYL)	Less than 5 ohms
C287-2	Lower G	Less than 5 ohms
C288-8	Upper G (6 CYL)	3.9-4.7 kohms

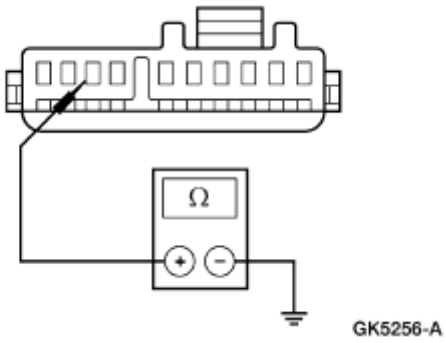
- **Are the resistances as specified?**

→ **Yes**
INSTALL a new tachometer. Gauges . TEST the system for normal operation.

→ **No**
INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

PINPOINT TEST G: INCORRECT TACHOMETER INDICATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE GROUND TO THE TACHOMETER	
1	
2 Instrument Cluster	
3  GK1813-A	3 If equipped with 5.0L engine, measure the resistance between instrument cluster C286-16, circuit 397 (BK/WH), and ground.
4	4 If equipped with 4.0L engine, measure the resistance between instrument cluster C288-8, circuit 398 (BK/YE), and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to G2 .

→ **No**
REPAIR circuit 397 (BK/WH) or circuit 398 (BK/YE). TEST the system for normal operation.

G2 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT

1

Instrument Cluster

2 Measure the resistance between the tachometer and instrument cluster printed circuit terminals; refer to the following chart:

Instrument Cluster Printed Circuit Terminal	Tachometer Terminal	Expected Values
C286-13	B	Less than 5 ohms
C286-15	S	Less than 5 ohms
C286-16	Upper G (8 CYL)	Less than 5 ohms
C287-2	Lower G	Less than 5 ohms
C288-8	Upper G (6 CYL)	3.9-4.7 kohms

- **Are the resistances as specified?**

→ **Yes**

	GO to G3 . → **No** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.
G3 CHECK FOR CLEAN TACH OUT (CTO) CIRCUIT OPEN OR SHORT	
	1 Check for CTO circuit open or short; refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. • **Is the CTO circuit OK?** → **Yes** INSTALL a new tachometer. REFER to Gauges . TEST the system for normal operation. → **No** INSTALL a new PCM. TEST the system for normal operation.

PINPOINT TEST H: THE CHARGE SYSTEM WARNING INDICATOR IS NEVER/ALWAYS ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE FUSE	
1 2 CJB Fuse 15 (7.5A)	• **Is the fuse OK?** → **Yes** GO to H2 . → **No** INSTALL a new fuse. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary. TEST the system for normal operation.
H2 CHECK THE CHARGE SYSTEM WARNING INDICATOR CONTROL CIRCUIT	
1	

Generator C121

2

3

GK1867-A

3 Connect a 7.5A fused jumper wire between generator C121-I, circuit 904 (LG/RD), and ground.

- **Does the charge system warning indicator illuminate?**

→ **Yes**
REFER to Section 414-00 .

→ **No**
GO to H3 .

H3 CHECK THE POWER TO THE INSTRUMENT CLUSTER

1

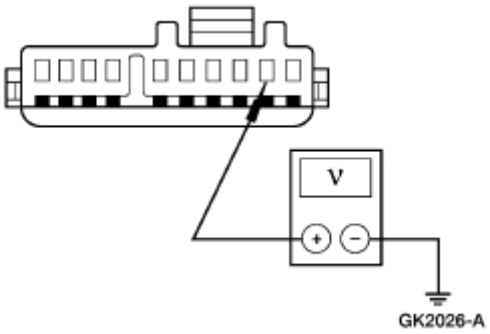
2

Instrument Cluster

3

4

4 Measure the voltage between instrument cluster C288-2, circuit 584 (YE), and ground.



- **Is the voltage greater than 10 volts?**

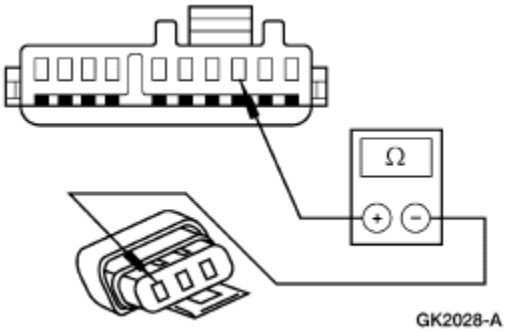
→ **Yes**
GO to H4 .

→ **No**
REPAIR circuit 584 (YE). TEST the system for normal operation.

H4 CHECK CIRCUIT 904 (LG/RD) FOR OPEN

1

2



2 Measure the resistance between instrument cluster C288-3, circuit 904 (LG/RD), and generator C121-I.

- **Is the resistance less than 5 ohms?**

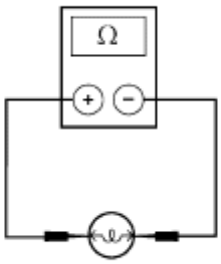
→ **Yes**
GO to H5 .

→ **No**
REPAIR circuit 904 (LG/RD). TEST the system for normal operation.

H5 CHECK THE CHARGE SYSTEM WARNING INDICATOR BULB

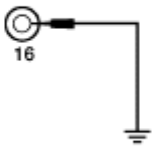
1

1 Measure for continuity between the terminals of the charge system warning indicator bulb.

 GK4131-A	• **Does continuity exist?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST J: AN INDICATOR IS INOPERATIVE — ANTI-LOCK BRAKE WARNING

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE ANTI-LOCK BRAKE WARNING INDICATOR CONTROL CIRCUIT	
1 2 Anti-Lock Brake Control Module C186 4 5	3 Connect the EEC-IV 60-Pin Breakout Box. 5 Connect a 7.5A fused jumper wire between EEC-IV 60-Pin Breakout Box pin 16, circuit 603 (DG), and ground.



GK6012-A

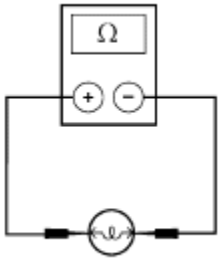
- **Does the anti-lock brake warning indicator illuminate?**

→ **Yes**
REFER to Section 206-09 .

→ **No**
GO to J2 .

J2 CHECK THE ANTI-LOCK BRAKE WARNING INDICATOR BULB

1



GK4131-A

1 Measure for continuity between the terminals of the anti-lock brake warning indicator bulb.

- **Does continuity exist?**

→ **Yes**
GO to J3 .

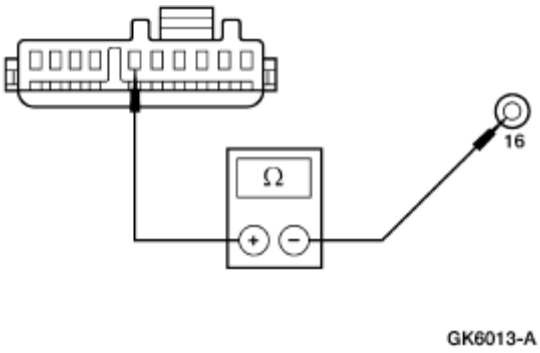
→ **No**
INSTALL a new bulb. TEST the system for normal operation.

J3 CHECK CIRCUIT 603 (DG) FOR OPEN

1

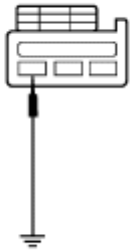
2

2 Measure the resistance between instrument cluster C288-6, circuit 603 (DG), and EEC-IV 60-Pin Breakout Box pin 16.

	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** REPAIR circuit 603 (DG). TEST the system for normal operation.

PINPOINT TEST K: AN INDICATOR IS INOPERATIVE — FUEL RESET

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE FUEL RESET INDICATOR CONTROL CIRCUIT	
1 2 Inertia Fuel Shutoff Switch C203 3 4	4 Connect a 7.5A jumper wire between inertia fuel shutoff switch C203-1, circuit 921 (GY/OG), and ground.



GK2018-A

- **Does the FUEL RESET indicator illuminate?**

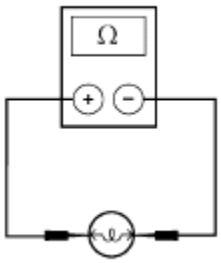
→ **Yes**
REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

→ **No**
GO to K2 .

K2 CHECK THE FUEL RESET INDICATOR BULB

1

2



GK4131-A

2 Measure for continuity between the terminals of the FUEL RESET indicator bulb.

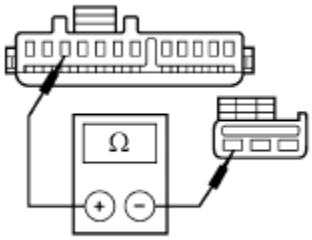
- **Does continuity exist?**

→ **Yes**
GO to K3 .

→ **No**
INSTALL a new bulb. TEST the system for normal operation.

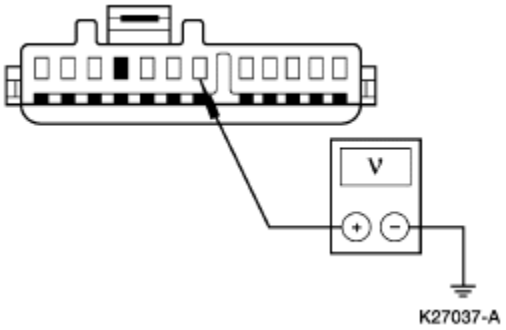
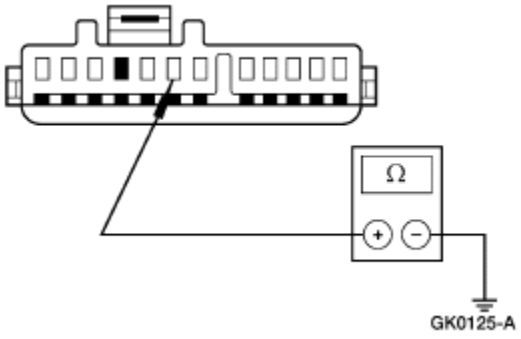
K3 CHECK CIRCUIT 921 (GY/OG) FOR OPEN

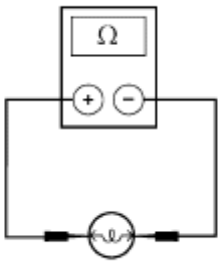
1

 Instrument Cluster 2  GK6257-A	2 Measure the resistance between instrument cluster C287-10, circuit 921 (GY/OG), and inertia fuel shutoff switch C203-1, circuit 921 (GY/OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** REPAIR circuit 921 (GY/OG). TEST the system for normal operation.

PINPOINT TEST L: AN INDICATOR IS INOPERATIVE — HIGH BEAM

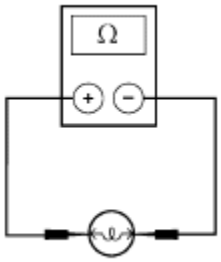
CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK THE POWER TO THE INSTRUMENT CLUSTER	
1 2 Instrument Cluster 3 	4 Turn the headlamp switch to the ON position. 5 Set the multifunction switch to the high beam

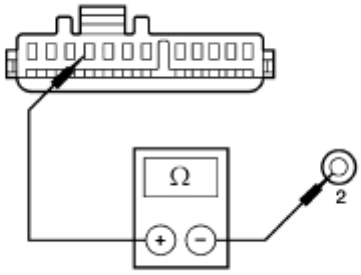
6  	position. 6 Measure the voltage between instrument cluster C287-6, circuit 12 (LG/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to L2 . → **No** REPAIR circuit 12 (LG/BK). TEST the system for normal operation.
L2 CHECK THE GROUND TO THE INSTRUMENT CLUSTER	
1 2  	2 Measure the resistance between instrument cluster C287-7, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to L3 . → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
L3 CHECK THE HIGH BEAM INDICATOR BULB	
1	1 Measure for continuity between the terminals

 GK4131-A	of the high beam indicator bulb. • **Does continuity exist?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST M: AN INDICATOR IS INOPERATIVE — CHECK ENGINE/MALFUNCTION INDICATOR LAMP (MIL)

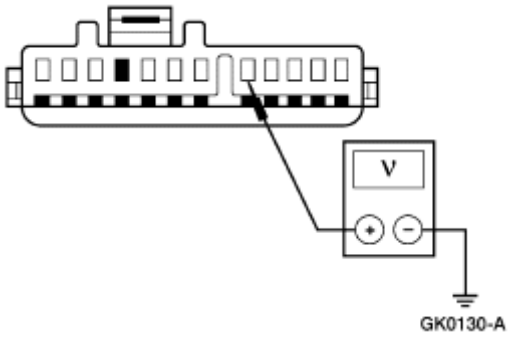
CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK THE ENGINE WARNING INDICATOR CONTROL CIRCUIT	
1 	
	2 Connect the EEC-V 104-Pin Breakout Box.
3 	
4	4 Connect a 7.5A fused jumper wire between EEC-V 104-Pin Breakout Box pin 2 and pin 24.
 GK1841-A	

	• **Does the CHECK ENGINE warning indicator illuminate?** → **Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. → **No** GO to M2 .
M2 CHECK THE BULB	
1 2  GK4131-A	2 Measure for continuity between the terminals of the CHECK ENGINE warning indicator bulb. • **Does continuity exist?** → **Yes** GO to M3 . → **No** INSTALL a new bulb. TEST the system for normal operation.
M3 CHECK CIRCUIT 658 (PK/LG) FOR OPEN	
1 Instrument Cluster 2	2 Measure the resistance between EEC-V 104-Pin Breakout Box pin 2 and instrument cluster C287-9, circuit 658 (PK/LG).

 GK8307-A	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** REPAIR circuit 658 (PK/LG). TEST the system for normal operation.

PINPOINT TEST N: AN INDICATOR IS INOPERATIVE — LH TURN SIGNAL

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK THE POWER TO THE INSTRUMENT CLUSTER	
1 2 Instrument Cluster 3 5	4 Place the multifunction switch in the LH turn signal position. 5 Measure the voltage between instrument cluster C287-5, circuit 3 (LG/WH), and ground.



- **Does the voltage vary from 0 to greater than 10 volts?**

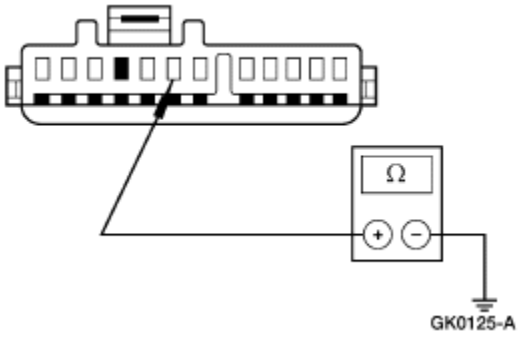
→ **Yes**
GO to N2 .

→ **No**
REPAIR circuit 3 (LG/WH). TEST the system for normal operation.

N2 CHECK THE GROUND TO THE INSTRUMENT CLUSTER

1

2



2 Measure the resistance between instrument cluster C287-7, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

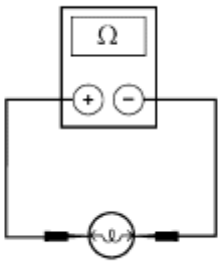
→ **Yes**
GO to N3 .

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

N3 CHECK THE LH TURN INDICATOR BULB

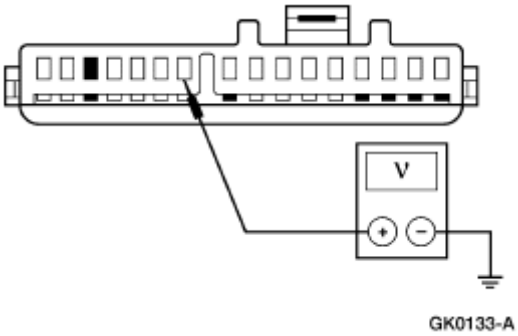
1

1 Measure for continuity between the terminals of the LH turn indicator bulb.

 GK4131-A	• **Does continuity exist?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST P: AN INDICATOR IS INOPERATIVE — RH TURN SIGNAL

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK THE POWER TO THE INSTRUMENT CLUSTER	
1 2 Instrument Cluster 3 5	4 Place the multifunction switch in the RH turn signal position. 5 Measure the voltage between instrument cluster C286-10, circuit 2 (WH/LB), and ground.



- **Does the voltage vary from 0 to greater than 10 volts?**

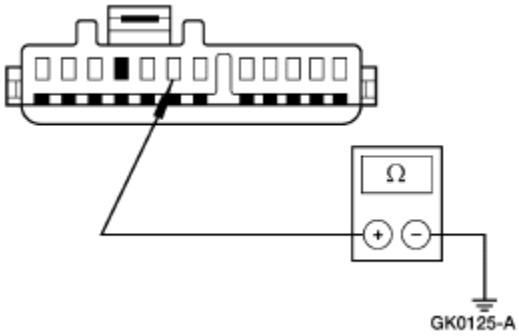
→ **Yes**
GO to P2 .

→ **No**
REPAIR circuit 2 (WH/LB). TEST the system for normal operation.

P2 CHECK THE GROUND TO THE INSTRUMENT CLUSTER

1

2



2 Measure the resistance between instrument cluster C287-7, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

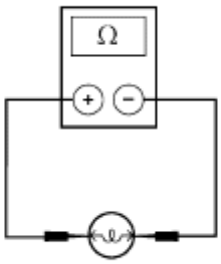
→ **Yes**
GO to P3 .

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

P3 CHECK THE RH TURN INDICATOR BULB

1

1 Measure for continuity between the terminals of the RH turn indicator bulb.

 GK4131-A	• **Does continuity exist?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST Q: AN INDICATOR IS INOPERATIVE — O/D OFF

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK OVERDRIVE OPERATION	
	1 Test drive the vehicle. • **Does overdrive operate correctly?** → **Yes** GO to Q2 . → **No** REFER to Section 307-05 .
Q2 CHECK THE O/D OFF INDICATOR CIRCUIT	
1 3 4	2 Connect EEC-V 104-Pin Breakout box. 4 Connect a 7.5A fused jumper wire between

GK1925-A

EEC-V 104-Pin Breakout Box pin 79 and pin 24.

5 Place the headlamp switch in the OFF position.

6 Place the headlamp switch in the ON position.

- **Does the O/D OFF indicator illuminate?**

→ **Yes**
REFER to Section 307-05 .

→ **No**
If the O/D OFF indicator does not illuminate with the headlamp switch in the ON position, GO to Q3 .

If the O/D OFF indicator does not illuminate with the headlamp switch in the OFF position, GO to Q4 .

If the O/D OFF indicator does not illuminate with the headlamp switch in the ON or OFF position, GO to Q5 .

Q3 CHECK VOLTAGE ON CIRCUIT 19 (LB/RD) TO HEADLAMP SWITCH

1

2

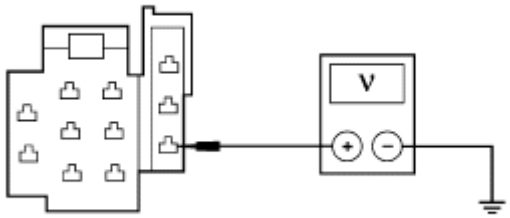
Headlamp Switch C216

3

4 Rotate the panel dimmer switch to the full illumination position.

5

5 Measure the voltage between headlamp



GK5300-A

switch C216-9, circuit 235 (RD/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation.

→ **No**
REPAIR circuit 235 (RD/BK). TEST the system for normal operation.

Q4 CHECK VOLTAGE TO THE HEADLAMP SWITCH

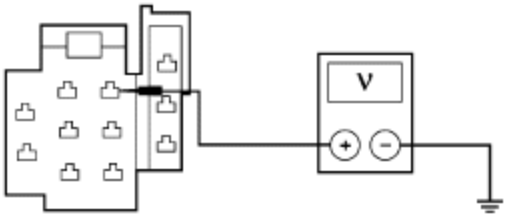
1

2

Headlamp Switch C216

3

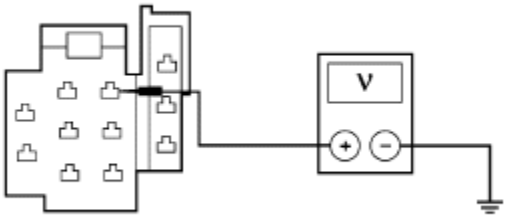
4



GK5301-A

4 Measure the voltage between headlamp switch C216-4, circuit 192 (BN/WH), and ground.

- **Is the voltage greater than 10 volts?**

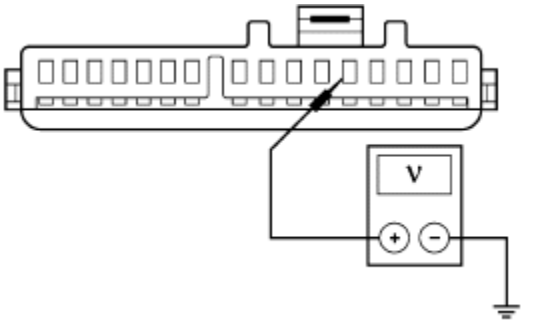
	→ **Yes** INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR circuit 192 (BN/WH). TEST the system for normal operation.
Q5 CHECK POWER SUPPLY TO THE HEADLAMP SWITCH	
1 2 Headlamp Switch C216 3 4  GK5301-A	4 Measure the voltage between headlamp switch C216-4, circuit 192 (BN/WH), and ground. • **Is the voltage greater than 10 volts?** → **Yes** RECONNECT headlamp switch C216. GO to Q6 . → **No** REPAIR circuit 192 (BN/WH). TEST the system for normal operation.
Q6 CHECK VOLTAGE TO THE INSTRUMENT CLUSTER	
1 	

2

Instrument Cluster

3

4



4 Measure the voltage between instrument cluster C286-5, circuit 484 (OG/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to Q8.

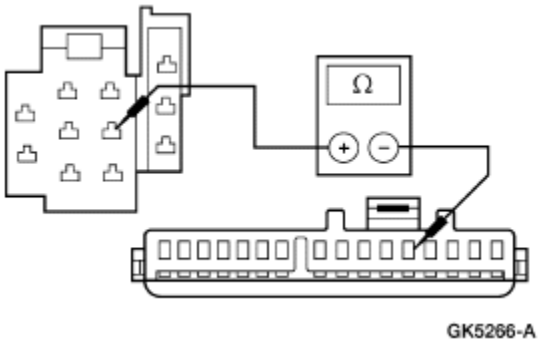
→ **No**
GO to Q7.

Q7 CHECK CIRCUIT 484 (OG/BK) FOR OPEN

1

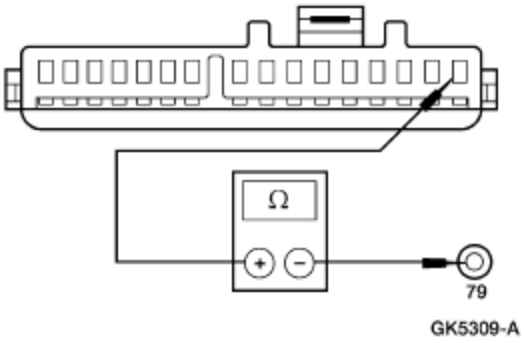
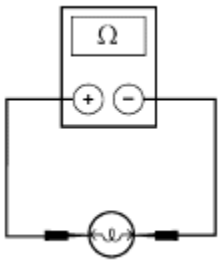
Headlamp Switch C216

2



2 Measure the resistance between headlamp switch C216-8, circuit 484 (OG/BK), and instrument cluster C286-5, circuit 484 (OG/BK).

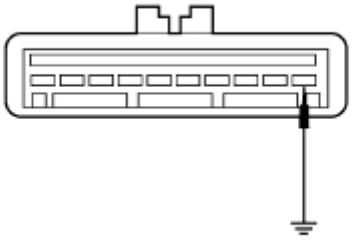
- **Is the resistance less than 5 ohms?**

	→ **Yes** INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR circuit 484 (OG/BK). TEST the system for normal operation.
Q8 CHECK CIRCUIT 911 (WH/LG)	
1 PCM 3  GK5309-A	2 Connect EEC-V 104-Pin Breakout Box. 3 Measure the resistance between EEC-V 104-Pin Breakout Box pin 79, circuit 911 (WH/LG), and instrument cluster C286-1, circuit 911 (WH/LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to Q9 . → **No** REPAIR circuit 911 (WH/LG). TEST the system for normal operation.
Q9 CHECK THE O/D OFF INDICATOR BULB	
1  GK4131-A	1 Measure for continuity between the terminals of the O/D OFF indicator bulb. • **Does continuity exist?**

	→ **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST R: THE SPEED CONTROL INDICATOR IS NEVER/ALWAYS ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK SPEED CONTROL OPERATION	
	1 Test drive the vehicle and operate the speed control. • **Does the speed control operate correctly?** → **Yes** GO to R2 . → **No** REFER to Section 310-03 .
R2 CHECK THE SPEED CONTROL INDICATOR CIRCUIT	
1 2 Speed Control Servo C171 3 4	4 Connect a 7.5A fused jumper wire between speed control servo C171-1, circuit 203 (OG/LB), and ground.



GK6319-A

5 Place the headlamp switch in the OFF position.

6 Place the headlamp switch in the ON position.

- **Does the speed control indicator illuminate?**

→ **Yes**
INSTALL a new speed control servo. REFER to Section 310-03 . TEST the system for normal operation.

→ **No**
If the speed control indicator does not illuminate in the ON position, GO to R3 .

If the speed control indicator does not illuminate in the OFF position, GO to R4 .

If the speed control indicator does not illuminate in the ON or OFF position, GO to R5 .

R3 CHECK VOLTAGE ON CIRCUIT 235 (RD/BK) TO HEADLAMP SWITCH

1

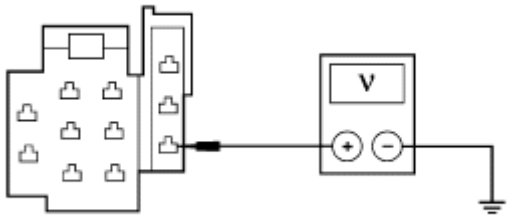
2

Headlamp Switch C216

3

4

4 Measure the voltage between headlamp switch C216-9, circuit 235 (RD/BK), and ground.



GK5300-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation.

→ **No**
REPAIR circuit 235 (RD/BK). TEST the system for normal operation.

R4 CHECK VOLTAGE TO THE HEADLAMP SWITCH

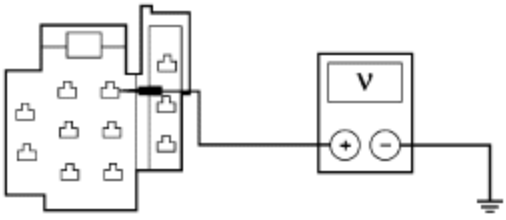
1

2

Headlamp Switch C216

3

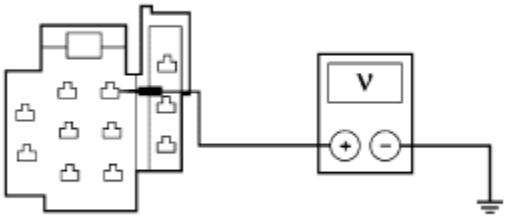
4



GK5301-A

4 Measure the voltage between headlamp switch C216-4, circuit 192 (BN/WH), and ground.

- **Is the voltage greater than 10 volts?**

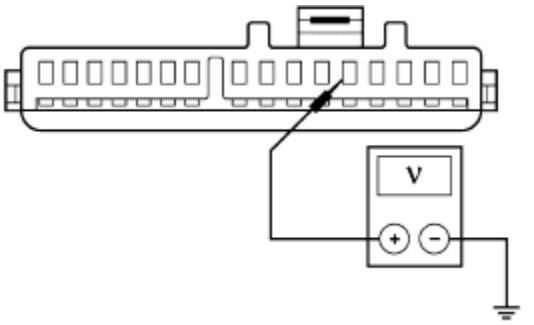
	→ **Yes** INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR circuit 192 (BN/WH). TEST the system for normal operation.
R5 CHECK POWER SUPPLY TO THE HEADLAMP SWITCH	
1 2 Headlamp Switch C216 3 4  GK5301-A	4 Measure the voltage between headlamp switch C216-4, circuit 192 (BN/WH), and ground. • **Is the voltage greater than 10 volts?** → **Yes** RECONNECT headlamp switch C205. GO to R6 . → **No** REPAIR circuit 640 (RD/YE). TEST the system for normal operation.
R6 CHECK VOLTAGE TO THE INSTRUMENT CLUSTER	
1 	

2

Instrument Cluster

3

4



4 Measure the voltage between instrument cluster C286-5, circuit 484 (OG/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to R8.

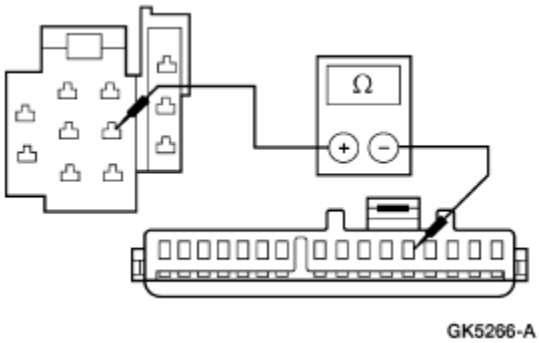
→ **No**
GO to R7.

R7 CHECK CIRCUIT 484 (OG/BK) FOR OPEN

1

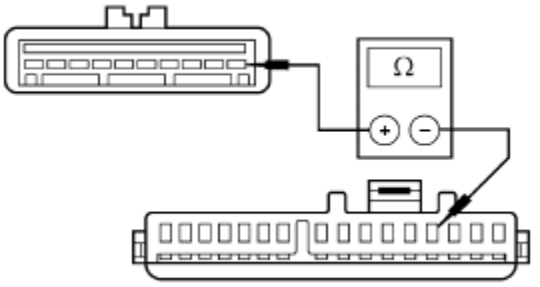
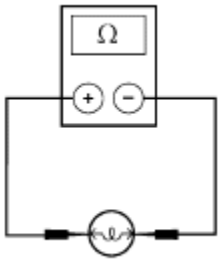
Headlamp Switch C216

2



2 Measure the resistance between headlamp switch C216-8, circuit 484 (OG/BK) and instrument cluster C286-5, circuit 484 (OG/BK).

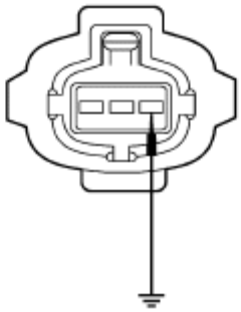
- **Is the resistance less than 5 ohms?**

	→ **Yes** INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR circuit 484 (OG/BK). TEST the system for normal operation.
R8 CHECK CIRCUIT 203 (OG/LB)	
1 Speed Control Servo C171 2  GK5302-A	2 Measure the resistance between speed control servo C171-1, circuit 203 (OG/LB), and instrument cluster C286-4, circuit 203 (OG/LB). • **Is the resistance less than 5 ohms?** → **Yes** GO to R9 . → **No** REPAIR circuit 203 (OG/LB). TEST the system for normal operation.
R9 CHECK THE SPEED CONTROL INDICATOR BULB	
1  GK4131-A	1 Measure for continuity between the terminals of the speed control indicator bulb. • **Does continuity exist?**

	→ **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

PINPOINT TEST S: AN INDICATOR IS INOPERATIVE — RED BRAKE WARNING

CONDITIONS	DETAILS/RESULTS/ACTIONS
S1 CHECK THE PARKING BRAKE SWITCH CONTROL CIRCUIT	
1 	2 Set the parking brake. • **Does the red BRAKE warning indicator illuminate?** → **Yes** RELEASE the parking brake. GO to S2 . → **No** GO to S5 .
S2 CHECK THE RED BRAKE WARNING INDICATOR CONTROL CIRCUIT	
1 2 Brake Fluid Level Switch C143 3 4	4 Connect a 7.5A fused jumper wire between brake fluid level switch C143-3, circuit 977 (VT/WH), and ground.



GK9636-A

- **Does the red BRAKE warning indicator illuminate?**

→ **Yes**
REFER to Section 206-00 .

→ **No**
GO to S3 .

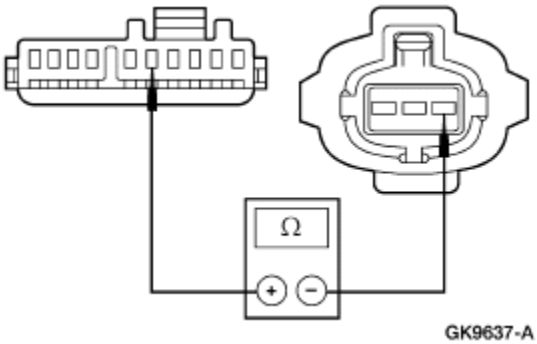
S3 CHECK CIRCUIT 977 (VT/WH) FOR OPEN

1

2

Instrument Cluster

3



GK9637-A

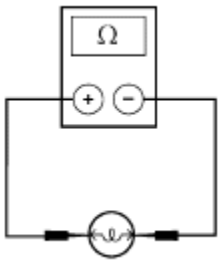
3 Measure the resistance between instrument cluster C288-5, circuit 977 (VT/WH), and brake fluid level switch C143-3, circuit 977 (VT/WH).

- **Is the resistance less than 5 ohms?**

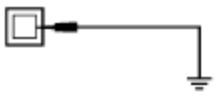
→ **Yes**
GO to S4 .

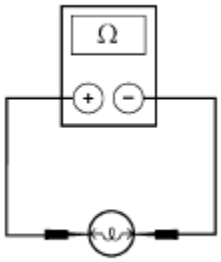
→ **No**
REPAIR circuit 977 (VT/WH). TEST the system for normal operation.

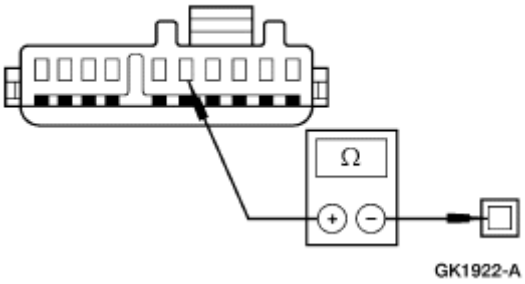
S4 CHECK THE RED BRAKE WARNING INDICATOR BULB

1  GK4131-A	1 Measure for continuity between the terminals of the red BRAKE warning indicator bulb. • **Does continuity exist?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** INSTALL a new bulb. TEST the system for normal operation.

S5 CHECK THE PARKING BRAKE SWITCH

1 2 Parking Brake Switch C211 3 4  GK1921-A	4 Connect a 7.5A fused jumper wire between parking brake switch C211, circuit 162 (LG/RD), and ground.

	• **Does the red BRAKE warning indicator illuminate?** → **Yes** INSTALL a new parking brake switch. TEST the system for normal operation. → **No** GO to S6.
S6 CHECK THE RED BRAKE WARNING INDICATOR BULB	
1 2  GK4131-A	2 Measure for continuity between the terminals of the red BRAKE warning indicator bulb. • **Does continuity exist?** → **Yes** GO to S7. → **No** INSTALL a new bulb. TEST the system for normal operation.
S7 CHECK CIRCUIT 977 (VT/WH) FOR OPEN	
1 Instrument Cluster 2	2 Measure the resistance between instrument cluster C288-5, circuit 977 (VT/WH), and parking brake switch C211, circuit 162 (LG/RD).

	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** REPAIR circuit 977 (VT/WH) or circuit 162 (LG/RD). TEST the system for normal operation.

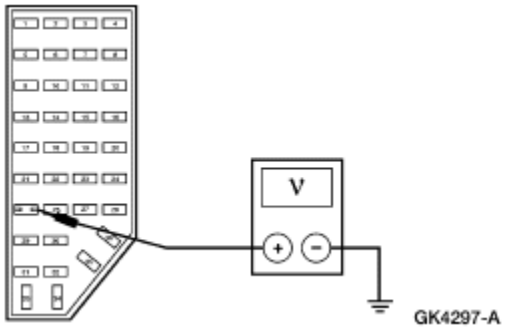
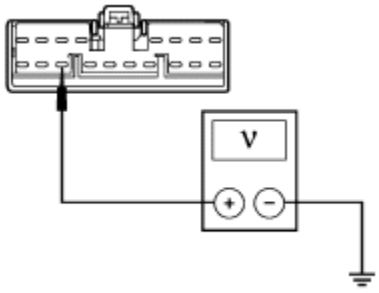
PINPOINT TEST T: AN INDICATOR IS INOPERATIVE — CHECK GAGE

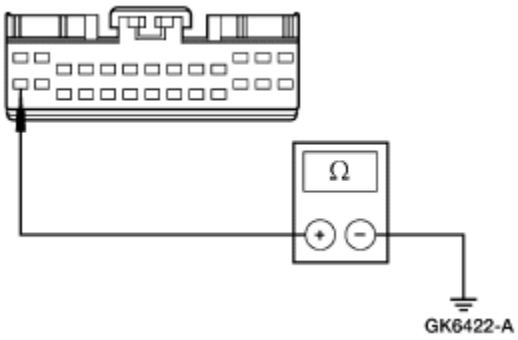
CONDITIONS	DETAILS/RESULTS/ACTIONS
T1 CHECK GAUGES	
1 	• **Are the gauges OK?** → **Yes** GO to T2 . → **No** RETURN to Symptom Chart.
T2 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT	
1 Instrument Cluster	2 Measure the resistance of the instrument cluster printed circuit between the following:

	■ CHECK GAGE indicator lamp socket and instrument cluster printed circuit terminal C287-8. ■ CHECK GAGE indicator lamp socket and instrument cluster gauge amplifier Pin 2. • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new coolant temperature/fuel level gauge and instrument cluster gauge amplifier. REFER to Gauges . TEST the system for normal operation. → **No** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

PINPOINT TEST U: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
U1 CHECK BJB MAXI-FUSE 1 (60A)	
1 BJB Maxi-Fuse 1 (60A)	• **Is the fuse OK?** → **Yes** GO to U2 . → **No** INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again CHECK circuit 1052 (TN/BK) for a short to ground. REPAIR as necessary.
U2 CHECK CJB FUSE 25 (7.5A)	
1 CJB Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to U3 .

	→ **No** INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again CHECK circuit 1001 (WH/YE) for a short to ground. REPAIR as necessary.
U3 CHECK CIRCUIT 1052 (TN/BK) FOR VOLTAGE	
1  	1 Measure the voltage between CJB Fuse 25 (7.5A) pin 2, circuit 1052 (TN/BK), and ground. • **Is voltage greater than 10 volts?** → **Yes** GO to U4 . → **No** REPAIR circuit 1052 (TN/BK). CLEAR the DTCs. TEST the system for normal operation.
U4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (WH/YE)	
1 2 GEM/CTM C283 3  	3 Measure the voltage between GEM/CTM C283-11, circuit 1001 (WH/YE), and ground. • **Is the voltage greater than 10 volts?**

	→ **Yes** GO to U5 . → **No** REPAIR circuit 1001 (WH/YE). CLEAR the DTCs. TEST the system for normal operation.
U5 CHECK CIRCUIT 570 (BK/WH) FOR OPEN	
1 GEM/CTM C280 2  	2 Measure the resistance between GEM/CTM C280-14, circuit 570 (BK/WH), and ground; and between GEM/CTM C280-26, circuit 570 (BK/WH), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 570 (BK/WH). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST V: THE DOOR AJAR INDICATOR DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
V1 CHECK THE IGNITION SWITCH STATES	
1 2 Scan Tool	

3 	3 **NOTE:** If the vehicle is equipped with a manual transmission depress the clutch while turning the ignition switch to START. Monitor the PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to V2 . → **No** REFER to Section 417-02 .
V2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
	1 Use the recorded results from the continuous and on-demand self-tests. • **Are any DTCs recorded?** → **Yes** If DTC B1322, REFER to Section 417-02 . If DTC B1323, GO to V3 . If DTC B1325, GO to V9 . If DTC B1330, REFER to Section 417-02 . If DTC B1334, REFER to Section 417-02 . If DTC B1338, REFER to Section 417-02 . If DTC B1574, REFER to Section 417-02 . If DTC B1342, INSTALL a new GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to V4 .
V3 CHECK THE DOOR AJAR WARNING INDICATOR OPERATION — MONITOR THE PID DRAJR_L	
1 2	2 Monitor the PID DRAJR_L.

3

3 Toggle the active command AJAR LAMP ON and OFF.

- **Does the PID DRAJR_L read OFF--- when the active command is OFF and read ON--- when the active command is ON?**

→ **Yes**
INSTALL a new GEM. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
If the PID DRAJR_L reads OFFO-G, GO to V4 .

If the PID DRAJR_L reads OFF-B-, GO to V9 .

V4 VERIFY THE OPERATION OF THE FUEL AND OIL GAUGE

1 Verify fuel and oil gauge operation.

- **Do the fuel and oil gauges operate?**

→ **Yes**
GO to V6 .

→ **No**
GO to V5 .

V5 CHECK VOLTAGE TO THE INSTRUMENT CLUSTER

1

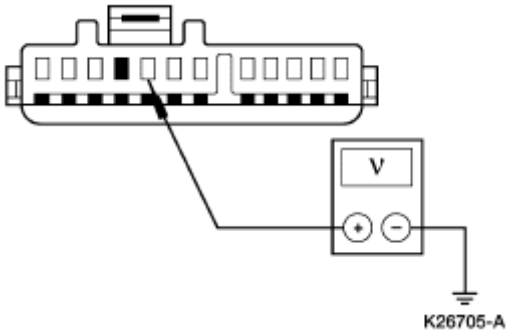
2

Instrument Cluster

3

4

4 Measure the voltage between instrument



cluster C287-8, circuit 640 (RD/YE), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to V6 .

→ **No**
REPAIR circuit 640 (RD/YE). TEST the system for normal operation.

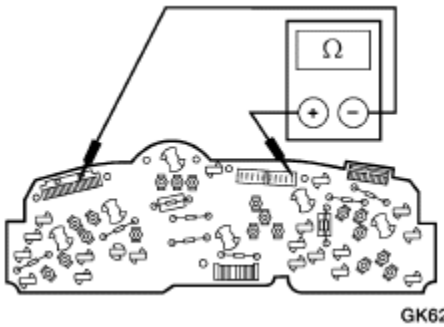
V6 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT FOR OPEN

1

2

Instrument Cluster

3

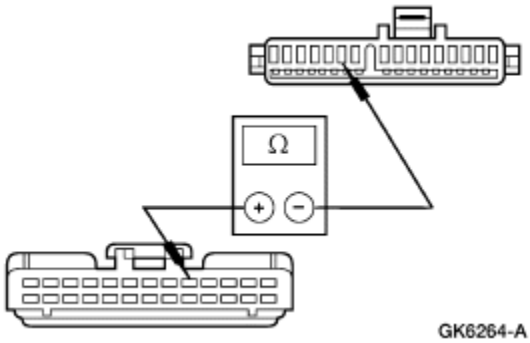
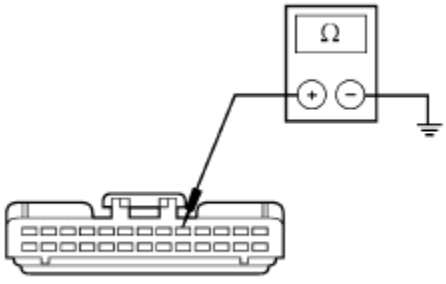


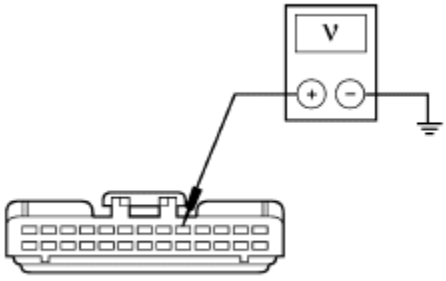
3 Measure the resistance between instrument cluster C286 terminal 11 and C287 terminal 8 (component side).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to V7 .

→ **No**
CHECK the DOOR AJAR warning indicator lamp. INSTALL a new lamp if necessary. If the

	lamp is OK, INSTALL a new instrument cluster printed circuit. CLEAR the DTCs. TEST the system for normal operation.
V7 CHECK CIRCUIT 627 (BK/OG) FOR OPEN	
1 GEM C280 2  	2 Measure the resistance between GEM C280-9, circuit 627 (BK/OG), and instrument cluster C286-11, circuit 627 (BK/OG). • **Is the resistance less than 5 ohms?** → **Yes** GO to V8 . → **No** REPAIR circuit 627 (BK/OG). CLEAR the DTCs. TEST the system for normal operation.
V8 CHECK CIRCUIT 627 (BK/OG) FOR SHORT TO GROUND	
1  	1 Measure the resistance between GEM C280-9, circuit 627 (BK/OG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** REPAIR circuit 627 (BK/OG). CLEAR the DTCs. TEST the system for normal operation.
V9 CHECK CIRCUIT 627 (BK/OG) FOR SHORT TO POWER	
1 2 GEM C280 3 Instrument Cluster 4 5  GK3448-A	5 Measure the voltage between GEM C280-9, circuit 627 (BK/OG), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 627 (BK/OG). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to V10 .
V10 CHECK THE INSTRUMENT CLUSTER FOR SHORT TO POWER — MONITOR THE PID DRAJR_L	
1	1 Monitor the PID DRAJR_L.

 2 	2 Set the active command AJAR LAMP to OFF. • **Does the PID DRAJR_L read OFF---?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new GEM. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST W: THE SAFETY BELT WARNING INDICATOR DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
W1 CHECK THE IGNITION STATES	
1 2 Scan Tool 3 	4 **NOTE:** If the vehicle is equipped with a manual transmission depress the clutch while turning the ignition switch to START. Monitor the PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?**

	→ **Yes** GO to W2 . → **No** REFER to Section 417-02 .
W2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
	1 Use the recorded results from the continuous and on-demand self-tests. • **Are any DTCs recorded?** → **Yes** If DTC B1342, INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. If DTC B1426, GO to W9 . If DTC B1428, GO to W3 . If DTC B1462, REFER to Section 413-09 . → **No** GO to W3 .
W3 VERIFY THE SAFETY BELT WARNING CHIME OPERATION	
	1 Verify the safety belt warning chime operation. • **Does the safety belt warning chime operate?** → **Yes** GO to W4 . → **No** REFER to Section 413-09 .
W4 CHECK THE PID SBLTLMP WHILE TOGGLING THE ACTIVE COMMAND SBLT LAMP	
1 2 3	2 Monitor the PID SBLTLMP. 3 Toggle the active command SBLT LAMP ON and OFF.

- **Does the PID SBLTLMP agree with the active command mode?**

→ **Yes**
INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
If the PID SBLTLMP reads OFFO-G, GO to W5 .

If the PID SBLTLMP reads ON-B-, GO to W10 .

W5 VERIFY THE OPERATION OF THE FUEL GAUGE

1 Verify the fuel gauge operation.

- **Does the fuel gauge operate?**

→ **Yes**
GO to W7 .

→ **No**
GO to W6 .

W6 CHECK VOLTAGE TO THE INSTRUMENT CLUSTER

1

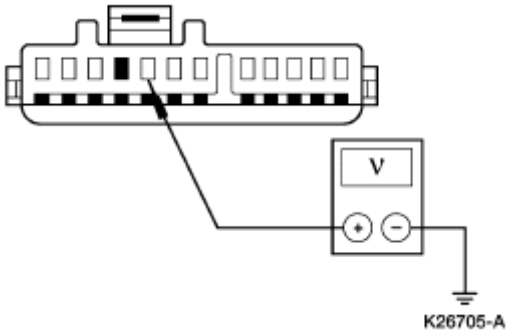
2

Instrument Cluster

3

4

4 Measure the voltage between instrument cluster C287-8, circuit 640 (RD/YE), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to W7 .

→ **No**
REPAIR circuit 640 (RD/YE). TEST the system for normal operation.

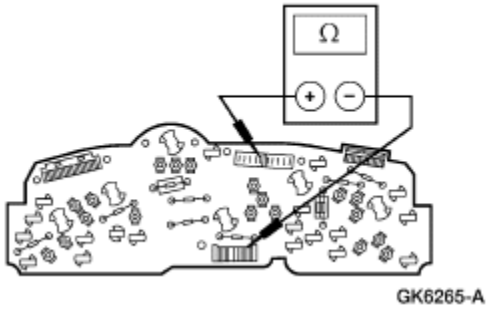
W7 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT FOR OPEN

1

2

Instrument Cluster

3

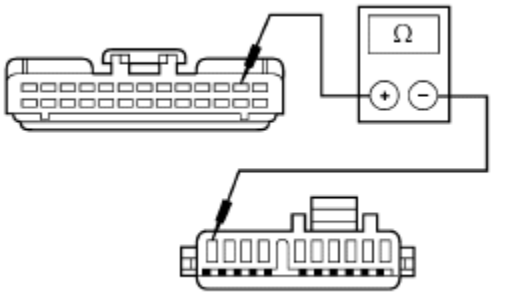
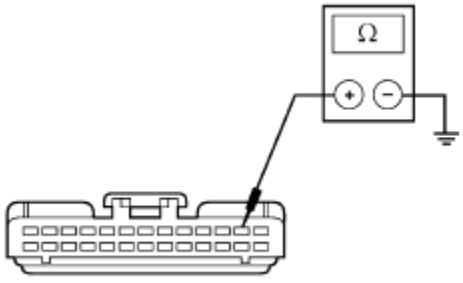


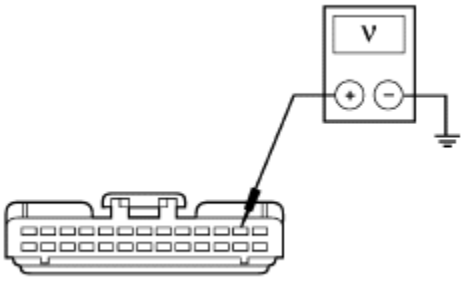
3 Measure the resistance between instrument cluster C287 terminal 8 and C288 terminal 10.

- **Is resistance less than 5 ohms?**

→ **Yes**
GO to W8 .

→ **No**
CHECK the safety belt warning indicator bulb. INSTALL a new bulb if necessary. If the bulb is

	OK, INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation.
W8 CHECK CIRCUIT 871 (YE) FOR OPEN	
1 GEM C280 2  GK3451-A	2 Measure the resistance between GEM C280-12, circuit 871 (YE), and instrument cluster C288-10, circuit 871 (YE). • **Is the resistance less than 5 ohms?** → **Yes** GO to W9 . → **No** REPAIR circuit 871 (YE). CLEAR the DTCs. TEST the system for normal operation.
W9 CHECK CIRCUIT 871 (YE) FOR SHORT TO GROUND	
1  GK3452-A	1 Measure the resistance between GEM C280-12, circuit 871 (YE), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for

	normal operation. → **No** REPAIR circuit 871 (YE). CLEAR the DTCs. TEST the system for normal operation.
W10 CHECK CIRCUIT 871 (YE) FOR SHORT TO POWER	
1 2 GEM C280 3 Instrument Cluster 4 5  GK3453-A	5 Measure the voltage between GEM C280-12, circuit 871 (YE), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 871 (YE). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to W11 .
W11 CHECK THE PID SBLTLMP WITH THE ACTIVE COMMAND SBLTLMP OFF	
1	1 Monitor the PID SBLTLMP.

 2 	2 Set the active command SBLT LAMP to OFF. • **Does the PID SBLTLMP read OFF O-G?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST X: AN INDICATOR IS INOPERATIVE — 4X4 HIGH, 4X4 LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
X1 CHECK THE IGNITION STATES	
1 Scan Tool	2 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch pedal when turning the ignition switch to START. Monitor the PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to X2 . → **No** REFER to Section 417-02 .
X2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES	

	1 Use the recorded results from the continuous and on-demand self-tests. • **Are any DTCs recorded?** → **Yes** If DTC B1342, REPLACE GEM. CLEAR the DTCs. TEST the system for normal operation. If DTC P1804, GO to X3 . If DTC P1806, GO to X3 . If DTC P1808, GO to X3 . If DTC P1810, GO to X3 . → **No** GO to X3 .
X3 VERIFY THE INOPERATIVE INDICATOR LAMP	
	1 Verify the inoperative indicator. • **Is the 4x4 HIGH indicator inoperative?** → **Yes** GO to X7 . → **No** If the 4x4 LOW indicator is inoperative, GO to X13 . If both the 4x4 HIGH and 4x4 LOW indicators are inoperative, GO to X4 .
X4 VERIFY THE O/D OFF LAMP OPERATES	
1 	2 Verify the O/D OFF indicator operates. • **Does the O/D OFF indicator operate?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to X5 .

X5 CHECK THE VOLTAGE TO THE INDICATORS

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Instrument Cluster

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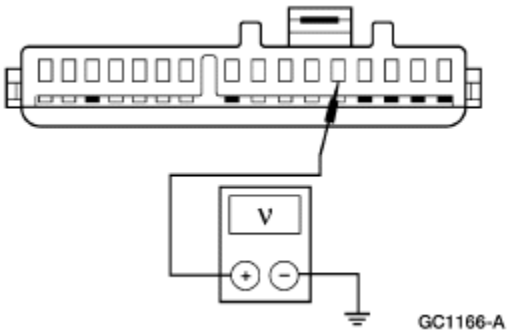


4 Measure the voltage between instrument cluster C286-5, circuit 484 (OG/BK) and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to X6 .

X6 CHECK CIRCUIT 484 (OG/BK) FOR OPEN AND SHORT TO GROUND

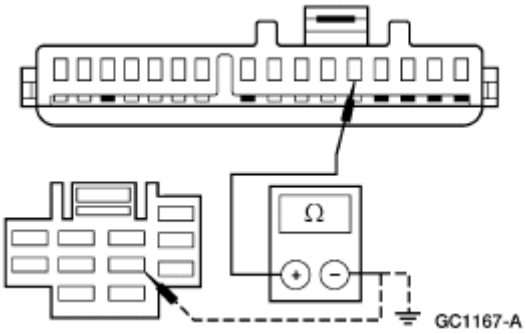
1

2

Headlamp Switch C216

3

3 Measure the resistance between instrument

	cluster C286-5, circuit 484 (OG/BK), and headlamp switch C216-8, circuit 484 (OG/BK); and between instrument cluster C286-5, circuit 484 (OG/BK), and ground. • **Is the resistance less than 5 ohms between the instrument cluster and headlamp switch; and greater than 10,000 ohms between the instrument cluster and ground?** → **Yes** REFER to Section 417-01 . → **No** REPAIR circuit 484 (OG/BK). CLEAR the DTCs. TEST the system for normal operation.
X7 CHECK THE 4X4 HIGH INDICATOR	
1 2 3 	2 Monitor the PID 4WDHIGH. 3 Toggle the active command HIGH LAMP to ON then OFF. The 4X4 HIGH indicator should illuminate, then go off. • **Does the indicator operate correctly?** → **Yes** Indicator is operating correctly; REFER to Section 308-07A . → **No** If the PID 4WDHIGH displays ON-B-, GO to X11 . If the PID 4WDHIGH displays OFFO-G, GO to X8 .

X8 CHECK THE GEM

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GEM C282

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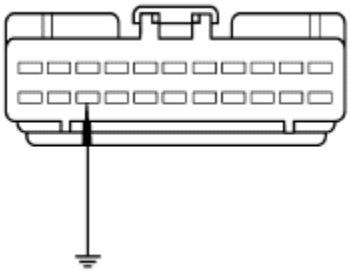


GC1168-A

4

3 Connect a 7.5A fused jumper wire between GEM C282-14, circuit 783 (GY) and ground.

- **Does the 4x4 HIGH indicator illuminate?**

→ **Yes**
INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

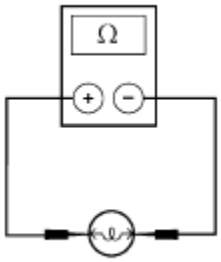
→ **No**
GO to X9 .

X9 CHECK THE 4X4 HIGH INDICATOR BULB

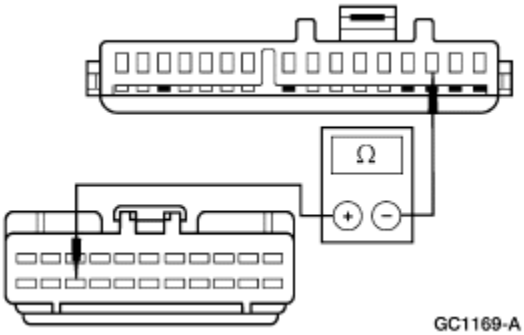
1 Remove the 4X4 HIGH indicator bulb.

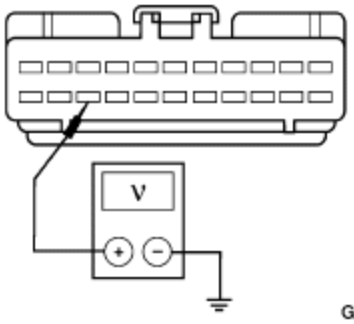
2 Measure for continuity between the terminals of the bulb.

2

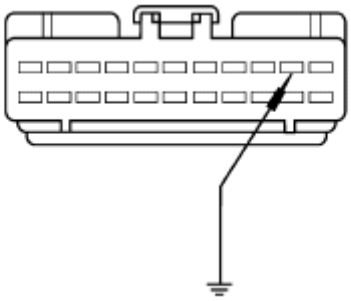


GK4131-A

	• **Does continuity exist?** → **Yes** GO to X10 . → **No** INSTALL a new bulb. CLEAR the DTCs. TEST the system for normal operation.
X10 CHECK CIRCUIT 783 (GY) FOR OPEN	
1 Instrument Cluster 2  GC1169-A	2 Measure the resistance between GEM C282-14, circuit 783 (GY) and instrument cluster C286-3, circuit 783 (GY). • **Is resistance less than 5 ohms?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 783 (GY). CLEAR the DTCs. TEST the system for normal operation.
X11 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT FOR SHORT TO POWER	
1 2 Instrument Cluster	

3 4 5 	4 Monitor the PID 4WDHIGH. 5 Toggle the active command HIGH LAMP to ON then OFF. • **Does the PID 4WDHIGH read ON-B-?** → **Yes** GO to X12 . → **No** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation.
X12 CHECK CIRCUIT 783 (GY) FOR SHORT TO POWER	
1 2 GEM C282 3  GC1170-A	3 Measure the voltage between GEM C282-14, circuit 783 (GY) and ground. • **Is any voltage indicated?**

	→ **Yes** REPAIR circuit 783 (GY). CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
X13 CHECK THE 4X4 LOW INDICATOR	
1 2 3 	2 Monitor the PID 4WDLOW. 3 Toggle the active command LOW LAMP to ON then OFF. The 4x4 LOW indicator should illuminate, then go off. • **Does the indicator operate correctly?** → **Yes** Indicator is operating correctly; REFER to Section 308-07A . → **No** If the PID 4WDLOW displays ON-B-, GO to X17 . If the PID 4WDLOW displays OFFO-G, GO to X14 .
X14 CHECK THE GEM	
1 2 GEM C282 3	3 Connect a 7.5A fused jumper wire between GEM C282-10, circuit 784 (LB/BK) and ground.


GC1171-A

4

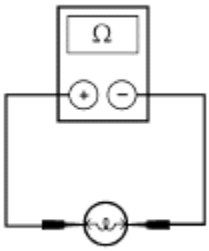
- **Does the 4X4 LOW indicator illuminate?**

→ **Yes**
INSTALL a new GEM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to X15 .

X15 CHECK THE 4X4 LOW INDICATOR BULB

2



GK3487-A

1 Remove the 4x4 LOW indicator bulb.

2 Measure for continuity between the terminals of the bulb.

- **Does continuity exist?**

→ **Yes**
GO to X16 .

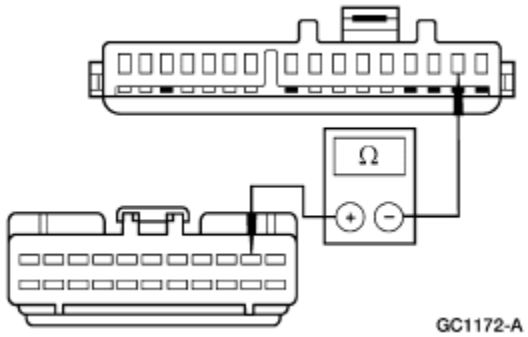
→ **No**
INSTALL a new bulb. CLEAR the DTCs. TEST the system for normal operation.

X16 CHECK CIRCUIT 784 (LB/BK) FOR OPEN

1

Instrument Cluster

2



2 Measure the resistance between GEM C282-10, circuit 784 (LB/BK) and instrument cluster C286-2, circuit 784 (LB/BK).

- **Is resistance less than 5 ohms?**

→ **Yes**
INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 784 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

X17 CHECK THE INSTRUMENT CLUSTER PRINTED CIRCUIT FOR SHORT TO POWER

1

2

Instrument Cluster

3

4

5

4 Monitor the PID 4WDLOW.

5 Toggle the active command LOW LAMP to ON then OFF.

- **Does the PID 4WDLOW read ON-B-?**

→ **Yes**
GO to X18 .

→ **No**
INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . CLEAR the DTCs. TEST the system for normal operation.

X18 CHECK CIRCUIT 784 (LB/BK) FOR SHORT TO POWER

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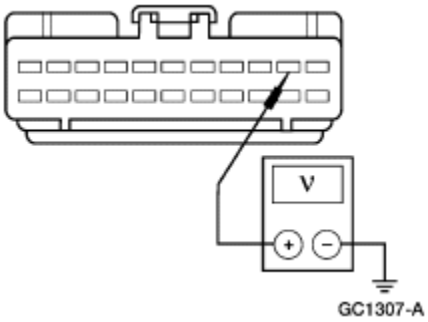
2

GEM C282

3

4



4 Measure the voltage between GEM C282-10, circuit 784 (LB/BK) and ground.

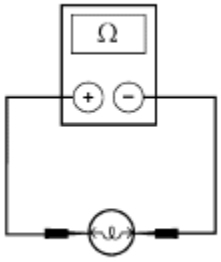
- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 784 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
INSTALL a new GEM. REFER to Section 419-

	10 . CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST Y: AN INDICATOR IS INOPERATIVE — AIR BAG

CONDITIONS	DETAILS/RESULTS/ACTIONS
Y1 CHECK BULB	
2  GK4131-A	1 Remove the air bag indicator bulb; refer to Warning Indicator Bulb . 2 Measure for continuity between the terminals of the air bag indicator bulb. • **Does continuity exist?** → **Yes** GO to Y2 . → **No** INSTALL a new bulb. TEST the system for normal operation.
Y2 CHECK INSTRUMENT CLUSTER PRINTED CIRCUIT	
	1 Visually inspect the instrument cluster printed circuit for damage, cracks, or hot spots. • **Is the instrument cluster printed circuit OK?** → **Yes** REFER to Section 501-20B . → **No** INSTALL a new instrument cluster printed circuit; REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation.

PINPOINT TEST Z: AN INDICATOR IS INOPERATIVE — CHECK SUSP

CONDITIONS	DETAILS/RESULTS/ACTIONS

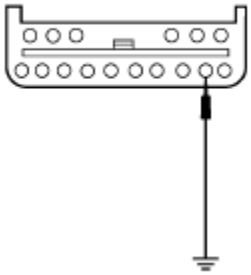
Z1

1

2

Air Suspension Control Module C2000

3



GK9638-A

4

3 Connect a 7.5A fused jumper wire between air suspension control module C2000 Pin 12, Circuit 419 (DG/LG), harness side and ground.

- **Does the CHECK SUSP indicator illuminate?**

→ **Yes**
REFER to Section 204-05 .

→ **No**
GO to Z2 .

Z2 CHECK CIRCUIT 419 (DG/LG) FOR OPEN

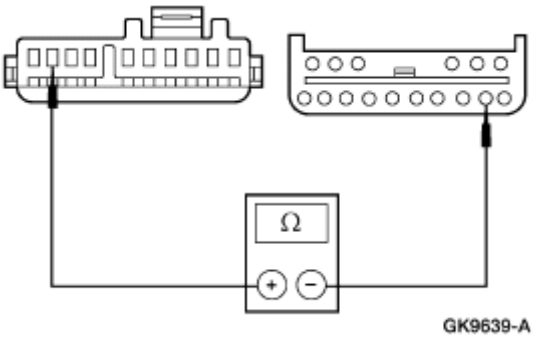
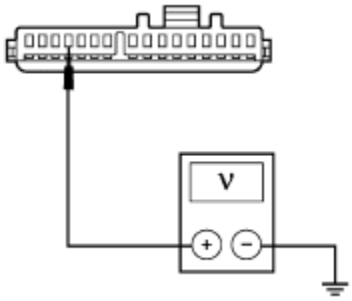
1

2

Instrument Cluster

3

3 Measure the resistance between instrument cluster C288 Pin 9, Circuit 419 (DG/LG), harness side and air suspension control

	module C2000 Pin 12, Circuit 419 (DG/LG), harness side. • **Is the resistance less than 5 ohms?** → **Yes** GO to Z3 . → **No** REPAIR the circuit. TEST the system for normal operation.
Z3 CHECK POWER TO CLUSTER — CIRCUIT 640 (RD/YE)	
1 2 	2 Measure the voltage between instrument cluster C286 Pin 13, Circuit 640 (RD/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new instrument cluster printed circuit. REFER to Instrument Cluster Printed Circuit . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST AA: AN INDICATOR IS ALWAYS ON — CHECK SUSP

CONDITIONS	DETAILS/RESULTS/ACTIONS
AA1 CHECK CIRCUIT 419 (DG/LG) FOR SHORT TO GROUND	
1 2 Air Suspension Control Module C2000 3 	• **Is the CHECK SUSP indicator illuminated?** → **Yes** REPAIR Circuit 419 (DG/LG) for short to ground. TEST the system for normal operation. → **No** REFER to Section 204-05 .

Component Tests

Gauge Test — Magnetic Gauge Test

Instrument Gauge System Tester is used to diagnose concerns with the instrument cluster magnetic gauges.

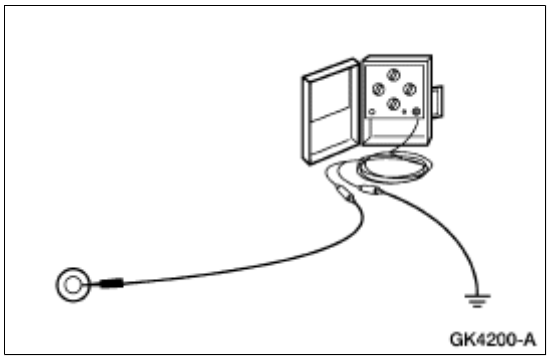
To test the magnetic gauges:

1. Disconnect the connector from the appropriate sender and connect the signal wire to the Instrument Gauge System Tester.

2. Turn the vehicle ignition switch lock cylinder to the ON position.

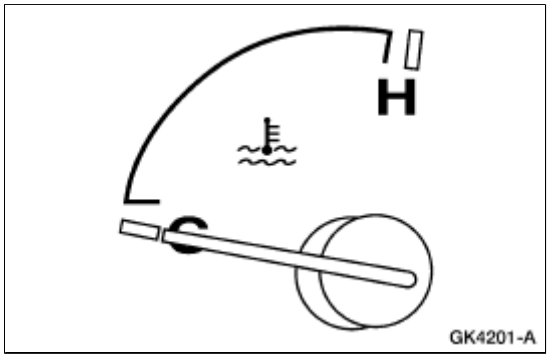
Gauge Test — Engine Coolant Temperature Gauge

Preliminary Setup



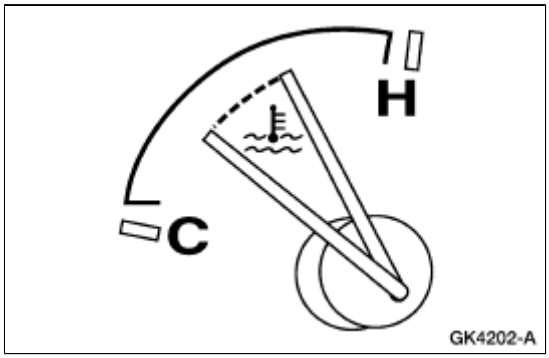
1. Disconnect water temperature indicator sender unit C104. Connect one lead of Instrument Gauge System Tester to water temperature indicator sender unit C104, circuit 39 (RD/WH), and the other lead to ground.

Check C (Cold) Indication



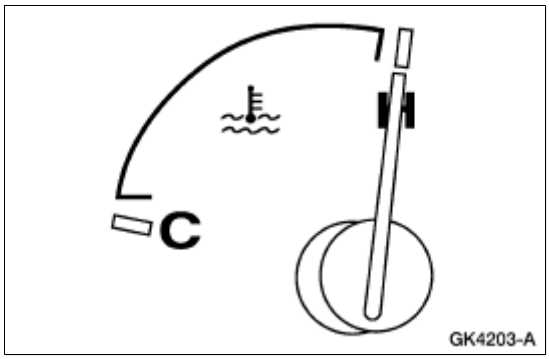
2. Set Instrument Gauge System Tester to 300 ohms. Key ON. Wait one minute. The engine coolant temperature gauge should indicate C (cold). Key OFF.

Check Normal Range Indication



3. Set Instrument Gauge System Tester to 45 ohms. Key ON. Wait one minute. The engine coolant temperature gauge pointer should be in the one quarter range to mid range. Key OFF.

Check H (Hot) Indication



4. Set Instrument Gauge System Tester to 18 ohms. Key ON. Wait one minute. The engine coolant temperature gauge should indicate H (hot). Key OFF. Return to the Pinpoint Test.

Gauge Test — Oil Pressure Gauge/Oil Pressure Switch

With Instrument Gauge System Tester attached to the oil pressure switch connector and the ignition switch lock cylinder in the RUN position (engine not running), set Instrument Gauge System Tester to infinite resistance. The center line of the pointer should fall on or below the "L" mark.

Short the connector directly to engine ground. The centerline of the pointer should fall slightly above mid-scale.

- If the oil pressure gauge tests within calibration, install a new oil pressure switch.
- If the oil pressure gauge still tests out of calibration, install a new gauge.

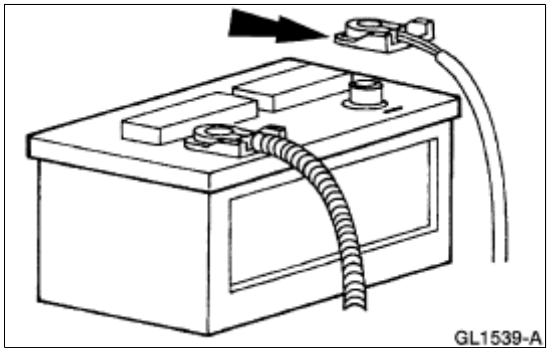
Gauge Test — Odometer Accuracy Test

To test the odometer accuracy, drive the vehicle over a measured distance of at least 16 consecutive kilometers (10 mile). Check measured distance against odometer measured distance. Acceptable odometer measured distance is 15.5-16.7 km (9.6-10.4 mile).

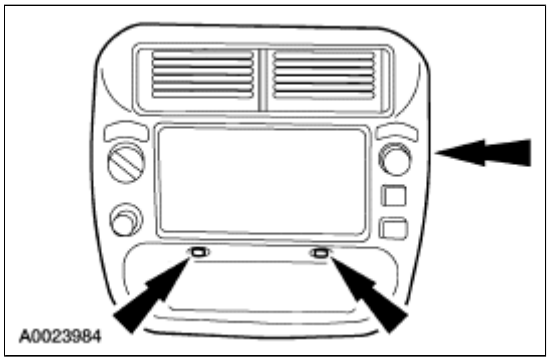
Instrument Cluster

Removal

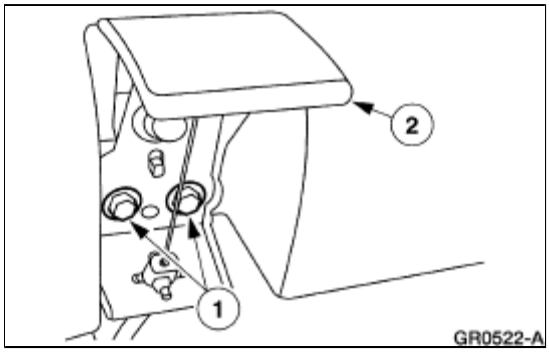
1. Disconnect the battery ground cable (14301).



2. Remove the screws and the center instrument panel finish panel.
    1. Disconnect the electrical connectors.

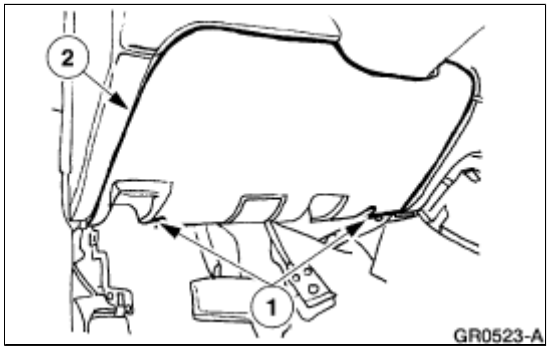


3. Remove the hood latch release handle.
    1. Remove the screws.
    2. Remove the hood latch release handle.

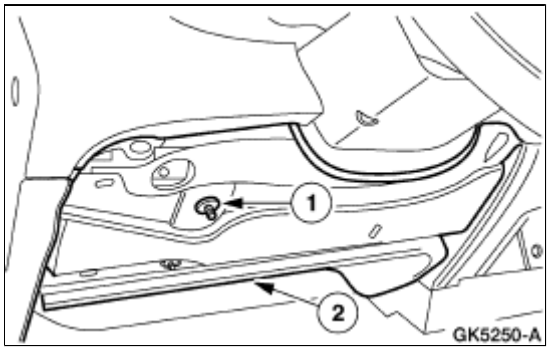


4. Remove the instrument panel steering column cover (044F08).
    1. Remove the screws.

2. Remove the instrument panel steering column cover.

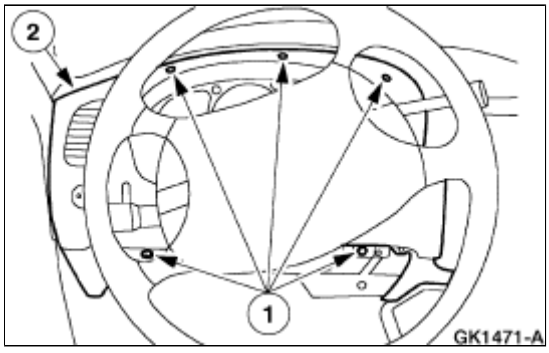


5. Remove the instrument panel steering column opening cover reinforcement (04502).
    1. Remove the four screws.
    2. Remove the instrument panel steering column opening cover reinforcement.

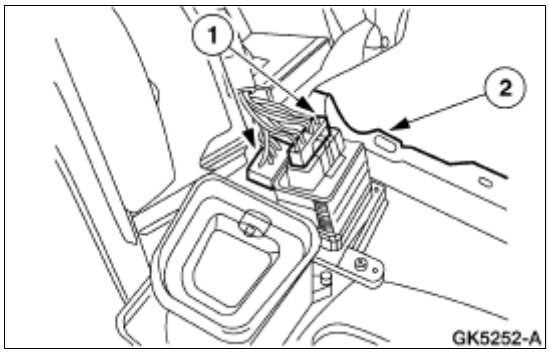


6. If equipped, position the column gearshift lever aside.

7. Pull out the cluster finish panel.
    1. Remove the screws.
    2. Pull out the cluster finish panel.

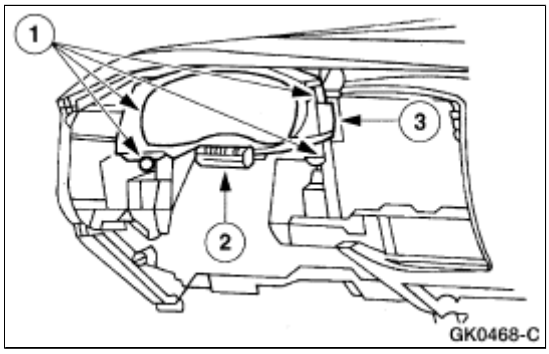


8. Remove the cluster finish panel.
    1. Disconnect the connectors.
    2. Remove the cluster finish panel.



9. **NOTE:** Illustration shows steering column removed for clarity.

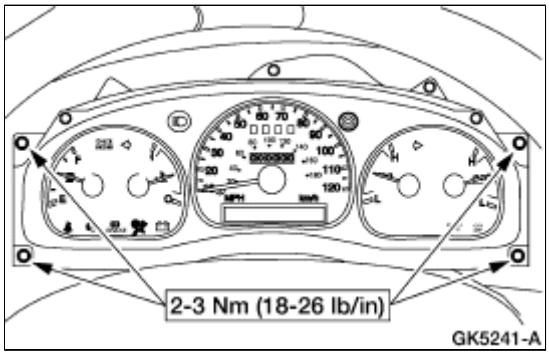
   Remove the instrument cluster.
   1. Remove the screws.
   2. If equipped with an automatic transmission, remove the transmission range indicator and pull the cluster forward to disconnect the three electrical connectors on the back.
   3. Remove the instrument cluster.

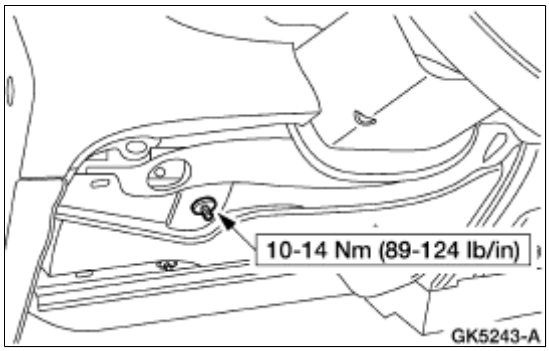


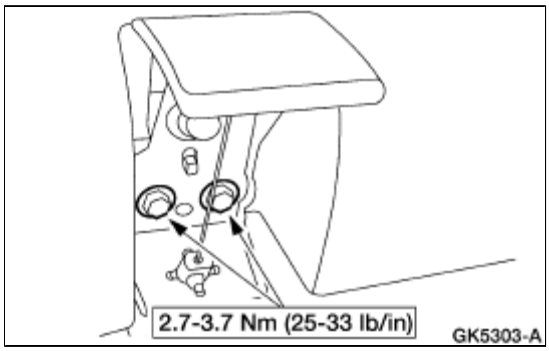
Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.




10-14 Nm (89-124 lb/in)
GK5243-A


2.7-3.7 Nm (25-33 lb/in)
GK5303-A

Instrument Cluster Printed Circuit

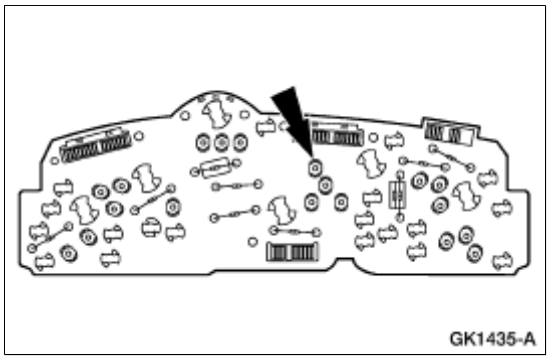
Removal

WARNING: ILLUMINATION BULBS ARE PRESSURIZED AND MAY SHATTER IF IMPROPERLY HANDLED. WEAR EYE PROTECTION WHEN REPLACING ILLUMINATION BULBS.

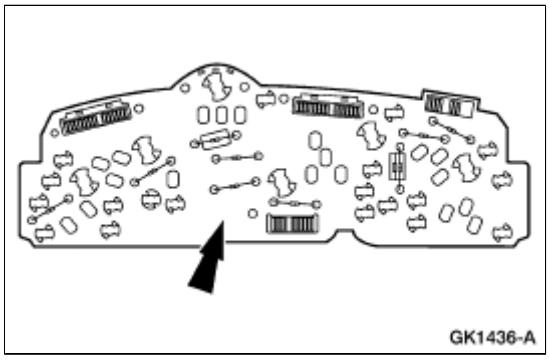
CAUTION: If gauges are being removed from the cluster assembly, do not remove the gauge pointers. Magnetic gauges cannot be recalibrated.

1. Remove the instrument cluster; refer to Instrument Cluster .
2. Remove the illumination and indicator bulbs; refer to Warning Indicator Bulb .
3. Remove the gauges; refer to Gauges .
4. **NOTE:** Do not reuse instrument gauge clips.

   Remove the nineteen instrument gauge clips.



5. Remove the instrument cluster printed circuit.



Installation

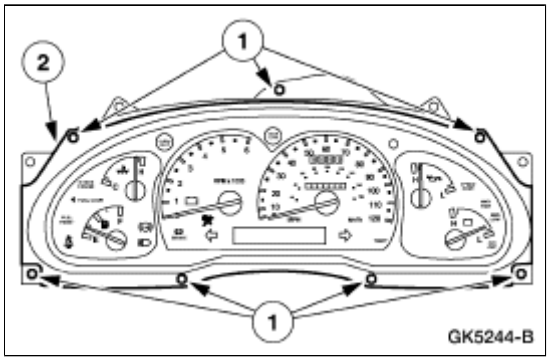
1. To install, reverse the removal procedure.

Cluster Lens

Removal

1. Remove the instrument cluster; refer to Instrument Cluster .

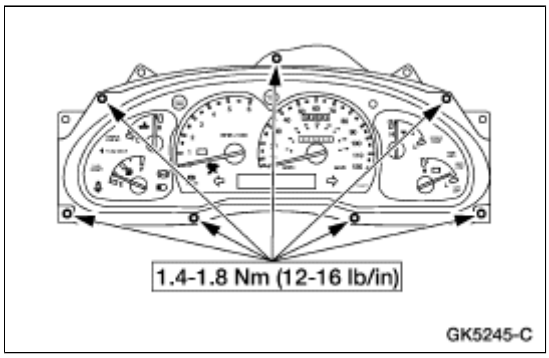
2. Remove the instrument cluster lens and mask assembly.
    1. Remove the screws.
    2. Remove the instrument cluster lens and mask assembly.

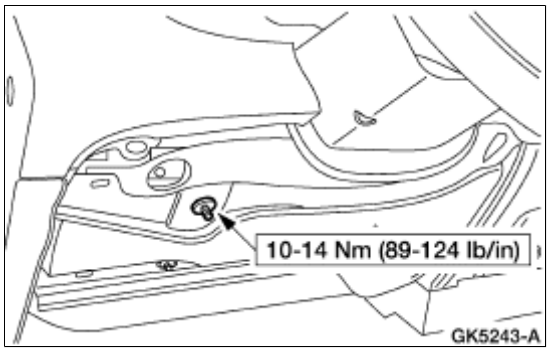


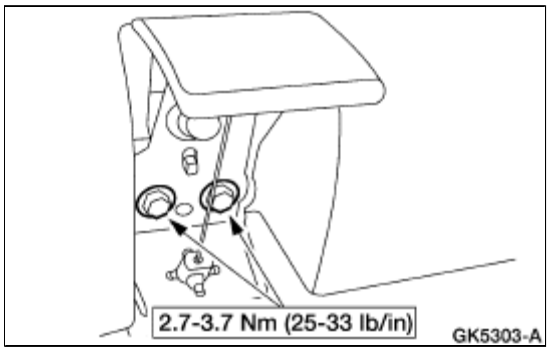
Installation

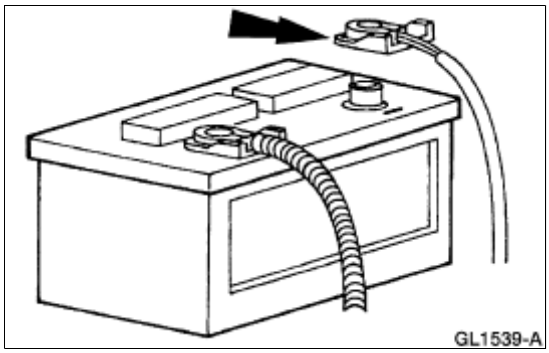
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

    To install, reverse the removal procedure.




10-14 Nm (89-124 lb/in)
GK5243-A


2.7-3.7 Nm (25-33 lb/in)
GK5303-A

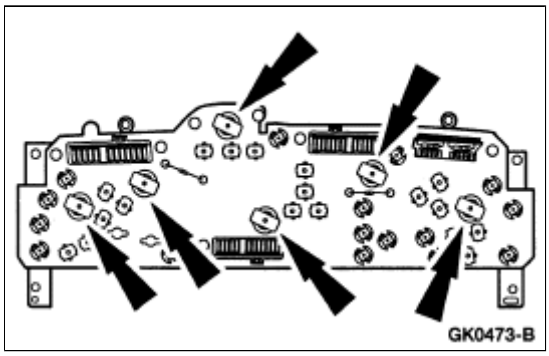

GL1539-A

Warning Indicator Bulb

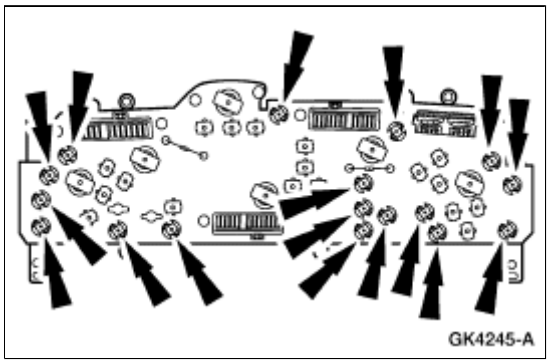
Removal

WARNING: Illumination bulbs are pressurized and may shatter if improperly handled. Wear eye protection when replacing illumination bulbs.

1. Remove the instrument cluster; refer to Instrument Cluster .
2. Remove the illumination sockets and bulbs.



3. Remove the indicator sockets and bulbs.



Installation

1. To install, reverse the removal procedure.

Gauges

Removal

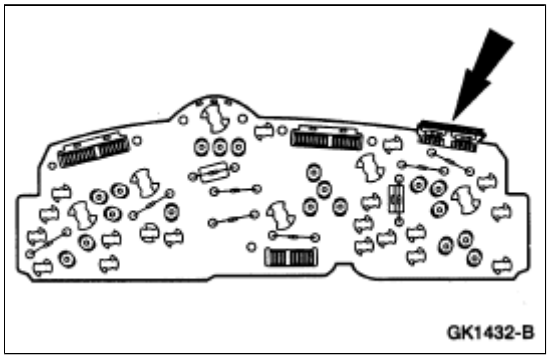
WARNING: Illumination bulbs are pressurized and may shatter if improperly handled. Wear eye protection when replacing illumination bulbs.

CAUTION: If gauges are being removed from the cluster assembly, do not remove the gauge pointers. Magnetic gauges cannot be recalibrated.

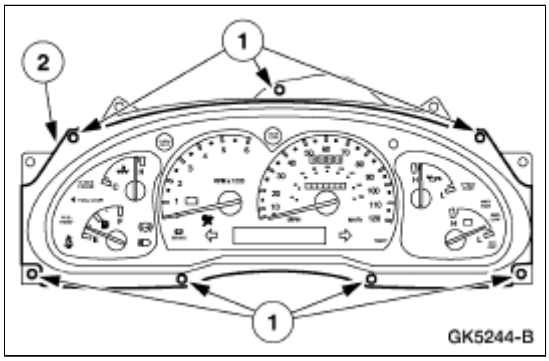
NOTE: Gauges are replaced as assemblies. They are not available individually.

NOTE: Do not reuse instrument gauge clips.

1. Remove the instrument cluster; refer to Instrument Cluster .
2. Remove the instrument cluster gauge amplifier (10E849).

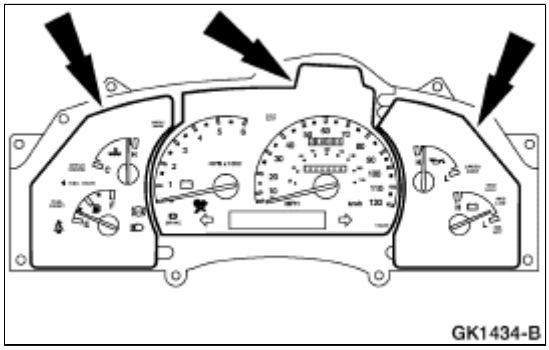


3. Remove the instrument cluster lens and mask assembly.
   1. Remove the screws.
   2. Remove the instrument cluster lens and mask assembly.



4. **NOTE:** The side gauge assemblies must be removed before removing the center assembly.

Gently remove the gauge assemblies.



Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Inner Fender Apron Bolts	10-14	8-10	—
Horn Bracket Mounting Bolt	8-12	—	71-106
Horn Switch Screws	6.5-7.5	—	58-66
Battery Ground Cable	7-10	—	62-89

Horn

Dual, electrically operated horns are mounted in the left front corner above the fender apron.

Horn Switch, Steering Wheel Mounted

The horn blow switches (13A875) are underneath the driver side air bag module (043B13) in the steering wheel (3600). The switches are powered through the air bag sliding contact (14A664) and ground through the steering column.

Horn

Refer to Wiring Diagrams Cell 44 , Horn/Cigar Lighter for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the horn.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged horns • Damaged horn blow switch	• Blown fuse • Damaged wiring harness • Loose or corroded connections

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

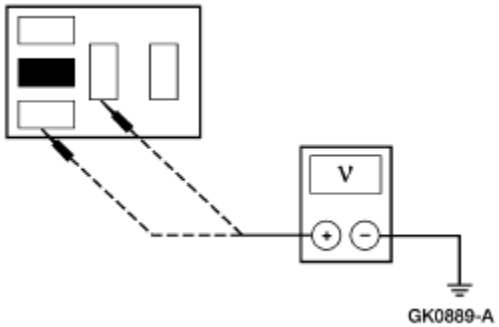
Symptom Chart

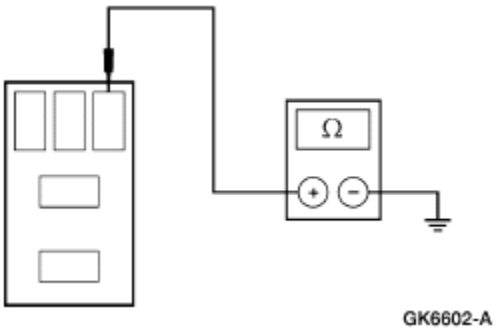
Symptom Chart

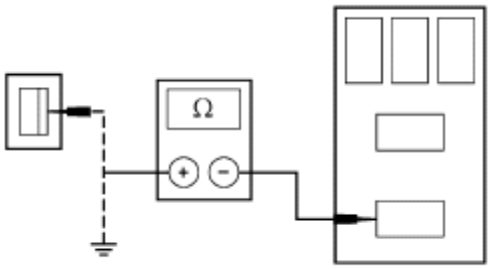
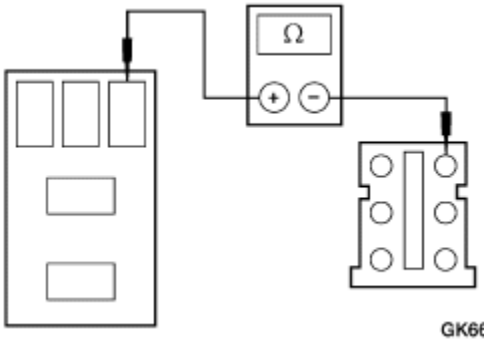
Condition	Possible Sources	Action
• The Horn Does Not Sound	• Fuse. • Circuitry. • Horn(s). • Horn relay. • Horn blow switch.	• GO to Pinpoint Test A .
• The Horn Sounds Continuously	• Circuitry. • Horn relay. • Horn(s). • Horn blow switch.	• GO to Pinpoint Test B .

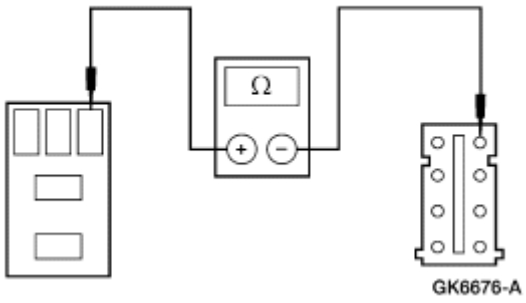
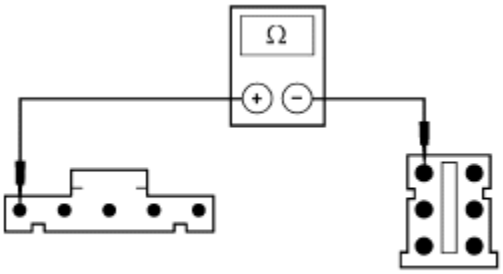
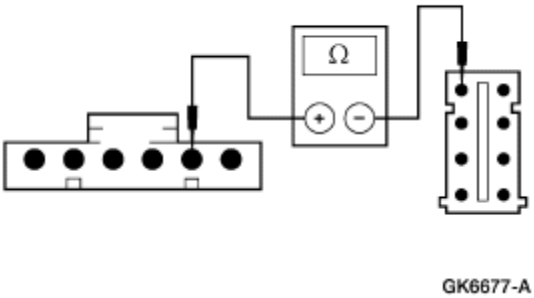
Pinpoint Tests

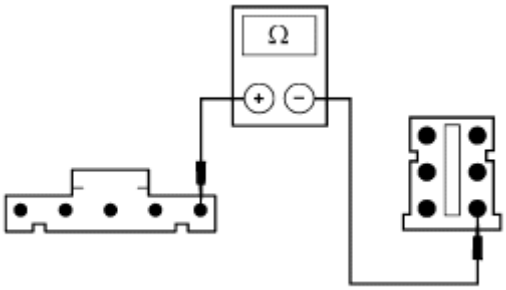
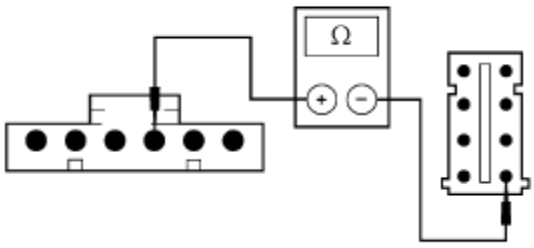
PINPOINT TEST A: THE HORN DOES NOT SOUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK POWER DISTRIBUTION BOX MINI-FUSE 10 (15A)	
1 2 Power Distribution Box Mini-Fuse 10 (15A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to A2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary.
A2 CHECK POWER SUPPLY TO HORN RELAY	
1 Horn Relay 2  GK0889-A	2 Measure the voltage between the horn relay connector pin 2, circuit 460 (Y/LB), and ground; and between the horn relay connector pin 5, circuit 460 (Y/LB), and ground. • **Are the voltages greater than 10 volts?**

	→ **Yes** GO to A3 . → **No** REPAIR circuit 460 (Y/LB). TEST the system for normal operation.
A3 CHECK HORN RELAY	
	1 Perform the Horn Relay Component Test; refer to Component Test. • **Is the horn relay OK?** → **Yes** GO to A4 . → **No** REPLACE the horn relay. TEST the system for normal operation.
A4 CHECK THE HORN BLOW SWITCH SIGNAL TO HORN RELAY	
1  GK6602-A	1 Measure the resistance between the horn relay connector pin 1, circuit 6 (Y/LG), and ground under the following conditions: **Horn Blow Switch Position** — **Resistance** Pressed — Less Than 5 Ohms Released — Greater Than 10,000 Ohms • **Are the resistances correct?** → **Yes** GO to A5 . → **No** GO to A6 .
A5 CHECK WIRE BETWEEN HORN RELAY AND HORN	
1 2 Horn(s)	

3  GK5839-A	3 Measure the resistance between the horn relay connector pin 3, circuit 1 (DB), and horn connector(s); and between the horn relay connector pin 3, circuit 1 (DB), and ground. • **Is the resistance less than 5 ohms between the horn relay connector and horn; and greater than 10,000 ohms between the horn relay connector and ground?** → **Yes** REPLACE the horn(s). TEST the system for normal operation. → **No** REPAIR circuit 1 (DB). TEST the system for normal operation.
A6 CHECK WIRE BETWEEN HORN RELAY AND AIR BAG SLIDING CONTACT	
2 3 Air Bag Sliding Contact C220 4  GK6603-A 5	1 Deactivate the air bag system; refer to Section 501-20B . 4 Measure the resistance between air bag sliding contact C220-2, circuit 6 (Y/LG), and horn relay connector pin 1, circuit 6 (Y/LG) (without steering wheel audio controls). 5 Measure the resistance between air bag

	sliding contact C220-2, circuit 6 (Y/LG), and horn relay connector pin 1, circuit 6 (Y/LG) (with steering wheel audio controls). • **Is the resistance less than 5 ohms?** → **Yes** GO to A7 . → **No** REPAIR circuit 6 (Y/LG). TEST the system for normal operation.
A7 CHECK AIR BAG SLIDING CONTACT	
1 	1 Disconnect the steering wheel switch harness from the air bag sliding contact.
2 	2 Measure the resistance between upper air bag sliding contact connector pin 1, circuit 6 (Y/LG) (component side), and lower air bag sliding contact connector pin2, circuit 6 (Y/LG) (component side) (without steering wheel audio controls).
3 	3 Measure the resistance between upper air bag sliding contact connector pin 5, circuit 6 (Y/LG) (component side), and lower air bag sliding contact connector pin 2, circuit 6 (Y/LG) (component side) (with steering wheel audio controls).
4	4 Measure the resistance between upper air bag sliding contact connector pin 5, circuit 570 (BK/W) (component side) (without steering wheel audio controls), and air bag

 GK6605-A 5  GK6678-A	sliding contact connector pin 5, circuit 570 (BK/W). 5 Measure the resistance between upper air bag sliding contact connector pin 4, circuit 570 (BK/W) (component side) (with steering wheel audio controls), and air bag sliding contact connector pin 7, circuit 570 (BK/W) (component side) (with steering wheel audio controls). • **Are the resistances less than 5 ohms?** → **Yes** GO to A8 . → **No** REPLACE the air bag sliding contact (14A664). TEST the system for normal operation.
A8 CHECK THE STEERING WHEEL SWITCH HARNESS	
	1 Inspect the steering wheel switch harness for chaffing, opens or possible short to ground. • **Is the steering wheel switch harness OK?** → **Yes** REPLACE the air bag. REFER to Section 501-20B . TEST the system for normal operation. → **No** REPLACE the steering wheel switch harness. TEST the system for normal operation.

PINPOINT TEST B: THE HORN SOUNDS CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK HORN CIRCUIT	

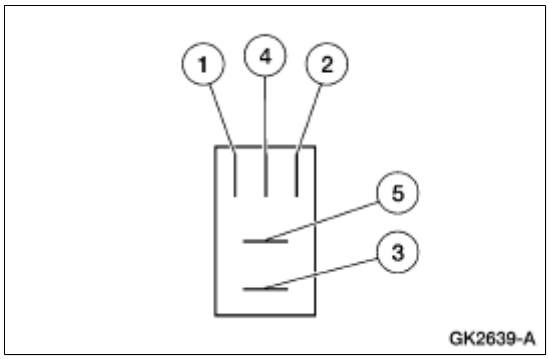
1 2 Horn Relay	• **Does the horn continue to sound?** → **Yes** REPAIR circuit 1 (DB). TEST the system for normal operation. → **No** GO to B2 .
B2 CHECK HORN RELAY	
	1 Perform the Horn Relay Component Test; refer to Component Test. • **Is the horn relay OK?** → **Yes** REINSTALL the horn relay. GO to B3 . → **No** REPLACE the horn relay. TEST the system for normal operation.
B3 CHECK CIRCUIT 6 (Y/LG)	
1 2 Air Bag Sliding Contact C220	• **Does the horn continue to sound?** → **Yes** GO to B4 . → **No** RECONNECT the air bag sliding contact. GO to B5 .
B4 CHECK REMOTE ANTI-THEFT PERSONALITY (RAP) MODULE INPUT	

1 RAP Module C409	• **Does the horn continue to sound?** → **Yes** REPAIR circuit 6 (Y/LG). TEST the system for normal operation. → **No** REPLACE the RAP module. REFER to Section 419-10 .
B5 CHECK THE AIR BAG SLIDING CONTACT	
2 	1 Deactivate the air bag system; refer to Section 501-20B . 2 Disconnect the steering wheel switch harness from the air bag sliding contact. • **Does the horn continue to sound?** → **Yes** REPLACE the air bag sliding contact. TEST the system for normal operation. → **No** GO to B6 .
B6 CHECK THE STEERING WHEEL SWITCH HARNESS	
	1 Inspect the steering wheel switch harness for chaffing, opens or possible short to ground. • **Is steering wheel switch harness OK?** → **Yes** REPLACE the air bag. REFER to Section 501-20B . TEST the system for normal operation. → **No** REPLACE the steering wheel switch harness. TEST the system for normal operation.

Component Test

Horn Relay

Horn Relay Terminal Location

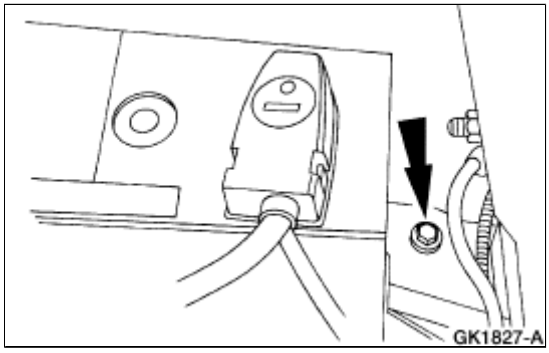


1. Use 73 Digital Multimeter to check for continuity between terminal 2 and all other terminals. If resistance is 5 ohms or less between terminal 2 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue the test. Use two jumper wires to connect relay terminal 1 and terminal 3 directly to the positive battery terminal. Set 73 Digital Multimeter in the volts position and check for voltage at terminal 4. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect a third jumper wire to terminal 2 and ground the jumper wire to a known good ground. Check for voltage at terminal 5. If battery voltage is not indicated, replace the relay.

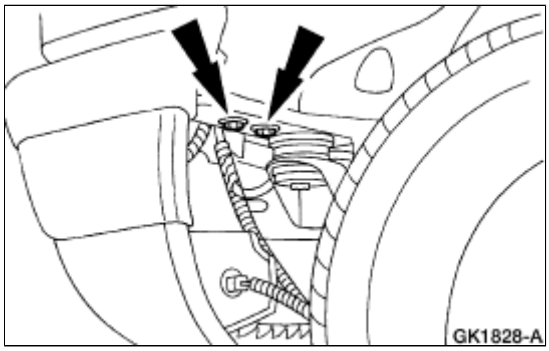
Horn

Removal

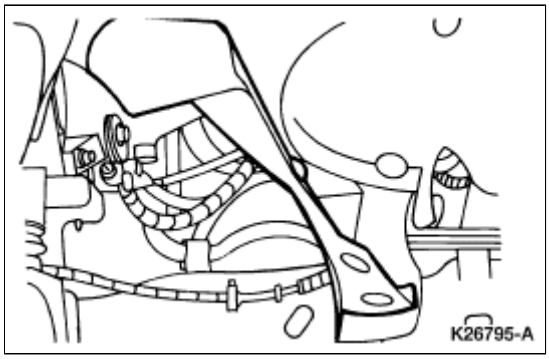
1. Raise and support the hood.
2. Remove the horn bracket bolt.



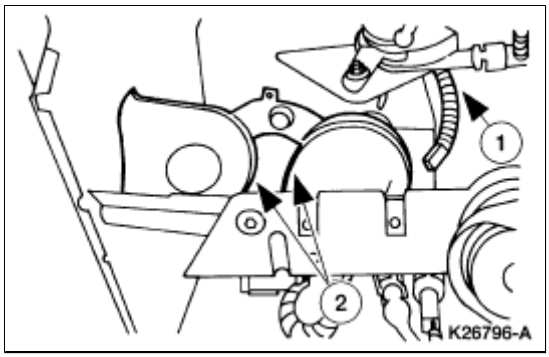
3. Remove the fender apron bolts.



4. Position the fender apron aside.

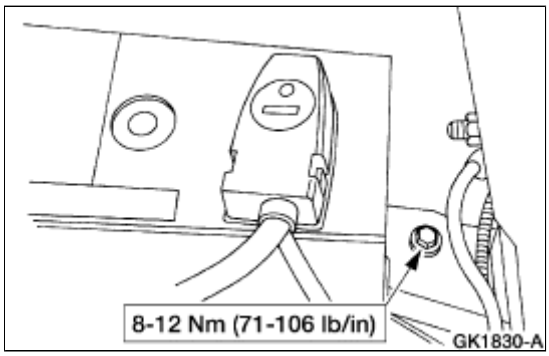


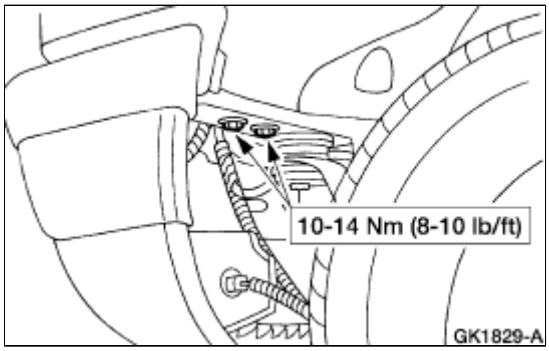
5. Remove the horn.
    1. Disconnect the electrical connector.
    2. Remove the horn.



Installation

1. To install, reverse the removal procedure.



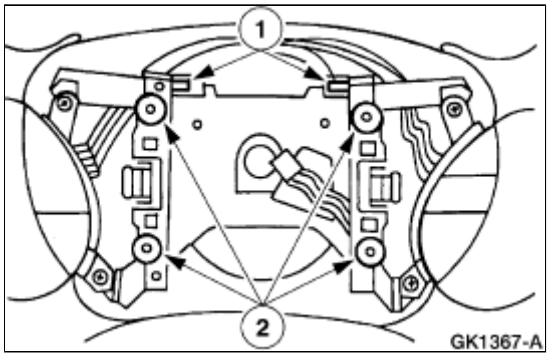


Switch

Removal

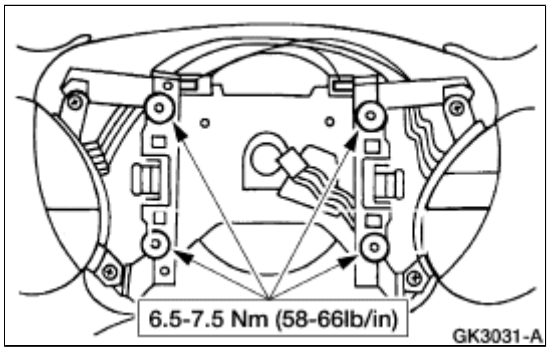
1. Remove the driver side air bag; refer to Section 501-20B .

2. Remove the switches.
    1. Disconnect the horn wire (BK) from the switches.
    2. Remove the attaching bolts from the switches and remove the switches.



Installation

1. To install, reverse the removal procedure.
    - Prove out the air bag system; refer to Section 501-20B .



Information and Message Center

The message center system consists of:

- message center switch module (10D996)
- message center indicator (10D898)

Message Center Switch Module

The message center switch module has seven switches and is located below the message center indicator in the center console.

The message center switches are:

- ENGLISH/METRIC mode
- fuel computer (FUEL)
  - RANGE
  - STATUS
  - economy (ECON)
- RESET
- system check and warnings (SYSTEM CHECK)
- OIL CHANGE RESET

Information and Message Center

Refer to Wiring Diagrams Cell 69 , Message Center for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter 105-R0051 or equivalent

Principles of Operation

Display Dimming

The dimming of the indicator display is controlled by the pulse width dimmer module. The voltage on Pin 2 controls the brightness of the message center display. When the exterior lamps are off, this voltage will be zero volts and the message center display will be at maximum brightness. When the exterior lamps are on, this voltage will be controlled by the pulse width dimmer module and will be between 2.5 volts and battery voltage. The message center display will be brighter as this voltage approaches battery voltage. If there is a warning on the message center display, the display will not dim to its lowest level.

When the headlamps (13008) or parking lamps are OFF, the display of the message center indicator will be maximum brightness and the labels for the center five switches of the message center switch module will not be illuminated.

When the headlamps or parking lamps are ON, the brightness of the display of the message center indicator and the labels for the center five switches of the message center switch module will be controlled by the pulse width dimmer module.

For additional information, refer to Section 413-00 .

English/Metric Mode

The ENGLISH/METRIC switch controls the display mode for both the message center indicator and the electronic automatic temperature control. A press of the ENGLISH/METRIC switch will change both displays between english mode and metric mode.

Vehicle Speed Signal

The vehicle speed signal is generated by the rear anti-lock brake sensor and sent to the 4-wheel anti-lock brake system (4WABS) module. The 4WABS module sends the vehicle speed signal via circuit 679 (GY/BK) to all systems which require a vehicle speed signal input.

Fuel Computer — Range

The RANGE feature has two displays: the distance that can be traveled before refueling, and the distance that was traveled since the last trip odometer reset. The RANGE switch will change the message center indicator between the two displays.

The RANGE (distance to empty) feature is calculated using the fuel flow signal from the powertrain control module (PCM) (12A650), the speed signal from the 4WABS module and the fuel level signal from the fuel level sender.

The fuel flow and speed signals are used to calculate a running average fuel economy (RAFE), which is multiplied by the fuel remaining to give the range.

RAFE is not the same number as the Average Fuel Economy displayed by the message center indicator.

RAFE is based on the past driving history and can only be reset by disconnecting the battery.

When the range decreases to 80 km (50 mile) to empty, the message center will display the LOW FUEL LEVEL warning.

With a fuel tank (9002) full of fuel (160 ohm signal from fuel sender) and after a battery disconnect, the RANGE should be approximately 644 km (400 miles) to empty.

The RANGE (trip odometer) feature is calculated using the speed signal from the 4WABS module. It can be reset to zero by pressing the reset switch while the trip odometer is displayed on the message center.

Fuel Computer — Status

The STATUS feature has two displays: Fuel-to-Empty and Fuel-Used. The STATUS switch will change the message center indicator between the two displays.

The fuel-to-empty calculation is achieved using the fuel level signal from the fuel level sender.

The fuel-used feature is calculated using the fuel flow signal from the PCM and can be reset to zero by pressing the RESET switch while the fuel-used feature is displayed on the message center.

Fuel Computer — Economy

The economy (ECON) feature has two displays: average and instant.

Depressing the ECON switch changes the message center indicator between both displays.

The economy is calculated using the fuel flow signal from the powertrain control module and the speed signal from the 4WABS module.

The average fuel economy feature can be reset by pressing the RESET switch while the average fuel economy feature is displayed on the message center indicator.

System Check and Warnings

The SYSTEM CHECK feature cycles the message center indicator through a status of each system being monitored.

- For each of the monitored systems, the message center indicator will indicate either an OK message or a warning message for two seconds.
- At normal conclusion of the system check sequence, the message center indicator will display all

active warnings or the last feature displayed before entering the SYSTEM CHECK mode.

- System warnings alert the driver to possible concerns or malfunctions in the vehicle operating systems.
- There are 7 warning messages which can be displayed for two seconds by the message center indicator to show the status of the monitored systems.
- When a warning occurs, the warning message is displayed and a one-second tone sounds. The warning message will appear at a brighter level if the message center indicator is dimmed.
- In the event of a multiple warning situation, the message center indicator will cycle the display to show all warnings by displaying each warning message for four seconds.
- To display the operator selectable features of the message center indicator while a warning is displayed, the warning message may be removed from the message center indicator display by pressing the RESET switch. The message center indicator will display the last selected feature if there are no more warning messages.
- This allows operation of all functions of the message center indicator after pressing the RESET switch and clearing the warning message.

Warning messages which have been reset will either reappear on the display in 10 minutes from the reset or will not reappear until an ignition switch OFF-RUN cycle.

If warning messages reappear it is a reminder that these warning conditions still exist. Warnings may be repeatedly reset. All warning messages will reappear after an entire SYSTEM CHECK sequence has been completed.

Charging System Warning (CHECK CHARGING SYSTEM)

This warning message is displayed when the electrical system is not maintaining correct voltage at the message center indicator. There will be a few seconds delay before the warning is displayed or removed.

Engine Coolant Temperature Warning (CHECK ENGINE TEMP)

This warning message is displayed when the engine coolant is overheating.

The message center indicator senses the voltage level on Circuit 39 (RD/WH) (C2008-8 to the message center indicator).

If that voltage is greater than approximately 2.7 volts, at a battery voltage of 13.5 volts there will be no warning. If it is less than approximately 2.7 volts, at a battery voltage of 13.5 volts then the warning will be displayed.

The message center indicator filters this input; therefore, there will be a few seconds delay before the warning is displayed or removed.

Fuel Level Warning (LOW FUEL LEVEL)

This warning message is displayed when there is approximately 80 km (50 mile) or less left before the vehicle runs out of fuel.

Oil Level Warning (LOW OIL LEVEL)

This warning message is displayed when the engine oil level is low.

When the engine oil level is normal, the input to the message center indicator will be an open circuit.

When the engine oil level is low, the low oil level sensor (6C624) will close, grounding the input to the

message center indicator and the warning will be displayed during the next ignition cycle of OFF to RUN. This low oil level sensor is only monitored when the ignition switch (11572) is OFF.

There is a delay of up to 12 minutes in this monitoring in order to allow the oil to drain back into the oil pan (6675) and reach the correct level.

Oil Life Warning (CHANGE OIL SOON or OIL CHANGE REQUIRED)

If the connection to the oil temperature sensor is open circuit or shorted, the message center display will read OIL TEMP SIGNAL ERROR instead of displaying the PERCENTAGE OIL LIFE LEFT during system check sequence.

One of these warning messages is displayed when the engine oil life remaining is five percent or less.

- When oil life left is between five percent and zero percent, the "CHANGE OIL SOON" message will be displayed.
- When oil life left reaches zero percent, the "OIL CHANGE REQUIRED" message will be displayed.

The message center indicator will indicate the percent of oil life remaining during System Check. This percentage is based on the driving history and the time since the last oil change. In order to ensure accurate oil life left indications, the driver should only carry out the OIL CHANGE RESET procedure, as described in the Owner's Guide, after an oil change.

To calculate the percentage of oil life remaining, the oil life feature uses:

- oil temperature sensor input
- tachometer input from the PCM
- vehicle speed signal input
- clock time (maintained internally by the message center)

- The oil life will decrease from 100 percent to 0 percent in no more than 12,070 km (7,500 mile) or 6 months. It will reach zero percent sooner under different driving conditions.
- The percentage of oil life remaining is the second display in the system check sequence.
- When oil life remaining is between five percent and zero percent, the "CHANGE OIL SOON" message will be displayed.
- When oil life left reaches zero percent, the "OIL CHANGE REQUIRED" message will be displayed.

Washer Fluid Level Warning (LOW WASHER FLUID)

This warning message is displayed when there is less than one quarter of the container of washer fluid remaining.

- When the washer fluid level is normal, the windshield washer reservoir fluid level sensor (17B649) will close, grounding the input Circuit 82 (PK/YE) at C2009-31 of the message center indicator.
- When the washer fluid level is low, the input to the message center indicator will be open and the warning will be displayed.

The message center indicator filters this input — therefore, there will be a 20-second delay before the warning is displayed or removed.

Warning Chime

A short warning chime (0.1 second) is output with every message center switch press. A longer warning

chime (1.0 second) is output when a new warning first appears on the message center indicator display.

To activate the warning, the message center pulls the chime request output below one volt during the length of the tone.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Damaged message center indicator
• Damaged message center switch module
• Low engine coolant level
• Low engine oil level
• Low windshield washer fluid level
	• Blown central junction box (CJB) fuse(s):
	  • Fuse 10 (7.5A)
	  • Fuse 36 (7.5A)
	• Damaged wiring harness
	• Loose or corroded connector(s)
	• Circuitry open/shorted

3. If inspection reveals obvious concerns that can be readily identified, repair as required.

4. Carry out the Message Center On-Board Diagnostic Test as follows:
   - Press RANGE and SYSTEM CHECK simultaneously while turning the ignition switch from the OFF position to the RUN position.
   - The following chart describes each test.

Message Center On-Board Diagnostic Test

Test	Description
ROM Level	Displays the Read Only Memory (ROM) level of the message center. This is used when requesting assistance from the hotline.
NVM Level	Displays the Non-Volatile Memory (NVM) level of the message center. This is used when requesting assistance from the hotline.
NVM Check	Displays the Non-Volatile Memory (NVM) for accuracy. If the message is NVM OK, proceed to the next step. If the message is REPLACE M/C, remove the message center switch module and install a new message center.
Display Check	Displays the same character in all 24 character positions. The initial character is all dots ON. Presses of the ENGLISH/METRIC switch sequence the display character through the entire character set. INSTALL a new message center indicator if the characters are not displayed correctly.
Tach Check	Determines if a tach signal is being received by the message center. If the message is TACH SIGNAL OK, the tach signal is being retrieved. If the message is TACH SIGNAL ERROR, no tach signal is being received. The engine must be running to receive a tach signal. GO to pinpoint test F, to check signal circuit. INSTALL a new message center indicator if concern is not in circuit or powertrain control module.
A/D (Analog-to-Digital	Displays the status of each of the analog inputs to the message center. Pressing the ENGLISH/METRIC switch sequences the A/D test forward, and the FUEL STATUS switch

Channel)	sequences the test backwards. See the A/D table for the analog voltage inputs associated with each test. This is used when requesting assistance from the hotline.
Digital Port	Displays the status of each of the digital inputs to the message center. Presses of the ENGLISH/METRIC switch sequence the digital port tests forward. See the digital port tables for the digital inputs associated with each test. This is used when requesting assistance from the hotline.

A/D Table

Test #	Analog Input Voltage Tested	Message Center Pin
A/D 0	Battery	27
A/D 1	Run	10
A/D 2	Fuel Level	3
A/D 3	Oil Temperature	9
A/D 4	Rheostat (Dimming)	2
A/D 5	Coolant Temperature	8
A/D 6	Switch Bank #2	1
A/D 7	Switch Bank #1	7

Digital Port Table (Port A)

Port A	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit Function	Internal Use Only	Internal Use Only	Internal Use Only	Fuel Tank Select	Internal Use Only	Internal Use Only	Washer Fluid Level	Engine Select
Bit = 0	N/A	N/A	N/A	20.8 gal Fuel Tank Selected	N/A	N/A	Low Washer Fluid	V6 Engine Selected
Message Center Pin	N/A	N/A	N/A	Pin 21 = 5V	N/A	N/A	Pin 31 = 5V	Pin 32 = 5V
Bit = 1	N/A	N/A	N/A	18.4 gal Fuel Tank Selected	N/A	N/A	Washer Fluid OK	V8 Engine Selected
Message Center Pin	N/A	N/A	N/A	Pin 21 = 0V	N/A	N/A	Pin 31 = 0V	Pin 32 = 0V

Digital Port Table (Port B)

Port B	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit Function	Oil Level Input	Spare	Spare	Internal Use Only	Spare	Internal Use Only	Internal Use Only	Internal Use Only
Bit = 0	Oil Level	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	OK							
Message Center Pin	Pin 23 = 5V	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bit = 1	Low Oil Level	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Message Center Pin	Pin 23 = 0V	N/A	N/A	N/A	N/A	N/A	N/A	N/A

- Press the RANGE switch to advance the message center indicator to the next test.
- To abort the on-board diagnostic mode and return to normal operation, turn the ignition switch to the OFF position.

5. If the concern(s) remain(s) after the inspection, determine the symptom(s) and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action

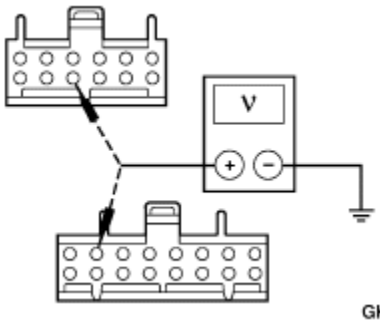
• The Message Center Is Not Operating Correctly	• CJB fuse(s):
	  ▪ Fuse 10 (7.5A)
	  ▪ Fuse 36 (7.5A)
	• Circuitry.
	• Message center indicator.
		• GO to Pinpoint Test A .

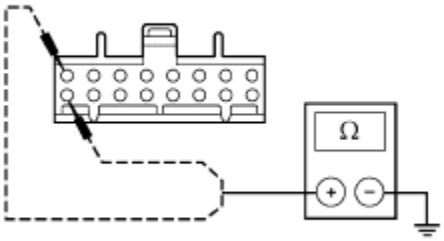
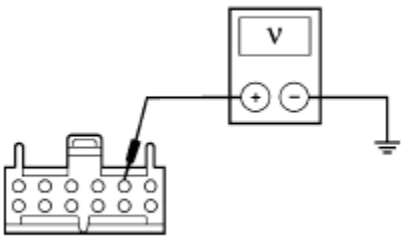
• The Message Center Switch Is Not Operating Correctly	• Circuitry. • Message center switch module. • Message center indicator.	• GO to Pinpoint Test B .
• The Fuel Computer Range Is Incorrect	• Circuitry. • Message center indicator. • Fuel level sender. • Powertrain control module (PCM).	• GO to Pinpoint Test C .
• The Charging System Warning Is Incorrect	• Circuitry. • Message center indicator.	• GO to Pinpoint Test D .
• The Engine Coolant Temperature Warning Is Not Operating Correctly	• Circuitry. • Message center indicator. • Water temperature sender unit.	• GO to Pinpoint Test E .
• The Oil Life Warning Is Incorrect — Oil Temp Signal Error	• Circuitry. • Message center indicator. • Low oil level sensor. • PCM.	• GO to Pinpoint Test F .

• The Oil Level Warning Is Not Operating Correctly	• Circuitry. • Message center indicator. • Low oil level sensor.	• GO to Pinpoint Test G .
• The Washer Fluid Level Warning Is Not Operating Correctly	• Circuitry. • Message center indicator. • Windshield washer reservoir fluid level sensor.	• GO to Pinpoint Test H .
• The Audible Warning Is Inoperative	• Circuitry. • Message center indicator. • CTM/GEM.	• REFER to Section 413-09 .

Pinpoint Tests

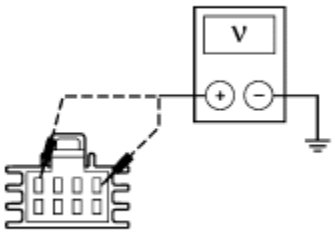
PINPOINT TEST A: THE MESSAGE CENTER IS NOT OPERATING CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK POWER FEED CIRCUITS 1003 (GY/YE) AND 54 (LG/YE)	
1 Message Center Indicator 2 3  	3 Measure the voltage between message center indicator C2008 Pin 10, Circuit 1003 (GY/YE), harness side and ground; and between message center indicator C2009 Pin 27, Circuit 54 (LG/YE), harness side and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to A2 .

	→ **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A2 CHECK GROUND CIRCUITS 570 (BK/WH) AND 57 (BK)	
1 2  GK3244-A	2 Measure the resistance between message center indicator C2009 Pin 28, Circuit 570 (BK/WH), harness side and ground; and between message center indicator C2009 Pin 36, Circuit 57 (BK), harness side and ground. • **Are the resistances less than 5 ohms?** → **Yes** GO to A3 . → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A3 CHECK CIRCUIT 19 (LB/RD)	
3  GK3245-A	1 Place the headlamp switch (11654) in the PARK position. 2 Rotate the panel dimmer switch to the full illumination position. 3 Measure the voltage between message center indicator C2008 Pin 2, Circuit 19 (LB/RD), and ground. • **Is the voltage greater than 10 volts?**

	→ **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

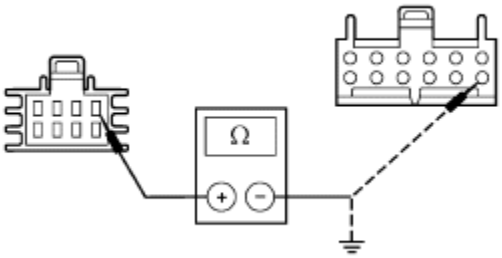
PINPOINT TEST B: THE MESSAGE CENTER SWITCH IS NOT OPERATING CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE VOLTAGE INPUTS TO THE MESSAGE CENTER SWITCH	
1 2 Message Center Switch Module C2007 3 4  GK4251-A	4 Measure the voltage between message center switch module C2007 Pin 1, Circuit 704 (DG/LG), harness side and ground; and between message center switch module C2007 Pin 4, Circuit 715 (LG), harness side and ground. • **Are the voltages approximately 5 volts?** → **Yes** GO to B4 . → **No** GO to B2 .
B2 CHECK CIRCUIT 704 (DG/LG) FOR AN OPEN OR SHORT	
1	

2

Message Center Indicator C2008

3



GK3248-A

3 Measure the resistance between message center switch module C2007 Pin 1, Circuit 704 (DG/LG), harness side and message center indicator C2008 Pin 7, Circuit 704 (DG/LG), harness side; and between the message center switch module C2007 Pin 1, Circuit 704 (DG/LG), harness side and ground.

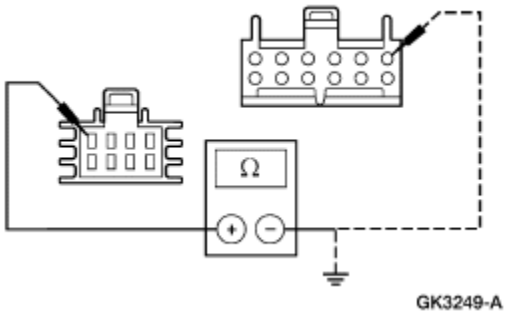
- **Is the resistance less than 5 ohms between message center switch module and message center indicator, and greater than 10,000 ohms between the message center switch module and ground?**

→ **Yes**
GO to B3 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

B3 CHECK CIRCUIT 715 (LG) FOR AN OPEN OR SHORT

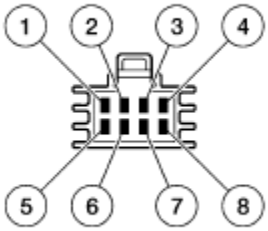
1

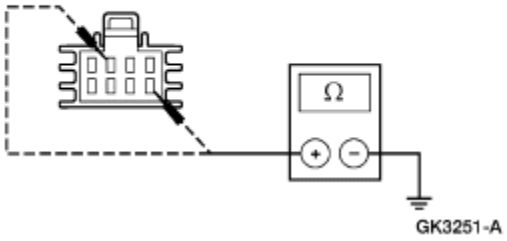


GK3249-A

1 Measure the resistance between message center switch module C2007 Pin 4, Circuit 715 (LG), harness side and message center indicator C2008 Pin 1, Circuit 715 (LG), harness side; and between the message center switch module C2007 Pin 4, Circuit 715 (LG), harness side and ground.

- **Is the resistance less than 5 ohms between message center switch module and message center indicator, and greater than 10,000 ohms between the**

	message center switch module and ground? → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
B4 CHECK THE MESSAGE CENTER SWITCH	
1 2  GK3250-A	2 Measure the resistance between the following switch terminals: **Switch Depressed** / **Switch Bank 1 Resistance Between Terminals 1 and 3** / **Switch Bank 2 Resistance Between Terminals 3 and 4** — / between 4374 and 5376 ohms / between 3645 and 4455 ohms ENGLISH METRIC / between 1313 and 1606 ohms / between 3645 and 4455 ohms RANGE / between 4374 and 5376 ohms / between 270 and 330 ohms STATUS / between 4374 and 5376 ohms / between 567 and 693 ohms ECON / between 4374 and 5376 ohms / between 1026 and 1254 ohms RESET / between 4374 and 5376 ohms / between 1845 and 2255 ohms SYSTEM CHECK / between 486 and 594 ohms / between 3645 and 4455 ohms OIL CHANGE RESET / between 810 and 990 ohms / between 3645 and 4455 ohms • **Are all resistance values within**

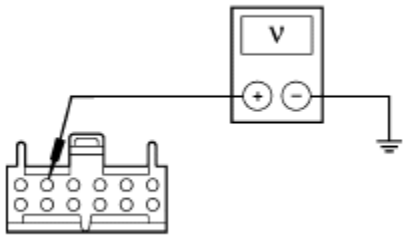
	specification? → **Yes** GO to B5 . → **No** INSTALL a new message center switch module. REFER to Switch . TEST the system for normal operation.
B5 CHECK CIRCUITS 57 (BK) AND 570 (BK/WH)	
1  	1 Measure the resistance between message center switch module C2007 Pin 5, Circuit 57 (BK), harness side and ground; and between the message center switch module C2007 Pin 3, Circuit 570 (BK/WH), harness side and ground. • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

PINPOINT TEST C: THE FUEL COMPUTER RANGE IS INCORRECT

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE POWERTRAIN CONTROL MODULE (PCM) OUTPUT	
CAUTION: Use correct probe adapter(s) when making measurements. Failure to use correct probe adapter(s) may damage the connector.	
1 2 	

Message Center Indicator

3



GK3252-A

3 Measure the voltage between message center indicator C2008 Pin 5, Circuit 305 (LB/PK), harness side and ground while starting the engine.

- **Is the voltage greater than 10 volts when the engine is being started and drops to about 2 volts at idle?**

→ **Yes**
GO to C3.

→ **No**
GO to C2.

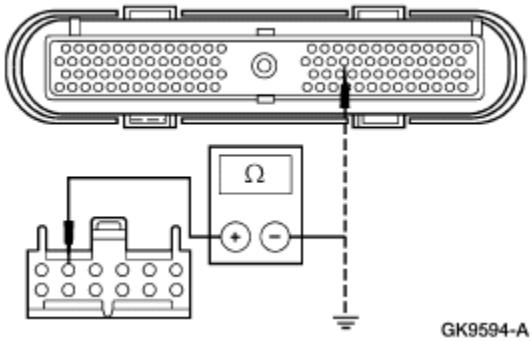
C2 CHECK CIRCUIT 305 (LB/PK)

1

2

PCM C202

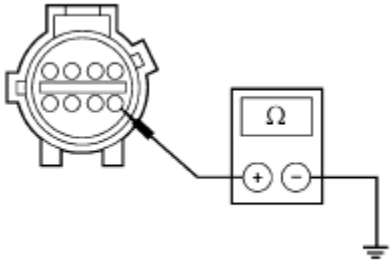
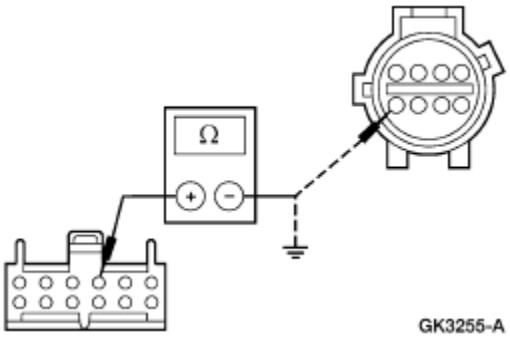
3

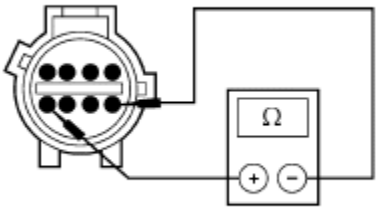
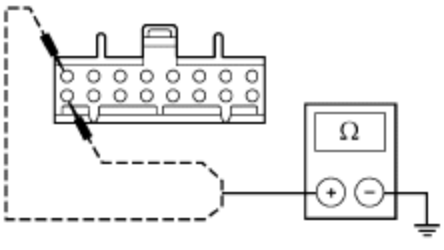


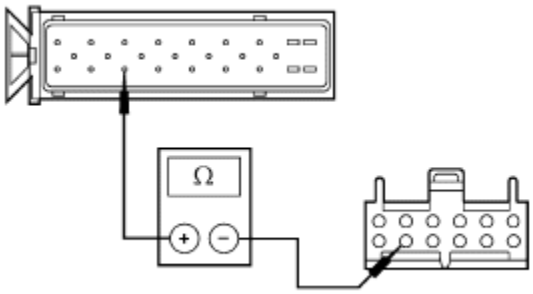
GK9594-A

3 Measure the resistance between message center indicator C2008 Pin 5, Circuit 305 (LB/PK), harness side and PCM C202 Pin 43, Circuit 305 (LB/PK), harness side; and between message center indicator C2008 Pin 5, Circuit 305 (LB/PK), harness side and ground.

- **Is the resistance less than 5 ohms between the message center indicator and the PCM; and greater than 10,000 ohms between the message center indicator and ground?**

	→ **Yes** INSTALL a new PCM. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
C3 CHECK CIRCUIT 651 (BK/YE) FOR AN OPEN	
1 2 Fuel Level Sensor and Pump C311 3  GK3254-A	3 Measure the resistance between the fuel level sensor and pump C311 Pin 5, Circuit 651 (BK/YE), harness side and ground. • **Is the resistance less than 5 ohms ?** → **Yes** GO to C4 . → **No** REPAIR the circuit. TEST the system for normal operation.
C4 CHECK CIRCUIT 29 (YE/WH)	
1  GK3255-A	1 Measure the resistance between message center indicator C2008 Pin 3, Circuit 29 (YE/WH), harness side and fuel level sensor and pump C311 Pin 8, Circuit 29 (YE/WH), harness side; and between message center indicator C2008 Pin 3, Circuit 29 (YE/WH), harness side and ground.

	• **Is the resistance less than 5 ohms between message center indicator and fuel level sensor and pump; and greater than 10,000 ohms between message center indicator and ground?** → **Yes** GO to C5 . → **No** REPAIR the circuit. TEST the system for normal operation.
C5 CHECK THE FUEL LEVEL SENDER	
1  GK3256-A	1 Measure the resistance between fuel level sensor and pump Pin 5 (component side) and Pin 8 (component side). • **Is the resistance between 15 and 160 ohms?** → **Yes** GO to C6 . → **No** INSTALL a new fuel level sender. TEST the system for normal operation.
C6 CHECK GROUND CIRCUITS 570 (BK/WH) AND 57 (BK)	
1  GK3244-A	1 Measure the resistance between message center indicator C2009 Pin 28, Circuit 570 (BK/WH), harness side and ground; and between message center indicator C2009 Pin 36, Circuit 57 (BK), harness side and ground. • **Are the resistances less than 5 ohms?**

	→ **Yes** GO to C7 . → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
C7 CHECK CIRCUIT 679 (GY/BK)	
1 4WABS Module C186 2  GK9595-A	2 Measure the resistance between message center indicator C2008 Pin 11, Circuit 679 (GY/BK), harness side and 4WABS module C186 Pin 19, Circuit 679 (GY/BK), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

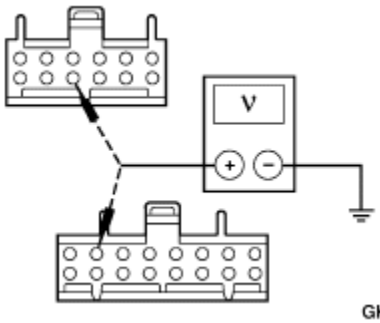
PINPOINT TEST D: THE CHARGING SYSTEM WARNING IS INCORRECT

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK FOR VOLTAGE TO THE MESSAGE CENTER	
1 2 	

Message Center Indicator

3

4



4 Measure the voltage between message center indicator C2008 Pin 10, Circuit 1003 (GY/YE), harness side and ground; and between message center indicator C2009 Pin 27, Circuit 54 (LG/YE), harness side and ground.

- **Are the voltages greater than 10 volts?**

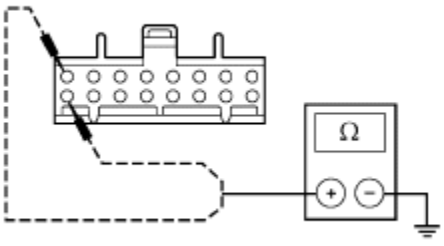
→ **Yes**
GO to D2 .

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

D2 CHECK GROUND CIRCUIT 570 (BK/WH) AND CIRCUIT 57 (BK)

1

2



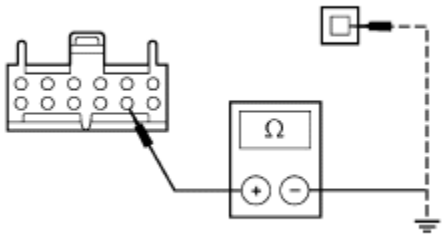
2 Measure the resistance between message center indicator C2009 Pin 28, Circuit 570 (BK/WH), harness side and ground; and between message center indicator C2009 Pin 36, Circuit 57 (BK), harness side and ground.

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation.

	→ **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

PINPOINT TEST E: THE ENGINE COOLANT TEMPERATURE WARNING IS NOT OPERATING CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK CIRCUIT 39 (RD/WH)	
1 2 Message Center Indicator C2008 3 Water Temperature Sender Unit C104 4  GK3263-A	4 Measure the resistance between message center indicator C2008 Pin 8, Circuit 39 (RD/WH), harness side and water temperature sender unit C104 Pin 1, Circuit 39 (RD/WH), harness side; and between message center indicator C2008 Pin 8, Circuit 39 (RD/WH), harness side and ground. • **Is the resistance less than 5 ohms between the message center indicator and water temperature sender unit; and greater than 10,000 ohms between the message center indicator and ground?** → **Yes** RECONNECT the message center indicator. GO to E2 . → **No** REPAIR the circuit. TEST the system for normal operation.

E2 CHECK THE MESSAGE CENTER INDICATOR

1 	2 Check the message center indicator for the engine coolant temperature warning error. • **Does the error exist?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** GO to E3 .

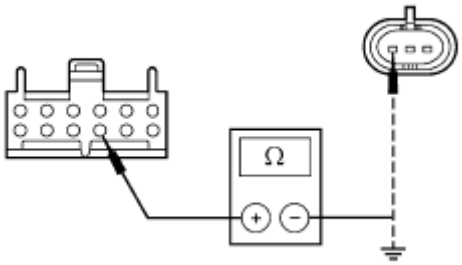
E3 CHECK THE MESSAGE CENTER INDICATOR FOR ERROR

1 2 GK3264-A 3 	2 Short to ground Circuit 39 (RD/WH) through a 9.7 ohm resistor between engine coolant temperature sender C104 Pin 1, harness side, and ground. 4 Check the message center indicator for the engine coolant temperature warning error. • **Does the error exist?** → **Yes** INSTALL a new water temperature sender unit. TEST the system for normal operation. → **No** INSTALL a new message center indicator.

	TEST the system for normal operation.

PINPOINT TEST F: THE OIL LIFE WARNING IS INCORRECT — OIL TEMP SIGNAL ERROR

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 VERIFY THE LOW OIL LEVEL SENSOR CONNECTOR IS SECURELY SEATED	
CAUTION: Use correct probe adapter(s) when making measurements. Failure to use correct probe adapter(s) may damage the connector.	
	1 Verify low oil level sensor C174 is securely seated. • **Is low oil level sensor C174 securely seated?** → **Yes** GO to F2 . → **No** REPAIR as necessary. TEST the system for normal operation.
F2 CHECK CIRCUIT 254 (DG/WH)	
1 2 Low Oil Level Sensor C174 3 Message Center Indicator C2008 4	4 Measure the resistance between message center indicator C2008 Pin 9, Circuit 254 (DG/WH), harness side and low oil level sensor C174 Pin 1, Circuit 254 (DG/WH), harness side; and between message center indicator C2008 Pin 9, Circuit 254 (DG/WH), harness side and ground.



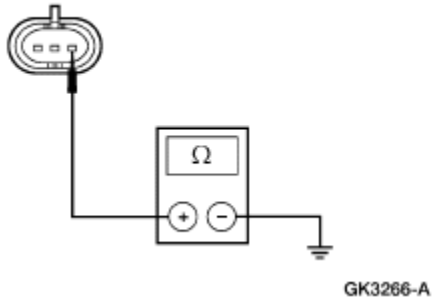
- **Is the resistance less than 5 ohms between message center indicator and low oil level sensor; and greater than 10,000 ohms between the message center indicator and ground?**

→ **Yes**
GO to F3 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

F3 CHECK GROUND CIRCUIT 570 (BK/WH)

1



1 Measure the resistance between low oil level sensor C174 Pin 3, Circuit 570 (BK/WH), harness side and ground.

- **Is the resistance less than 5 ohms?**

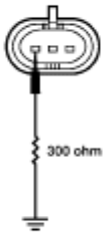
→ **Yes**
RECONNECT message center indicator C2008. GO to F4 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

F4 CHECK THE LOW OIL LEVEL SENSOR

1

1 Short to ground Circuit 254 (DG/WH) through a 300 ohm resistor between low oil level sensor C174 Pin 1, harness side, and ground.



GK3267-A

2

- **Does the message center indicator read OIL TEMP SIGNAL ERROR during system check?**

→ **Yes**
GO to F5 .

→ **No**
INSTALL a new low oil level sensor. TEST the system for normal operation.

F5 CHECK CIRCUIT 679 (GY/BK)

1

2

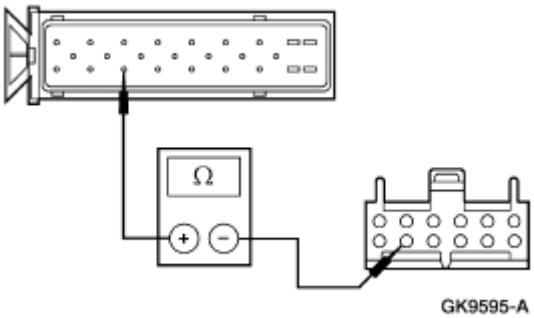
4WABS Module C186

3

Message Center Indicator C2008

4

4 Measure the resistance between message center indicator C2008 Pin 11 , Circuit 679 (GY/BK), harness side and 4WABS module C186 Pin 19, Circuit 679 (GY/BK), harness side.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F6 .

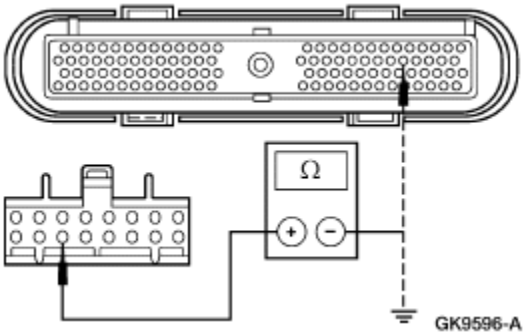
→ **No**
REPAIR the circuit. TEST the system for normal operation.

F6 CHECK CIRCUIT 11 (TN/YE)

1

PCM

2



2 Measure the resistance between message center indicator C2009 Pin 34, Circuit 11 (TN/YE), harness side and PCM C202 Pin 48, Circuit 11 (TN/YE), harness side; and between message center indicator C2009 Pin 34, Circuit 11 (TN/YE), harness side and ground.

- **Is the resistance less than 5 ohms between the message center indicator and the PCM; and greater than 10,000 ohms between the message center indicator and ground?**

→ **Yes**
GO to F7 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

F7 CHECK TACH SIGNAL

NOTE: Carry out the TACH CHECK procedure in on-board diagnostic mode with engine running.	
	1 Press RANGE and SYSTEM CHECK switches simultaneously while turning the ignition switch to RUN and starting the engine. 2 Press RANGE switch to advance the message center indicator until TACH CHECK is displayed. • **Is the TACH SIGNAL OK message displayed?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** INSTALL a new PCM. TEST the system for normal operation.

PINPOINT TEST G: THE OIL LEVEL WARNING IS NOT OPERATING CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 VERIFY THE LOW OIL LEVEL SENSOR CONNECTOR IS SECURELY SEATED	
	1 Verify low oil level sensor C174 is securely seated. • **Is low oil level sensor C174 securely seated?** → **Yes** GO to G2 . → **No** REPAIR as necessary. TEST the system for normal operation.
G2 CHECK THE ENGINE OIL LEVEL	
	1 Check the engine oil level. • **Is the engine oil level in correct range?** → **Yes** GO to G3 . → **No** REFILL as necessary. TEST the system for normal operation.

G3 CHECK CIRCUIT 258 (WH/PK)

1

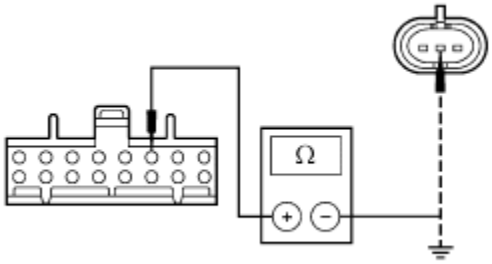
2

Low Oil Level Sensor C174

3

Message Center Indicator C2009

4



GK3271-A

4 Measure the resistance between message center indicator C2009 Pin 23, Circuit 258 (WH/PK), harness side and low oil level sensor C174 Pin 2, Circuit 258 (WH/PK), harness side; and between message center indicator C2009 Pin 23, Circuit 258 (WH/PK), harness side and ground.

- **Is the resistance less than 5 ohms between message center indicator and low oil level sensor; and greater than 10,000 ohms between message center indicator and ground?**

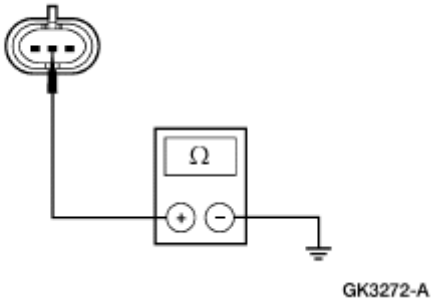
→ **Yes**
GO to G4 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

G4 CHECK THE LOW OIL LEVEL SENSOR

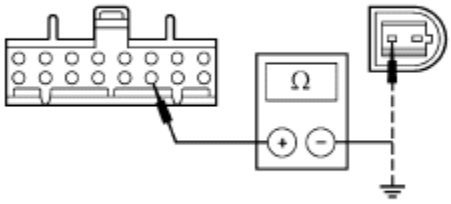
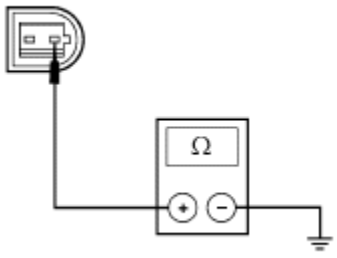
1

1 Measure the resistance between the low oil level sensor terminal 2 (component side) and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** INSTALL a new low oil level sensor. TEST the system for normal operation.

PINPOINT TEST H: THE WASHER FLUID LEVEL WARNING IS NOT OPERATING CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE WINDSHIELD WASHER RESERVOIR FLUID LEVEL	
	1 Check the windshield washer reservoir level. • **Is the windshield washer reservoir level in correct range?** → **Yes** GO to H2 . → **No** REFILL as necessary. TEST the system for normal operation.
H2 CHECK CIRCUIT 82 (PK/YE)	
1 2 	

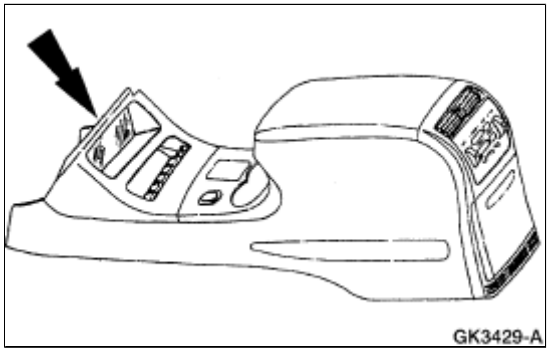
Message Center Indicator C2009 3 Windshield Washer Reservoir Fluid Level Sensor C197 4  GK3273-A	4 Measure the resistance between message center indicator C2009 Pin 31, Circuit 82 (PK/YE), harness side and windshield washer reservoir fluid level sensor C197 Pin 1, Circuit 82 (PK/YE), harness side; and between message center indicator C2009 Pin 31, Circuit 82 (PK/YE), harness side and ground. • **Is the resistance less than 5 ohms between message center indicator and windshield washer reservoir fluid level sensor; and greater than 10,000 ohms between message center indicator and ground?** → **Yes** GO to H3 . → **No** REPAIR the circuit. TEST the system for normal operation.
H3 CHECK CIRCUIT 57 (BK)	
1  GK3274-A	1 Measure the resistance between windshield washer reservoir fluid level sensor C197 Pin 2, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to H4 . → **No**

	REPAIR the circuit. TEST the system for normal operation.
H4 CHECK THE WINDSHIELD WASHER RESERVOIR FLUID LEVEL SENSOR	
1 GK3275-A	1 Measure the resistance between windshield washer reservoir fluid level sensor terminal 1 (component side) and terminal 2 (component side). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new message center indicator. REFER to Message Center Assembly . TEST the system for normal operation. → **No** INSTALL a new windshield washer reservoir fluid level sensor. TEST the system for normal operation.

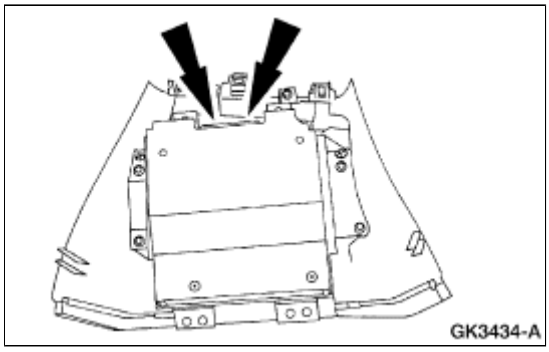
Message Center Assembly

Removal

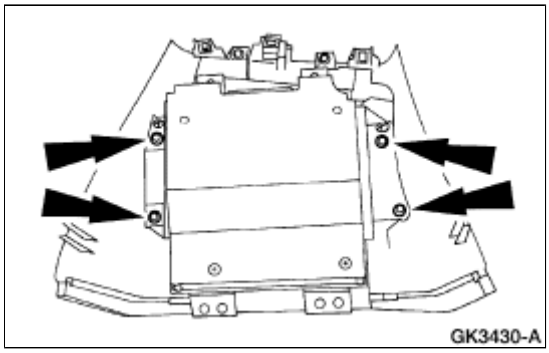
1. Remove the message center console.
    - Grasp the front of the console and lift upward.



2. Disconnect the electrical connectors from the message center indicator (10D898).



3. Remove the screws retaining the message center indicator.



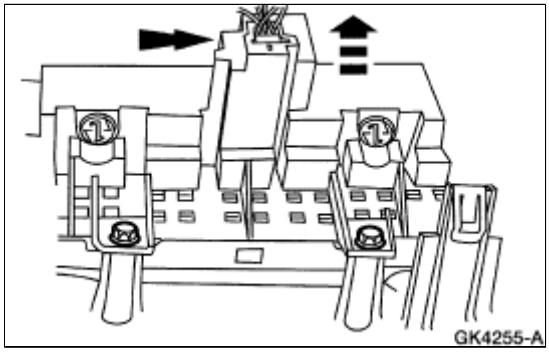
Installation

1. To install, reverse the removal procedure.

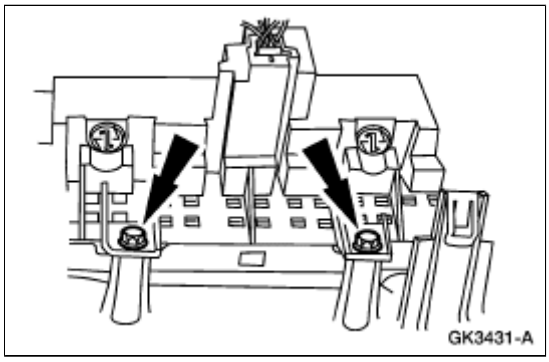
Switch

Removal

1. Remove the message center indicator (10D898). Refer to Message Center Assembly .
2. Disconnect the electrical connector.



3. Remove the message center switch module screws and remove the module.

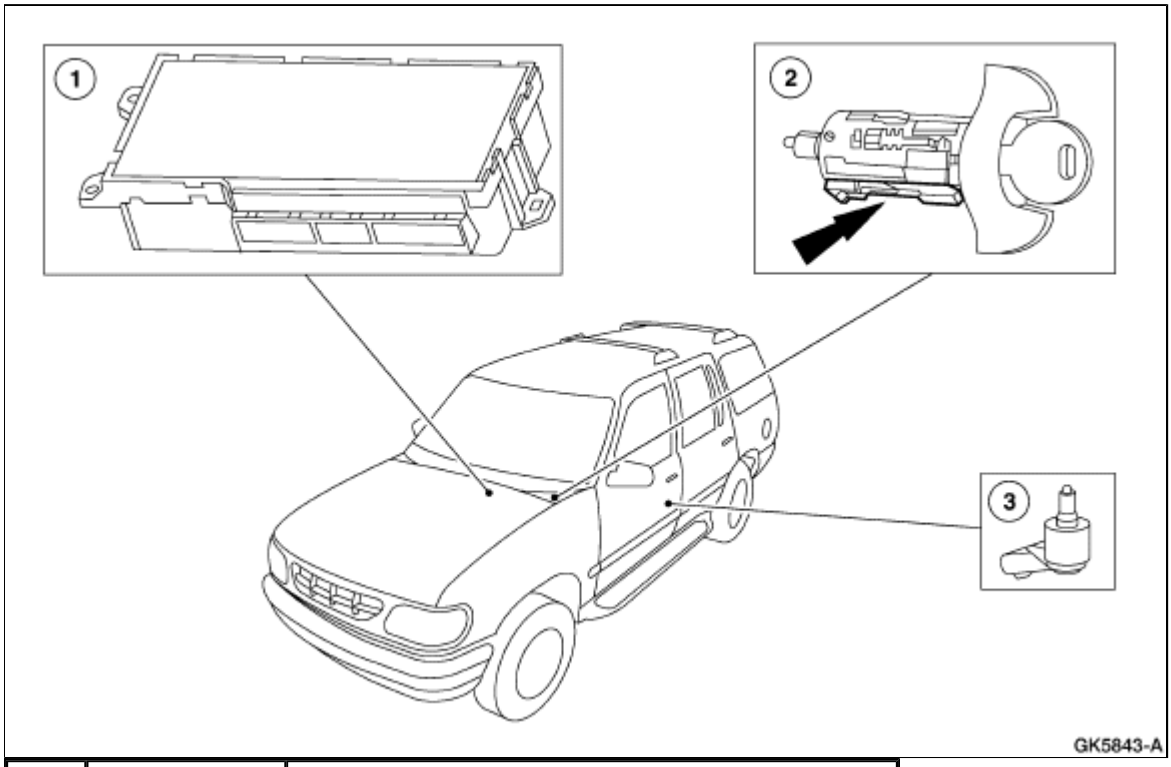


Installation

1. To install, reverse the removal procedure.

Warning Devices

Warning Devices



Item	Part Number	Description
1	—	Generic Electronic Module (GEM) (Optional)
2	—	Ignition Warning Switch
3	—	Door Open Warning Lamp Switch

NOTE: The generic electronic module/central timer module (GEM/CTM) is connected to the ISO link and is diagnosed through the data link connector (DLC) with a scan tool.

There are five warning chimes and lamps the GEM/CTM controls: headlamps operating without the ignition on (chime only), door ajar (chime and lamp), key-in-ignition (chime only), driver seat belt warning (chime and lamp), and message center.

Audible Warnings

Warning Condition	Lamp Duration	Audible Duration	Audible Output
Safety Belt	60 Seconds	6 Seconds	Chime, 60/Min. 740 Hz
Key In Ignition	—	Continuous	Chime, 120/Min. 740 Hz
Headlamps On	—	Continuous	Chime, 240/Min. 740 Hz

Door Ajar	Continuous	1 Second	Single Tone, 1000 Hz
Message Center (Tone Request)	—	1 Second	Single Tone, 1000 Hz

When the is turned to RUN or START from OFF or ACC, the chime will sound for six seconds or until the safety belt is buckled.

The will turn on for 60 seconds or until the driver safety belt is fastened. Both the chime and the lamp turn on at the same time.

If the safety belt is buckled before the ignition switch is turned to RUN or START, from OFF or ACC, neither the chime nor lamp will be activated.

Anytime the is changed to RUN from START while the safety belt warning indicator is activated, the safety belt warning indicator will remain activated until either the timing sequence has been executed or the safety belt is buckled.

When at least one door is ajar and the key is in the RUN position, the door ajar cluster lamp is activated and remains on until all doors are closed. A warning tone will sound once any time the key is in the ignition switch and any door is open.

The key-in-ignition warning will sound when the driver side is opened with the key in the and the in OFF or ACC. It will continue to sound until the key is removed, the is closed, or the is in RUN or START.

The headlamp-on reminder chime will be activated if the headlamps or parking lamps are on, the key is not in the ignition switch, and the driver door is opened.

A single tone will be provided each time a ground signal is received from the message center. A one-second tone will sound for warning indications from the message center. A 100 milli-second tone will sound for each message center button depressed.

Gauges and Warning Devices

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell 62 , Instrument Cluster for schematic and connector information.

Refer to Wiring Diagrams Cell 66 , Warning Chime for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter or equivalent 105-R0057
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Inspection and Verification

1. **NOTE:** The generic electronic module (GEM)/central timer module (CTM) must be reconfigured upon replacement. Refer to the scan tool help screen on the configuration card to program the tire size and axle ratio.

   The warning lamps are a GEM/CTM controlled system; refer to Section 419-10 .

2. Verify the customer concern by operating the system in question.

3. Visually inspect for the following obvious signs of mechanical and electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections • Circuitry • Bulb

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:

- check that the program card is properly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the scan tool still does not communicate with the vehicle, refer to the New Generation STAR Tester manual.

6. Perform the DATA LINK DIAGNOSTIC TEST. If scan tool Tester responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for GEM/CTM, go to Pinpoint Test E.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the GEM/CTM.

7. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar Driver Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door	GEM/CTM	REFER to Section 417-02 .

	Circuit Short to Ground		
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	GO to Pinpoint Test C .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	GO to Pinpoint Test D .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window Driver One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window Driver One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window Driver Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window Driver Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .

B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	GO to Pinpoint Test A .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delayed Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	GO to Pinpoint Test B .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit	GEM	REFER to Section 501-16 .

	Failure		
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size ratio. TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral InTow Indicator Circuit Short to Battery	GEM	GO to Pinpoint Test F .
P1764	Transmission Neutral InTow Indicator Circuit Fault	GEM	GO to Pinpoint Test F .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .

P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD LOW Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact	GEM	REFER to Section 308-07A .

	Plate General Circuit Failure		
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Driver Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, ON-B-, OFFO-G
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G

PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage LOW	GEM/CTM
B1322	Door Ajar Driver Circuit Short to Ground	GEM/CTM
B1330	Door Ajar Passenger Circuit Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM

B1410	Power Window LF Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Door Ajar Warning Indicator Does Not Operate Properly	• Door ajar warning indicator bulb. • Instrument cluster. • Circuitry. • GEM/CTM. • DTC B1322. • DTC B1323. • DTC B1325. • DTC B1330. • DTC B1334. • DTC B1338. • DTC B1342. • DTC B1574.	• REFER to Section 413-01 .
• The Safety Belt Warning Indicator Does Not Operate Properly	• Instrument cluster. • Safety belt warning indicator bulb. • Safety belt warning indicator switch. • Circuitry. • GEM/CTM. • DTC B1342. • DTC B1426. • DTC B1428. • DTC B1462.	• REFER to Section 413-01 .
• The Safety Belt Warning Chime Does Not Operate Properly	• Safety belt warning indicator switch (10B924). • Circuit(s). • GEM/CTM. • DTC B1342. • DTC B1462.	• GO to Pinpoint Test A .
• The Headlamp On Reminder Chime Does Not Operate Properly	• Headlamp switch (11654).	• GO to Pinpoint Test

	• Circuitry. • LF door open warning switch. • GEM/CTM. • DTC B1322. • DTC B1342. • DTC B1577.	B .
• A Chime Is Inoperative — I/P Chime Does Not Sound When Message Center Keys Are Activated	• Circuitry. • Message center indicator. • GEM. • DTC B1340. • DTC B1342.	• GO to Pinpoint Test C .
• The Key-In-Ignition Chime Does Not Operate Properly	• Key-in-ignition warning switch. • Circuitry. • GEM/CTM. • DTC B1342. • DTC B1352.	• GO to Pinpoint Test D .
• No Communication With the Module — Generic Electronic Module/Central Timer Module	• Circuitry. • Fuse(s). • GEM/CTM.	• GO to Pinpoint Test E .
• An Indicator Is Inoperative — The Neutral In Tow Indicator Is Inoperative	• Circuitry. • GEM. • DTC P1763. • DTC P1764. • Data link connector (DLC).	• GO to Pinpoint Test F .

Pinpoint Tests

CAUTION: Before removing and installing the GEM or its connectors, disconnect the battery. Failure to follow this caution will result in the GEM storing many erroneous DTCs, and it may exhibit erratic operation after installation.

CAUTION: Be careful when probing the fuse junction panel, power distribution box or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

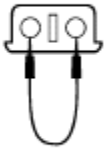
CAUTION: Electronic modules are sensitive to static discharges. If exposed to these charges, damage may result.

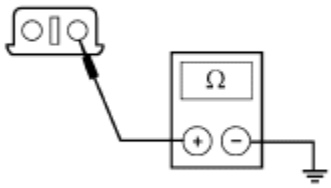
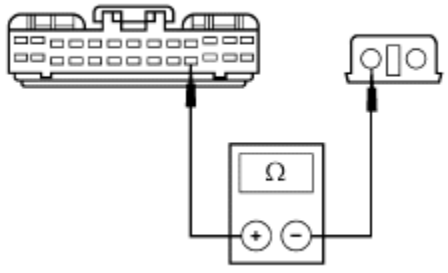
NOTE: If continuous DTCs are recorded and the symptom is not present when performing the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

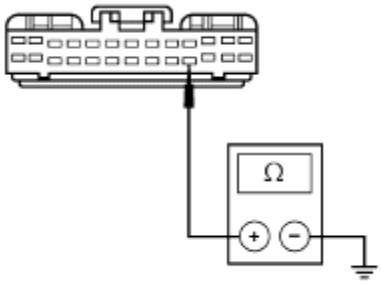
Complete the entire pinpoint test related to the symptom before replacing the GEM.

PINPOINT TEST A: THE SAFETY BELT WARNING CHIME DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3 	4 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch states?** → **Yes** GO to A2 . → **No** REFER to Section 417-02 .
A2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Clear Continuous DTCs 3 GEM/CTM On-Demand Self-Test	1 Retrieve and document continuous DTCs.

	• **Are any DTCs recorded?** → **Yes** If DTC B1462, GO to A3 . If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A3 .
A3 CHECK THE SAFETY BELT WARNING INDICATOR SWITCH — MONITOR THE GEM/CTM PID D_SBELT	
1 2 Safety Belt Warning Indicator Switch C324 3 4 5  GK3454-A	4 Monitor the GEM/CTM PID D_SBELT. 5 Connect, then remove a jumper wire between safety belt warning indicator switch C324, circuit 85 (BR/LB), and C324, circuit 57 (BK). • **Does the GEM/CTM PID D_SBELT indicate OUT when connected and IN when removed?** → **Yes** REPLACE the safety belt warning indicator

	switch. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to A4 .
A4 CHECK THE GROUND TO THE SAFETY BELT WARNING INDICATOR SWITCH FOR OPEN — CIRCUIT 57 (BK)	
1 2  GK3455-A	2 Measure the resistance between safety belt warning indicator switch C324, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to A5 . → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
A5 CHECK THE CIRCUIT BETWEEN GEM/CTM C280 AND SAFETY BELT WARNING INDICATOR SWITCH FOR OPEN — CIRCUIT 85 (BR/LB)	
1 GEM/CTM C280 2  GK6058-A	2 Measure the resistance between GEM/CTM C280-23, circuit 85 (BR/LB), and safety belt warning indicator switch C324, circuit 85 (BR/LB).

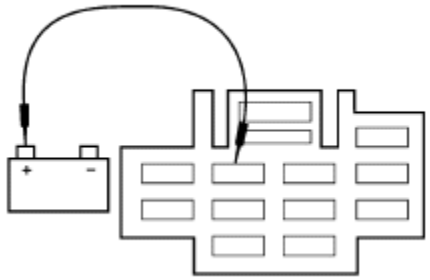
	• **Is the resistance less than 5 ohms?** → **Yes** GO to A6 . → **No** REPAIR circuit 85 (BR/LB). CLEAR the DTCs. TEST the system for normal operation.
A6 CHECK CIRCUIT 85 (BR/LB) FOR SHORT TO GROUND	
1  GK6059-A	1 Measure the resistance between GEM/CTM C280-23, circuit 85 (BR/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 85 (BR/LB). CLEAR the DTCs. TEST the system for normal operation.

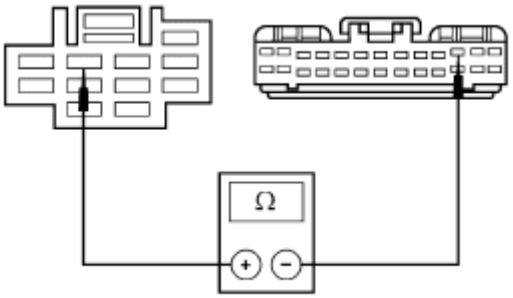
PINPOINT TEST B: THE HEADLAMP ON REMINDER CHIME DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3	3 **NOTE:** If the vehicle is equipped with a

	manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch states?** → **Yes** GO to B2 . → **No** REFER to Section 417-02 .
B2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM On-Demand Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1322, REFER to Section 417-02 , Pinpoint Test C . If DTC B1577, GO to B8 . If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B3 .
B3 VERIFY THE INTERIOR LAMPS OPERATE BY OPENING THE LF DOOR	
	1 Open the driver door. • **Do the interior lamps illuminate?**

	→ **Yes** GO to B4 . → **No** REFER to Section 417-02 .
B4 VERIFY THE PARK/TURN LAMPS OPERATE	
	1 Verify the park/turn lamps operate. • **Do the park/turn lamps operate?** → **Yes** GO to B5 . → **No** REFER to Section 417-01 .
B5 CHECK THE HEADLAMP SWITCH — MONITOR THE GEM/CTM PID PARK_SW	
1 	1 Monitor the GEM/CTM PID PARK_SW. 2 Place the headlamp switch in the PARK and ON positions. • **Does the GEM/CTM PID PARK_SW indicate ON when the headlamp switch is in the ON or PARK position and OFF when the headlamp switch is in the OFF position?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B6 .
B6 CHECK THE SIGNAL INPUT FROM CIRCUIT 1032 (W/BK) TO THE GEM/CTM — MONITOR THE GEM/CTM PID PARK_SW	
1 2 Headlamp Switch C216	

3 4 5  GK4319-A	4 Monitor the GEM/CTM PID PARK_SW. 5 Connect a jumper wire between headlamp switch C216-3, circuit 1032 (W/BK), and the positive battery terminal. • **Does the GEM/CTM PID PARK_SW indicate OFF?** → **Yes** GO to B7 . → **No** GO to B8 .
B7 CHECK CIRCUIT 1032 (W/BK) FOR OPEN	
1 2 GEM/CTM C280 3	3 Measure the resistance between GEM/CTM C280-11, circuit 1032 (W/BK), and headlamp switch C216-3, circuit 1032 (W/BK).



GK6060-A

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 1032 (W/BK). CLEAR the DTCs. TEST the system for normal operation.

B8 CHECK THE HEADLAMP SWITCH — MONITOR THE GEM/CTM PID PARK_SW

1

2

Headlamp Switch C216

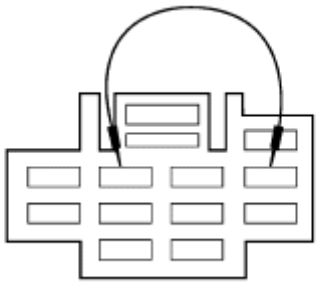
3

4

5

4 Monitor the GEM/CTM PID PARK_SW.

5 Connect a jumper wire between headlamp switch C216-5, circuit 195 (T/W), and C216-3, circuit 1032 (W/BK).



GK3460-A

- **Does the GEM/CTM PID PARK_SW indicate ON when the jumper wire is connected and OFF when the wire is removed?**

→ **Yes**
REPLACE the headlamp switch; REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to B9 .

B9 CHECK CIRCUIT 1032 (W/BK) FOR SHORT TO POWER

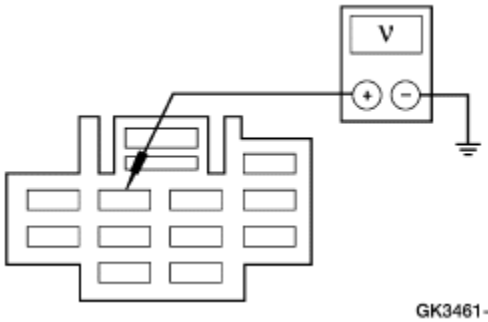
1

GEM/CTM C280

2

3 Measure the voltage between headlamp switch C216-3, circuit 1032 (W/BK), and ground.

3



GK3461-A

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 1032 (W/BK). CLEAR the

	DTCs. TEST the system for normal operation. → **No** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST C: A CHIME IS INOPERATIVE — I/P CHIME DOES NOT SOUND WHEN MESSAGE CENTER KEYS ARE ACTIVATED

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 GEM On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1340, GO to C2 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C2 .

C2 CHECK THE GEM PID IPCHIME TRIGGERING THE GEM ACTIVE COMMAND CHIME ON AND OFF

1

1 Monitor the GEM PID IPCHIME while triggering the active command CHIME, ON and OFF.

- **Does the GEM PID IPCHIME agree with the active command?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to C3 .

C3 CHECK THE GEM FOR CHIME OPERATION — GROUND MESSAGE CENTER C2009-25

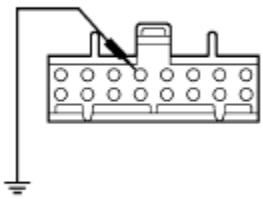
1

2

Message Center C2009

3

4

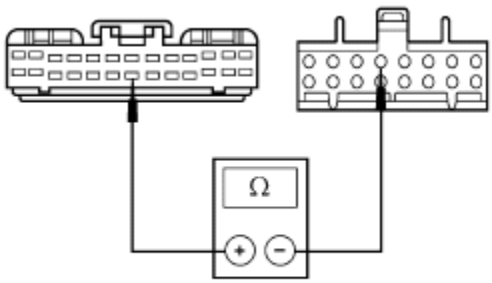
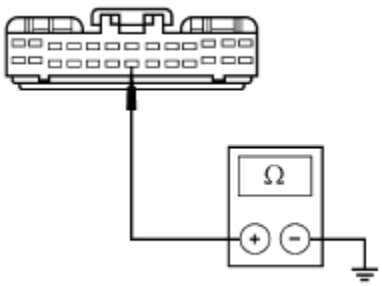


GK3282-A

4 Connect a jumper wire between message center C2009-25, circuit 183 (T/Y), and ground.

- **Does the chime operate?**

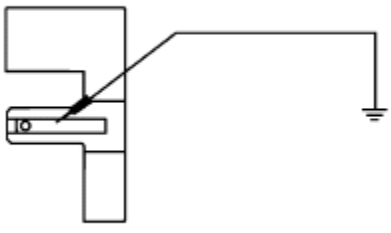
→ **Yes**
REPLACE the message center; REFER to Section 413-08 . CLEAR the DTCs. TEST the

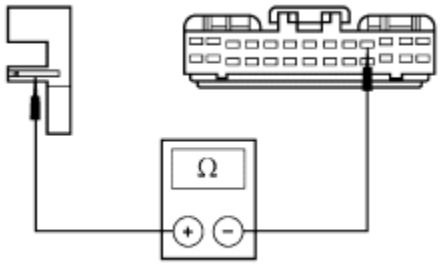
	system for normal operation. → **No** GO to C4 .
C4 CHECK CIRCUIT 183 (T/Y) FOR OPEN	
1 2 GEM C280 3  GK6069-A	3 Measure the resistance between GEM C280-20, circuit 183 (T/Y), and message center C2009-25, circuit 183 (T/Y). • **Is the resistance less than 5 ohms?** → **Yes** GO to C5 . → **No** REPAIR circuit 183 (T/Y). CLEAR the DTCs. TEST the system for normal operation.
C5 CHECK CIRCUIT 183 (T/Y) FOR SHORT TO GROUND	
1  GK6061-A	1 Measure the resistance between GEM C280-20, circuit 183 (T/Y), and ground. • **Is the resistance greater than 10,000 ohms?**

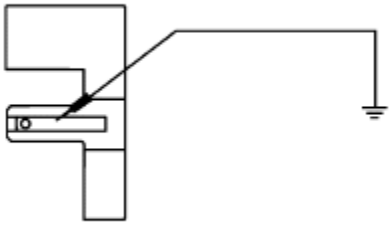
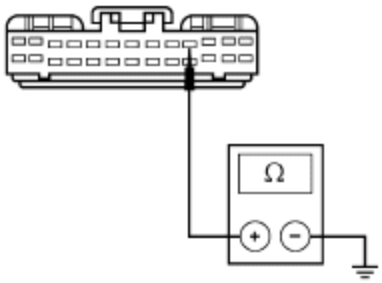
	→ **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 183 (T/Y). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: THE KEY IN IGNITION WARNING CHIME DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 GEM/CTM On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1352, GO to D2 . If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** GO to D2 .
D2 CHECK THE GEM/CTM PID IGN_KEY WITH THE KEY IN AND OUT OF THE IGNITION	
1 	1 Monitor the GEM/CTM PID IGN_KEY with the key in the ignition switch and the key out of the ignition switch. • **Does the GEM/CTM PID IGN_KEY indicate IN with the key in the ignition switch and OUT with the key removed from the ignition switch.** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** If the GEM/CTM PID IGN_KEY continuously indicates OUT, GO to D3 . If the GEM/CTM PID IGN_KEY continuously indicates IN, GO to D5 .
D3 CHECK THE GEM/CTM FOR CHIME OPERATION	
1 	2 Remove the ignition switch lock cylinder; refer to Section 211-04 .
3 	
4  GK3084-A	4 Momentarily connect a jumper wire between key-in-ignition warning switch, circuit 158 (BK/PK), and ground. • **Does the chime operate?**

	→ **Yes** REPLACE the key-in-ignition warning switch; REFER to Switch— Key-In-Ignition Warning . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D4 .
D4 CHECK CIRCUIT 158 (BK/PK) FOR OPEN	
1 2 GEM/CTM C280 3  GK6062-A	3 Measure the resistance between GEM/CTM C280-10, circuit 158 (BK/PK), and key in ignition warning switch, circuit 158 (BK/PK). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 158 (BK/PK). CLEAR the DTC. TEST the system for normal operation.
D5 CHECK THE GEM/CTM FOR CHIME OPERATION	
1 3	2 Remove the ignition switch lock cylinder; refer to Section 211-04 .

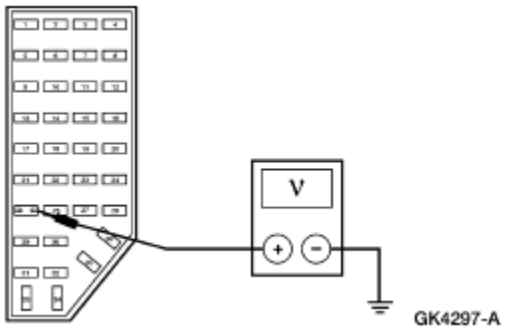
 4  GK3084-A	4 Momentarily connect a jumper wire between key-in-ignition warning switch, circuit 158 (BK/PK), and ground. • **Does the chime operate?** → **Yes** REPLACE the key-in-ignition warning switch; REFER to Switch— Key-In-Ignition Warning . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D6 .
D6 CHECK CIRCUIT 158 (BK/PK) FOR SHORT TO GROUND	
1 2 GEM/CTM C280 3  GK6063-A	3 Measure the resistance between GEM/CTM C280-10, circuit 158 (BK/PK), and ground. • **Is the resistance greater than 10,000 ohms?**

	→ **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 158 (BK/PK). CLEAR the DTC. TEST the system for normal operation.

PINPOINT TEST E: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE/CENTRAL TIMER MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK POWER DISTRIBUTION BOX MAXI-FUSE 1 (50A)	
1 Fuse 1 (50A)	• **Is the fuse OK?** → **Yes** GO to E2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
E2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to E3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.
E3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE	

1



1 Measure the voltage between fuse junction panel fuse 25 (7.5A) pin 2, circuit 1052 (T/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E4 .

→ **No**
REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.

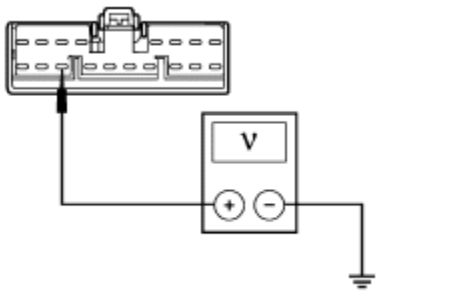
E4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (W/Y)

1

2

GEM/CTM C283

3

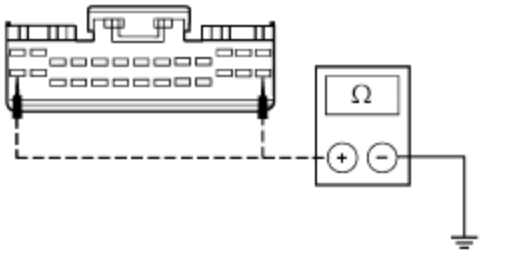


3 Measure the voltage between GEM/CTM C283-11, circuit 1001 (W/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E5 .

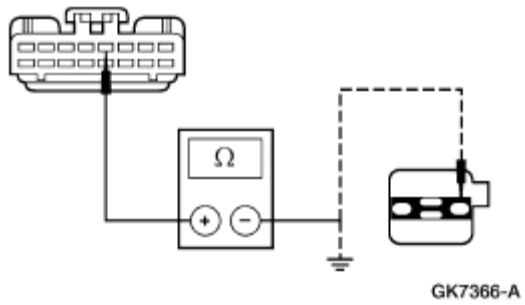
→ **No**
REPAIR circuit 1001 (W/Y). CLEAR the DTCs.

	TEST the system for normal operation.
E5 CHECK CIRCUIT 570 (BK/W) FOR OPEN	
1 GEM/CTM C280 2  GC1770-A	2 Measure the resistance between GEM/CTM C280-14, circuit 570 (BK/W), and ground; and between GEM/CTM C280-26, circuit 570 (BK/W), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST F: AN INDICATOR IS INOPERATIVE — THE NEUTRAL IN TOW INDICATOR IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE NEUTRAL IN TOW STATUS — MONITOR THE GEM PID NTF	
1 2 Scan Tool 3 	3 Monitor the GEM PID NTF.

	• **Does the GEM PID NTF indicate OFF?** → **Yes** ENABLE the neutral in-tow function using SBDS. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to F2 .
F2 CHECK THE NEUTRAL IN TOW INDICATOR — GEM ACTIVE COMMAND NEUTRAL IN TOW LAMP ON AND OFF	
1 	1 Trigger the GEM active command NEUTRAL IN TOW LAMP NTFLAMP ON and OFF • **Does the neutral in tow indicator turn on and off ?** → **Yes** CHECK the ignition switch, brake switch and PRNDL inputs to the GEM. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to F3 .
F3 CHECK CIRCUIT 323 (LB/Y) FOR OPEN AND SHORT TO GROUND	
1 2 GEM C281 3 Neutral Tow C207 4	4 Measure the resistance between GEM C381-5, circuit 323 (LB/Y), and neutral tow C207, circuit 323 (LB/Y); and between GEM C281-5, circuit 323 (LB/Y), and ground.



- **Is the resistance less than 5 ohms between the two connectors and greater than 10, 000 ohms between the GEM and ground.**

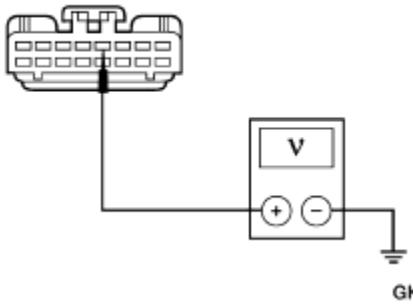
→ **Yes**
GO to F4 .

→ **No**
REPAIR circuit 323 (LB/Y). CLEAR the DTCs. TEST the system for normal operation.

F4 CHECK CIRCUIT 323 (LB/Y) FOR SHORT TO POWER

1

2



2 Measure the voltage between GEM C281-5, circuit 323 (LB/Y), and ground.

- **Is any voltage indicated?**

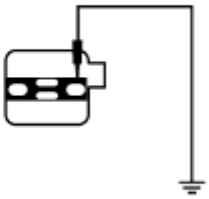
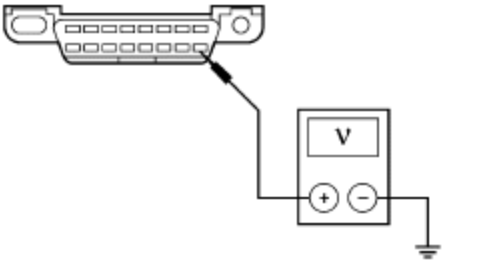
→ **Yes**
REPAIR circuit 323 (LB/Y). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to F5 .

F5 CHECK THE NEUTRAL IN TOW INDICATOR FOR PROPER OPERATION

1

1 Connect a jumper wire between neutral tow

 GK7368-A	C207, circuit 323 (LB/Y), and ground. • **Does the neutral tow indicator illuminate?** → **Yes** GO to F7 . → **No** GO to F6 .
F6 CHECK FOR VOLTAGE TO THE NEUTRAL TOW INDICATOR — CIRCUIT 693 (O)	
1  GK2634-A	1 Measure the voltage between DLC C291-16, circuit 693 (O), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the neutral in tow indicator. CLEAR the DTCs. TEST the system for normal operation. → **No** DIAGNOSE the module communication network; REFER to Section 418-00 .
F7 CHECK THE TRANSFER CASE SHIFT CAPABILITY	
1 GEM C281 2	

 3	3 Place the 4WD mode switch in the 4WD HIGH position.
 GC1175-A	
4	4 Place the 4WD mode switch in the 4WD LOW position.
 GC1176-A	
5	5 Place the 4WD mode switch in the AUTO position.
 GC1174-A	
	• **Does the vehicle shift into all 4WD positions properly?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** DIAGNOSE the transfer case; REFER to Section 308-07A .

Module —Generic Electronic (GEM)/Central Timer (CTM)

Removal and Installation

For additional information, refer to Section 419-10 .

Switch —Door Ajar

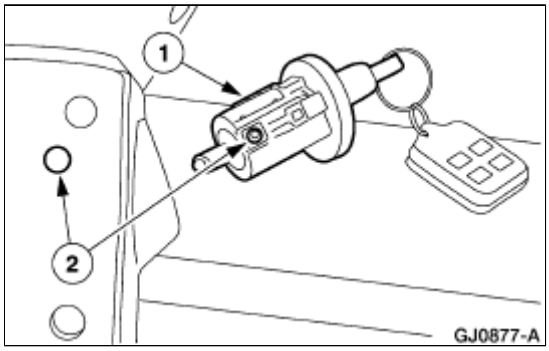
Removal and Installation

For additional information, refer to Section 501-14A .

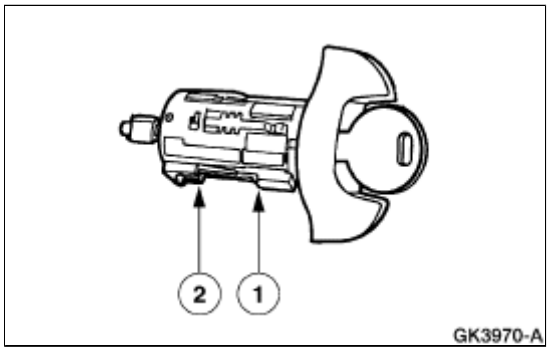
Switch — Key-In-Ignition Warning

Removal

1. Remove the ignition switch lock cylinder.
    1. Insert the ignition key and turn to the RUN position.
    2. Insert a punch in the access hole of the steering column and press the release tab while pulling out the ignition switch lock cylinder.

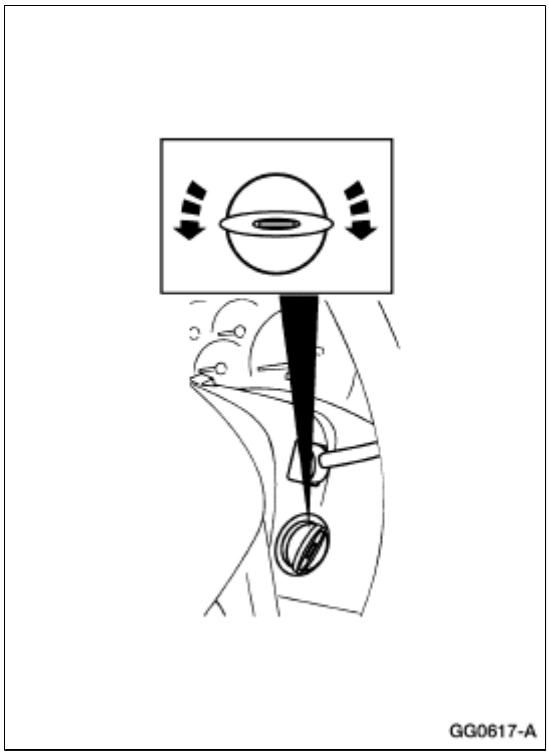


2. Remove the key-in-ignition warning switch.
    1. Pry the clip down.
    2. Push the key-in-ignition warning switch off the rear of the ignition switch lock cylinder.



Installation

1. To install, reverse the removal procedure.
    - Verify ignition switch lock cylinder operation.


GG0617-A

General Specifications

Item	Specification
Azimuth system check object position 1 (P1) and position 5 (P5) , distance from sensor	90 cm (35 in)
Azimuth system check object position 2 (P2), 3 (P3) and position 4 (P4) , distance from sensor	160 cm (63 in)

Torque Specifications

Description	Nm	lb-in
Instrument panel steering column opening cover reinforcement screws	7	63

Parking Aid —Reverse Sensing System

The parking aid system consists of the following:

- four sensors located in the rear bumper (sensors snap into rear bumper retaining ring holes)
- speaker-audible tone (located behind the LH C-pillar trim panel)
- parking aid module (PAM) (located behind the jack storage panel)
- parking aid disable assist switch (located in the instrument panel)
- International Standards Organization (ISO) 9141 diagnostics

Parking Aid —Reverse Sensing System

Refer to Wiring Diagrams Cell 66 , Warning Chimes for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter 105-R0057 or equivalent
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Principles of Operation

NOTE: The liftgate must be closed for correct operation of the parking aid system.

The parking aid system detects objects behind the vehicle when the vehicle is in reverse. The parking aid does this by calculating the distance to an object by the use of four ultrasonic sensors mounted in the rear bumper. The ultrasonic field is emitted in a semicircular area around the rear of the vehicle. The sensors can detect objects approximately 1.8 m (5.9 ft) to the rear of the vehicle, 50 cm (1.6 ft) to the rear side of the vehicle, and 16 cm (6 in) above ground. A 750 Hz variable warning tone is generated from a speaker located behind the LH C-pillar trim panel. The speaker increases its warning tone rate as the vehicle gets closer to an obstacle. When an object is detected within 25 cm (10 in) of the sensors, the warning tone becomes continuous.

The parking aid system is enabled when the vehicle ignition is in RUN and reverse (R) gear is selected. The parking aid disabled indicator will illuminate for three seconds when the ignition is turned to RUN. The system can be disabled by pressing the parking aid switch on the instrument panel. The parking aid system will indicate it is disabled by illuminating the parking aid disabled indicator. The system will always enable when the ignition is transitioned to RUN and entry into reverse (R).

The parking aid system will be disabled if a fault is detected in any of the four sensors, the parking aid speaker or the parking aid module. This will be indicated by the parking aid disabled indicator being illuminated. The parking aid is on the International Standards Organization (ISO) 9141 network and can be diagnosed with a scan tool.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect the following for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Central junction box Fuse 27 (15A) • Damaged wiring harness • Loose or corroded connectors • Parking aid module • Fuse junction panel • Relays • Parking aid sensors • Parking aid disable switch and LED • Parking aid speaker • Reversing lamps

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the scan tool does not power up, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:
   - CKT 914, CKT 915 or CKT 70 — ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00.
   - NO RESP/NOT EQUIP for parking aid, GO to Pinpoint Test A.
   - System passed, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the parking aid module (PAM).

6. If the DTCs retrieved are related to the concern, go to the Parking Aid Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Parking Aid Diagnostic Trouble Code (DTC) Index

Parking Aid Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1299	Power supply sensor circuit short to ground	Parking aid	GO to Pinpoint Test A .
B1342	ECU is defective	Parking aid	CLEAR the DTCs. REPEAT the PAM self-test. RETRIEVE the DTCs. If DTC B1342 is retrieved again, INSTALL a new parking aid; REFER to Parking Aid Module in this section.
B2373	LED #1 circuit short to battery	Parking aid	GO to Pinpoint Test B .
B2477	Module configuration failure	Parking aid	REFER to Section 418-01 .
C1699	Left rear sensor circuit short to Vbat	Parking aid	GO to Pinpoint Test B .
C1700	Left rear sensor circuit failure	Parking aid	GO to Pinpoint Test B .

C1701	Left rear sensor circuit fault	Parking aid	GO to Pinpoint Test B .
C1702	Right rear sensor circuit short to Vbat	Parking aid	GO to Pinpoint Test B .
C1703	Right rear sensor circuit failure	Parking aid	GO to Pinpoint Test B .
C1704	Right rear sensor circuit fault	Parking aid	GO to Pinpoint Test B .
C1705	Left rear center sensor circuit short to Vbat	Parking aid	GO to Pinpoint Test B .
C1706	Left rear center sensor circuit failure	Parking aid	GO to Pinpoint Test B .
C1707	Left rear center sensor fault	Parking aid	GO to Pinpoint Test B .
C1708	Right rear center sensor circuit short to Vbat	Parking aid	GO to Pinpoint Test B .
C1709	Right rear center sensor circuit failure	Parking aid	GO to Pinpoint Test B .
C1710	Right rear center sensor fault	Parking aid	GO to Pinpoint Test B .
C1742	Rear sounder circuit failure	Parking aid	GO to Pinpoint Test B .
C1743	Rear sounder circuit short to Vbat	Parking aid	GO to Pinpoint Test B .
C1748	Switch input circuit short to ground	Parking aid	GO to Pinpoint Test B .
C1920	LED #1 circuit failure	Parking aid	GO to Pinpoint Test B .

Symptom Chart

Symptom Chart

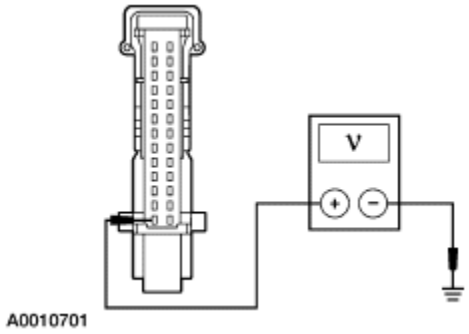
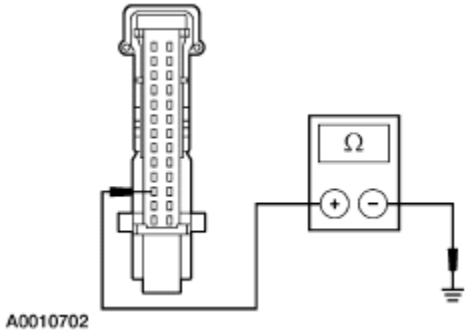
Condition	Possible Sources	Action
• No communication with the parking aid module (PAM)	• Circuit(s). • Fuse junction panel Fuse 27 (15A). • PAM.	• GO to Pinpoint Test A .
• Parking aid is inoperative	• Circuitry. • Parking aid sensor. • Parking aid speaker. • Parking aid disable switch. • Parking aid	• GO to Pinpoint Test B .

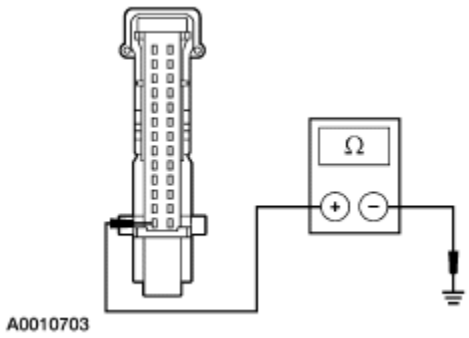
	module (PAM).	
• Continuous or intermittent tone when no obstacles or fault codes are present (certain obstacles may appear "stealthy" to the system, depending on geometric shape, size and material).	• Dirty or iced over parking aid sensor (s).	• CLEAN the rear bumper and sensors with high-pressure water.
	• Parking aid sensor bezel(s) or Parking aid sensors locked into the rear bumper incorrectly.	• RELOCK the parking aid sensor bezels into the rear bumper. RELOCK the parking aid sensors into the parking aid sensor bezels.
	• Parking aid sensors are not aligned correctly.	• CARRY OUT the azimuth check. REFER to Azimuth System Check in this section. CHECK minimum detectable object verification.

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE PARKING AID MODULE (PAM)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 USE DIAGNOSTIC TROUBLE CODES (DTCS) FROM PAM MODULE SELF-TEST	
	1 Use the recorded results from PAM self-test. • **Is DTC B1299 retrieved?** → **Yes** GO to A4 . → **No** GO to A2 .
A2 CHECK PAM CIRCUIT 298 (VT/OG) FOR VOLTAGE	
1 2 	

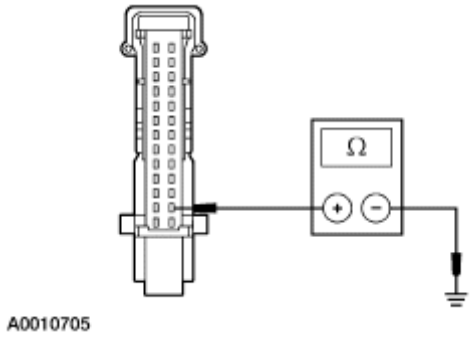
PAM C440 3 4  A0010701	4 Measure the voltage between PAM C440 pin 1, circuit 298 (VT/OG), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A3 . → **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1 2  A0010702	2 Measure the resistance between PAM C440 pin 3, circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No**

	REPAIR the circuit. TEST the system for normal operation.
A4 CHECK CIRCUIT 298 (VT/OG)	
1 2 PAM C440 3  A0010703	3 Measure the resistance between PAM C440 pin 1, circuit 298 (VT/OG), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to A2 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: PARKING AID IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 USE THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM PAM SELF-TEST	
	1 Use the recorded results from PAM self-test. • **Are any DTCs recorded?** → **Yes** If DTC C1700, C1703, C1706 or C1709, GO to B2 . If DTC C1699, C1702, C1705 or C1708, GO to

	B8 . If DTC C1701, C1704, C1707 or C1710, GO to B2 . If DTC C1742, GO to B11 . If DTC C1743, GO to B17 . If DTC B2373, GO to B23 . If DTC C1748, GO to B27 . → **No** GO to B24 .
B2 CHECK CIRCUIT 1440 (DG/YE) FOR A SHORT TO GROUND	
2 PAM C440 3 A0010704	1 Disconnect the parking aid sensor in question. 3 Measure the resistance between PAM C440 pin 16, circuit 1440 (DG/YE), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B3 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B3 CHECK CIRCUIT 1439 (BN/PK) FOR A SHORT TO GROUND	
1	1 Measure the resistance between PAM C440 pin 15, circuit 1439 (BN/PK), harness side and ground.



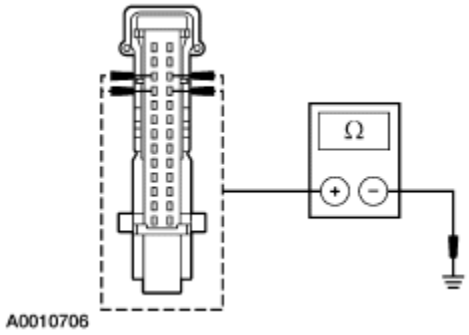
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to B4 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

B4 CHECK THE CIRCUIT IN QUESTION FOR SHORT TO GROUND

1



1 Measure the resistance between PAM C440 pin, harness side and ground; refer to the following chart.

Connector Pin	Circuit
C440 pin 10	1442 (DG/WH)
C440 pin 11	1441 (WH/LG)
C440 pin 23	1443 (WH/LB)
C440 pin 24	1444 (DB/YE)

- **Are the resistances greater than 10,000 ohms?**

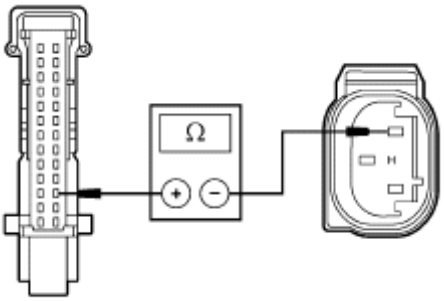
→ **Yes**
GO to B5 .

→ **No**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

B5 CHECK CIRCUIT 1440 (DG/YE) FOR AN OPEN

1

1 Measure the resistance between PAM C440 pin 16, circuit 1440 (DG/YE), harness side and parking aid sensor, circuit 1440 (DG/YE), harness side.



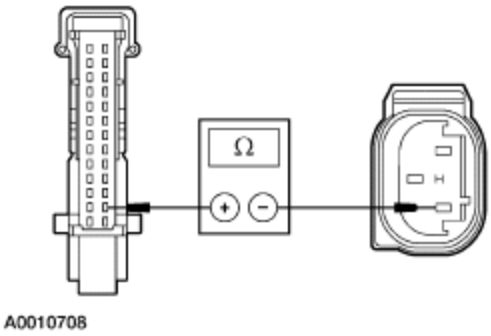
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B6 .

→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

B6 CHECK CIRCUIT 1439 (BN/PK) FOR AN OPEN

1



1 Measure the resistance between PAM C440 pin 15, circuit 1439 (BN/PK), harness side and parking aid sensor, circuit 1439 (BR/PK), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B7 .

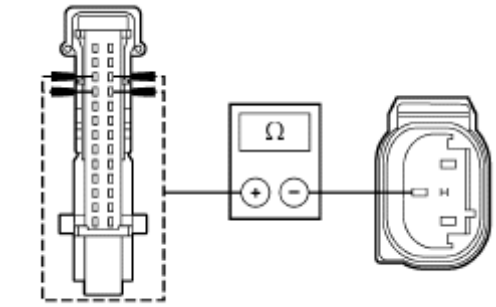
→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

B7 CHECK CIRCUIT IN QUESTION FOR AN OPEN

1

1 Measure the resistance between PAM C440 pin, harness side and parking aid sensor pin, harness side; refer to the following chart.

PAM Connector Pin	Parking Aid Sensor Connector Pin	Circuit
C440 pin 10	C444 pin 2	1442



		(DG/WH)
C440 pin 11	C443 pin 2	1441 (WH/LG)
C440 pin 23	C445 pin 2	1443 (WH/LB)
C440 pin 24	C446 pin 2	1444 (DB/YE)

- **Are the resistances less than 5 ohms?**

→ **Yes**
If all four parking aid sensors recorded DTCs, INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.

If all four parking aid sensors did not record DTCs, INSTALL a new sensor(s) for the one in question. For additional information, REFER to Parking Aid Sensor in this section. CLEAR the DTCs. REPEAT the self-test.

→ **No**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

B8 CHECK CIRCUIT 1440 (DG/YE) FOR A SHORT TO VOLTAGE

2

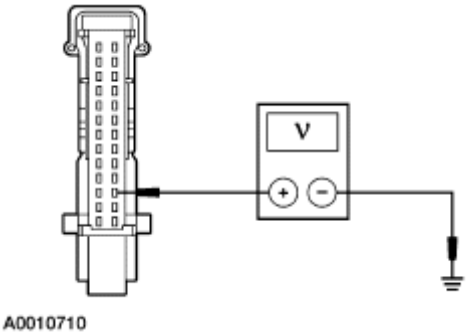
PAM C440

3

4

1 Disconnect the parking aid sensor in question.

4 Measure the voltage between PAM C440 pin 16, circuit 1440 (DG/YE), harness side and ground.



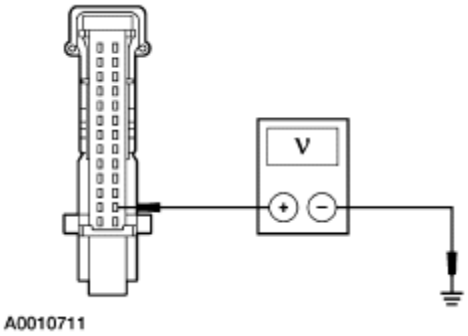
- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

→ **No**
GO to B9 .

B9 CHECK CIRCUIT 1439 (BN/PK) FOR A SHORT TO VOLTAGE

1



1 Measure the voltage between PAM C440 pin 15, circuit 1439 (BN/PK), harness side and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

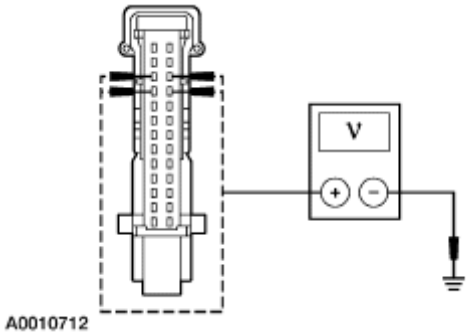
→ **No**
GO to B10 .

B10 CHECK CIRCUIT IN QUESTION FOR SHORT TO VOLTAGE

1

1 Measure the voltage between PAM C440 pin, harness side and ground; refer to the following chart.

Connector Pin	Circuit
C440 pin 10	1442 (DG/WH)
C440 pin 11	1441 (WH/LG)



C440 pin 23	1443 (WH/LB)
C440 pin 24	1444 (DB/YE)

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

→ **No**
If all four parking aid sensors recorded DTCs, INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.

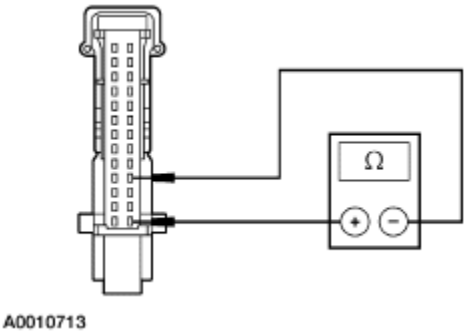
If all four parking aid sensors did not record DTCs, INSTALL a new sensor(s) for the one in question. For additional information, REFER to Parking Aid Sensor in this section. CLEAR the DTCs. REPEAT the self-test.

B11 CHECK CIRCUIT 1437 (BK/PK) AND CIRCUIT 1438 (DG) FOR AN OPEN

1

PAM C440

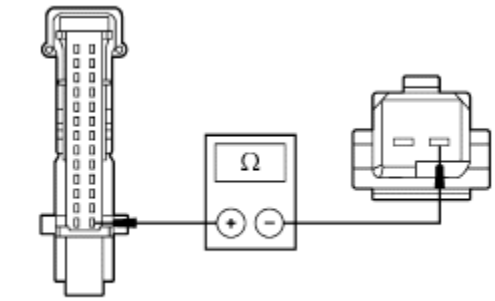
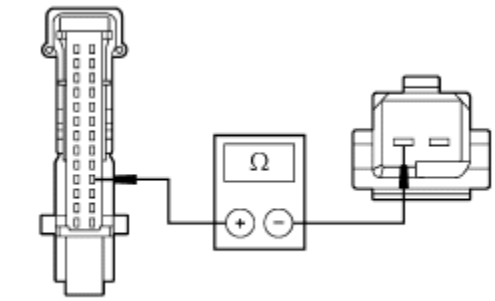
2

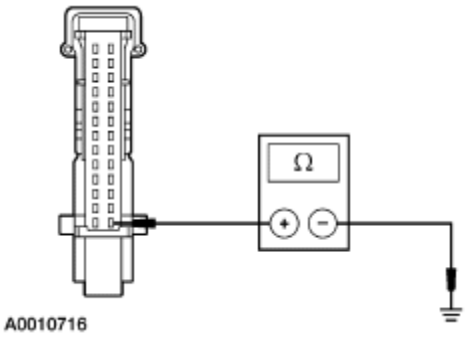
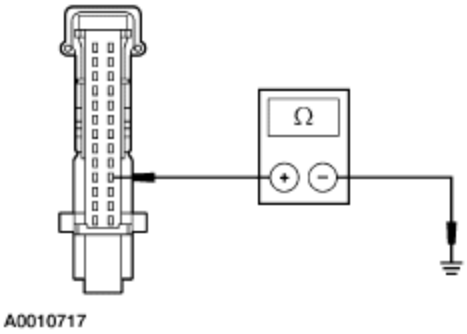


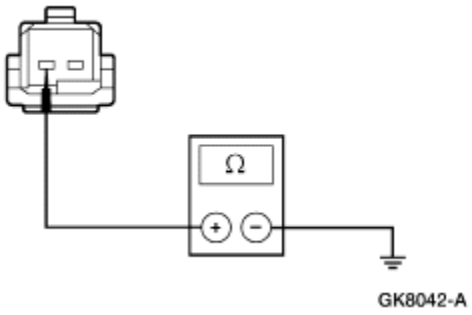
2 Measure the resistance between PAM C440 pin 14, circuit 1437 (BK/PK), harness side and C440 pin 17, circuit 1438 (DG), harness side.

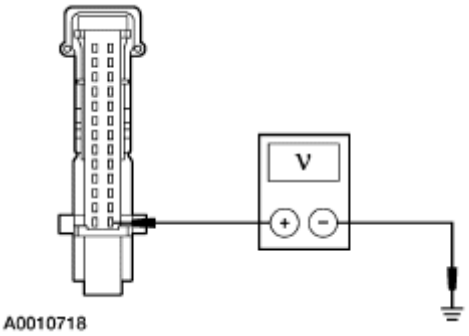
- **Is the resistance greater than 60 ohms?**

→ **Yes**

	GO to B12 . → **No** GO to B14 .
B12 CHECK CIRCUIT 1437 (BK/PK) FOR AN OPEN	
1 Parking Aid Speaker C441 2  A0010714	2 Measure the resistance between PAM C440 pin 14, circuit 1437 (BK/PK), harness side and parking aid speaker C441 pin 1, circuit 1437 (BK/PK), harness side. • **Is the resistance less than 5 ohms?** → **Yes** GO to B13 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B13 CHECK CIRCUIT 1438 (DG) FOR AN OPEN	
1  A0010715	1 Measure the resistance between PAM C440 pin 17, circuit 1438 (DG), harness side and parking aid speaker C441 pin 2, circuit 1438 (DG), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new parking aid speaker. For additional information, REFER to Parking Aid Speaker in this section. CLEAR the DTCs.

	REPEAT the self-test. → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B14 CHECK CIRCUIT 1437 (BK/PK) FOR A SHORT TO GROUND	
1 PAM Speaker C441 2  A0010716	2 Measure the resistance between PAM C440 pin 14, circuit 1437 (BK/PK), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B15 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B15 CHECK CIRCUIT 1438 (DG) FOR A SHORT TO GROUND	
1  A0010717	1 Measure the resistance between PAM C440 pin 17, harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes**

	GO to B16 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B16 CHECK PARKING AID SPEAKER FOR A SHORT TO GROUND	
1  GK8042-A	1 Measure the resistance between parking aid speaker C441 pin 1, component side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test. → **No** INSTALL a new parking aid speaker. For additional information, REFER to Parking Aid Speaker in this section. CLEAR the DTCs. REPEAT the self-test.
B17 CHECK CIRCUIT 1437 (BK/PK) AND CIRCUIT 1438 (DG) FOR A SHORT TO VOLTAGE	
1 PAM C440 2 3	3 Measure the voltage between PAM C440 pin 14, circuit 1437 (BK/PK), harness side and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B18 .

→ **No**
INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.

B18 CHECK CIRCUIT 1437 (BK/PK) FOR A SHORT TO VOLTAGE

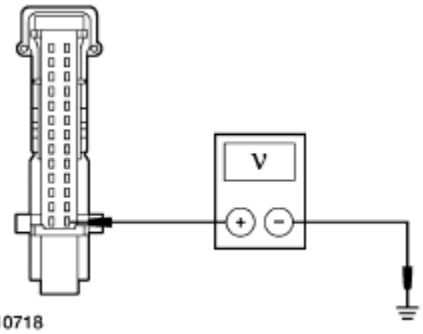
1

2

Parking Aid Speaker C441

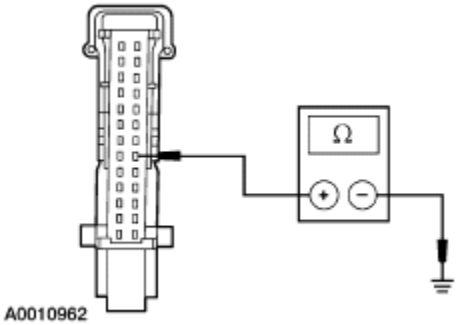
3

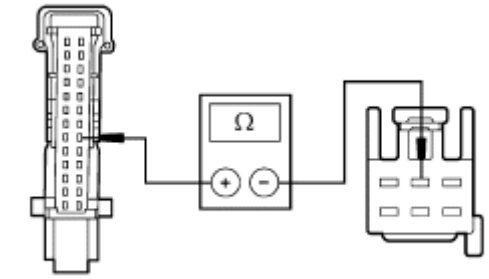
4



4 Measure the voltage between PAM C440 pin 14, circuit 1437 (BK/PK), harness side and ground.

- **Is the voltage greater than 10 volts?**

	→ **Yes** REPAIR circuit 1437 (BK/PK). CLEAR the DTCs. REPEAT the self-test. → **No** REPAIR circuit 1438 (DG). CLEAR the DTCs. REPEAT the self-test.
B19 CHECK CIRCUIT 1436 (VT/OG) FOR A SHORT TO GROUND	
1 PAM C440 2  	2 Measure the resistance between PAM C440 pin 19, circuit 1436 (VT/OG), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B20 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B20 CHECK CIRCUIT 1436 (VT/OG) FOR AN OPEN	
1 Parking Aid Disable Switch C2015 2	2 Measure the resistance between PAM C440 pin 19, circuit 1436 (VT/OG), harness side and parking aid switch C2015 pin 2, circuit 1436 (VT/OG).



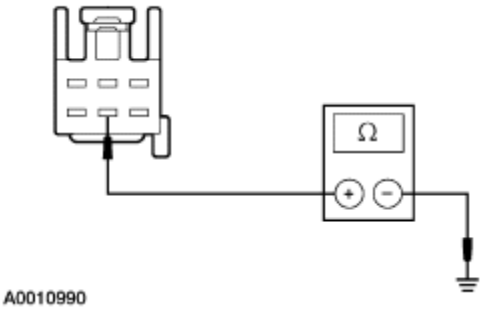
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B21 .

→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

B21 CHECK CIRCUIT 57 (BK) FOR AN OPEN

1



1 Measure the resistance between parking aid switch C2015 pin 5, circuit 57 (BK), harness side and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B22 .

→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

B22 CHECK PARKING AID DISABLED INDICATOR DIODE

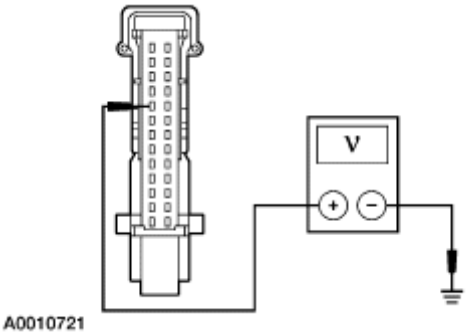
1 Check the parking aid disabled indicator diode.

- **Is the parking aid disabled indicator OK?**

→ **Yes**
INSTALL a new PAM. For additional information, REFER to Parking Aid Module in

	this section. CLEAR the DTCs. REPEAT the self-test. → **No** INSTALL a new parking aid switch. For additional information, REFER to Parking Aid Switch in this section. CLEAR the DTCs. REPEAT the self-test.
B23 CHECK CIRCUIT 1436 (VT/OG) FOR A SHORT TO VOLTAGE	
1 PAM C440 2 	• **Is the parking aid disabled indicator illuminated?** → **Yes** REPAIR circuit 1436 (VT/OG). CLEAR the DTCs. REPEAT the self-test. → **No** INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.
B24 CHECK PARKING AID SENSORS FOR PROPER ALIGNMENT	
NOTE: If the vehicle has been in an accident, the PAM sensors may not be aligned correctly.	
	1 Check the bumper for correct alignment, refer to Elevation System Check—No Ground Reflection Verification Check in this section. 2 Check the parking aid sensors and holders for correct adjustment. Refer to Azimuth System Check (Minimum Detectable Object Verification). • **Are the bumper and parking aid sensors correctly aligned?** → **Yes** GO to B25 . → **No** INSTALL a new bumper. For additional information, REFER to Section 501-19 . If the

	vehicle has been in an accident, further body work may be required to bring the parking aid sensors into correct alignment.
B25 CHECK REVERSING LAMPS OPERATION	
2 3 	1 Engage the parking brake. 4 Check the reversing lamps operation. • **Does the RH reversing lamp illuminate?** → **Yes** GO to B26 . → **No** REFER to Section 417-01 .
B26 CHECK CIRCUIT 140 (BK/PK) FOR VOLTAGE	
1 2 PAM C440 3 4	4 Measure the voltage between PAM C440 pin 9, circuit 140 (BK/PK), harness side and ground.



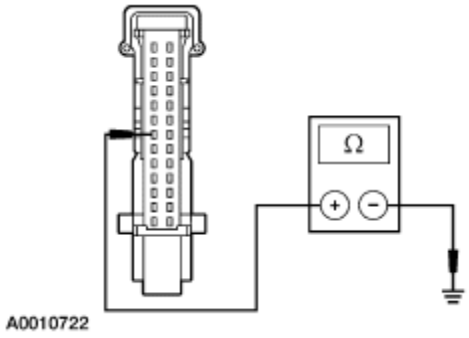
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B27 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

B27 CHECK CIRCUIT 1435 (DG/VT) FOR A SHORT TO GROUND

1



1 Measure the resistance between PAM C440 pin 7, circuit 1435 (DG/VT), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to B29 .

→ **No**
GO to B28 .

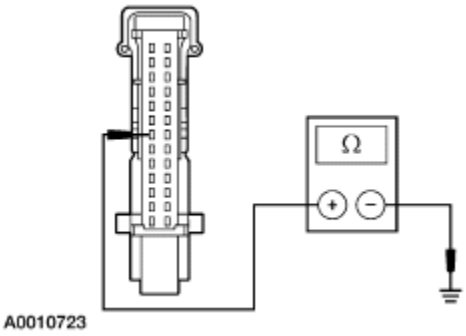
B28 CHECK CIRCUIT 1435 (DG/VT) FOR A SHORT TO GROUND — PARKING AID SWITCH DISCONNECTED

1

2

Parking Aid Switch C2015

3



3 Measure the resistance between PAM C440 pin 7, circuit 1435 (DG/VT), harness side and ground.

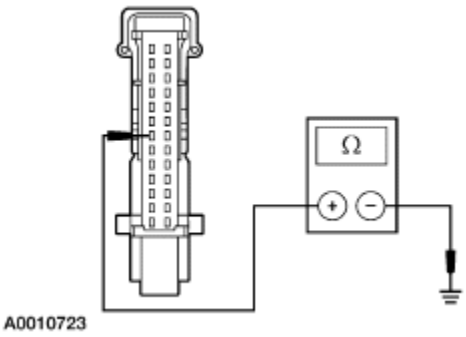
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new parking aid switch. For additional information, REFER to Parking Aid Switch in this section.TEST the system for normal operation.

→ **No**
REPAIR the circuit. TEST the system for normal operation.

B29 CHECK CIRCUIT 1435 (DG/VT) FOR AN OPEN

1

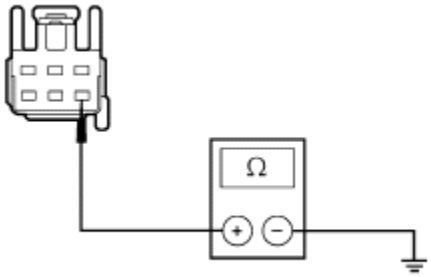
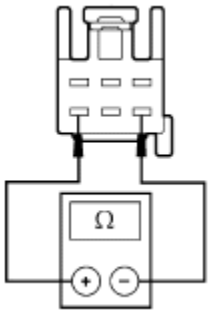


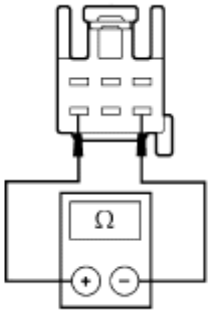
1 While depressing the parking aid switch, measure the resistance between PAM C440 pin 7, circuit 1435 (DG/VT), harness side and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.

→ **No**

	GO to B30 .
B30 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1 Parking Aid Switch C2015 2  GK8049-A	2 Measure the resistance between parking aid switch C2015 pin 4, circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to B31 . → **No** REPAIR the circuit. TEST the system for normal operation.
B31 CHECK THE PARKING AID SWITCH	
1  A0010991 2	1 Measure the resistance between parking aid switch pin 6 and pin 4. 2 While pressing the parking aid switch, measure the resistance between parking aid switch pin 6 and pin 4.



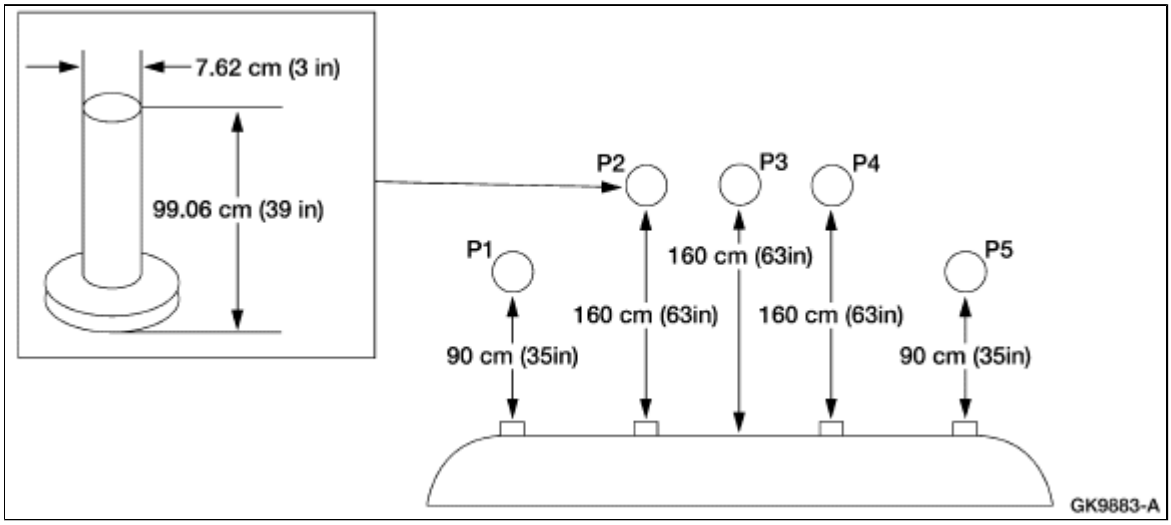
- **Is the resistance greater than 10,000 ohms with the parking aid switch not pressed and less than 35 ohms with the parking aid switch pressed?**

→ **Yes**
INSTALL a new PAM. For additional information, REFER to Parking Aid Module in this section. CLEAR the DTCs. REPEAT the self-test.

→ **No**
INSTALL a new parking aid switch. TEST the system for normal operation.

Azimuth System Check

Maximum Detectable Object Locations



1. **NOTE:** The object used in this system check can be fabricated from 7.62 cm (3 in) diameter pipe 99.06 cm (39 in) length.

   NOTE: The following system check should be carried out with the vehicle on a level surface.

   NOTE: The parking aid system will default to on when the ignition key is cycled from off to on.

   Turn the ignition to the ON position, engine off.

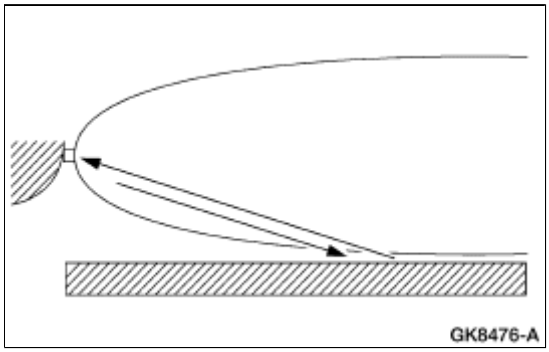
2. Set the parking brake on.

3. Place the gear shift in REVERSE.

4. Verify that the parking aid system detects the specified object when placed in the five specified locations (P1, P2, P3, P4, P5).

Elevation System Check —No Ground Reflection Verification Check

1. Ground reflection verification and sensor coverage pattern.



2. The parking aid system must be checked to assure that the system does not see signals from ground reflections.

3. The following system check should be carried out with the vehicle on a 3.0 meters wide by 4.5 meters deep (15 feet wide by 10 feet deep) smooth concrete surface, free of all obstacles and noise from fan and pneumatic tools.

4. Turn the ignition to the on position, engine off.

5. Set the parking brake on.

6. Place the gear shift in reverse.

7. **NOTE:** No audible alerts should be heard. If audible alerts are heard, check to make sure the bumper is properly installed and is not tilted downward so that the sensor is pointing at the ground.

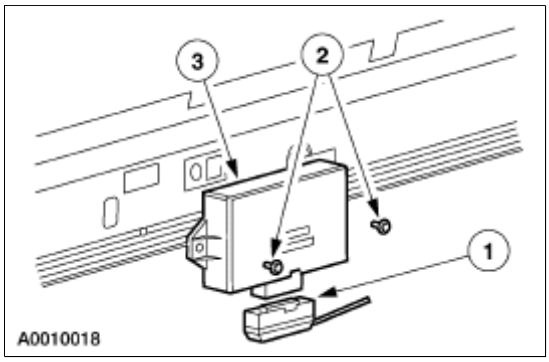
   Verify that no audible alerts are heard.

Parking Aid Module

Removal and Installation

1. Remove the jack storage panel.

2. Remove the parking aid module.
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the parking aid module.



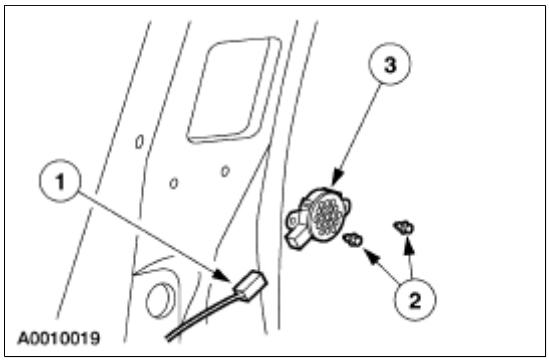
3. To install, reverse the removal procedure.

Parking Aid Speaker

Removal and Installation

1. Remove the LH quarter trim panel. For additional information, refer to Section 501-05 .

2. Remove the parking aid speaker.
    1. Disconnect the electrical connector.
    2. Remove the pin-type retainers.
    3. Remove the parking aid speaker.



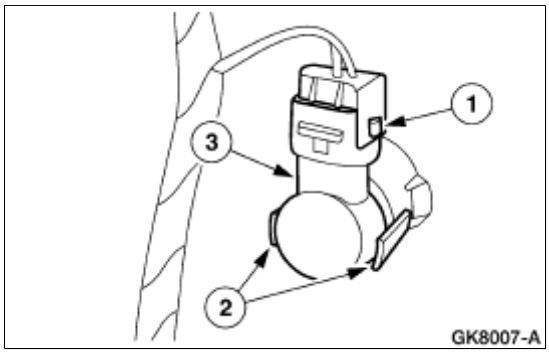
3. To install, reverse the removal procedure.

Parking Aid Sensor

Removal and Installation

1. Remove the rear bumper. For additional information, refer to Section 501-19 .

2. Remove the parking aid sensor.
    1. Disconnect the electrical connecter.
    2. Release the tabs.
    3. Remove the parking aid sensor.

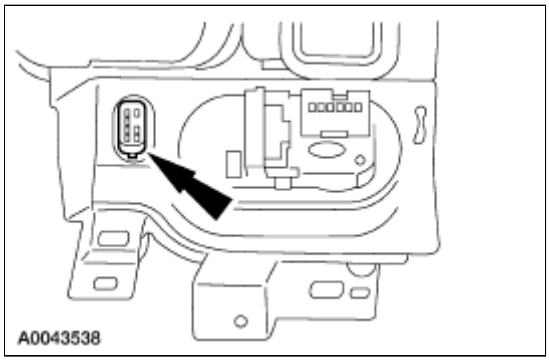


3. To install, reverse the removal procedure.

Parking Aid Switch

Removal and Installation

1. Remove the audio unit. For additional information, refer to Section 415-01 .
2. Remove the instrument cluster finish panels. For additional information, refer to Section 501-12 .
3. Remove the parking aid switch.



4. To install, reverse the removal procedure.

SPECIFICATIONS

General Specifications

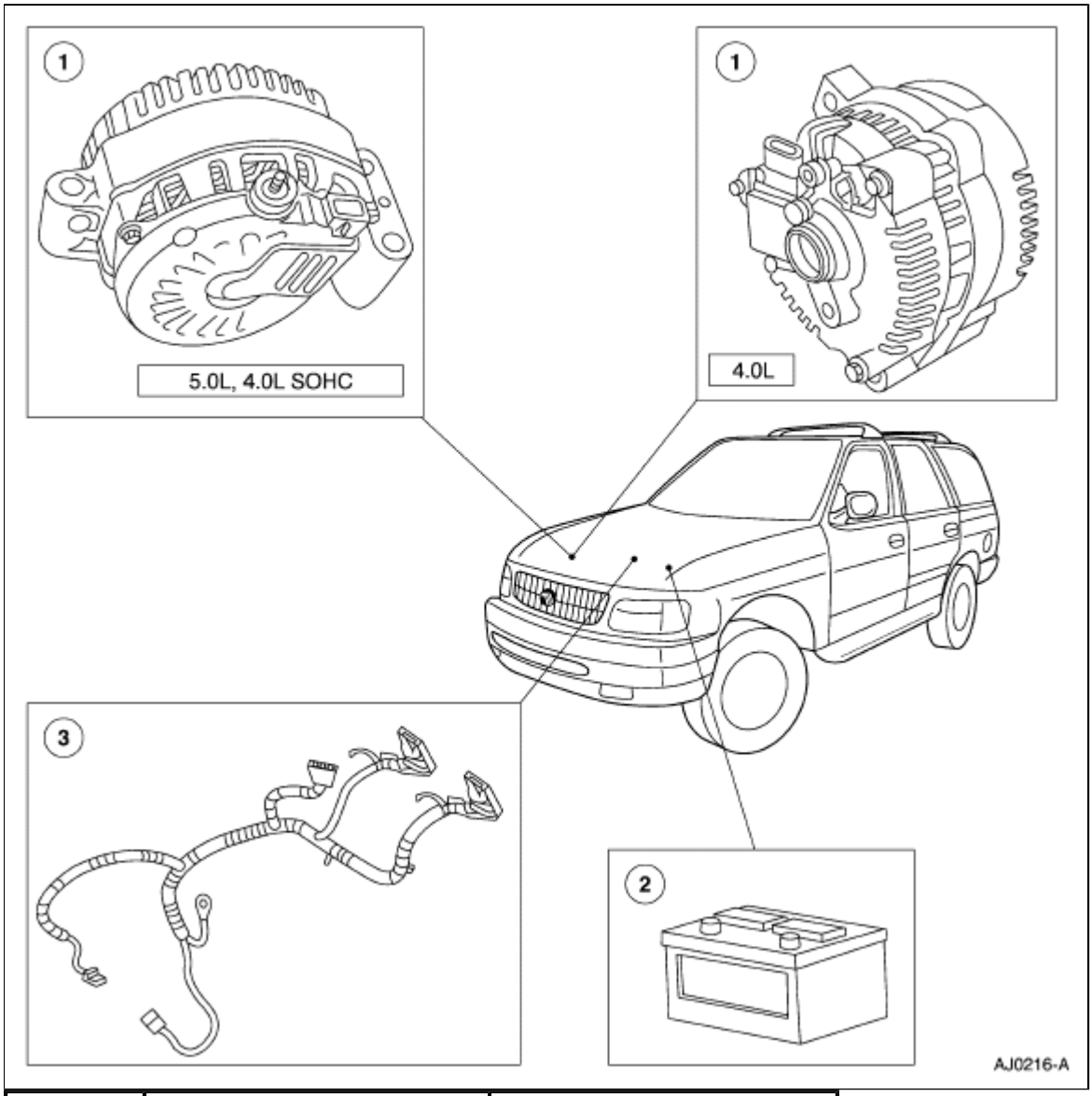
Item	Specification
Battery	72/amp/hr
58/120 Generator	65/amp
45/110 Generator	60/amp
35/90 Generator	45/amp

Torque Specifications

Description	Nm	lb-ft	lb-in
Brush Holder Screws	2.8-4.0	—	25-35

Charging System

Component Location



Item	Part Number	Description
1	10300	Generator
2	10655	Battery
3	—	Wire Harness

Charging System

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter 105-R0057 or equivalent
ST1179-A	SABRE Premium Electrical System Tester 010-00736 or equivalent

Inspection and Verification

WARNING: Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near batteries to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation.

WARNING: When lifting a plastic-cased battery, excessive pressure on the end walls could cause acid to spew through the vent caps resulting in personal injury or damage to the vehicle or to the battery. Lift with a battery carrier or with your hands on opposite corners.

1. Verify the customer's concern by operating the vehicle to duplicate the concern.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Battery	• Battery charge

• Generator drive belt • Generator pulley	• Fuse(s) power distribution box: 24 (30A); fuse junction panel: Fuse 15 (7.5A) • Electrical connectors • Electrical connections • Battery charge warning indicator • Other electrical systems malfunctions

3. If the inspection reveals obvious concern(s) that can be readily identified, service as required.

4. Measure the open circuit battery voltage. If the battery voltage is less than 12.0 volts, test and recharge the battery before continuing with diagnosis.

5. Observe charging system warning indicator status under the following conditions:
    1. The charging system warning indicator will illuminate with the ignition switch in RUN and the engine OFF.
    2. The charging system warning indicator will be OFF with the engine running.
    3. The charging system warning indicator will be OFF with the ignition switch OFF.

6. Check the battery voltage before and after starting the engine to determine if the battery voltage increases. Refer to the Normal Charging System Voltages chart.

Normal Charging System Voltages

Terminal	A	S	I	Alt B+	Batt	Eng to Bat Gnd
Key OFF	12V	0V	0V	12V	12V	0V
Key On - Engine Off	12V	0V	1-3V	12V	12V	0V
Engine Running	12V-15V	6-8V	12V-15V	12V-15V	12V-15V	0V

7. If the concern(s) remains after the inspection determine the symptom(s) and go to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Charging System Warning Indicator is ON with the Engine Running (The Battery Voltage Does Not Increase) 4.0L	• A Circuit 36 (Y/W). • A Circuit mini-fuse. • B+ Circuit 38 (BK/O). • B+ fuse link. • I Circuit 904 (LG/R) • Voltage regulator. • Generator	• GO to Pinpoint Test A .
• The Charging System Warning Indicator is OFF with the Ignition Switch in the RUN Position and the Engine OFF (Battery Voltage Does Not Increase) 4.0L	• Voltage regulator connector. • I Circuit 904 (LG/R). • Fuse 15 (7.5A). • Voltage regulator. • Loose or damaged generator.	• GO to Pinpoint Test B .

	• Harness connector.	
• The Charging System Warning Indicator is ON with the Engine Running and the Battery Voltage Increases 4.0L	• S Circuit 4 (W/BK). • Generator. • Voltage regulator.	• GO to Pinpoint Test C .
• The Charging System Warning Indicator is OFF with the Ignition Switch in the RUN Position and the Engine OFF (Battery Voltage Increases) 4.0L	• Charging system warning indicator lamp bulb. • Instrument cluster. • S Circuit 4 (W/BK). • Generator. • Voltage regulator.	• GO to Pinpoint Test D .
• The Charging System Warning Indicator Operates Correctly but the Battery Voltage Does Not Increase 4.0L	• B+ Circuit 38 (BK/O). • B+ fuse link. • Loose or damaged harness connector. • Battery cables. • Generator. • Voltage regulator.	• GO to Pinpoint Test E .
• The Battery is Dead or Will Not Stay Charged or Low Battery or Generator Voltage 4.0L	• Corroded terminal(s). • Loose connection(s). • High key-off load. • Generator. • Voltage regulator.	• GO to Pinpoint Test F .
• The Charging System Warning Indicator Flickers/Is Intermittent 4.0L	• Loose connection(s). • Mini-fuse A Circuit loose. • Fuse 15 (7.5A) I Circuit loose. • Generator. • Voltage regulator.	• GO to Pinpoint Test G .
• The System Overcharges (Battery Voltage Greater Than 15.5 Volts) 4.0L	• A Circuit 36 (Y/W). • Generator (low output). • Voltage regulator. • I Circuit 904 (LG/R).	• GO to Pinpoint Test H .
• Battery Leakage or Damage 4.0L	• A Circuit 36 (Y/W). • Generator. • Voltage regulator. • Battery.	• GO to Pinpoint Test J .
• The Voltage Gauge Reads High or Low 4.0L	• Generator (low output) • Voltage regulator. • Voltage gauge. • Instrument cluster/wiring.	• GO to Pinpoint Test K .
• The Generator is Noisy	• Loose bolts/brackets. • Drive belt. • Generator/Pulley.	• GO to Pinpoint Test L .
• Radio Interference	• Generator. • Wiring/routing. • In-vehicle entertainment system.	• GO to Pinpoint Test M .

• The Charging System Warning Indicator is ON with the Engine Running (The Battery Voltage Does Not Increase) 4.0L (SOHC), 5.0L	• A Circuit 36 (Y/W). • A Circuit mini-fuse. • B+ Circuit 38 (BK/O). • B+ fuse link. • I Circuit 904 (LG/R) • Voltage regulator. • Generator	• GO to Pinpoint Test N .
• The Charging System Warning Indicator is OFF with the Ignition Switch in the RUN Position and the Engine OFF (Battery Voltage Does Not Increase) 4.0L (SOHC), 5.0L	• Voltage regulator connector. • I Circuit 904 (LG/R). • Fuse 15 (7.5A). • Voltage regulator. • Loose or damaged generator. • Harness connector.	• GO to Pinpoint Test P .
• The Charging System Warning Indicator is ON with the Engine Running and the Battery Voltage Increases 4.0L (SOHC), 5.0L	• Generator. • Voltage regulator.	• GO to Pinpoint Test Q .
• The Charging System Warning Indicator is OFF with the Ignition Switch in the RUN Position and the Engine OFF (Battery Voltage Increases) 4.0L (SOHC), 5.0L	• Charging system warning indicator lamp bulb. • Instrument cluster. • Generator. • Voltage regulator.	• GO to Pinpoint Test R .
• The Charging System Warning Indicator Operates Correctly but the Battery Voltage Does Not Increase 4.0L SOHC, 5.0L	• B+ Circuit 38 (BK/O). • B+ fuse link. • Loose or damaged harness connector. • Battery cables. • Generator. • Voltage regulator.	• GO to Pinpoint Test S .
• The Battery is Dead or Will Not Stay Charged or Low Battery or Generator Voltage 4.0L SOHC, 5.0L	• Corroded terminal(s). • Loose connection(s). • High key-off load. • Generator. • Voltage regulator.	• GO to Pinpoint Test T .
• The Charging System Warning Indicator Flickers/Is Intermittent 4.0L SOHC, 5.0L	• Loose connection(s). • Mini-fuse A Circuit loose. • Fuse 15 (7.5A) I Circuit loose. • Generator. • Voltage regulator.	• GO to Pinpoint Test U .
• The System Overcharges (Battery Voltage Greater Than 15.5 Volts) 4.0L SOHC, 5.0L	• A Circuit 36 (Y/W). • Generator (low output). • Voltage regulator. • I Circuit 904 (LG/R).	• GO to Pinpoint Test V .
• Battery Leakage or Damage 4.0L SOHC, 5.0L	• A Circuit 36 (Y/W). • Generator. • Voltage regulator. • Battery.	• GO to Pinpoint Test W .
• The Voltage Gauge Reads High or Low	• Generator (low	• GO to

4.0L SOHC, 5.0L	output) • Voltage regulator. • Voltage gauge. • Instrument cluster/wiring.	Pinpoint Test X .

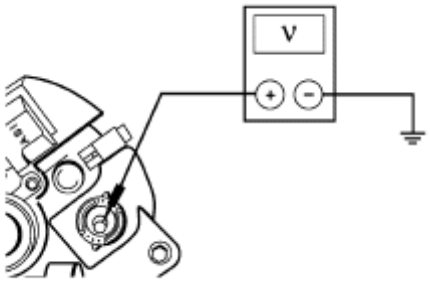
Pinpoint Tests

CAUTION: Do not make jumper connections except as directed. Improper connections may damage the voltage regulator test terminals.

CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins.

PINPOINT TEST A: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING (THE BATTERY VOLTAGE DOES NOT INCREASE) — 4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE A CIRCUIT MINI-FUSE 24 (15A)	
1 2 In-line Mini-fuse (15A)	2 Check A circuit Mini-fuse 24 (15A) in power distribution box. • **Is the fuse OK?** → **Yes** GO to A2 . → **No** INSTALL a new Mini-fuse 24 (15A). TEST the system for normal operation.
A2 CHECK CIRCUIT 38 (BK/O)	
1	1 Measure the voltage between the B+ terminal on the generator, circuit 38 (BK/O).



GJ0432-A

- **Is the voltage equal to battery positive voltage (B+)?**

→ **Yes**
GO to A3 .

→ **No**
REPAIR circuit 38 (BK/O). TEST the system for normal operation.

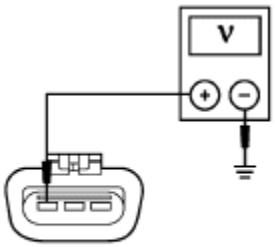
A3 CHECK CIRCUIT 36 (Y/W)

1

2

Generator Connector C121

3



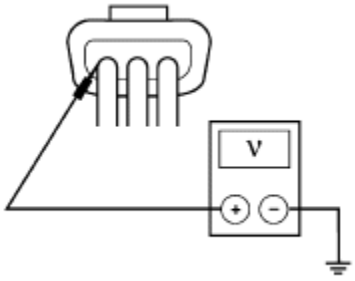
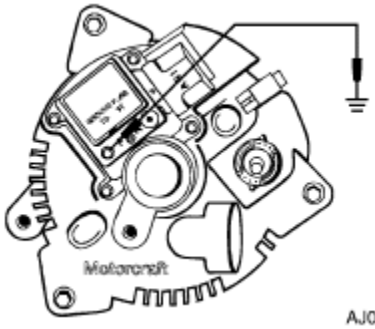
AJ0202-A

3 Measure the voltage between generator connector pin C-121-A circuit 36 (Y/W) and ground.

- **Is the voltage equal to battery positive voltage (B+)?**

→ **Yes**
GO to A4 .

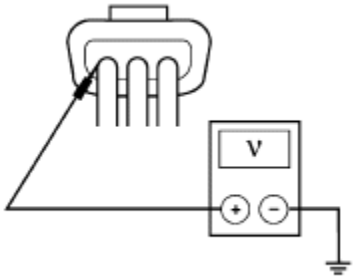
→ **No**

	REPAIR circuit 36 (Y/W). TEST the system for normal operation.
A4 CHECK I CIRCUIT 904 (LG/R) FOR AN OPEN	
1 Generator Connector C121 2 3  GJ0440-A	3 **NOTE:** The voltage regulator (VR) (10316) must be connected to the wiring harness for this test. Measure the voltage between the generator I-terminal, circuit 904 (LG/R) and ground. • **Is the voltage greater than 1 volt?** → **Yes** GO to A5 . → **No** REPAIR circuit 904 (LG/R) for an open or short. TEST the system for normal operation.
A5 CHECK THE GENERATOR OUTPUT	
1 2  AJ0204-A	2 With the engine running, ground the F pin on the generator/regulator.

	• **Does the battery voltage increase and the charging system warning indicator turn off?** → **Yes** INSTALL a new voltage regulator. TEST the system for normal operation. → **No** INSTALL a new generator (GEN) (10300). TEST the system for normal operation.

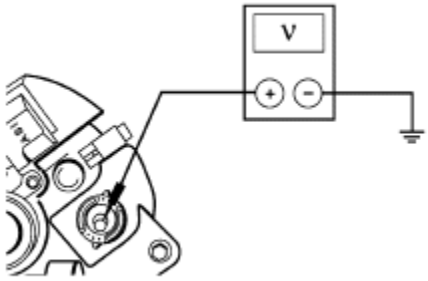
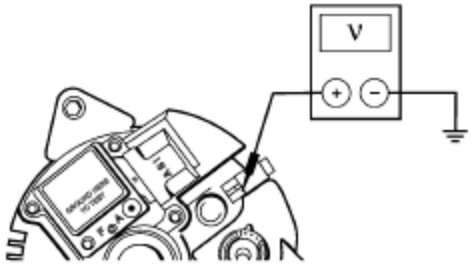
PINPOINT TEST B: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE OFF (BATTERY VOLTAGE DOES NOT INCREASE)—4.0L

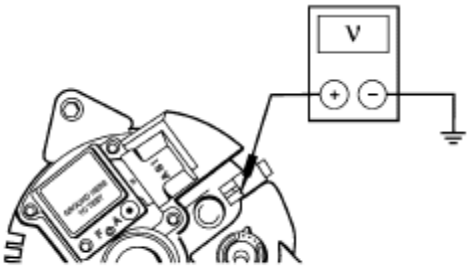
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 INSPECT GENERATOR CONNECTOR C121	
1 Generator Connector C121	2 Check generator connector C121 for bent, or damaged pins. • **Is the connector OK?** → **Yes** GO to B2 . → **No** REPAIR connector C121 as necessary. TEST the system for normal operation.
B2 CHECK THE GENERATOR GROUNDS	
	1 Check all ground connections between the generator, voltage regulator and the battery. • **Are the ground connections OK?** → **Yes** GO to B3 . → **No** REPAIR connections as necessary. TEST the system for normal operation.
B3 CHECK THE VOLTAGE AT I CIRCUIT 904 (LG/R)	

1 Generator Connector C121 2 3  GJ0440-A	3 **NOTE:** The generator connector C121 must be connected to the generator for this test. Measure the voltage between the generator I terminal, circuit 904 (LG/R) and ground. • **Is the voltage greater than 1 volt?** → **Yes** INSTALL a new voltage regulator. → **No** REPAIR circuit 904 (LG/R) for open circuit. TEST the system for normal operation.

PINPOINT TEST C: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING AND THE BATTERY VOLTAGE INCREASES—4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK CONNECTOR C120	
1 Generator Connector C120	2 Make sure that connector C120 is correctly mated to the generator and making contact. • **Is the connection OK?** → **Yes** GO to C2 .

	→ **No** REPAIR connector C120 as necessary. TEST the system for normal operation.
C2 CHECK THE GENERATOR OUTPUT VOLTAGE	
1 2  GJ0432-A	2 With the engine running at 2000 rpm, measure the voltage output at the generator B+ terminal. • **Is the voltage output less than 16 volts?** → **Yes** GO to C3 . → **No** GO to Pinpoint Test H .
C3 CHECK THE GENERATOR FOR LOW VOLTAGE	
1 2  GJ0431-A	2 With the engine running at 2000 rpm, measure the voltage output at the generator one-way connector C121, S circuit. • **Is the voltage output less than 5 volts?** → **Yes**

	INSTALL a new voltage regulator. TEST the system for normal operation. → **No** GO to C4 .
C4 CHECK CIRCUIT 4 (W/BK) VOLTAGE	
1 2 Generator Connector C121 3 4  GJ0431-A	4 With the engine running, check the voltage at the generator S terminal. • **Is the voltage greater than 5 volts?** → **Yes** REPAIR circuit 4 (W/BK) as necessary. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

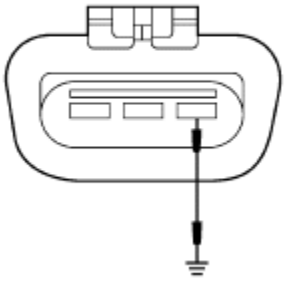
PINPOINT TEST D: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE OFF (BATTERY VOLTAGE INCREASES)—4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE CHARGING SYSTEM WARNING INDICATOR OPERATION	
1	

2

Generator Connector C121

3



AJ0206-A

3 Ground the generator connector C121 I circuit with the ignition switch in the RUN position and the engine OFF.

- **Is the warning indicator on?**

→ **Yes**
GO to D2 .

→ **No**
REPAIR connector C121, I circuit 904 (LG/R) as necessary. TEST the system for normal operation.

D2 CHECK THE GENERATOR S CIRCUIT 4 (W/BK)

1

Generator Connector C121

2

Generator Connector C120

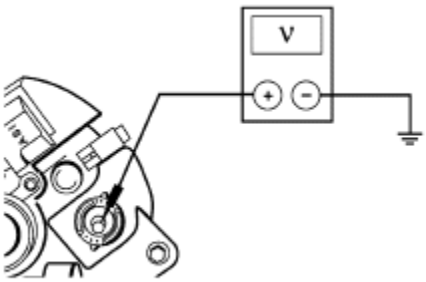
3 Observe the warning indicator.

- **Is the warning indicator on?**

→ **Yes**
INSTALL a new generator. TEST the system for normal operation.

	→ **No** INSTALL a new voltage regulator. TEST the system for normal operation.

PINPOINT TEST E: THE CHARGING SYSTEM WARNING INDICATOR OPERATES CORRECTLY BUT THE BATTERY VOLTAGE DOES NOT INCREASE—4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK CIRCUIT 38 (BK/O) VOLTAGE	
1 2  GJ0432-A	2 Check for voltage at generator B+ connector with the ignition switch in the RUN position and the engine OFF. • **Is the voltage equal to battery positive voltage (B+)?** → **Yes** GO to E2 . → **No** REPAIR circuit 38 (BK/O) as necessary. TEST the system for normal operation.
E2 CHECK THE GENERATOR CONNECTORS	
1 Generator Connector C121	2 Check the battery terminals and generator connectors C121 and C120 for corrosion and tightness. • **Are all the connectors clean and tight?**

	→ **Yes** CARRY OUT the Generator On-Vehicle Tests. REFER to Component Tests in this section. → **No** REPAIR the connectors as necessary. TEST the system for normal operation.

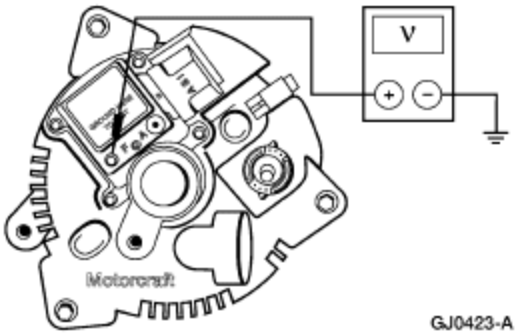
PINPOINT TEST F: THE BATTERY IS DEAD OR WILL NOT STAY CHARGED OR LOW BATTERY OR GENERATOR VOLTAGE—4.0L

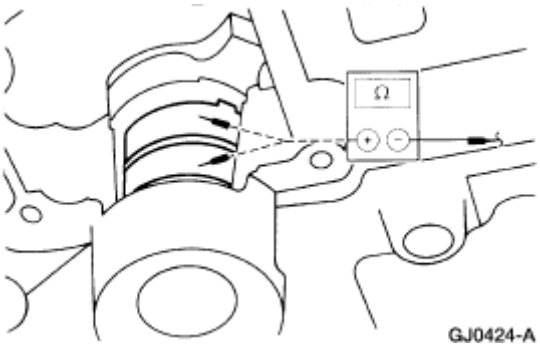
CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE BATTERY DRAIN	
1 	2 Make sure that all interior lamps and switches are off. 3 Check the battery drain. • **Is the drain greater than 0.5 amps?** → **Yes** CARRY OUT the Battery — Drain Testing. REFER to Component Tests in this section. → **No** GO to F2 .
F2 CHECK THE GENERATOR OUTPUT	
	1 Check the generator output. Carry out the Generator On-Vehicle Tests. Refer to Component Tests in this section. • **Is the generator OK?** → **Yes** GO to F3 . → **No** INSTALL a new generator. TEST the system for normal operation.
F3 CHECK THE BATTERY CONDITION	
	1 Carry out the Battery — Condition Test to determine if the battery can hold a charge and is OK for use. Refer to Section 414-01 • **Is the battery OK?** → **Yes**

	GO to F4 . → **No** INSTALL a new battery (10655). TEST the system for normal operation.
F4 CHECK OTHER ELECTRICAL SYSTEMS FOR DRAINS	
	1 Check the drains from electronic modules. Carry out the test for Battery — Electronic Drains Which Shut Off When the Battery Cable is Disconnected. Refer to Component Tests in this section. • **Are electronic modules OK?** → **Yes** RECHARGE the battery. TEST the system for normal operation. → **No** INSTALL a new module or REPAIR the circuit causing the electrical drain as necessary. TEST the system for normal operation.

PINPOINT TEST G: THE CHARGING SYSTEM WARNING INDICATOR FLICKERS/IS INTERMITTENT — 4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE POWER TO CIRCUITS 36 (Y/W) AND 904 (LG/R)	
1 2 Mini-fuse 24 (15A) 3 Fuse 15 (7.5A)	3 Check Fuse 15 (7.5A) and the Mini-fuse 24 (15A). • **Are the fuses OK?** → **Yes** GO to G2 . → **No** INSTALL a new fuse(s) as necessary. TEST the system for normal operation.
G2 CHECK THE FIELD CIRCUIT	

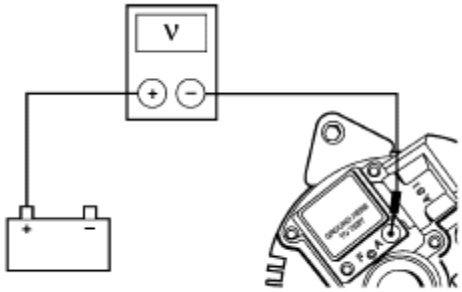
1 2  	2 Measure the voltage at test point F at the rear of the generator. • **Is the voltage equal to the battery voltage?** → **Yes** GO to G4 . → **No** GO to G3 .
G3 CHECK FOR A GROUNDED SLIP RING	
1 2 Generator Connector C121 3 Generator Connector C120 4	4 Remove the voltage regulator from the generator. Measure the resistance from both generator slip rings to ground.

	• **Is the resistance greater than 1 K ohms?** → **Yes** INSTALL a new generator. TEST the system for normal operation. → **No** INSTALL a new voltage regulator. TEST the system for normal operation.
G4 CHECK THE WARNING SYSTEM INDICATOR OPERATION	
1 	2 With the engine running, increase the engine speed, check the indicator operation and check for a battery voltage increase. • **Does the battery voltage increase above 15 volts or does the indicator flicker?** → **Yes** REPAIR circuit 904 (LG/R) as necessary. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

PINPOINT TEST H: THE SYSTEM OVERCHARGES (BATTERY VOLTAGE GREATER THAN 15.5 VOLTS) — 4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK FOR A VOLTAGE DROP	
1	

2



2 Check for voltage drop from the battery positive post and the voltage regulator A terminal.

- **Is the voltage drop less than 0.5 volts?**

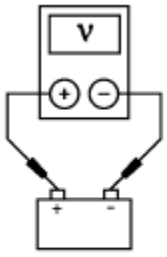
→ **Yes**
GO to H2 .

→ **No**
REPAIR circuit 36 (Y/W) for high resistance as necessary. TEST the system for normal operation.

H2 CHECK THE BATTERY VOLTAGE

1

2



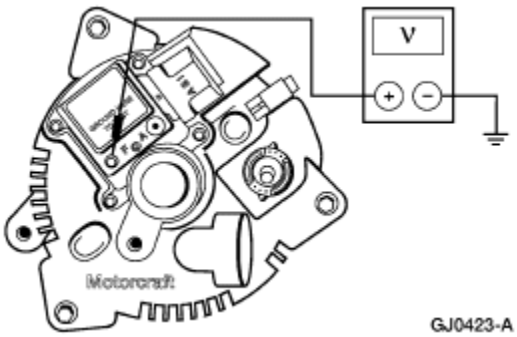
2 With the engine running, turn off all accessories. Increase the engine speed and monitor the voltage at the battery.

- **Does the battery voltage remain less than 15 volts?**

→ **Yes**
GO to H3 .

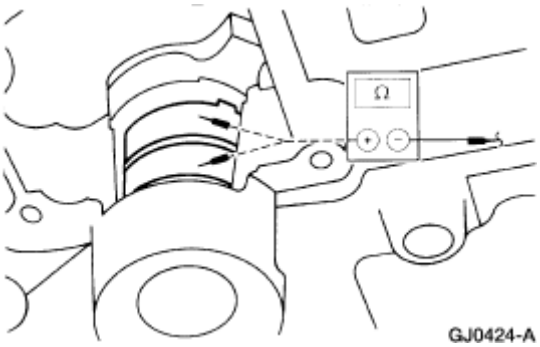
→ **No**
GO to H6 .

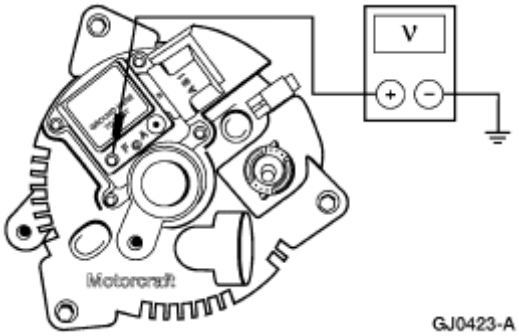
H3 CHECK THE GENERATOR FOR LOW VOLTAGE

1	
2 	2 With the ignition switch OFF, measure the voltage at the voltage regulator F terminal. • **Does the voltage equal battery voltage?** → **Yes** GO to H5 . → **No** GO to H4 .

H4 CHECK FOR A GROUNDED SLIP RING

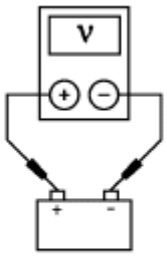
1	
2 Generator Connector C121	
3 Generator Connector C120	
4	4 Remove the voltage regulator from the generator. Measure the resistance from both generator slip rings to ground.

	• **Is the resistance greater than 1 K ohms?** → **Yes** INSTALL a new voltage regulator. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.
H5 CHECK THE WARNING SYSTEM INDICATOR OPERATION	
1 	2 With the engine running, increase the engine speed, check the indicator operation and check for a battery voltage increase. • **Does the battery voltage increase above 15 volts or does the indicator flicker?** → **Yes** REPAIR circuit 904 (LG/R) as necessary. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.
H6 CHECK THE VOLTAGE REGULATOR OPERATION	
1	1 With the engine running, monitor the voltage at the F pin while increasing the engine speed.

	• **Does the voltage at pin F increase with higher engine speed?** → **Yes** INSTALL a new generator. TEST the system for normal operation. → **No** INSTALL a new voltage regulator. TEST the system for normal operation.

PINPOINT TEST J: BATTERY LEAKAGE OR DAMAGE — 4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK FOR ACID LEAKAGE AND DAMAGE	
	1 Check for acid damage to the vehicle harnesses and to the body. • **Is there acid damage?** → **Yes** REPAIR damaged areas as necessary. → **No** GO to J2 .
J2 CHECK THE CHARGING SYSTEM FOR OVERCHARGING	
1 2	2 With the engine running turn off all accessories. Increase the engine speed and monitor the voltage at the battery.



AJ0210-A

- **Does battery voltage increase more than 15 volts?**

→ **Yes**
GO to Pinpoint Test H .

→ **No**
GO to J3 .

J3 CHECK THE BATTERY MOUNTING

1 Make sure the battery is properly mounted and level in the battery tray.

- **Is the battery properly mounted?**

→ **Yes**
GO to J4 .

→ **No**
INSTALL the battery. TEST the system for normal operation.

J4 CHECK FOR BATTERY CONTACT

1 Make sure that there are no fasteners or other parts contacting the battery case causing excess pressure.

- **Is there anything contacting the battery case?**

→ **Yes**
REMOVE or REPOSITION these items as necessary. TEST the system for normal operation.

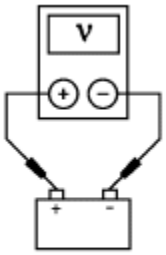
→ **No**
GO to J5 .

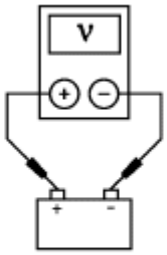
J5 CHECK THE BATTERY CASE FOR DAMAGE

1 Check the battery case for damage such as cracks or poor seals.

	• **Is the battery OK?** → **Yes** The charging system is OK. TEST the system for normal operation. → **No** INSTALL a new battery. TEST the system for normal operation.

PINPOINT TEST K: THE VOLTAGE GAUGE READS HIGH OR LOW — 4.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE BATTERY VOLTAGE	
1 2  AJ0210-A	2 With the engine running, turn off all accessories. Increase the engine speed and monitor the voltage at the battery. • **Is the battery voltage more than 15 volts?** → **Yes** GO to Pinpoint Test H . → **No** GO to K2 .
K2 CHECK THE VOLTAGE GAUGE OPERATION	
1	1 With the engine running monitor the voltage gauge reading and the battery voltage.

 AJ0210-A	• **Are the voltage readings consistent?** → **Yes** The charging system is operating normally. → **No** GO to Section 413-01 to continue diagnostics.

PINPOINT TEST L: THE GENERATOR IS NOISY

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK FOR ACCESSORY DRIVE NOISE	
	1 Check the drive belt for damage and to verify installation. Refer to Section 303-05 . 2 Check the accessory mounting brackets for loose bolts or misalignment. 3 Check for a bent generator pulley. • **Is the accessory drive OK?** → **Yes** GO to L2 . → **No** REFER to Section 303-05 for diagnosis and testing of the accessory drive system.
L2 SUBSTITUTE A KNOWN GOOD GENERATOR	
1 2 Generator Connector	

C121 4 	3 Install a known good generator. • **Is the noise present with a known good generator?** → **Yes** INSTALL the original generator and CHECK other accessories to FIND the cause of the noise. → **No** INSTALL a new generator. RETEST the system for normal operation.

PINPOINT TEST M: RADIO INTERFERENCE

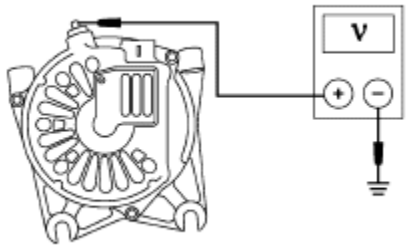
CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 VERIFY THERE IS RADIO INTERFERENCE	
1 	
	2 Tune the radio to a station where the interference is present.
3 	
4 Generator Connector C121	4 Disconnect the generator connector C121.
5 	
	• **Is the interference present with the generator disconnected?** → **Yes** REFER to Section 415-00 for diagnosis and testing of the in-vehicle entertainment system.

	→ **No** GO to M2 .
M2 SUBSTITUTE A KNOWN GOOD GENERATOR	
1 3 	2 Install a known good generator (GEN) (10346). • **Is there radio interference present with a known good generator ?** → **Yes** INSTALL the original generator and REFER to Section 415-00 for diagnosis and testing of the in-vehicle entertainment system. → **No** INSTALL a new generator. RETEST the system.

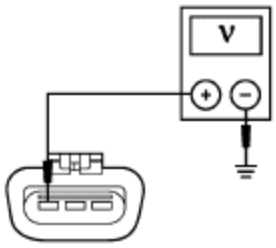
PINPOINT TEST N: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING (THE BATTERY VOLTAGE DOES NOT INCREASE) — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK THE A CIRCUIT FUSE LINK (18 GA)	
1 2 Fuse 15 (15A)	2 Check the A circuit Fuse 24 (15A) in Power Distribution Box. • **Is the fuse OK?** → **Yes** GO to N2 . → **No** INSTALL a new Fuse 24 (15A). TEST the system for normal operation.

N2 CHECK CIRCUIT 38 (BK/O)

1  AJ0213-A	1 Measure the voltage between the B+ terminal on the generator, circuit 38 (BK/O). • **Is the voltage equal to battery positive voltage (B+)?** → **Yes** GO to N3 . → **No** REPAIR circuit 38 (BK/O). TEST the system for normal operation.

N3 CHECK CIRCUIT 36 (Y/W)

1 Generator Connector C121 2  AJ0202-A	2 Measure the voltage between generator connector pin C-121-A circuit 36 (Y/W) and ground. • **Is the voltage equal to battery positive voltage (B+)?** → **Yes** GO to N4 . → **No** REPAIR circuit 36 (Y/W). TEST the system for normal operation.

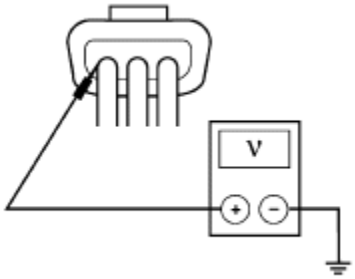
N4 CHECK I CIRCUIT 904 (LG/R) FOR AN OPEN

1

Generator Connector C121

2

3



GJ0440-A

3 **NOTE:** The voltage regulator must be connected to the wiring harness for this test.

Measure the voltage between the generator I-terminal, circuit 904 (LG/R) and ground.

- **Is the voltage greater than 1 volt?**

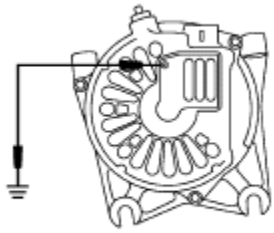
→ **Yes**
GO to N5 .

→ **No**
REPAIR circuit 904 (LG/R)as necessary. TEST the system for normal operation.

N5 CHECK THE GENERATOR OUTPUT

1

2



AJ0212-A

2 With the engine running, ground the F pin on the generator/regulator.

- **Does the battery voltage increase and**

	the charging system warning indicator turn off? → **Yes** INSTALL a new generator. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

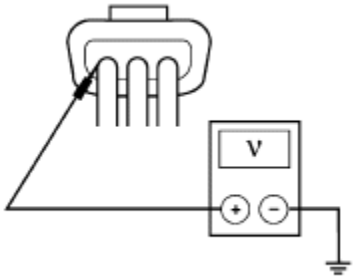
PINPOINT TEST P: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE OFF (BATTERY VOLTAGE DOES NOT INCREASE) — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK GENERATOR CONNECTOR C121	
1 Generator Connector C121	2 Check generator connector C121 for bent, or damaged pins. • **Is the connector OK?** → **Yes** GO to P2 . → **No** REPAIR connector C121 as necessary. TEST the system for normal operation.
P2 CHECK THE GENERATOR GROUNDS	
	1 Check all ground connections between the generator, voltage regulator and the battery. • **Are the ground connections OK?** → **Yes** GO to P3 . → **No** REPAIR connections as necessary. TEST the system for normal operation.
P3 CHECK THE VOLTAGE AT I CIRCUIT 904 (LG/R)	
1	

Generator Connector C121

2

3



GJ0440-A

3 **NOTE:** The generator connector C121 must be connected to the generator for this test.

Measure the voltage between the generator I terminal, circuit 904 (LG/R) and ground.

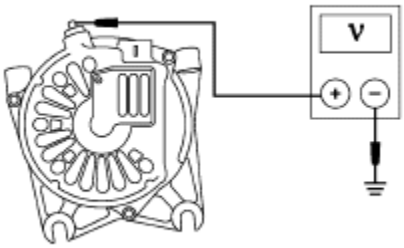
- **Is the voltage greater than 1 volt?**

→ **Yes**
INSTALL a new generator.

→ **No**
REPAIR circuit 904 (LG/R) for open circuit.
TEST the system for normal operation.

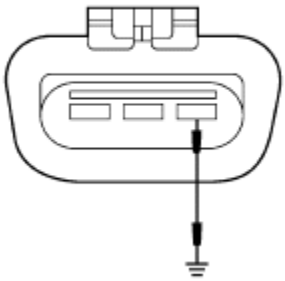
PINPOINT TEST Q: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING AND THE BATTERY VOLTAGE INCREASES — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK CONNECTOR C121	
1 Generator Connector C121	2 Make sure that connector C121 is correctly mated to the generator and making contact. • **Is the connection OK?** → **Yes** GO to Q2 .

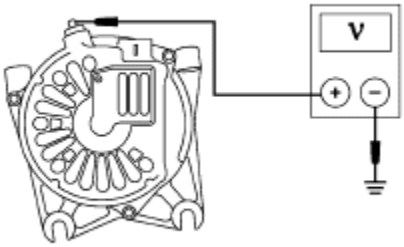
	→ **No** REPAIR connector C121 as necessary. TEST the system for normal operation.
Q2 CHECK THE GENERATOR OUTPUT VOLTAGE	
1 2  AJ0213-A	2 With the engine running at 2000 rpm, measure the voltage output at the generator B+ terminal. • **Is the voltage output less than 16 volts?** → **Yes** GO to Q3 . → **No** GO to Pinpoint Test V .
Q3 CHECK THE WARNING INDICATOR OPERATION	
1 2 Generator Connector C121 3 	4 With the engine running at idle, check the Warning Indicator. • **Is the Warning Indicator on?**

	→ **Yes** REPAIR connector C121, I circuit 904 (LG/R) as necessary. TEST the system for normal operation. → **No** GO to Pinpoint Test R .

PINPOINT TEST R: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE OFF (BATTERY VOLTAGE INCREASES) — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK THE CHARGING SYSTEM WARNING INDICATOR OPERATION	
1 2 Generator Connector C121 3  AJ0206-A	3 Ground the generator connector C121 I circuit with the key ON and the engine OFF. • **Is the warning indicator on?** → **Yes** INSTALL a new generator. TEST the system for normal operation. → **No** REPAIR connector C121, I circuit 904 (LG/R) as necessary. TEST the system for normal operation.

PINPOINT TEST S: THE CHARGING SYSTEM WARNING INDICATOR OPERATES CORRECTLY BUT THE BATTERY VOLTAGE DOES NOT INCREASE — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
S1 CHECK CIRCUIT 38 (BK/O) VOLTAGE	
1 2  AJ0213-A	2 Check for voltage at generator B+ connector with the key ON and the engine OFF. • **Is the voltage equal to battery positive voltage (B+)?** → **Yes** GO to S2. → **No** REPAIR circuit 38 (BK/O) as necessary. TEST the system for normal operation.
S2 CHECK THE GENERATOR CONNECTORS	
1 Generator Connector C121	2 Check the battery and generator connector C121 for corrosion and tightness. • **Are the connectors clean and tight?** → **Yes** REFER to Generator On-Vehicle Tests. → **No** REPAIR the connectors as necessary. TEST the system for normal operation.

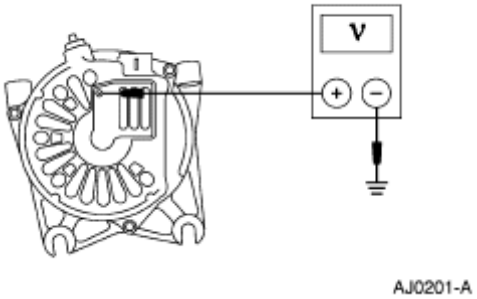
PINPOINT TEST T: THE BATTERY IS DEAD OR WILL NOT STAY CHARGED OR LOW BATTERY OR GENERATOR VOLTAGE — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
T1 CHECK THE BATTERY DRAIN	
1 	2 Make sure that all interior lights and switches are off and all doors are closed. Carry out Battery — Drain Test. Refer to Component Tests in this section. • **Is the drain greater than 0.5 amps?** → **Yes** GO to Component Tests, Battery—Drain Testing. → **No** GO to T2 .
T2 CHECK THE GENERATOR OUTPUT	
	1 Check the generator output. Refer to Generator On-Vehicle Tests. • **Is the generator OK?** → **Yes** GO to T3 . → **No** INSTALL a new generator. TEST the system for normal operation.
T3 CHECK THE BATTERY CONDITION	
	1 Carry out the Battery — Condition Test to determine if the battery can hold a charge and is OK for use. Refer to Section 414-01 . • **Is the battery OK?** → **Yes** GO to T4 . → **No** INSTALL a new battery. TEST the system for normal operation.
T4 CHECK OTHER SYSTEMS FOR DRAINS	
	1 Check for drains from electronic modules. Refer to Component Tests, Battery — Electronic Drains Which Shut Off When the Battery Cable is Disconnected. • **Are electronic modules OK?** → **Yes** RECHARGE the battery. TEST the system for normal operation.

	→ **No** INSTALL a new module as necessary. TEST the system for normal operation.

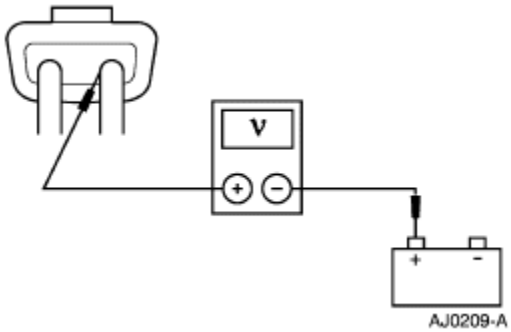
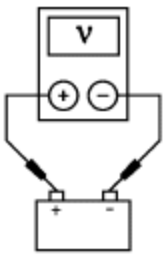
PINPOINT TEST U: THE CHARGING SYSTEM WARNING INDICATOR FLICKERS/IS INTERMITTENT — 4.0L SOHC, 5.0L

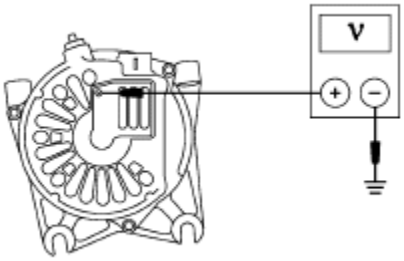
CONDITIONS	DETAILS/RESULTS/ACTIONS
U1 CHECK THE POWER TO CIRCUITS 36 (Y/W) AND 904 (LG/R)	
1 2 Fuse 24 (15A) 3 Fuse 15 (7.5A)	3 Check Fuse 15 (7.5A) and Fuse 24 (15A). • **Are the fuses OK?** → **Yes** GO to U2 . → **No** REPAIR as necessary. TEST the system for normal operation.
U2 CHECK THE FIELD CIRCUIT	
1 2	2 Using an insulated probe, measure voltage at test point F at rear of Generator.

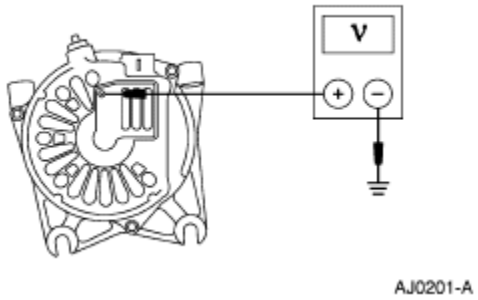
 AJ0201-A	• **Is the voltage equal to the battery voltage?** → **Yes** GO to U3 . → **No** INSTALL a new generator. TEST the system for normal operation
U3 CHECK THE WARNING SYSTEM INDICATOR OPERATION	
1 	2 With the engine running, increase the engine speed, check the indicator operation and check for a battery voltage increase. • **Does the battery voltage increase above 15 volts or does the indicator flicker?** → **Yes** REPAIR circuit 904 (LG/R) as necessary. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

PINPOINT TEST V: THE SYSTEM OVERCHARGES (BATTERY VOLTAGE GREATER THAN 15.5 VOLTS) — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
V1 CHECK FOR VOLTAGE DROP	
1	

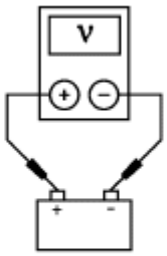
2  AJ0209-A	3 Check for voltage drop from the battery positive post and the voltage regulator A circuit at connector C121. • **Is the voltage drop less than 0.5 volts?** → **Yes** GO to V2 . → **No** REPAIR circuit 36 (Y/W) for high resistance as necessary. TEST the system for normal operation.
V2 CHECK BATTERY VOLTAGE	
1 2  AJ0210-A	2 With the engine running, turn off all accessories. Increase the engine speed and monitor the voltage at the battery. • **Does the battery voltage remain less than 15 volts?** → **Yes**

	GO to V3 . → **No** GO to V5 .
V3 CHECK THE GENERATOR FOR LOW VOLTAGE	
1 2  	2 With the ignition switch OFF, use an insulated probe to measure the voltage at the voltage regulator F terminal. • **Does the voltage equal battery voltage?** → **Yes** GO to V4 . → **No** INSTALL a new generator. TEST the system for normal operation.
V4 CHECK THE WARNING SYSTEM INDICATOR OPERATION	
1 	2 With the engine running, increase the engine speed and check the indicator operation for a battery voltage increase. • **Does the battery voltage increase above 15 volts or does the indicator flicker?** → **Yes** REPAIR circuit 904 (LG/R) as necessary. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

V5 CHECK VOLTAGE REGULATOR OPERATION	
1  	1 With the engine running, use an insulated probe to monitor the voltage at the F pin while increasing the engine speed. • **Does the voltage at pin F increase with higher engine speed?** → **Yes** INSTALL a new voltage regulator. TEST the system for normal operation. → **No** INSTALL a new generator. TEST the system for normal operation.

PINPOINT TEST W: BATTERY LEAKAGE OR DAMAGE — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
W1 CHECK FOR ACID LEAKAGE AND DAMAGE	
	1 Check for acid damage to the vehicle harnesses and to the body. • **Is there acid damage?** → **Yes** REPAIR damaged areas as necessary. → **No** GO to W2 .
W2 CHECK CHARGING SYSTEM FOR OVERCHARGING	
1 2	2 With the engine running, turn off all accessories. Increase the engine speed and monitor the voltage at the battery.



AJ0210-A

- **Does battery voltage increase more than 15 volts?**

→ **Yes**
GO to Pinpoint Test V .

→ **No**
GO to W3 .

W3 CHECK BATTERY MOUNTING

1 Make sure the battery is properly mounted and level in the battery tray.

- **Is the battery properly mounted?**

→ **Yes**
GO to W4 .

→ **No**
REPAIR as necessary. TEST the system for normal operation.

W4 CHECK FOR BATTERY CONTACT

1 Make sure that there are no fasteners or other parts contacting the battery case causing excess pressure.

- **Is there anything contacting the battery case?**

→ **Yes**
REPAIR as necessary. TEST the system for normal operation.

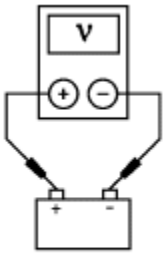
→ **No**
GO to W5 .

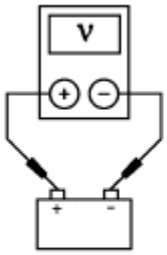
W5 CHECK BATTERY CASE FOR DAMAGE

1 Check the battery case for damage such as cracks or poor seals.

	• **Is the battery OK?** → **Yes** SYSTEM is OK. TEST the system for normal operation. → **No** INSTALL a new battery. TEST the system for normal operation.

PINPOINT TEST X: THE VOLTAGE GAUGE READS HIGH OR LOW — 4.0L SOHC, 5.0L

CONDITIONS	DETAILS/RESULTS/ACTIONS
X1 CHECK BATTERY VOLTAGE	
1 2  AJ0210-A	2 With the engine running, turn off all accessories. Increase the engine speed and monitor the voltage at the battery. • **Is the battery voltage more than 15 volts?** → **Yes** GO to Pinpoint Test H . → **No** GO to X2 .
X2 CHECK VOLTAGE GAUGE OPERATION	
1	1 With the engine running monitor the voltage gauge reading and the battery voltage.

 AJ0210-A	• **Are the voltage readings consistent?** → **Yes** SYSTEM is operating normally. → **No** REFER to Section 413-01 to continue diagnostics.

Component Tests

Battery — Drain Testing

1. Check for current drains on the battery in excess of 50 milliamps with all the electrical accessories off and the vehicle at rest. Current drains can be tested with the following procedure.

WARNING: Do not attempt this test on a lead-acid battery that has recently been recharged. Explosive gases can cause personal injury.

CAUTION: To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.

NOTE: Many computers draw 10 mA or more continuously.

NOTE: Use an in-line ammeter between the battery positive or negative post and its respective cable.

2. Turn the switch to mA/A dc.

3. Disconnect the battery terminal and touch the probes.

4. Isolate the circuit causing the current drain by pulling out one fuse after another from the fuse junction panel while reading the display.
   The current reading will drop when the fuse on the bad circuit is pulled.

5. Reinstall the fuse and test the components (including connectors) of that circuit to find defective component(s).

The current reading (current drain) should be less than 0.05 amp. If current drain exceeds 0.05 amp, a constant current drain is present (Underhood, glove compartment and luggage compartment lamps that do

not shut off properly are all possible sources of current drain).

- If the drain is not caused by a vehicle lamp, remove the fuses from the interior fuse junction panel one at a time, until the cause of the drain is located.
- If the drain is still undetermined, remove the fuses one at a time at the power distribution box to find the problem circuit.

Battery — Electronic Drains Which Shut Off When the Battery Cable Is Disconnected

1. Repeat the steps of the battery drain testing.

2. Without starting the engine, turn the ignition switch to RUN for a moment and then OFF. Wait one minute for the illuminated entry lamps to turn off if equipped.

3. Connect the voltmeter and read the voltage.

The current reading (current drain) should be less than 0.05 amp. If current drain exceeds 0.05 amp after a few minutes, and if this drain did not show in previous tests, the drain is most likely caused by a malfunctioning electronic component. As in previous tests, remove the fuses in the fuse junction panel one at a time to locate the problem circuit.

Generator On-Vehicle Tests

CAUTION: To prevent damage to the generator, do not make jumper wire connections except as directed.

CAUTION: Do not allow any metal object to come in contact with the housing and the internal diode cooling fins with key on or off. A short circuit will result and burn out the diodes.

NOTE: Battery posts and cable clamps must be clean and tight for accurate meter indications.

NOTE: Refer to the battery tester manual for complete directions on checking out the charging system.

1. Turn OFF all lamps and electrical components.

2. Place the vehicle in transmission range NEUTRAL and apply the parking brake.

3. Carry out Load Test and No-Load Test according to the following component tests.

Generator On-Vehicle Test — Load Test

4. Switch the tester to the ammeter function.

5. Connect the positive and negative leads of the tester to the corresponding battery terminals.

6. Connect the current probe to the generator B+ output lead, circuit 38 (BK/O).

7. With the engine running at 2000 rpm, adjust the tester load bank to determine the output of the generator. Refer to the Symptom Chart in this section for diagnostic procedures.

8. With the engine running, turn the A/C on, the blower motor on high speed and the headlamps on high beam.

9. Increase the engine speed to approximately 2,000 rpm. The voltage should increase a minimum of 0.5 volt above the base voltage.
    - If the voltage does not increase as specified, carry out the Generator On-Vehicle Tests in this section.
    - If the voltage increases as specified, the charging system is operating normally.

Generator On-Vehicle Test — No-Load Test

1. Switch the tester to the voltmeter function.

2. Connect the voltmeter positive lead to the generator B+ terminal and the negative lead to ground.

3. Turn all electrical accessories off.

4. With the engine running at 2000 rpm, check the generator output voltage. The voltage should be between 13.0 and 15.0 volts. If not, refer to the Symptom Chart for diagnostic procedures.

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery Cable Bolts	7-10	—	62-89
Battery Ground Cable to Engine Block Stud Nut (5.0L)	11-20	8-15	—
Battery Ground Cable to Frame Bolt	11-13	8-10	—
Battery Ground Cable to Radiator Support Nut	11-13	8-10	—
Battery Ground Cable to Starter Motor Stud Nut (4.0L)	23-32	17-24	—
Battery Hold-Down Bracket Bolt	10-14	7-10	—
Battery Tray Bolts	26-34	19-25	—
Starter Motor Nut	9-14	—	80-123
Starter Motor Solenoid Relay Switch Cable Nuts	5-11	—	44-98
Chassis Ground Cable Nut	11-13	8-10	—

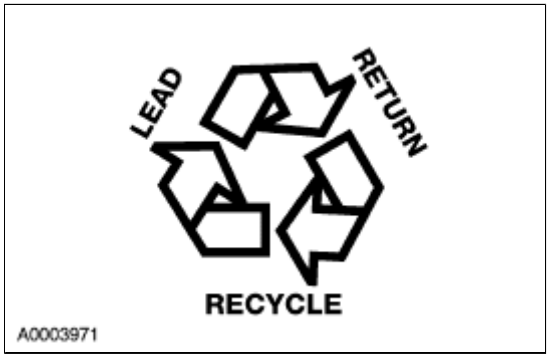
Battery and Cables

Vehicles are equipped with a 12 volt maintenance-free battery.

The battery and cable system consists of the following components:

- battery
- battery cable assembly
- battery tray

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



Battery

Special Tool(s)

ST2442-A	Micro 490 Digital Battery Analyzer 162-00004

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Battery • Battery mounting	• Battery cables • Battery posts

3. If an obvious cause for a concern is found, correct the cause before proceeding to the next step.
4. If the fault is not visually evident, proceed to the pinpoint test.

Pinpoint Tests

PINPOINT TEST A: BATTERY CONDITION TEST

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 TEST BATTERY CONDITION	
NOTE: No battery with a red test-eye should be replaced. The red eye only means the battery is discharged, not necessarily defective. **NOTE:** Failure to fully charge the battery before retesting may cause false readings.	
	1 Verify the battery condition using the Battery Analyzer. • **Is the battery OK?** → **Yes**

	Does the meter read, GOOD BATTERY? RETURN the battery to service. REFER to Section 414-00 . Does the meter read, GOOD-RECHARGE? CHARGE the battery and RETURN to service. REFER to Section 414-00 . Does the meter read, CHARGE & RETEST? Fully CHARGE the battery and RETEST. → **No** Does the meter read, REPLACE BATTERY? INSTALL a new battery. Does the meter read, BAD CELL-REPLACE? INSTALL a new battery.

Battery Disconnect

WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

WARNING: To avoid accidental deployment and possible injury, the backup power supply must be depleted before repairing or installing any front or side air bag supplemental restraint system (SRS) components and before repairing, installing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches. Failure to follow these procedures may result in personal injury.

Refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in personal injury.

WARNING: When lifting a battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners. Failure to follow these instructions may result in personal injury.

WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn its strategy.

   Disconnect the battery ground cable.

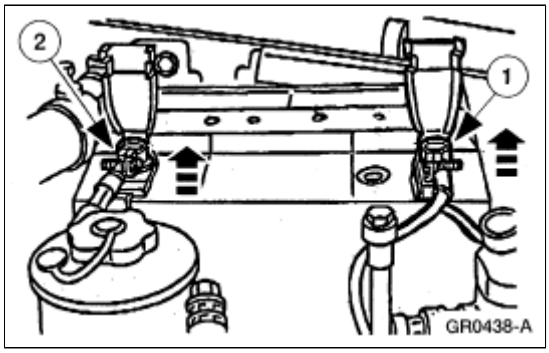
2. Disconnect the positive battery cable.

3. To install, reverse the removal procedure.

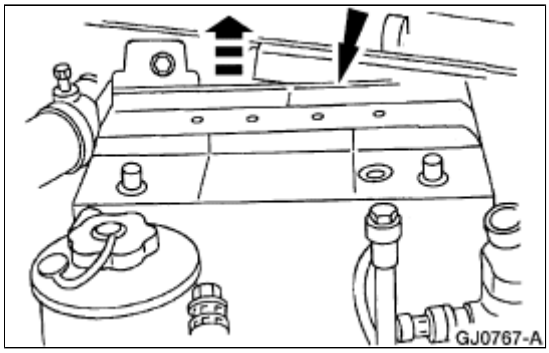
Battery

Removal

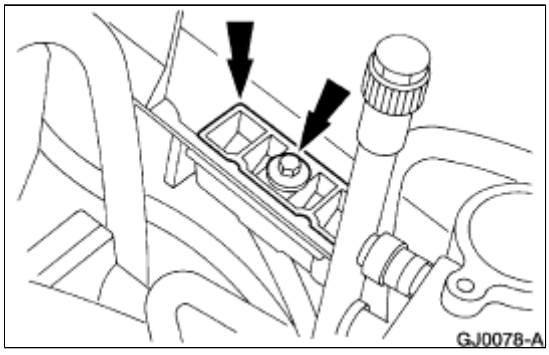
1. Disconnect the battery cables.
    1. Disconnect the battery ground cable (14301).
    2. Disconnect the battery to starter relay cable (14300).



2. Remove the battery heat shield (10A682).



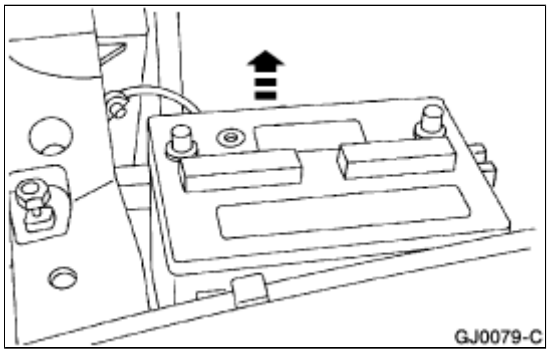
3. Remove the bolt and the battery hold down clamp.



4. **WARNING: When lifting a battery (10655) , excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery**

carrier or with your hands on opposite corners.

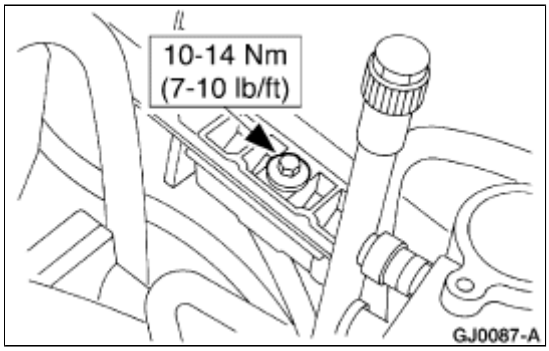
Remove the battery.

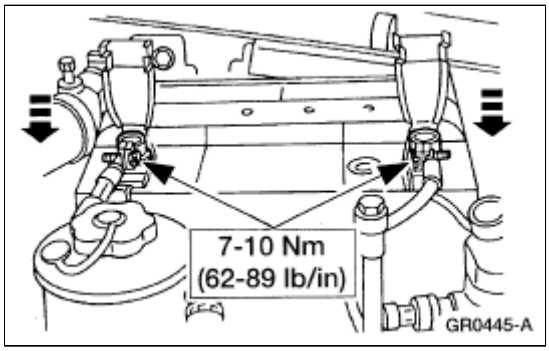


Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn the strategy.

   Follow the removal procedure in reverse order.

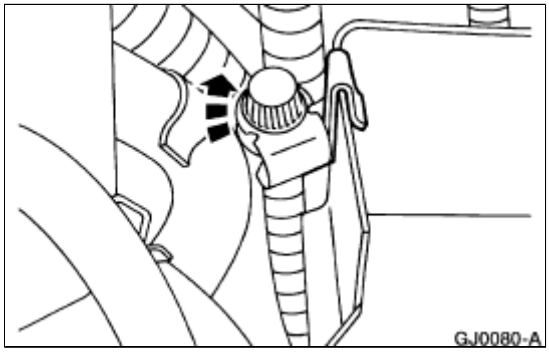




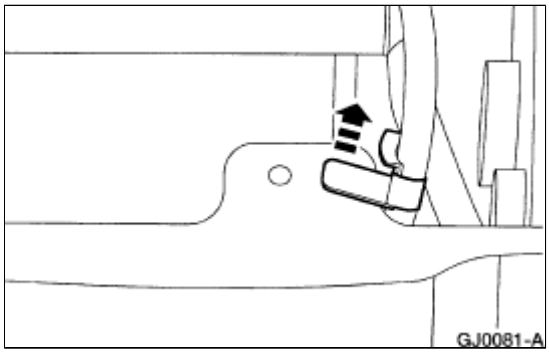
Battery Tray

Removal

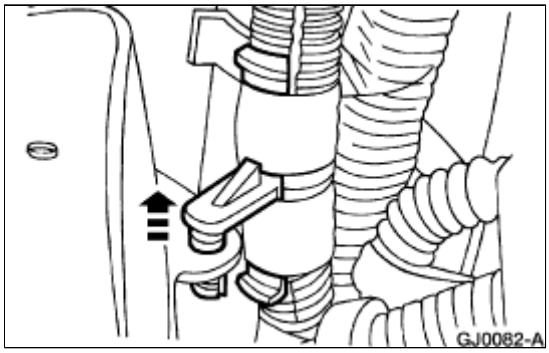
1. Remove the battery (10655); refer to Battery in this section.
2. Remove the evaporative emissions service port from the battery tray (10732).



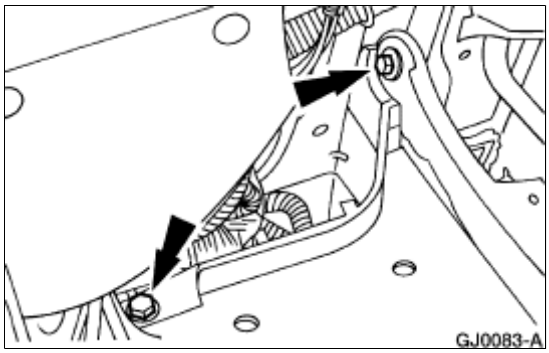
3. Remove the battery ground cable (14301) to battery tray pushpin.



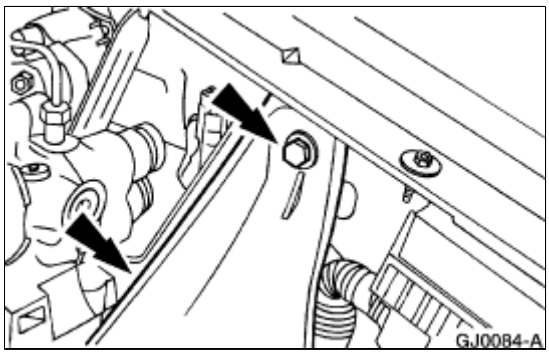
4. Remove the battery to starter relay cable (14300) to battery tray pushpin.



5. Remove the bolts.



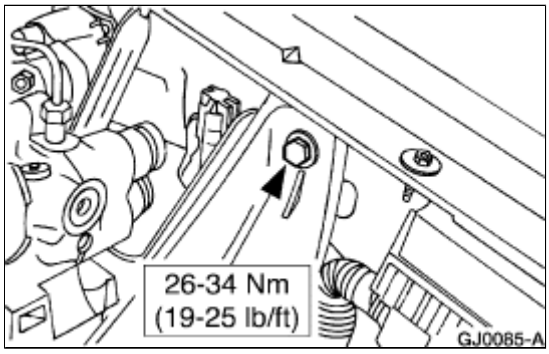
6. Remove the bolt and the battery tray.

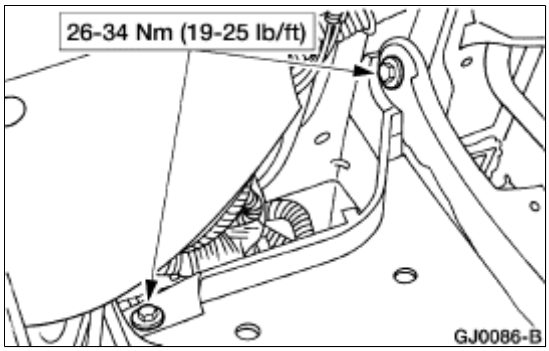


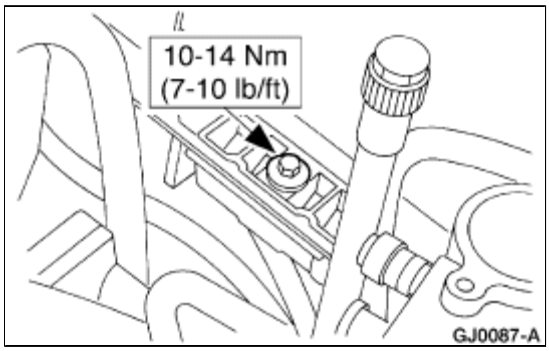
Installation

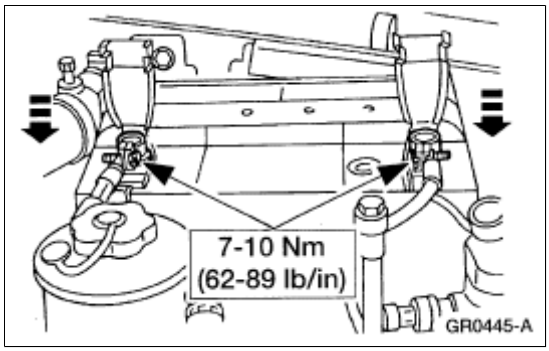
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   Follow the removal procedure in reverse order.




26-34 Nm (19-25 lb/ft)
GJ0086-B

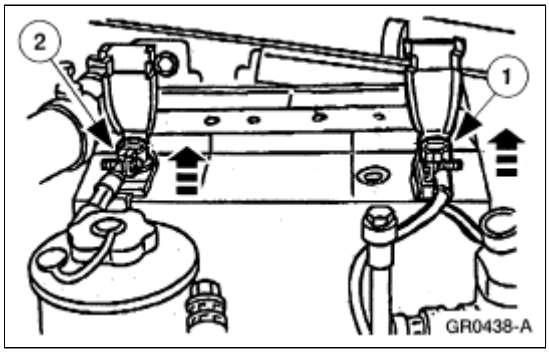

10-14 Nm
(7-10 lb/ft)
GJ0087-A


7-10 Nm
(62-89 lb/in)
GR0445-A

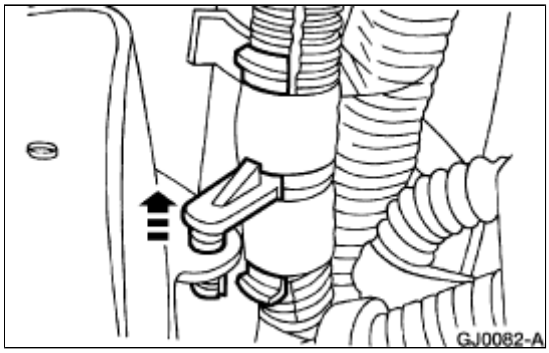
Battery Cables —4.0L

Removal

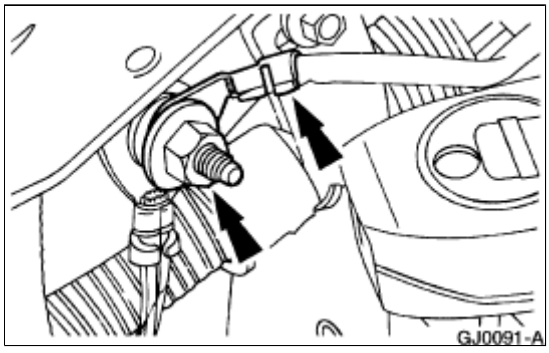
1. Disconnect the battery cables.
    1. Disconnect the battery ground cable (14301).
    2. Disconnect the battery to starter relay cable (14300).



2. Remove the three battery cable wire harness pushpins.

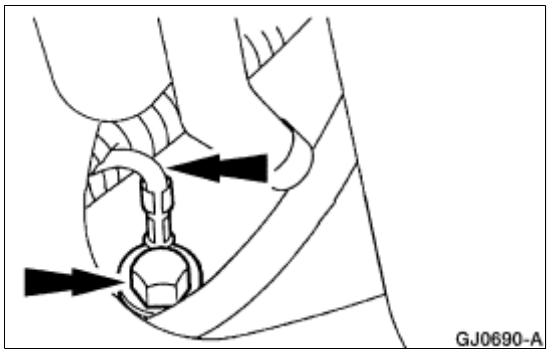


3. Remove the nut and the chassis ground cable.

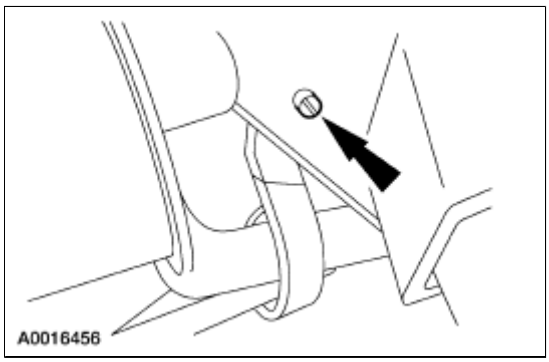


4. Raise and support the vehicle; refer to Section 100-02 .

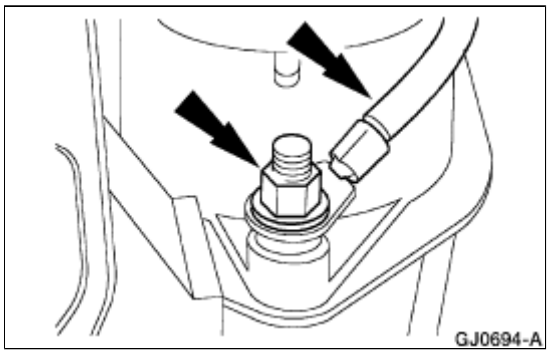
5. Remove the bolt, the frame ground cable, and the bracket.



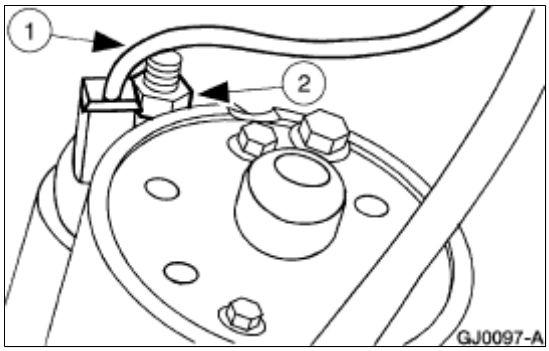
6. Remove the bolt from the battery cable bracket.



7. Remove the battery ground cable nut from the starter motor stud and remove the battery ground cable.

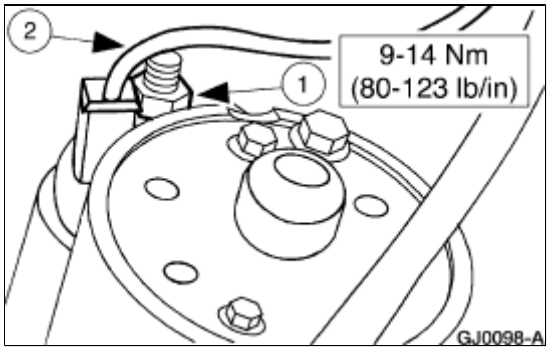


8. Remove the starter motor wiring harness.
    1. Remove the push-on electrical connector.
    2. Remove the starter motor wiring harness to starter motor nut and wire.
        - Remove battery cable wiring harness.

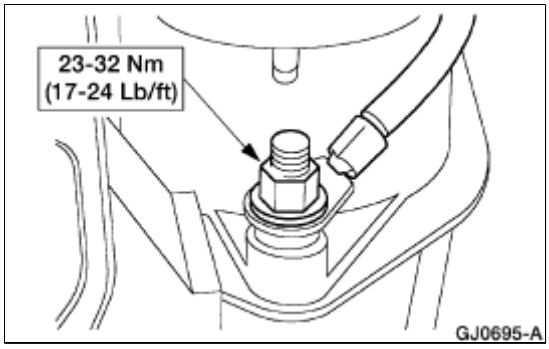


Installation

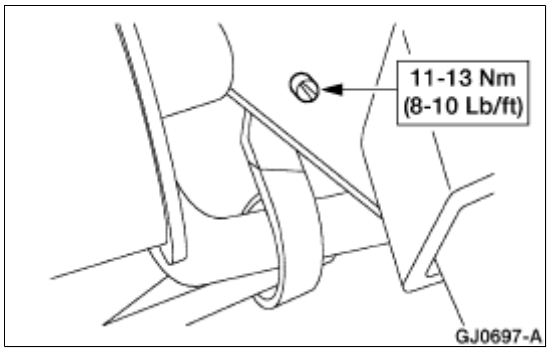
1. Install the starter motor wiring harness.
    1. Install the starter motor wiring harness to starter motor wire and nut.
    2. Install the push-on electrical connector.



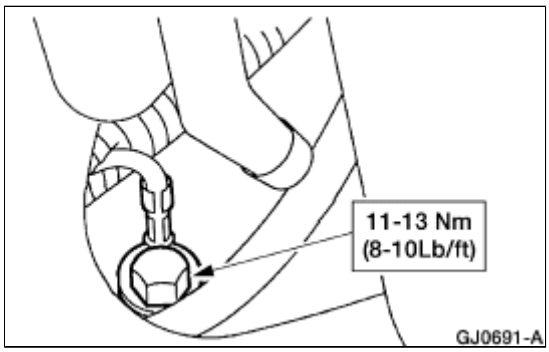
2. Install the battery ground cable to the starter motor stud and install the nut.



3. Install the battery cable bracket and the bolt.

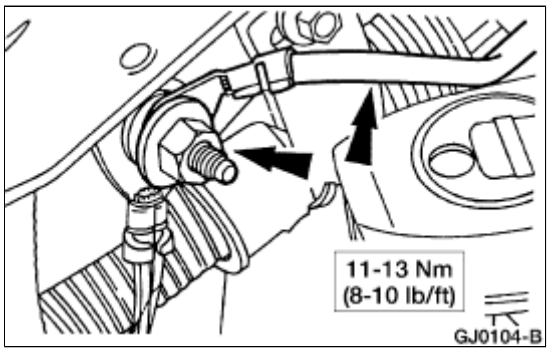


4. Position the frame ground cable, bracket and install the bolt.

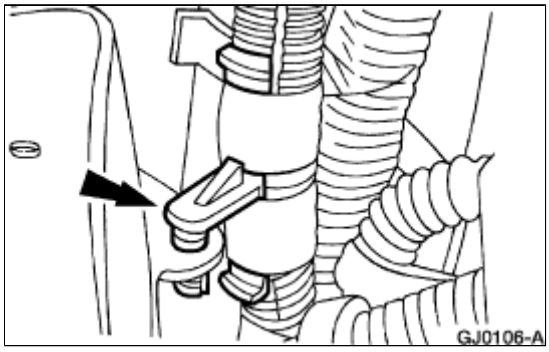


5. Lower the vehicle.

6. Install the chassis ground cable and the nut.

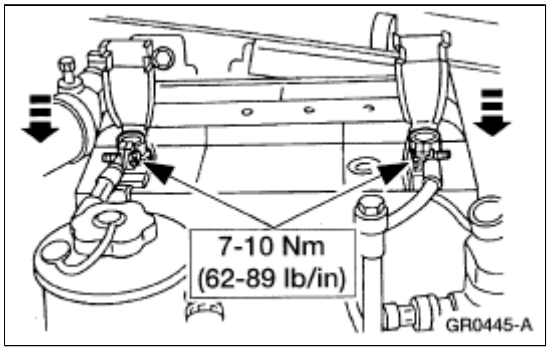


7. Install the three battery cable wire harness pushpins.



8. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn the strategy.

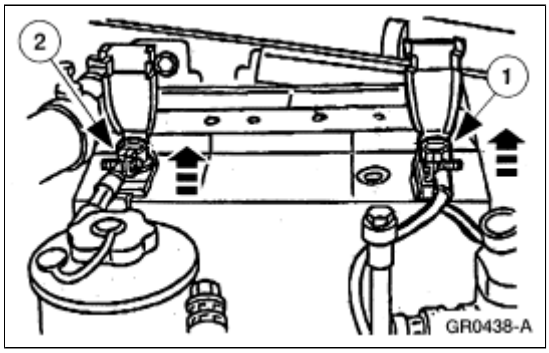
   Connect the battery to starter relay cable and then connect the battery ground cable.



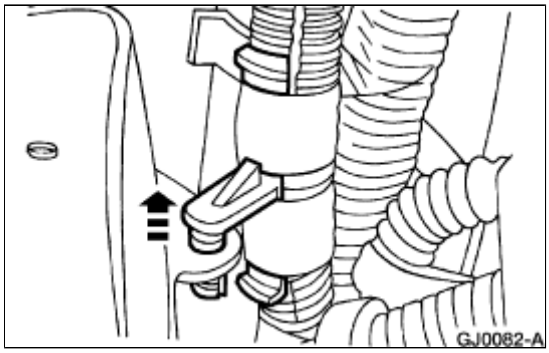
Battery Cables —5.0L

Removal

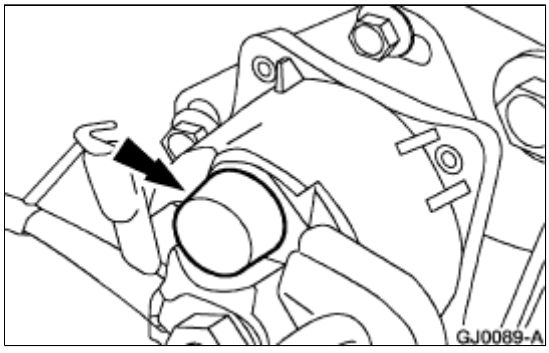
1. Disconnect the battery cables.
    1. Disconnect the battery ground cable (14301).
    2. Disconnect the battery to starter relay cable (14300).



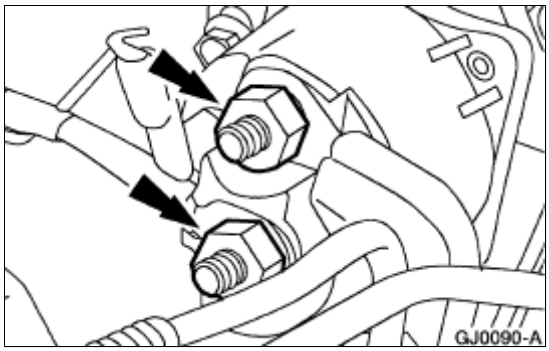
2. Remove the battery cable to battery tray pushpins.



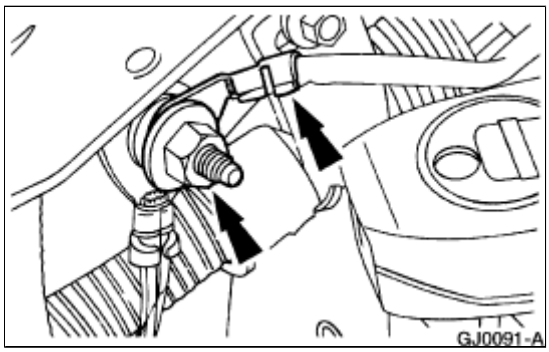
3. Remove the starter motor solenoid top nut insulator.



4. Remove the two starter motor solenoid relay switch cable nuts and the starter motor solenoid relay switch cable.

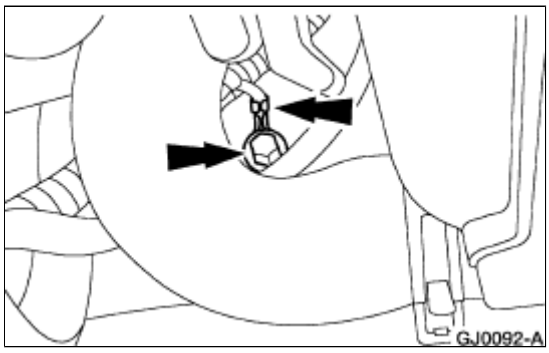


5. Remove the nut and the chassis ground cable.

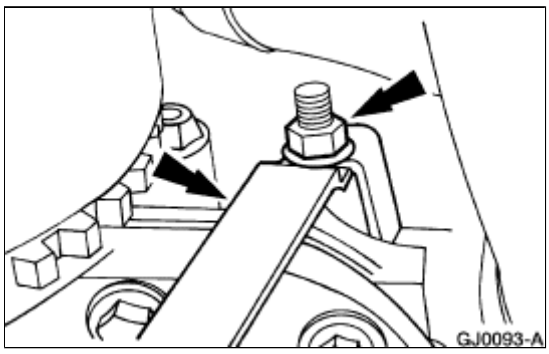


6. Raise and support the vehicle; refer to Section 100-02 .

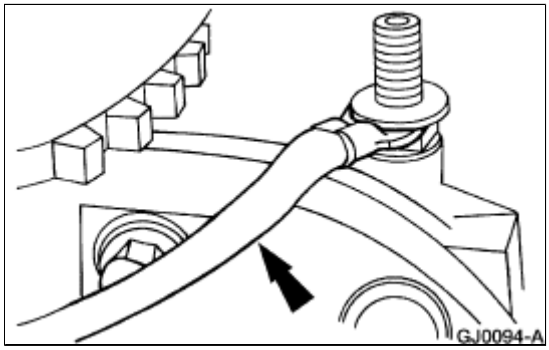
7. Remove the screw and the frame ground cable.



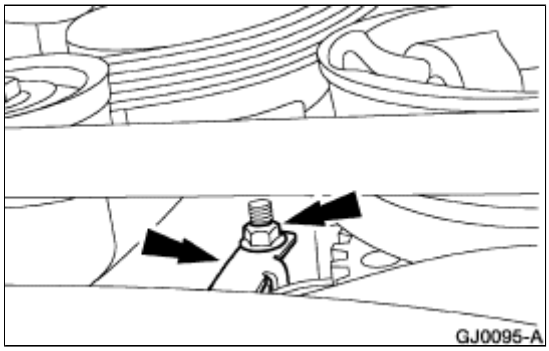
8. Remove the nut and the battery cable bracket.



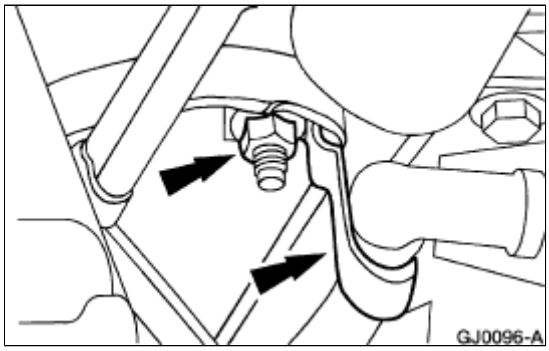
9. Remove the battery ground cable from the engine block stud.



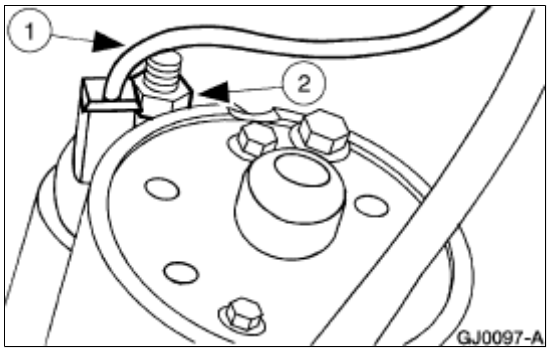
10. Remove the nut and the battery cable bracket.



11. Remove the nut and the battery cable bracket.

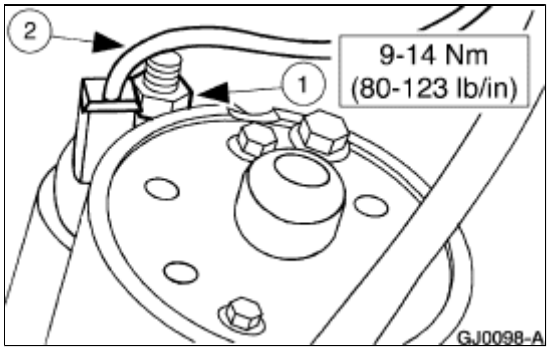


12. Remove the starter motor wiring harness.
    1. Remove the push-on electrical connector.
    2. Remove the starter motor wiring harness to starter motor nut and wire.
        - Remove battery cable wiring harness.

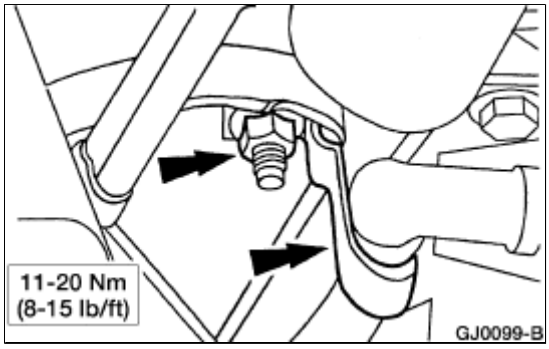


Installation

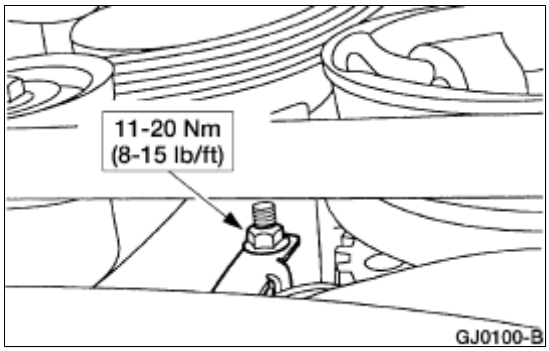
1. Install the starter motor wiring harness.
    1. Install the starter motor wiring harness to starter motor wire and nut.
    2. Install the push-on electrical connector.



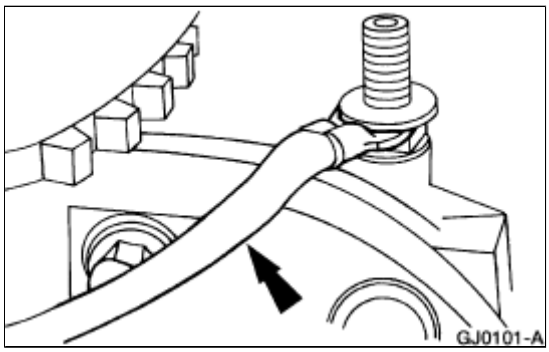
2. Install the battery cable bracket and the nut.



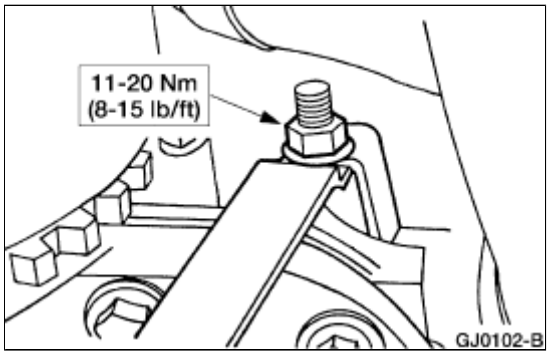
3. Install the battery cable bracket and the nut.



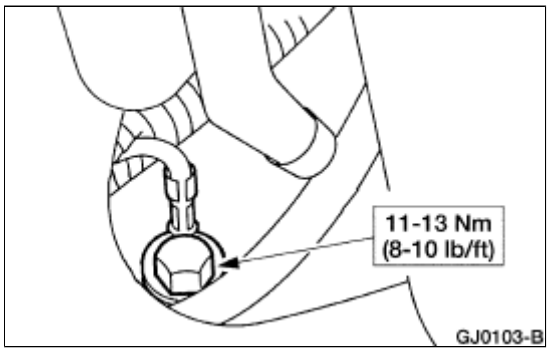
4. Install the battery ground cable on the engine block stud.



5. Install the battery cable bracket and the nut.

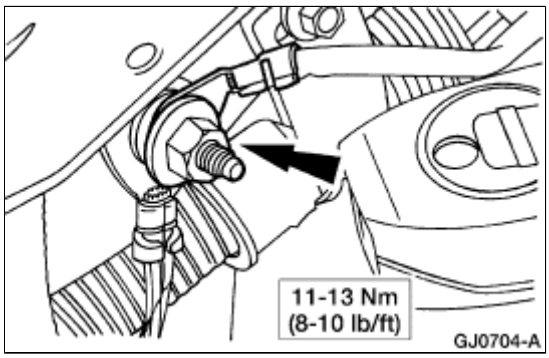


6. Position the frame ground cable and install the bolt.

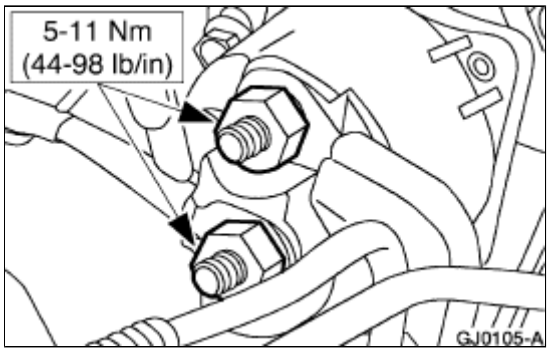


7. Lower the vehicle.

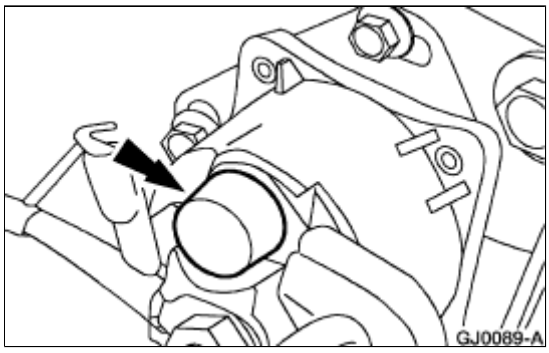
8. Install the chassis ground cable and the nut.



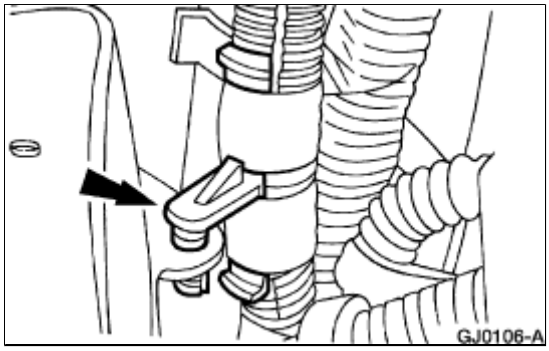
9. Install the starter motor solenoid relay switch cable and the two starter motor solenoid relay switch cable nuts.



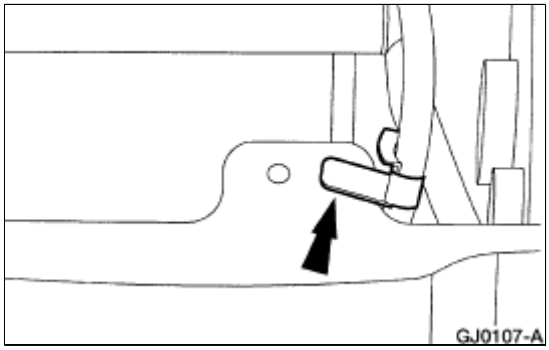
10. Install the starter motor solenoid top nut insulator.



11. Install the positive battery cable to battery tray pushpin.

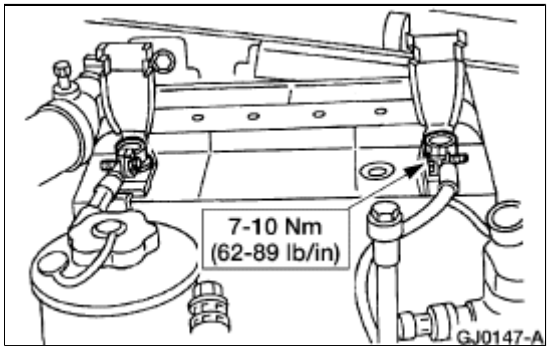


12. Install the battery ground cable to battery tray pushpin.



13. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

    Connect the battery to starter relay cable and then connect the battery ground cable.



General Specifications

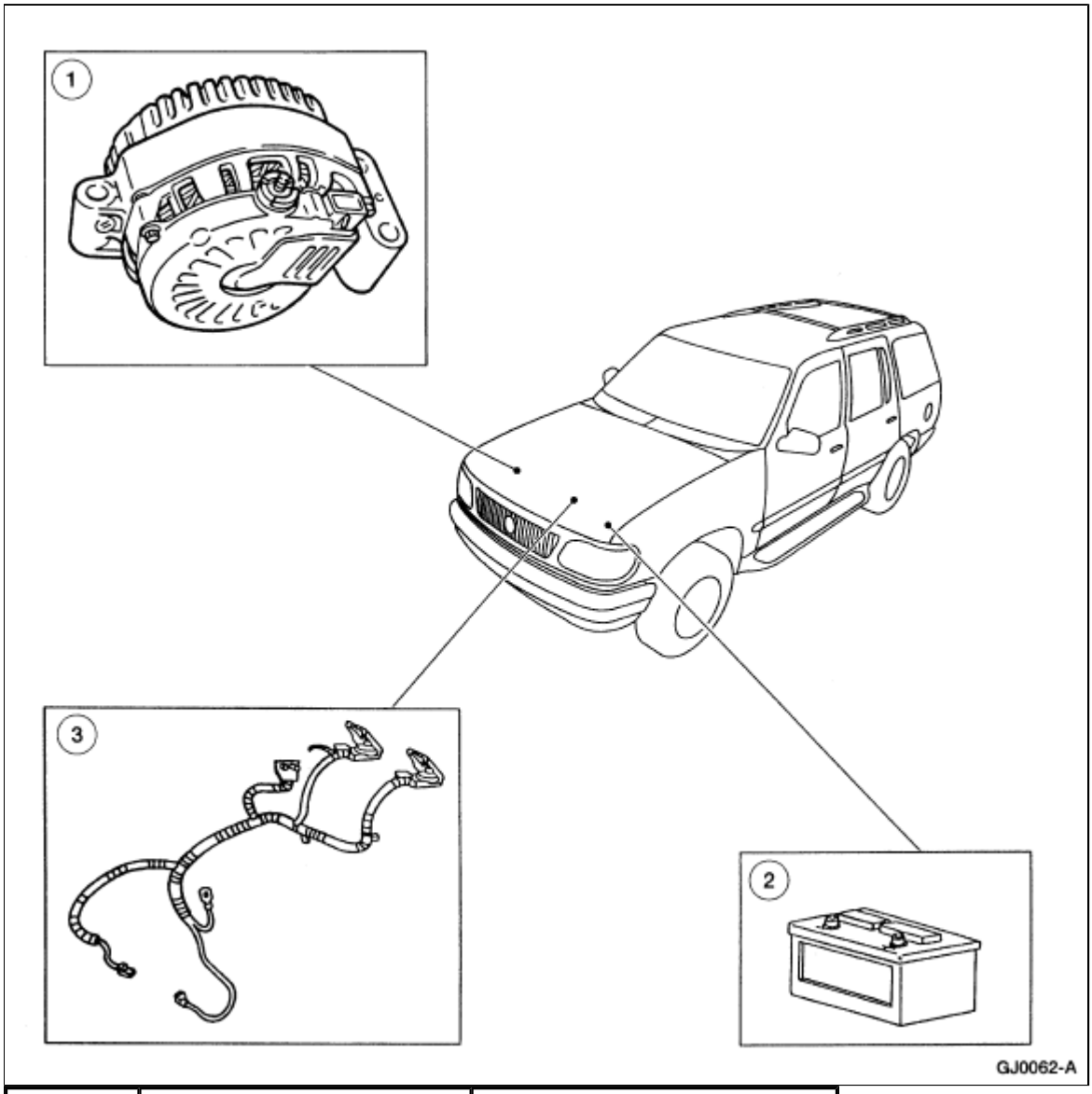
Item	Specification
Battery	72 amp/hr
58/120 Generator	65 amp
45/110 Generator	60 amp
35/90 Generator	45 amp

Torque Specifications

Description	Nm	lb-ft	lb-in
Generator to bracket bolts	40-55	30-40	—
Generator to bracket stud bolt	40-55	30-40	—
A/C manifold and tube bracket nut	15-22	11-16	—
B+ terminal nut	9-12	—	80-106
Generator pulley nut	82-135	61-99	—
Voltage regulator/brush holder screws	2.3-3.4	—	21-30

Generator

Component Location



Item	Part Number	Description
1	10300	Generator
2	10655	Battery
3	—	Wiring harness

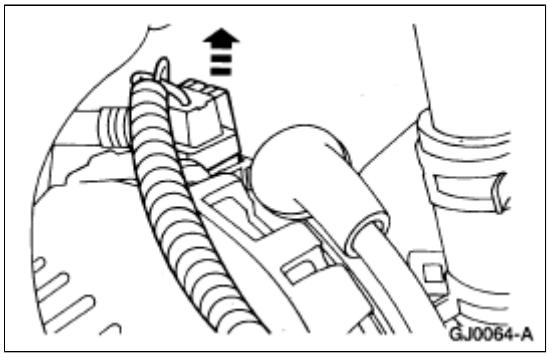
Generator

Refer to Section 414-00 .

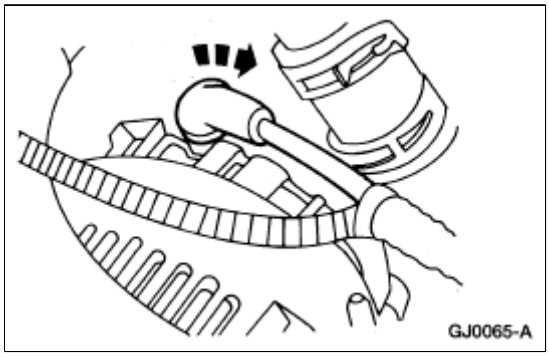
Generator —4.0L (SOHC) and 5.0L

Removal

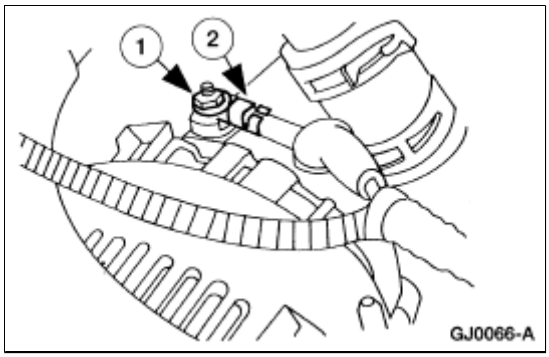
1. Disconnect the battery (14301). For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube (9B659). For additional information, refer to Section 303-12 .
3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Disconnect the wiring harness to voltage regulator electrical connector.



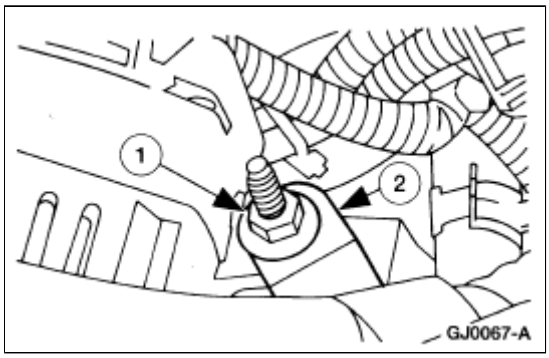
5. Remove the B+ terminal cover.



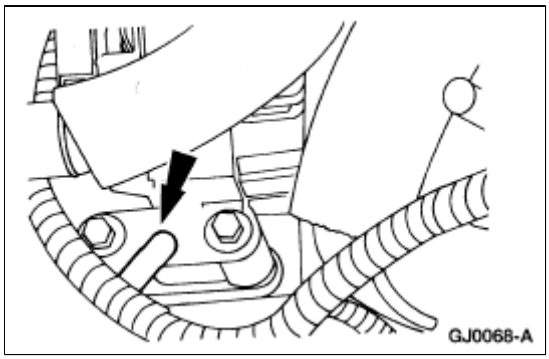
6. Remove the B+ terminal electrical connector.
    1. Remove the B+ terminal nut.
    2. Disconnect the B+ terminal electrical connector.



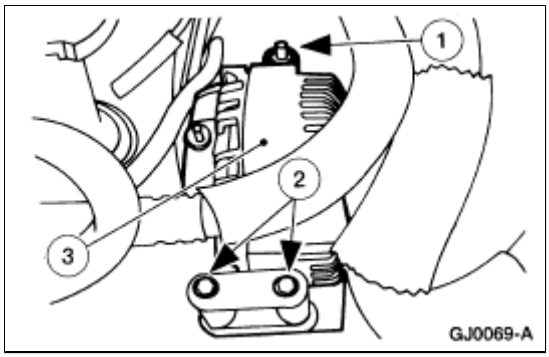
7. On vehicles equipped with 5.0L engine, position the A/C manifold and tube bracket aside.
    1. Remove the nut.
    2. Position the A/C manifold and tube bracket aside.



8. Remove the wiring harness-to-generator pin-type retainer.

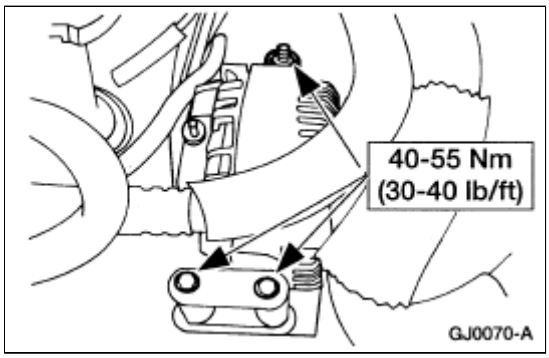


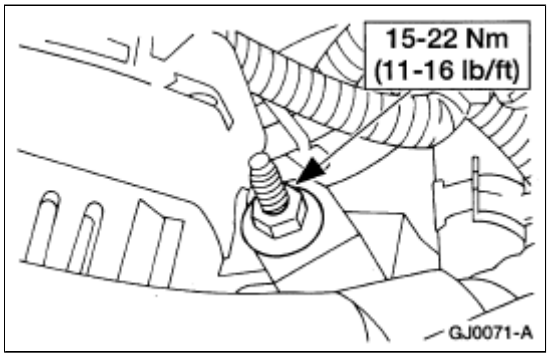
9. Remove the generator (GEN) (10300).
    1. Remove the stud bolt.
    2. Remove the bolts.
    3. Remove the generator.

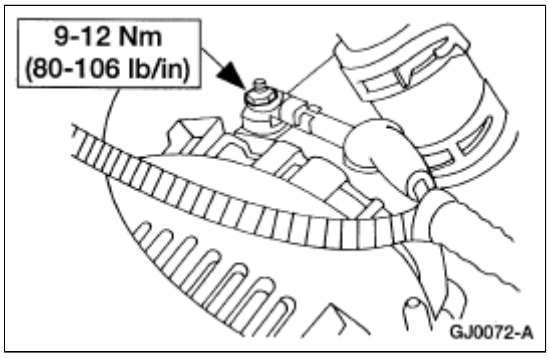


Installation

1. To install, reverse the removal procedure.

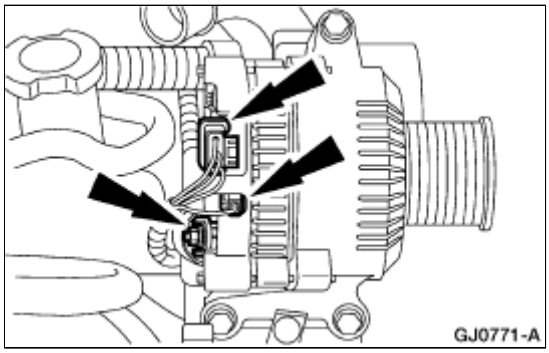




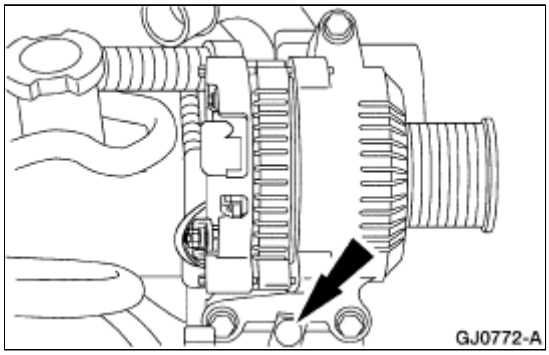


Generator —4.0L (Push Rod)

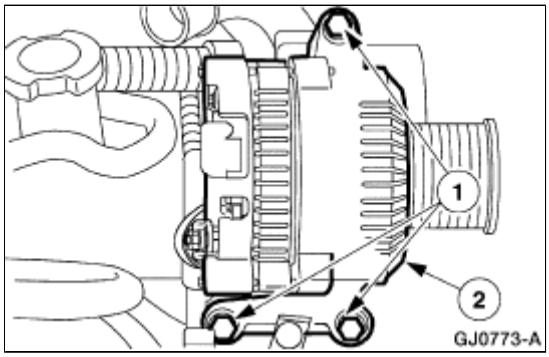
1. Disconnect the battery (14301). For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube (9B659). For additional information, refer to Section 303-12 .
3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Disconnect the electrical connectors.



5. Remove the wiring harness-to-generator pin-type retainer.

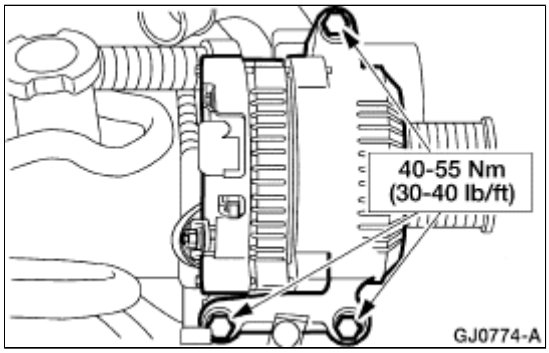


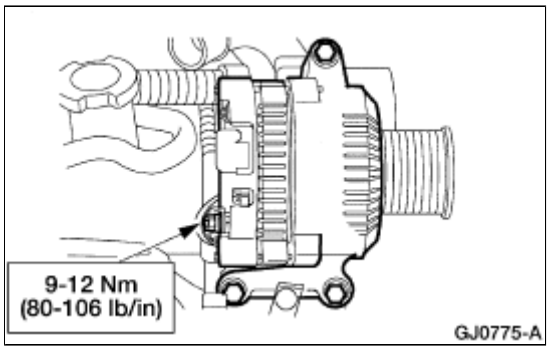
6. Remove the generator (GEN) (10300).
    1. Remove the bolts.
    2. Remove the generator.



Installation

1. To install, reverse the removal procedure.



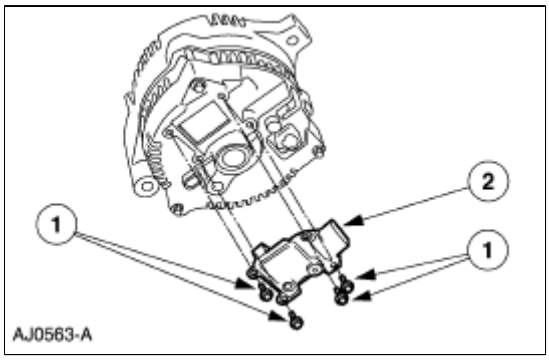


Voltage Regulator —Brush Holder

Removal

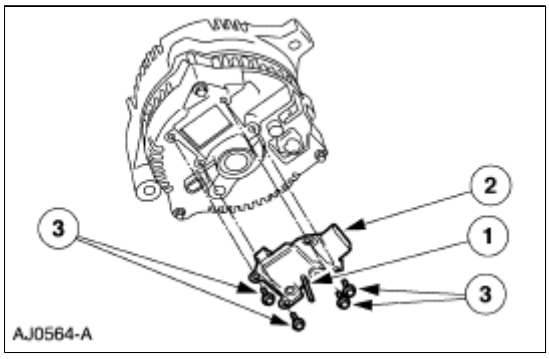
1. Remove the generator. For additional information, refer to Generator—4.0L (Push Rod) in this section.

2. Remove the voltage regulator/brush holder assembly.
    1. Remove the screws.
    2. Remove the voltage regulator/brush holder assembly.



Installation

1. Install the voltage regulator/brush holder assembly.
    1. Depress the brushes and insert a wire to hold brushes during installation.
    2. Install the voltage regulator/brush holder assembly.
    3. Install the screws and remove the wire.

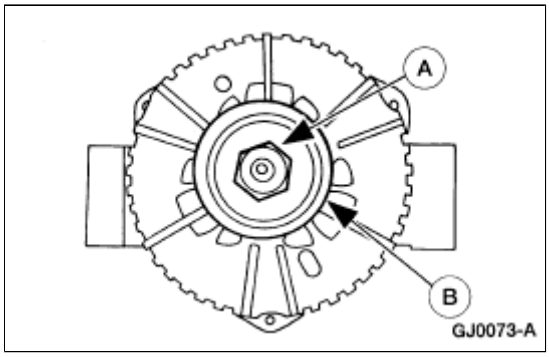


2. Install the generator. For additional information, refer to Generator—4.0L (Push Rod) in this section.

Generator Pulley

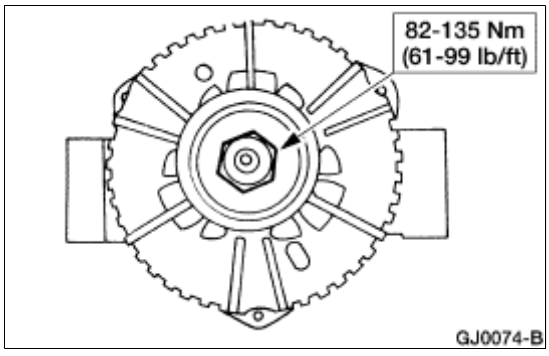
Removal

1. Disconnect the battery (14301). For additional information, refer to Section 414-01 .
2. Remove the generator (GEN) (10300). For additional information, refer to Generator—4.0L (Push Rod) or Generator—4.0L (SOHC) and 5.0L in this section.
3. Remove the (A) nut and the (B) generator pulley (10344).



Installation

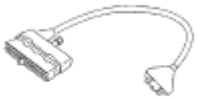
1. To install, reverse the removal procedure.



Audio System

Refer to Wiring Diagrams Cell 130 , Audio for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
 ST1684-A	ABS Breakout Box Adapter 418-063 (T97P-50-ALA)
ST1449-A	EEC-IV 60-Pin Breakout Box or equivalent 418-005 (014-00322)

Inspection and Verification

1. Verify the customer concern by operating the electronic audio system with the engine running and the vehicle in and out of motion.

2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Audio unit physically damaged, misaligned or any controls inoperative • Antenna or antenna cable physically damaged or misaligned • Radio speakers mounting/speaker cones physically damaged or misaligned • Radio ignition interference capacitor, radio frequency interference suppression bond or radio receiver hood bonding strap misaligned, corroded or loose	• Blown central junction box (CJB) Fuse 1 (7.5A), Fuse 20 (7.5A), Fuse 28 (7.5A), and Fuse 29 (25A) • Damaged connectors • Damaged ignition switch (11572) • Damaged circuitry • Damaged audio unit

3. If the fault is not visually evident, proceed to Speaker Walk-Around Test, DM100i Self-Diagnostic Mode, or T100i DM Self-Diagnostic Mode.

Speaker Walk-Around Test and T100i DM Self-Diagnostic Mode

NOTE: The audio unit must be turned ON and in radio tuner mode (AM/FM) to enter the Speaker Walk-Around Test or the T100i DM self-diagnostic mode.

The T100i DM self-diagnostic mode tests can only be entered while in the Speaker Walk-Around Test.

4. To enter the Speaker Walk-Around Test, press Preset Buttons 3 and 6 simultaneously, hold for approximately three seconds and then release.

5. The Speaker Walk-Around Test stops at each speaker and applies tone to each speaker for approximately 1-2 seconds. Each speaker is tested and shown on the display in the following sequence: SPEAKER RF, SPEAKER LF, SPEAKER LR, SPEAKER RR, ANTENNA, SUBWOOFER I.

6. The Speaker Walk-Around Test automatically continues and tests if the CD/DJ is present and responding. NO CD/DJ is displayed if the CD/DJ is not present or not responding.

7. To exit Speaker Walk-Around Test turn the ignition key OFF or turn the audio unit OFF.

8. The T100i DM self-diagnostic mode has five manual tests available:
    - Preset button 1 = Audio internal/external SELF TEST. This test is an on-demand self-test. If diagnostic trouble codes (DTCs) are retrieved, press TUNE > to scroll view the DTCs stored. Refer to the T100i DM Diagnostic Trouble Code (DTC) Index. If system is OK, NO DTCS is displayed.
    - Preset button 2 = View/Clear continuous DTCS (historical DTCS) (early production). On late production, preset button 2 will have no self-test function. NO DTCS is displayed if no DTCs are retrieved. Press TUNE > button to view if any DTCs are stored. Refer to the T100i DM Diagnostic Trouble Code (DTC) Index. To clear all DTCs press the EJ (eject) button. DTCS CLEAR is displayed.
    - **NOTE:** Always DOCUMENT, CLEAR, and CARRY OUT the T100i DM On-Demand Self-Test again.

      Preset button 3 = SIGNAL TEST. This test measures the average strength at the current tuner setting.
    - Preset button 4 = Software configuration level. This test queries each radio system controller for their software configuration level. SOFT LEVELS will be displayed upon completion of the query.
    - Preset button 5 = DISPLAY TEST. This test will light all the T100i DM display segments for 5 seconds then turn all segments OFF. When the test is complete DISPLAY TEST is displayed on the bezel.

9. To enter these tests, press the preset button desired while in the Speaker Walk-Around Test or still in the T100i DM self-diagnostic mode.

10. To exit the T100i DM self-diagnostic mode, turn the ignition switch OFF or the T100i DM OFF.

11. If the concern remains and the fault is not detected, proceed to Symptom Chart to continue diagnostics.

Speaker Walk-Around Test and DM100i Self-Diagnostic Mode

NOTE: The audio unit must be turned ON and in radio tuner mode (AM/FM) to enter the Speaker Walk-Around Test or the DM100i self-diagnostic mode.

The DM100i self-diagnostic mode can only be entered while in the Speaker Walk-Around Test.

1. To enter the Speaker Walk-Around Test, press Preset Buttons 3 and 6 simultaneously, hold approximately three seconds and release.

2. The Speaker Walk-Around Test stops at each speaker and applies sound to each speaker for about one to two seconds. Each speaker is tested and shown on the display in the following sequence: RF, LF, LR, RR.

3. To exit Speaker Walk-Around Test, turn the ignition switch OFF, turn the audio unit OFF, or preset button 1 for "DIA".

4. **NOTE:** Always DOCUMENT, CLEAR, and CARRY OUT the DM100i Self-Test again.

   The DM100i Self-Diagnostic Mode has six manual tests available:
   - Preset button 1 = ENTER DIAGNOSTICS. This test enters diagnostics from the Speaker Walk-Around Test. Metrics are available with SEL and ON buttons indicating time played in AM/FM, Media, number of buttons pressed, etc.
   - Preset button 2 = EEPROM BLOCK STATUS. This test shows validity of memory to calibrate clock and seek sensitivity.
   - Preset button 3 = EXIT DIAGNOSTICS.
   - Preset button 4 = Software configuration level. This test queries each radio system controller for its software configuration level.
   - Preset button 5 = DISPLAY TEST. This test lights all the DM100i display segments for five seconds and then turns all segments off.
   - Preset button 6 = RAM CONTENTS READOUT. To enter these tests, press Preset Button 1 while in the Speaker Walk-Around Test, then the desired preset button.

5. To exit the DM100i Self-Diagnostic Mode, turn the ignition switch OFF or the DM100i OFF.

6. If the concern remains and the fault is not detected, proceed to the Symptom Chart to continue diagnostics.

T100i DM Diagnostic Trouble Code (DTC) Index

T100i DM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
9342	ECU Is Defective	T100i DM	CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility if DTC 9342 is retrieved again.
A401	Audio Tape Deck Mechanism Fault	T100i DM	VERIFY that no tape is inserted in the T100i DM. CLEAR and DOCUMENT the DTCs. CARRY OUT the T100i DM self-test. If DTC A401 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility.

A402	Audio CD/DJ Thermal Shutdown Fault	T100i DM	GO to Pinpoint Test B .
A403	Audio CD/DJ Internal Fault	T100i DM	GO to Pinpoint Test B .
A404	Audio Steering Wheel Switch Circuit Fault	T100i DM	CLEAR and DOCUMENT the DTCs. CARRY OUT the T100i DM Self-Test. If DTC A404 is retrieved again, GO to Pinpoint Test N .
A405	Audio Single-Disc CD Player Thermal Shutdown Fault	T100i DM	CLEAR and Document the DTCs. CARRY OUT the T100i DM Self-Test. If DTC A405 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility.
A406	Audio Single-Disc CD Player Internal Fault	T100i DM	CLEAR and Document the DTCs. CARRY OUT the T100i DM Self-Test. If DTC A405 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility.
E003	Audio Compact Disc/Disc Jockey (CD/DJ) Is Not Responding	T100i DM	If equipped with CD/DJ, GO to Pinpoint Test B .
E005	Audio Rear Integrated Control Panel Unit Is Not Responding	T100i DM	**NOTE:** U2005 is retrieved if RICP is not present, disconnected or inoperative. VERIFY if the vehicle is equipped with RICP/RSC. GO to Pinpoint Test K .
E008	Audio Phone Is Not Responding	T100i DM	Not applicable. Vehicle is not equipped with cellular phone.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The audio unit is inoperative — does not operate correctly	• CJB Fuse 20 (7.5A), Fuse 28 (7.5A), and Fuse 29 (25A). • Circuitry. • Audio unit. • Ignition switch.	• GO to Pinpoint Test A .
• The audio unit display blank — audio unit operates	• Audio unit.	• REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
• The audio unit/tape player display is blank — the audio unit/tape player operates	• Audio unit.	• REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system after the repair.
• The cassette player only	• Audio unit.	• REMOVE the audio unit and

is inoperative		SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
• The CD changer is inoperative/does not operate correctly	• CJB Fuse 29 (25A). • Circuitry. • Audio unit. • CD changer. • Ignition switch.	• GO to Pinpoint Test B .
• Noisy reception	• Antenna connections. • Noise suppression equipment. • Audio unit.	• GO to Pinpoint Test C .
• Noisy reception — FM only	• FM signal.	• INFORM the customer of methods for obtaining the best reception.
• No sound from one or more of the speakers — not all speakers	• Speaker(s). • Circuitry. • Audio unit.	• GO to Pinpoint Test D .
• No sound from all of the speakers	• Audio unit. • Circuitry.	• GO to Pinpoint Test E .
• Poor quality sound from one or more speakers (not all speakers)	• Speaker(s). • Circuitry. • Audio unit.	• GO to Pinpoint Test F .
• Poor quality sound from all speakers	• Speaker(s). • Circuitry. • Audio unit.	• GO to Pinpoint Test G .
• During CD mode, the audio unit display shows: CDE1	• CDDJ mechanism error.	• A mechanical failure has occurred. TRY to EJECT the magazine, as this may clear the error condition. If the magazine will not eject, REMOVE the digital audio compact disc changer and SEND it to an authorized Ford audio systems repair facility. • TURNING power off than on may clear CDE1 error.
• During CD mode, the audio unit display shows: CDE2	• Laser focus error.	• Focus error — probably bad, dirty or scratched disc. TRY a known good disc. REMOVE the digital audio compact disc changer and SEND it to an authorized Ford audio systems repair facility.
• During CD mode, the audio unit display shows: TOO HOT	• Thermal shutdown.	• Digital audio compact disc changer thermal shutdown protection mode; if temperature exceeds 60°C (140°F), changer will shut down to preserve laser life.

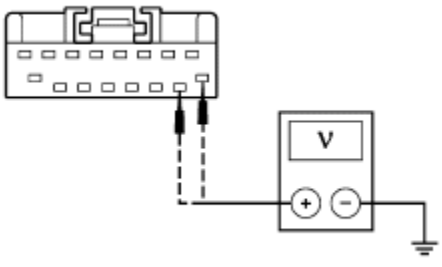
		ALLOW audio unit to cool down.
• During CD mode, the audio unit display shows: BAD CD	• Unreadable CD.	• CHECK all discs. If problem occurs on one disc, CHECK that disc. If problem occurs on all discs, VERIFY that discs are installed labeled-side up in the magazine. If discs are not scratched, dirty or inserted upside down, REMOVE the digital audio compact disc changer and SEND it to an authorized Ford audio systems repair facility.
• During CD mode, the audio unit display shows: NO CD	• No CD found.	• NO CD is displayed when a CD is not found in a slot.
• Loud pops when cycling the ignition switch	• Circuitry. • Subwoofer.	• GO to Pinpoint Test H .
• One or more audio control buttons (such as volume, seek, tune and scan) is not functional in either radio, tape or CDDJ mode or all modes — audio unit display functions correctly	• Audio unit.	• REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
• When the headlamp switch is in park or headlamp position, there is no front audio unit back lighting — all other backlighting functions are normal	• Circuitry. • Audio unit.	• REFER to Section 413-00 .
• The power antenna is inoperative	• Power antenna motor. • Power antenna module. • CJB Fuse 1 (7.5A). • Antenna cable. • Antenna mast. • Audio unit.	• GO to Pinpoint Test I .
• The audio unit is inoperative/does not operate correctly — response time between pressing any of the audio control buttons and system response is more than two seconds	• CDDJ. • Rear integrated control panel (RICP). • Audio unit.	• GO to Pinpoint Test J .
• No rear integrated control panel (RICP) backlighting	• RICP. • Circuitry.	• REFER to Section 413-00 .
• The auxiliary audio	• RICP.	• GO to Pinpoint Test K .

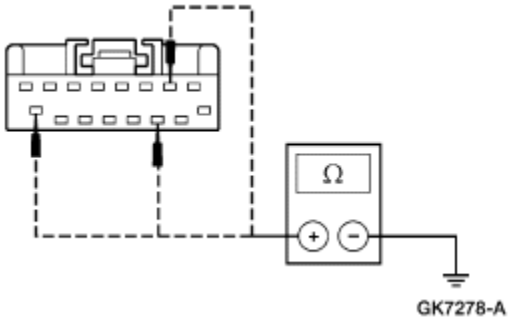
buttons are inoperative — rear integrated control panel (RICP)	• CJB Fuse 29 (25A). • Headphones. • Circuitry.	
• No auxiliary headphone audio	• Headphones. • RICP. • Circuitry.	• GO to Pinpoint Test L .
• The auxiliary audio buttons are inoperative — steering wheel control switch(es)	• Circuitry. • Steering wheel control switch (es). • Audio unit.	• GO to Pinpoint Test M .
• The subwoofer is inoperative	• Circuitry. • Subwoofer. • Audio unit.	• GO to Pinpoint Test N .
• The audio unit does not operate correctly — speed sensitive volume (SSV)	• Circuitry. • Audio unit.	• GO to Pinpoint Test O .

Pinpoint Tests

PINPOINT TEST A: THE AUDIO UNIT IS INOPERATIVE — DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK OPERATION OF THE AUDIO UNIT	
1 	2 Turn on the radio. • **Is the audio unit display illuminated?** → **Yes** GO to A2 . → **No** GO to A4 .
A2 CHECK FOR SOUND COMING FROM THE RADIO SPEAKERS	
	1 Verify that sound is coming from the radio speakers. • **Is there sound coming from the radio speakers?**

	→ **Yes** GO to A3 . → **No** GO to Pinpoint Test D .
A3 CHECK THE AUDIO UNIT CONTROLS AND FEATURES	
	1 Refer to the owner literature for audio system controls. 2 Verify that the controls and features operate correctly. • **Do the controls and features operate correctly?** → **Yes** System operation normal at this time. → **No** If the controls and features are all inoperative, GO to A4 . If the controls and features are only partially inoperative, REMOVE the audio unit and SEND it to an authorized Ford audio system facility. TEST the system for normal operation.
A4 CHECK VOLTAGE AT THE AUDIO UNIT	
1 Audio Unit C256 2 3  GK9986-A	3 Measure the voltage between: ▪ audio unit C256 Pin 9, Circuit 797 (LG/VT), and ground. ▪ audio unit C256 Pin 10, Circuit 137 (YE/BK), and ground. • **Are the voltages greater than 10 volts?**

	→ **Yes** GO to A5 . → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A5 CHECK THE GROUND CIRCUITS TO THE AUDIO UNIT	
1 2  	2 Measure the resistance between: ■ audio unit C256 Pin 2, Circuit 57 (BK), and ground. ■ audio unit C256 Pin 11, Circuit 694 (BK/LG), and ground. ■ audio unit C256 Pin 16, Circuit 694 (BK/LG), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

PINPOINT TEST B: THE CD CHANGER IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CARRY OUT THE SPEAKER WALK-AROUND TEST — CHECK FOR CD/DJ	
1 	2 Turn on the radio. 3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously.

	• **Is NO CD/DJ displayed?** → **Yes** GO to B4 . → **No** GO to B2 .
B2 CHECK OPERATION OF CD CHANGER	
1 	2 Verify the audio unit controls and features are operating correctly. Refer to the owner literature. 3 Verify that the CD changer powerloading function is operating correctly. Refer to the owner literature. • **Does the audio unit display CD?** → **Yes** GO to B3 . → **No** GO to B4 .
B3 CHECK FOR SOUND COMING FROM THE RADIO SPEAKERS	
	1 Load a known good CD and press the CD button. • **Is sound coming from the speakers?** → **Yes** GO to B4 . → **No** GO to Pinpoint Test E .
B4 CHECK CIRCUITS BETWEEN THE COMPONENTS FOR OPEN — CIRCUITS 690 (GY), 798 (LG/RD), 799 (OG/BK), 856 (VT), 1068 (LG/BK), 833 (TN), 832 (LB/PK)	
1 2 	

CD Changer C2005

3

Audio Unit C228

4

RICP C2003

5 Measure the resistances of the circuits between CD changer C2005, audio unit C228, and rear integrated control panel (RICP) C2003 as follows:

Audio Unit C228	CD Changer C2005	RICP C2003
Pin 17	Pin 1	—
Pin 20	Pin 8	—
Pin 18	Pin 7	—
Pin 19	Pin 2	—
Pin 5	Pin 11	Pin 15
Pin 7	Pin 12	Pin 13
Pin 6	Pin 6	Pin 12

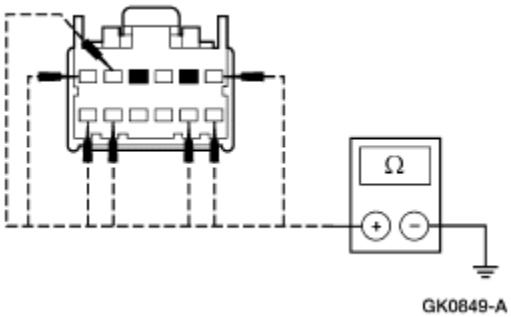
- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to B5 .

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

B5 CHECK CIRCUITS BETWEEN THE COMPONENTS FOR SHORT TO GROUND

1



1 Measure the resistances between the CD changer C2005 and ground as follows:

CD Changer C2005	Circuit
Pin 1	690 (GY)
Pin 2	856 (VT)
Pin 6	832 (LB/PK)
Pin 7	799 (OG/BK)
Pin 8	798 (LG/RD)

Pin 11	1068 (LG/BK)
Pin 12	833 (TN)

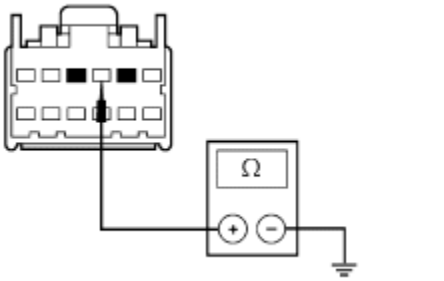
- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
GO to B6 .

→ **No**
REPAIR the circuits(s) in question. TEST the system for normal operation.

B6 CHECK GROUND AT CD CHANGER

1



1 Measure the resistance between CD changer C2005 Pin 4, Circuit 694 (BK/LG), harness side and ground.

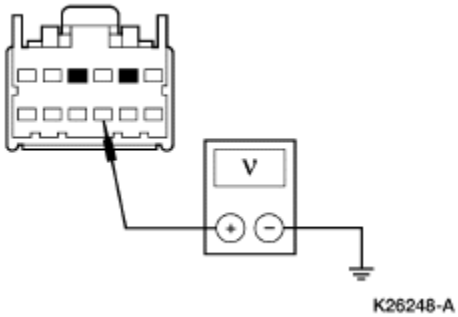
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B7 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

B7 CHECK VOLTAGE TO CD CHANGER

1



1 Measure the voltage between CD changer C2005 Pin 10, Circuit 797 (LG/VT), harness side and ground.

- **Is the voltage greater than 10 volts?**

	→ **Yes** REMOVE the CD changer and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST C: NOISY RECEPTION

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK ANTENNA GROUND	
	1 Measure the resistance between antenna base and the battery ground cable. • **Is the resistance less than 5 ohms?** → **Yes** GO to C3. → **No** GO to C2.
C2 CHECK ANTENNA CABLE CONNECTIONS	
1	1 Check the antenna connections including the extension cable. 2 Check to make sure the antenna is securely mounted to the vehicle body at ground points. • **Are the connections clean, secure and in metal-to-metal contact?** → **Yes** GO to C3. → **No** CLEAN and SECURE the antenna connections as needed. TEST the system for normal operation. If equipped with power antenna, GO to Pinpoint Test J.
C3 CHECK SUPPRESSION EQUIPMENT/MOUNTING AND CONNECTING CIRCUITS	
	1 Check all required suppression equipment and the radio frequency interference suppression bond. Refer to Section 415-01. 2 Check the radio receiver hood bonding strap for integrity, cleanliness and metal-to-metal contact. 3 **NOTE:** The capacitor mounting points are used to complete the electrical circuit and must be mounted securely to clean surfaces.

	Check the mounting and connecting circuits of the radio ignition interference capacitor for integrity, cleanliness and metal-to-metal contact. • **Are the connections clean, secure and in metal-to-metal contact?** → **Yes** GO to C4 . → **No** CLEAN, SECURE and INSTALL new suppression equipment as necessary. TEST the system for normal operation.
C4 CHECK RADIO IGNITION INTERFERENCE CAPACITOR	
1 2 Check the operation of the radio ignition interference capacitor by replacing it with a known good component. 3 4 Turn the radio on and check the radio reception. • **Is the noise eliminated?** → **Yes** INSTALL a new radio ignition interference capacitor. TEST the system for normal operation. → **No** GO to C5 .	
C5 CHECK GENERATOR	
1 2 Check the generator by disconnecting the wiring harness from the voltage regulator. 3 4 Turn the radio on and check the radio reception. • **Is the noise eliminated?**	

→ **Yes**
INSTALL a new generator. REFER to Section 414-02 . TEST the system for normal operation.

→ **No**
GO to C6 .

C6 CHECK IGNITION CIRCUITS

1

2 Check the ignition circuits for correct routing, grounding and integrity of connections.

3 Check the spark plugs and the spark plug wires.

- **Are the ignition components OK?**

→ **Yes**
GO to C7 .

→ **No**
REPAIR the ignition system as required. TEST the system for normal operation.

C7 SUBSTITUTE ANTENNA

1 Substitute a known good antenna. Ground the antenna base to an unpainted metal surface on the vehicle.

2

3 Verify the operation of the audio unit.

- **Is the noise eliminated?**

→ **Yes**
INSTALL a new antenna. TEST the system for normal operation.

→ **No**
GO to C8 .

C8 SUBSTITUTE ANTENNA EXTENSION CABLE

1

2 Substitute a known good antenna extension cable.

3

4 Verify the operation of the audio unit.

- **Is the noise eliminated?**

→ **Yes**
INSTALL a new antenna extension cable. TEST the system for normal operation.

→ **No**
GO to C9 .

C9 SUBSTITUTE AUDIO UNIT

1

2 Substitute a known good audio unit.

3

4 Verify the operation of the audio unit.

- **Is the noise eliminated?**

→ **Yes**
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

→ **No**
GO to C10 .

C10 REPOSITION COMPONENTS

1

2 Determine if the noise can be eliminated by repositioning the antenna extension cable, radio speaker circuits or radio power feed circuits away from other circuits and/or brackets.

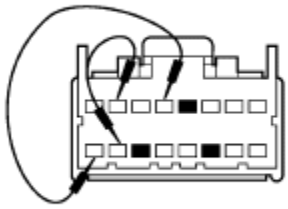
3

4 Verify the operation of the audio unit.

	• **Is the noise eliminated?** → **Yes** Permanently REPOSITION the components as needed. TEST the system for normal operation. → **No** GROUND various parts of the vehicle to the frame using a jumper cable. (For example: engine, fenders, quarter panels, stone deflectors, body sheet metal.) When noise is eliminated, PROVIDE a permanent ground where required. TEST the system for normal operation.

PINPOINT TEST D: NO SOUND FROM ONE OR MORE OF THE SPEAKERS — NOT ALL SPEAKERS

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CARRY OUT SPEAKER WALK-AROUND TEST — ISOLATE INOPERATIVE SPEAKER	
1 	2 Turn on the radio. 3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously. • **Are all speakers without sound?** → **Yes** GO to Pinpoint Test E . → **No** GO to D2 .
D2 CHECK RADIO SPEAKER — SUBSTITUTE WITH A KNOWN GOOD SPEAKER	
1 3 	2 Substitute affected speaker with a known good component. 4 Turn on the radio.

	• **Is the radio speaker operational?** → **Yes** INSTALL a new radio speaker. TEST the system for normal operation. → **No** If rear speaker is inoperative and the vehicle is equipped with RICP, GO to D3 . If front speaker is inoperative or if the vehicle is not equipped with RICP, GO to D6 .
D3 CHECK RICP — BYPASS THE RICP	
1 2 RICP C2003 3  GK0577-A 4 	3 Connect a 10A fused jumper wire between RICP C2003 Pin 4, Circuit 802 (OG/RD), and RICP C2003 Pin 9, Circuit 825 (TN/LG); and between RICP C2003 Pin 2, Circuit 800 (GY/LB), and RICP C2003 Pin 10, Circuit 827 (TN/WH). • **Is the affected radio speaker operational?** → **Yes** INSTALL a new RICP. TEST the system for normal operation. → **No** GO to D4 .
D4 CHECK CIRCUITS BETWEEN AUDIO UNIT AND RICP	

1

Audio Unit

2

3 Measure the resistances between audio unit C256 and RICP C2003; and between audio unit C256 and ground as follows:

Circuit	Audio Unit C256 Pin	RICP C2003 Pin
800 (GY/LB)	12	2
801 (TN/YE)	13	1
802 (OG/RD)	5	4
803 (BN/PK)	6	3

- **Are the resistances less than 5 ohms between the audio unit and the RICP, and greater than 10,000 ohms between the audio unit and ground?**

→ **Yes**
GO to D5 .

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

D5 CHECK CIRCUITS BETWEEN RICP AND SPEAKER(S)

1 Measure the resistances between the affected speaker(s) and RICP C2003; and between RICP C2003 and ground as follows:

RICP C2003 Pin	Speaker
9	RR
10	LR
1	LR
3	RR

- **Are the resistances less than 5 ohms between radio speaker(s) and the RICP, and greater than 10,000 ohms between the RICP and ground?**

→ **Yes**
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

D6 CHECK CIRCUITS BETWEEN AUDIO UNIT AND AFFECTED SPEAKER(S)

1 Measure the resistances between audio unit C256 and affected speakers; and between audio unit C256 and ground as follows:

Front Speakers

Audio Unit C256 Pin	Speaker
7	RF
8	RF
14	LF
15	LF

Rear Speakers (Without RICP)

Audio Unit C256 Pin	Speaker
5	RR
6	RR
12	LR
15	LR

- **Are the resistances less than 5 ohms between the radio speaker(s) and audio unit, and greater than 10,000 ohms between the audio unit and ground?**

→ **Yes**
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

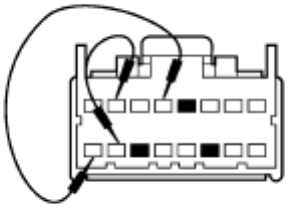
PINPOINT TEST E: NO SOUND FROM ALL OF THE SPEAKERS

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK FOR AUDIO UNIT OPERATION	
1	2 Turn the audio unit on. • **Does the audio unit display illuminate?** → **Yes** GO to E2 . → **No** GO to Pinpoint Test A .
E2 CHECK THE SPEAKER OPERATION	
	1 CARRY OUT the Speaker Walk-Around Test. • **Are all radio speakers inoperative?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** GO to Pinpoint Test D .

PINPOINT TEST F: POOR QUALITY SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK SOUND QUALITY	
1	2 Turn on the radio. 3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously. • **Do all radio speakers have poor sound quality?**

	→ **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** GO to F2.
F2 TEST SPEAKER	
1 3 	2 Substitute the affected radio speaker with a known good component. 4 Turn on the radio. • **Is the radio speaker sound quality OK?** → **Yes** INSTALL a new radio speaker. TEST the system for normal operation. → **No** If rear speaker is distorted and the vehicle is equipped with RICP, GO to F3. If front speaker is distorted or if the vehicle is not equipped with RICP, GO to F6.
F3 CHECK RICP	
1 2 RICP C2003 3	3 Connect a 10A fused jumper wire between RICP C2003 Pin 4, Circuit 802 (OG/RD), and RICP C2003 Pin 9, Circuit 825 (TN/LG); and between RICP C2003 Pin 2, Circuit 800 (GY/LB), and RICP C2003 Pin 10, Circuit 827 (TN/WH).



GK0577-A

4

- **Is the affected radio speaker quality OK?**

→ **Yes**
INSTALL a new RICP; REFER to Section 415-01 . TEST the system for normal operation.

→ **No**
GO to F4 .

F4 CHECK CIRCUITS BETWEEN AUDIO UNIT AND RICP

1

2

Audio Unit

3 Measure the resistances between audio unit C256 and RICP C2003; and between audio unit C256 and ground as follows:

Circuit	Audio Unit C256 Pin	RICP C2003 Pin
800 (GY/LB)	12	2
801 (TN/YE)	13	1
802 (OG/RD)	5	4
803 (BN/PK)	6	3

	• **Are the resistances less than 5 ohms between the audio unit and RICP and greater than 10,000 ohms between the audio unit and ground?** → **Yes** GO to F5 . → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
F5 CHECK CIRCUITS BETWEEN RICP AND SPEAKER(S)	
	1 Measure the resistances between the affected radio speaker(s) and RICP C2003; and between RICP C2003 and ground as follows: **RICP C2003 Pin / Radio Speaker** 9 — RR 10 — LR 1 — LR 3 — RR • **Are the resistances less than 5 ohms between the radio speaker(s) and the RICP and greater than 10,000 ohms between the RICP and ground?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
F6 CHECK CIRCUITS BETWEEN AUDIO UNIT AND AFFECTED SPEAKER(S)	
	1 Measure the resistances between audio unit C256 and affected radio speakers; and between audio unit C256 and ground as follows: **Front radio speakers** **Audio Unit C256 Pin / Radio Speaker** 7 — RF 8 — RF 14 — LF

15	LF

Rear Radio Speakers (Without RICP)

Audio Unit	Radio Speaker
5	RR
6	RR
12	LR
15	LR

- **Are the resistances less than 5 ohms between the radio speaker(s) and the audio unit and greater than 10,000 ohms between the audio unit and ground?**

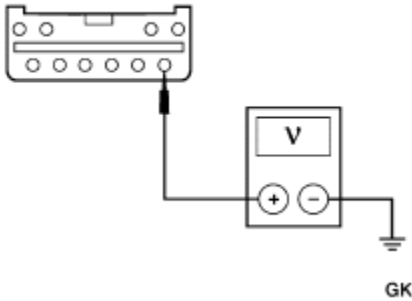
→ **Yes**
REMOVE the audio unit and SEND it to an authorized Ford Audio System repair facility. TEST the system for normal operation.

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

PINPOINT TEST G: POOR QUALITY/DISTORTED SOUND FROM ALL SPEAKERS

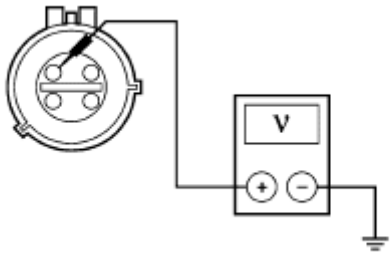
CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK POOR SOUND QUALITY IN ALL SPEAKERS	
1	2 Turn on the radio. 3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously. • **Is there poor quality or distortion in all radio speakers?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** GO to Pinpoint Test F .

PINPOINT TEST H: LOUD POPS WHEN CYCLING THE IGNITION SWITCH

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK SUBWOOFER ENABLE LINE — CIRCUIT 173 (DG/VT) FOR SHORT TO BATTERY POWER	
1 Subwoofer Amplifier C333	
2  GK5296-A	2 Measure the voltage between subwoofer amplifier C333 Pin 1, Circuit 173 (DG/VT), harness side and ground. • **Is voltage present?** → **Yes** REPAIR the circuit. TEST the system for normal operation. → **No** REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

PINPOINT TEST I: THE POWER ANTENNA IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CHECK CIRCUIT 451 (LB/YE)	
1 Antenna C362	
2 	
3	3 Measure the voltage between antenna C362



GK5292-A

Pin 1, Circuit 451 (LB/YE), harness side and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to I2 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

I2 CHECK CIRCUIT 1000 (RD/BK)

1

2

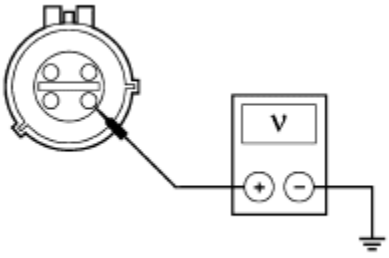
Starter Relay C127

3

3 Hold the ignition switch in the START position.

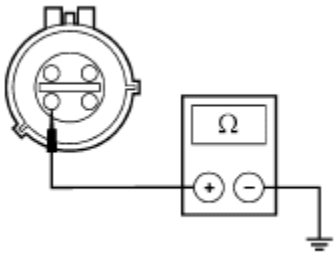
4

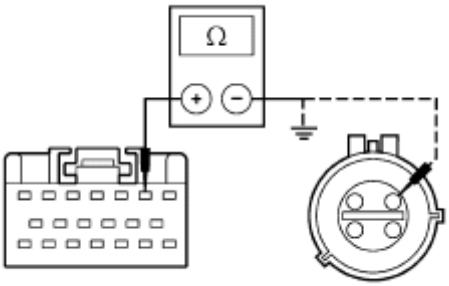
4 Measure the voltage between antenna C362 Pin 4, Circuit 1000 (RD/BK), harness side and ground.



GK5293-A

5

Starter Relay C127	• **Is the voltage greater than 10 volts?** → **Yes** GO to I3 . → **No** REPAIR the circuit. TEST the system for normal operation.
I3 CHECK GROUND CIRCUIT 57 (BK)	
1 2  GK5294-A	2 Measure the resistance between antenna C362 Pin 3, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to I4 . → **No** REPAIR the circuit. TEST the system for normal operation.
I4 CHECK CIRCUIT 747 (OG/LB)	
1 Audio Unit C228 2	2 Measure the resistance between audio unit C228 Pin 2, Circuit 747 (OG/LB), harness side and antenna C362 Pin 2, Circuit 747 (OG/LB), harness side; and between audio unit C228 Pin 2, Circuit 747 (OG/LB), harness side and ground.



GK7147-A

- **Is the resistance less than 5 ohms between the audio unit and the antenna and greater than 10,000 ohms between the audio unit and ground?**

→ **Yes**
GO to I5 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

I5 CHECK THE AUDIO UNIT

1 Substitute the audio unit with a known good component.

2

Antenna C362

3

Audio Unit C228

4

5 Turn the radio on for 10 seconds, and then off.

- **Is the antenna operational?**

→ **Yes**
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

	→ **No** INSTALL a new power antenna; REFER to Section 415-02 . TEST the system for normal operation.

PINPOINT TEST J: THE AUDIO UNIT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — RESPONSE TIME BETWEEN PRESSING ANY OF THE AUDIO CONTROL BUTTONS AND SYSTEM RESPONSE IS MORE THAN TWO SECONDS

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 DETERMINE IF REAR INTEGRATED CONTROL PANEL (RICP) IS LOCKING UP THE NETWORK	
1 2 RICP C2003 3 	4 Rotate the front control unit volume knob. • **Is the time between when the volume knob is rotated and the response (sound is louder) greater than two seconds?** → **Yes** GO to J2 . → **No** INSTALL a new RICP; REFER to Section 415-01 . TEST the system for normal operation.
J2 DETERMINE IF DIGITAL AUDIO COMPACT DISC CHANGER IS LOCKING UP THE NETWORK	
1 2 CD Changer	

C2005 3 	4 Rotate the front control unit volume knob. • **Is the time between when the volume knob is rotated and the response (sound is louder) greater than two seconds?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REMOVE the CD changer and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

PINPOINT TEST K: THE AUXILIARY AUDIO BUTTONS ARE INOPERATIVE — REAR INTEGRATED CONTROL PANEL (RICP)

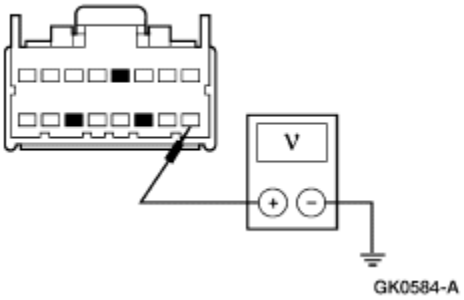
CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THAT THE RICP IS ENABLED	
1 	2 Turn the audio unit on. 3 Press Preset Buttons 3 and 5 simultaneously to enable the RICP. The headphone symbol should be shown on the audio unit display. 4 Operate the audio unit from the RICP. • **Does the RICP operate correctly?** → **Yes** The system is operating OK. INFORM the customer of the RICP enable/disable feature by pressing Preset Buttons 3 and 5 simultaneously. → **No** GO to K2 .
K2 CHECK POWER FEED TO RICP — CIRCUIT 797 (LG/VT)	
1	

2

RICP C2003

3

4



4 Measure the voltage between RICP C2003 Pin 16, Circuit 797 (LG/VT), harness side and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to K3 .

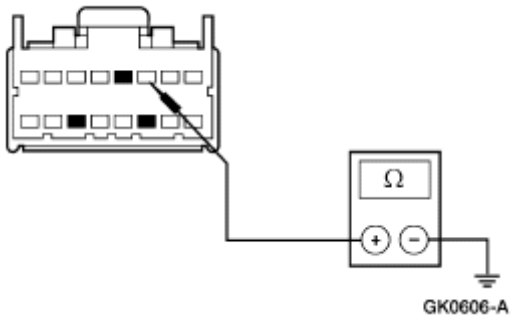
→ **No**
REPAIR the circuit. TEST the system for normal operation.

K3 CHECK CIRCUIT 694 (BK/LG) FOR OPEN

1

2

2 Measure the resistance between RICP C2003 Pin 6, Circuit 694 (BK/LG), harness side and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to K4 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

K4 CHECK CIRCUIT 1068 (LG/BK) FOR OPEN

1

2

Audio Unit

3

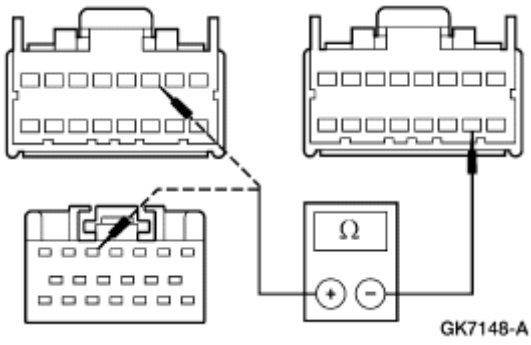
CD Changer C2005

4

RICP C2003

5

5 Measure the resistance between audio unit C228 Pin 5, Circuit 1068 (LG/BK), harness side and RICP C2003 Pin 15, Circuit 1068 (LG/BK), harness side.



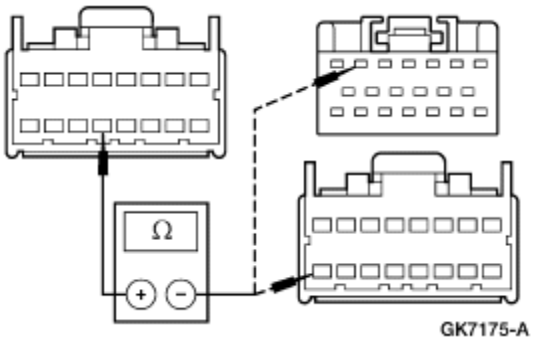
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to K5 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

K5 CHECK CIRCUIT 832 (LB/PK) FOR OPEN

1



1 Measure the resistance between audio unit C228 Pin 6, Circuit 832 (LB/PK), harness side and RICP C2003 Pin 12, Circuit 832 (LB/PK), harness side.

- **Is the resistance less than 5 ohms?**

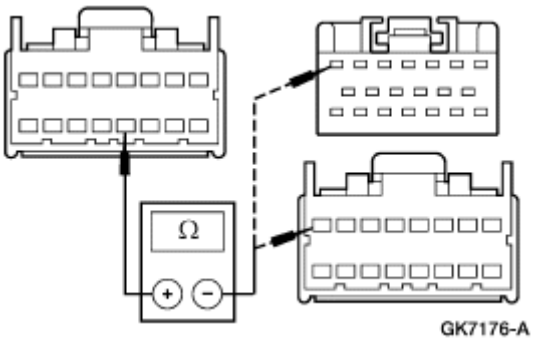
→ **Yes**
GO to K6 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

K6 CHECK CIRCUIT 833 (TN) FOR OPEN

1

1 Measure the resistance between audio unit C228 Pin 7, Circuit 833 (TN), harness side and RICP C2003 Pin 13, Circuit 833 (TN), harness side.

	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new RICP; REFER to Section 415-01 . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST L: NO AUXILIARY HEADPHONE AUDIO

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK THE AUXILIARY HEADPHONE OPERATION	
1 	2 Turn the audio unit on. 3 Press Preset Buttons 3 and 5 simultaneously to enable the RICP. The headphone symbol should be shown on the audio unit display. 4 Plug a known good headphone into the headphone jack and press the speaker ON/OFF button. Refer to the owner literature. • **Does the headphone operate correctly?** → **Yes** The system is operating OK. INFORM the customer of the speaker ON/OFF button on the RICP. REFER to the Owner's/Audio Guide. → **No** GO to L2 .
L2 CHECK REAR SPEAKERS	
1	

2 Turn on the audio unit.

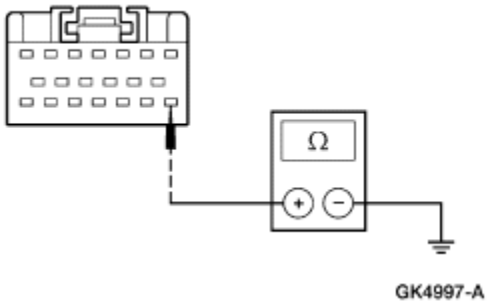
3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously.

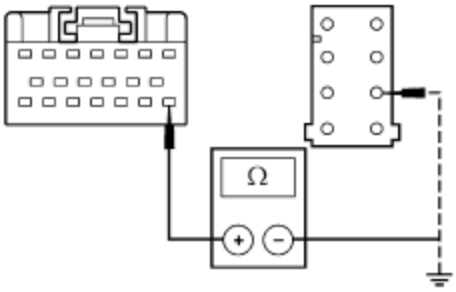
- **Do the rear speakers operate correctly?**

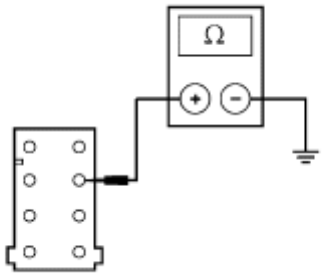
→ **Yes**
INSTALL a new RICP; REFER to Section 415-01 . TEST the system for normal operation.

→ **No**
GO to Pinpoint Test D .

PINPOINT TEST M: THE AUXILIARY AUDIO BUTTONS ARE INOPERATIVE — STEERING WHEEL CONTROL SWITCH(ES)

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK THE STEERING WHEEL CONTROL SWITCH CIRCUITS	
1 2 Audio Unit 3  GK4997-A	3 Measure the resistance between audio unit C228 Pin 14, Circuit 595 (LB/RD), harness side and ground while pressing the steering wheel control switches as follows: **Switch** / **Resistance Range** VOL Down: 69.27-77.38 ohms VOL Up: 198.5-217.61 ohms NEXT: 419.4-467.5 ohms MODE: 848.1-945.1 ohms No Buttons Pressed: 4,560-5,080 ohms • **Are the resistances within specification?**

	→ **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system after the repair. → **No** GO to M2 .
M2 CHECK CIRCUIT 595 (LB/RD) FOR OPEN OR SHORT TO GROUND	
1 Air Bag Sliding Contact C220 2 Audio Unit 3  GK5790-A	3 Measure the resistances between audio unit C228 Pin 14, Circuit 595(LB/RD), harness side and air bag sliding contact C220 Pin 6, Circuit 595 (LB/RD), harness side; and between audio unit C228 Pin 14, Circuit 595 (LB/RD), harness side and ground. • **Is the resistance less than 5 ohms between the audio unit and the air bag sliding contact and greater than 10,000 ohms between the audio unit and ground?** → **Yes** GO to M3 . → **No** REPAIR the circuit. TEST the system for normal operation.
M3 CHECK GROUND CIRCUIT 848 (DG/OG)	
1	1 Measure the resistance between air bag sliding contact C220 Pin 4, Circuit 848 (DG/OG), harness side and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M4 .

→ **No**
GO to M7 .

M4 CHECK THE SIGNAL CIRCUIT IN STEERING WHEEL CONTROL SWITCH HARNESS

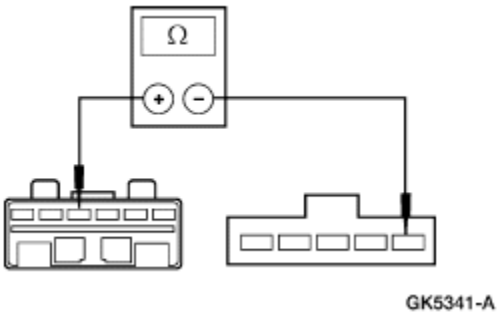
1 Deactivate the air bag system; refer to Section 501-20B .

2

Steering Wheel Control Switch Harness

3 Measure the resistance between steering wheel control switch connector Pin 5 (YE) and steering wheel control switch harness connector Pin 3 (YE).

3



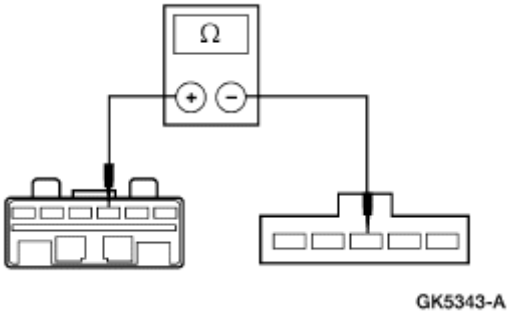
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M5 .

→ **No**
INSTALL a new steering wheel control switch harness. TEST the system for normal operation.

M5 CHECK GROUND CIRCUIT IN STEERING WHEEL CONTROL SWITCH HARNESS

1 Measure the resistance between steering



wheel control switch connector Pin 3 (BK) and steering wheel control switch harness connector Pin 4 (BK).

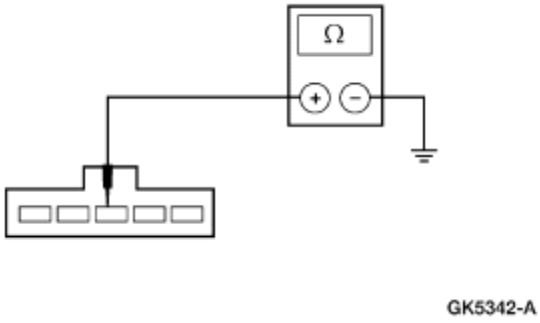
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M6 .

→ **No**
INSTALL a new steering wheel control switch harness. TEST the system for normal operation.

M6 CHECK GROUND THROUGH THE AIR BAG SLIDING CONTACT

2



1 Reconnect the steering wheel control switch harness to the air bag sliding contact (14A664).

2 Measure the resistance between steering wheel control switch harness connector Pin 3 (BK) and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new steering wheel control switch (es). TEST the system for normal operation.

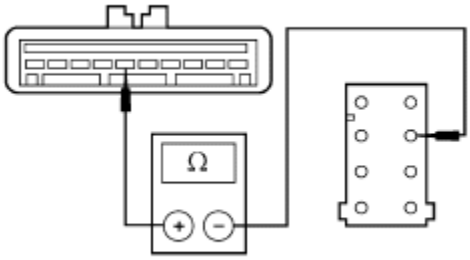
→ **No**
INSTALL a new air bag sliding contact; REFER to Section 501-20B . TEST the system for normal operation.

M7 CHECK GROUND CIRCUIT 848 (DG/OG)

1

Speed Control Servo C171

2



GK5792-A

2 Measure the resistance between air bag sliding contact C220 Pin 4, Circuit 848 (DG/OG), harness side and speed control servo C171 Pin 6, Circuit 848 (DG/OG), harness side.

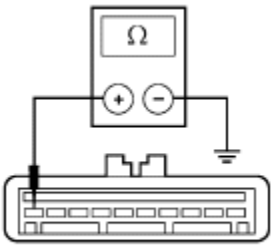
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M8 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

M8 CHECK GROUND TO SERVO

1



GK6978-A

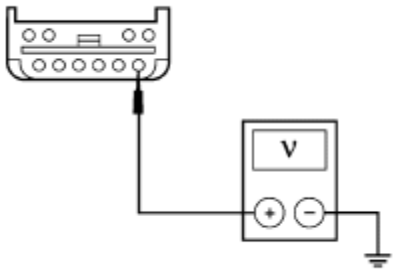
1 Measure the resistance between speed control servo C171 Pin 1, Circuit 57 (BK), harness side and ground.

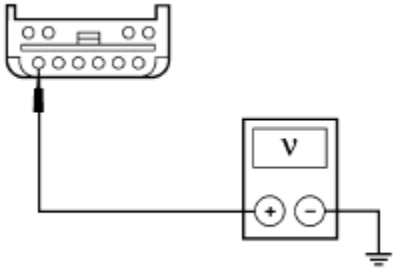
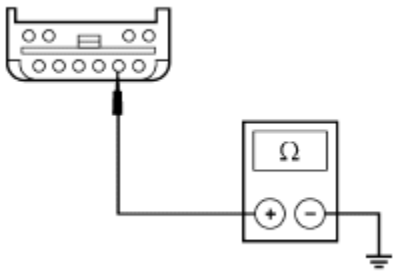
- **Is the resistance less than 5 ohms?**

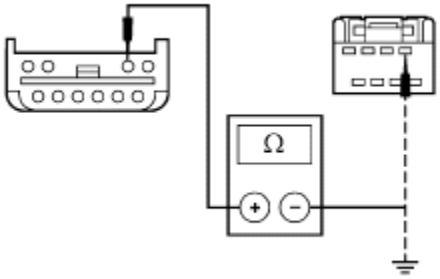
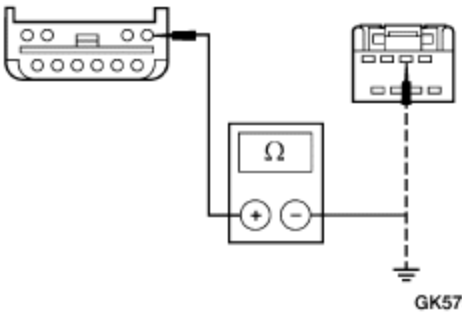
→ **Yes**
INSTALL a new speed control servo (9C735); REFER to Section 310-03 . TEST the system for normal operation.

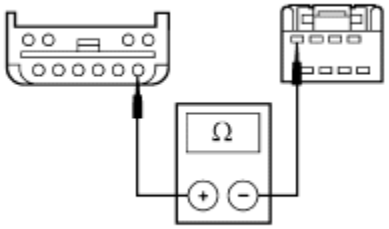
→ **No**
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST N: THE SUBWOOFER IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CARRY OUT THE SPEAKER WALK-AROUND TEST — CHECK SUBWOOFER OPERATION	
1 	2 Turn on the audio unit. 3 Carry out the Speaker Walk-Around Test by pressing Preset Buttons 3 and 6 simultaneously. • **Does the subwoofer sound operate correctly?** → **Yes** The system is operating OK. → **No** GO to N2 .
N2 CHECK CIRCUIT 173 (DG/VT)	
1 2 Subwoofer Amplifier C333 3 4  GK4985-A	4 Measure the voltage between subwoofer amplifier C333 Pin 1, Circuit 173 (DG/VT), harness side and ground. • **Is the voltage greater than 4.1 volts?**

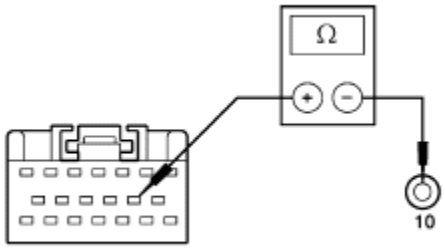
	→ **Yes** GO to N3 . → **No** GO to N7 .
N3 CHECK CIRCUIT 797 (LG/VT)	
1 2  GK5793-A	2 Measure the voltage between subwoofer amplifier C333 Pin 1, Circuit 797 (LG/VT), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to N4 . → **No** REPAIR the circuit. TEST the system for normal operation.
N4 CHECK CIRCUIT 694 (BK/LG)	
1  GK5794-A	1 Measure the resistance between subwoofer amplifier C333 Pin 5, Circuit 694 (BK/LG), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to N5 . → **No**

	REPAIR the circuit. TEST the system for normal operation.
N5 CHECK CIRCUIT 167 (OG/BN)	
1 Audio Unit C215 2  GK5796-A	2 Measure the resistances between subwoofer amplifier C333 Pin 8, Circuit 167 (OG/BN), harness side and audio unit C215 Pin 2, Circuit 167 (OG/BN), harness side; and between subwoofer amplifier C333 Pin 8, Circuit 167 (OG/BN), harness side and ground. • **Is the resistance less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?** → **Yes** GO to N6 . → **No** REPAIR the circuit. TEST the system for normal operation.
N6 CHECK CIRCUIT 168 (RD/BK)	
1  GK5795-A	1 Measure the resistances between subwoofer amplifier C333 Pin 7, Circuit 168 (RD/BK), harness side and audio unit C215 Pin 1, Circuit 168 (RD/BK), harness side; and between subwoofer amplifier C333 Pin 7, Circuit 168 (RD/BK), harness side and ground. • **Is the resistance less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?**

	→ **Yes** REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
N7 CHECK CIRCUIT 173 (DG/VT) FOR OPEN	
1  GK6979-A	1 Measure the resistance between subwoofer amplifier C333 Pin 1, Circuit 173 (DG/VT), harness side and audio unit C215 Pin 4, Circuit 173 (DG/VT), harness side. • **Is the resistance less than 5 ohms?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST O: THE AUDIO UNIT DOES NOT OPERATE CORRECTLY — SPEED SENSITIVE VOLUME (SSV)

CONDITIONS	DETAILS/RESULTS/ACTIONS
O1 CHECK VEHICLE SPEEDOMETER	
1 	2 Turn on the audio unit. 3 Press the volume control button for three seconds, then release. Speed sensitive volume (SSV) setting should be displayed. To change the SSV setting, press select button < or >. Set the SSV setting to 7 (maximum). 4 Drive the vehicle and observe the vehicle

	speedometer. • **Does the speedometer operate correctly?** → **Yes** GO to O2 . → **No** REFER to Section 413-01 .
O2 CHECK SSV SPEED SIGNAL CIRCUIT 679 (GY/BK)	
1 2 Audio Unit C228 3 Anti-Lock Brake Module C186 5  GK7188-A	4 Connect the ABS Breakout Box Adapter between the anti-lock brake module C186 and the EEC-IV 60-Pin Breakout Box. 5 Measure the resistance between audio unit C228 Pin 9, Circuit 679 (GY/BK), harness side and the EEC-IV 60-Pin Breakout Box Pin 10, Circuit 679 (GY/BK). • **Is the resistance less than 5 ohms?** → **Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. → **No**

	REPAIR the circuit. TEST the system for normal operation.

Torque Specifications

Description	Nm	lb-in
Console Compartment Trim Panel Screw	2-3	17-26
Console Glove Compartment Door Hinge Screw	2-3	17-26
Console Rear Panel Screw	1.2-1.8	11-16
Intake Manifold Ground Strap Nut	7-9	62-80
Radio Amplifier Bracket Bolt	10-14	88-124
Radio Amplifier Bracket Nut	7-9	62-80
Radio Amplifier Bracket Screw	7-10	62-88
Radio Amplifier Mounting Screw	7-10	62-88
Radio Chassis Rear Support Nut	3.5-4	31-35
Rear Integrated Control Panel Screws	2-3	17-26
Wiper Motor Stud Ground Strap Nut	7-9	62-80
Rear Radio Chassis Support	3.5-4	31-35
Battery Ground Cable Screw	7-10	62-89
Cylinder Head Ground Strap Bolt	8.9-12.1	79-107

Audio System

The audio system consists if the following components.

- Rear integrated control panel (RICP)
- Steering wheel controls (SWC)
- Audio unit
- Digital audio compact disc player (18D806)

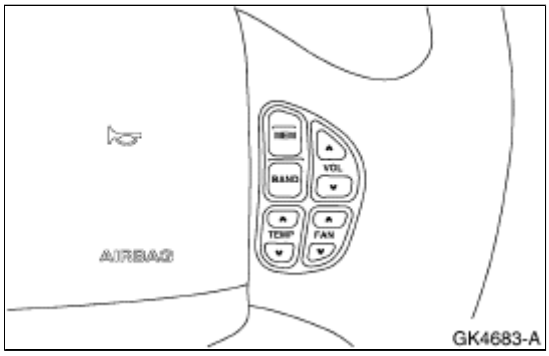
There are four audio systems available:

- the M100 AM/FM cassette radio.
- the M100 AM/FM/CD.
- the DM100i AM/FM/Cassette/CD (premium).
- the T100i DM AM/FM/Cassette/CD (premium/audiophile).

The RICP audio controls are activated and deactivated by pressing the front chassis radio memory buttons "3" and "5" simultaneously.

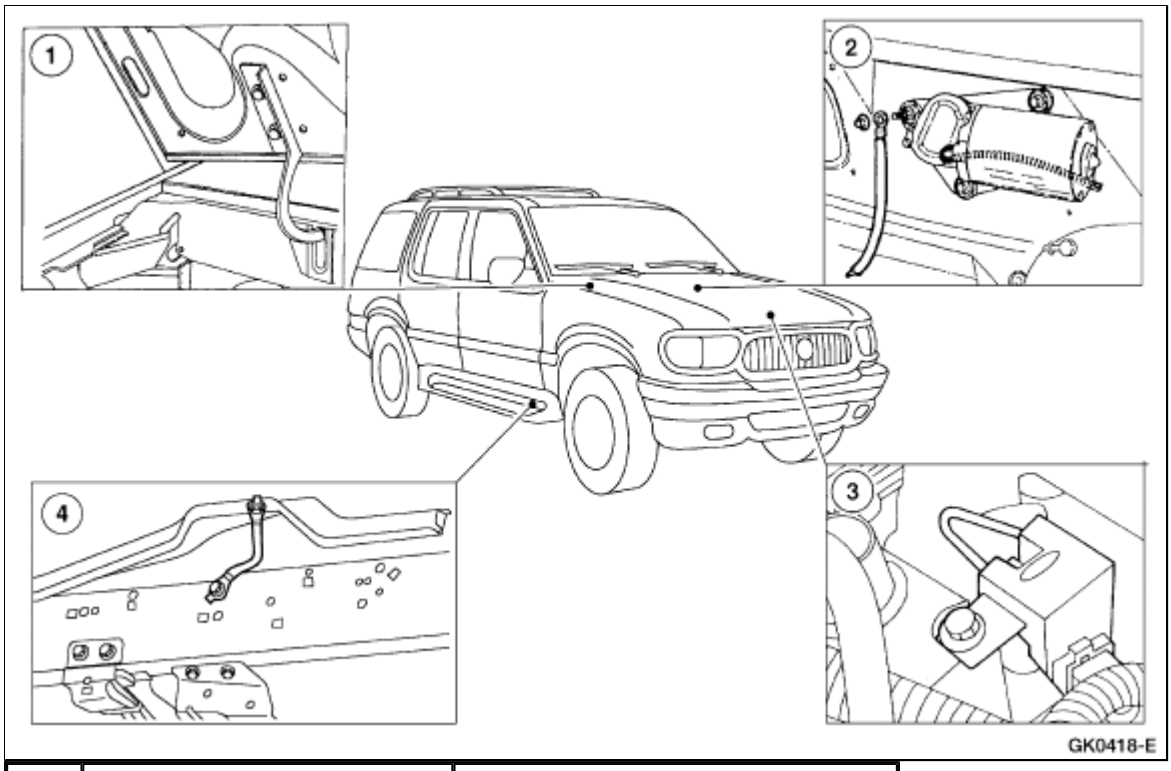
The audio controls of the RICP allow the rear passengers to control volume, station, mode, front chassis radio memory presets, and speaker or headphone selection. The mini-headphone jacks are also located on the panel. Refer to the Audio Guide for more information.

Steering Wheel Integrated Audio Controls



The audio controls on the steering wheel allow the driver to control volume, AM/FM band, and memory presets. The audio controls are located on the right side of the steering wheel.

Radio Frequency Interference Suppression Equipment



Item	Part Number	Description
1	—	Ground strap (part of hood hinge)
2	14303 (4.0L) 19A095 (5.0L)	Ground strap-bulkhead to engine
3	18801	Capacitor
4	19A095	Ground strap-body to frame

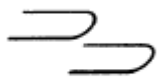
The radio suppression equipment reduces interference transmitted through the radio speakers by the engine ignition and electrical systems.

Audio System

Refer to Section 415-00 .

Audio Unit

Special Tool(s)

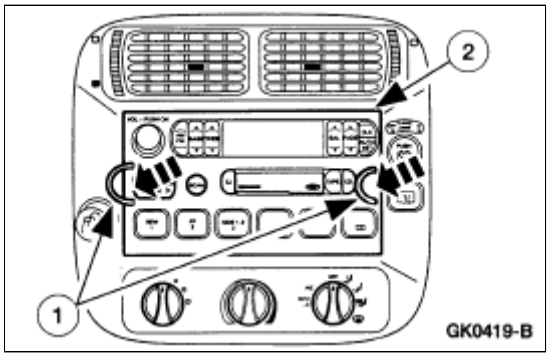
 ST1445-A	Radio Removing Tool 415-001 (T87P-19061-A)

Removal

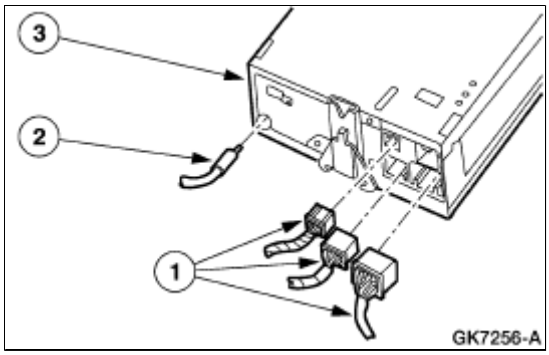
1. **NOTE:** The removal and installation procedures apply to all original equipment instrument panel (04320) mounted radio chassis (18806).

   Disconnect the battery ground cable (14301).

2. Remove the radio chassis.
   1. Insert Radio Removing Tool into the radio face plate and release the radio retaining clips.
   2. Pull outward on Radio Removing Tool to remove the radio chassis from the instrument panel.



3. Remove the radio.
   1. Disconnect the electrical connectors.
   2. Disconnect the radio antenna lead in cable.
   3. Remove the radio.



Installation

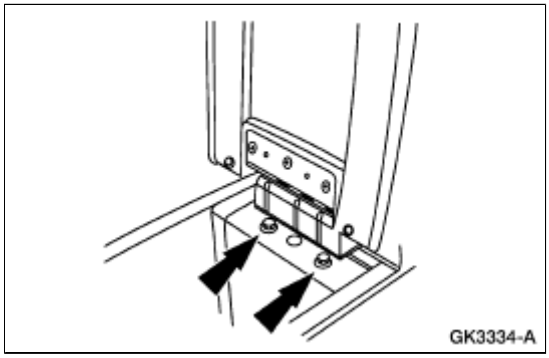
1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

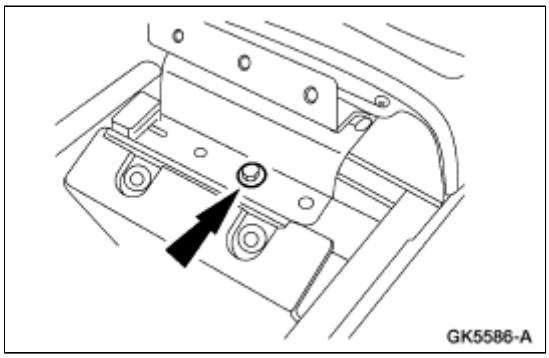
Auxiliary Control —Rear Integrated Control Panel

Removal

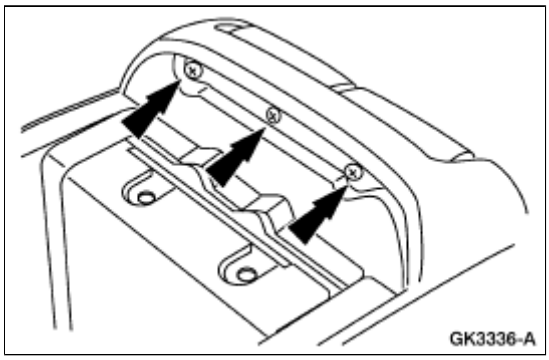
1. Disconnect the battery ground cable (14301).
2. Remove the console compartment trim panel screws.



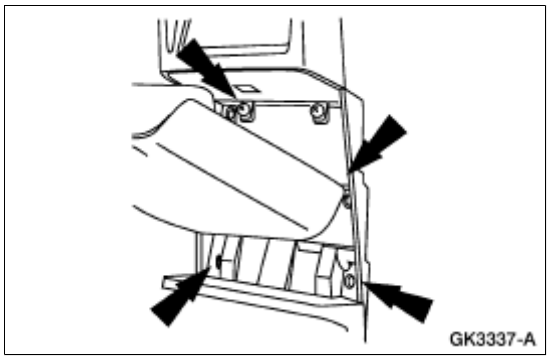
3. Remove the console compartment door hinge screw.



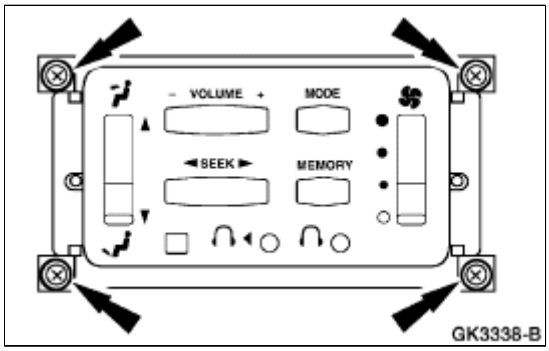
4. Remove the console rear panel screws at the top of the panel.



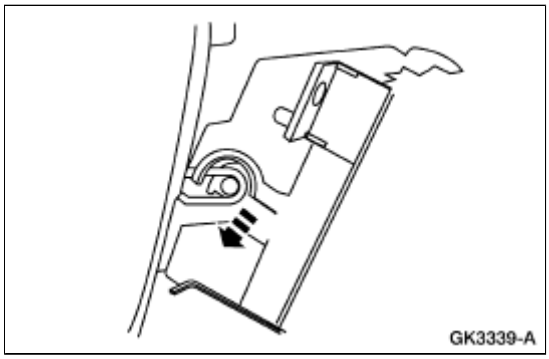
5. Remove the console rear panel screws at the cupholder.



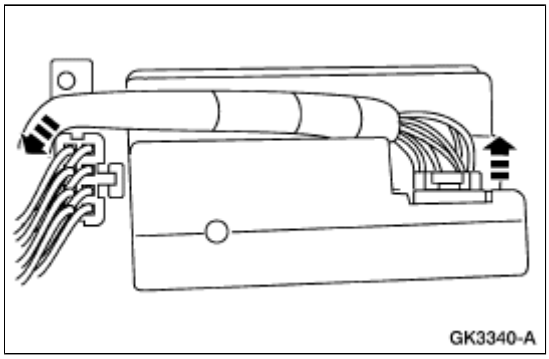
6. Remove the rear integrated control panel screws.



7. Disconnect the floor/panel control arm at the control head.



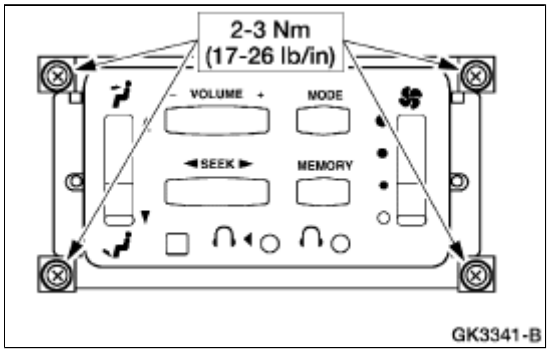
8. Disconnect the rear blower motor control and rear radio controls electrical connectors.

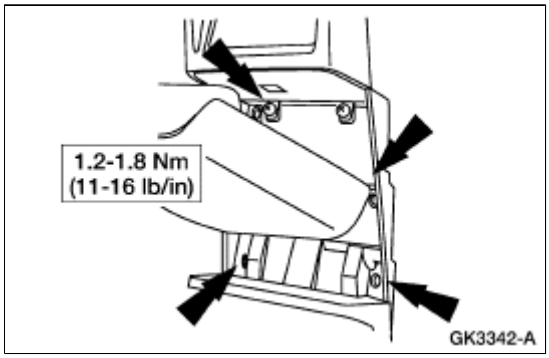


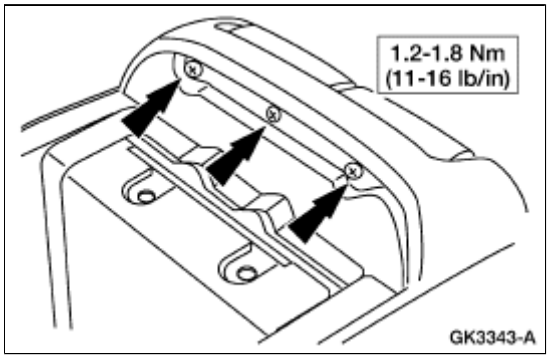
Installation

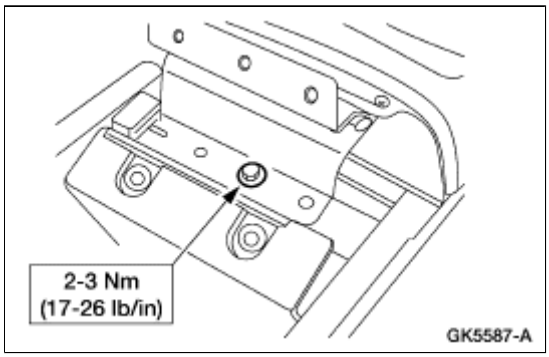
1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

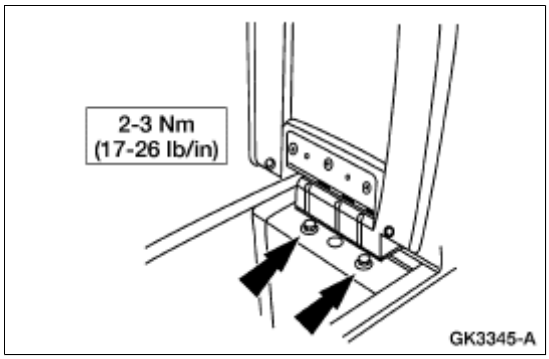
   To install, reverse the removal procedure.










2-3 Nm
(17-26 lb/in)
GK3345-A

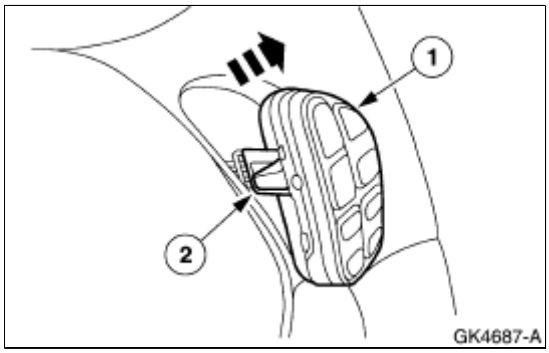
Auxiliary Control —Steering Wheel Controls

Removal

1. Disconnect the battery ground cable.

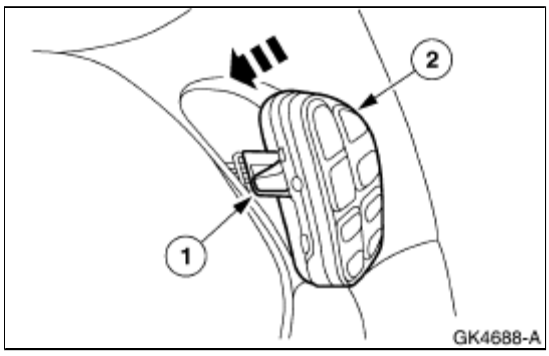
2. **NOTE:** The steering wheel is leather wrapped and should be protected when removing the steering wheel controls.

   Remove the steering wheel controls.
   1. Carefully remove the steering wheel controls.
   2. Disconnect the steering wheel controls.



Installation

1. Install the steering wheel controls.
   1. Connect the steering wheel controls.
   2. Install the steering wheel controls.



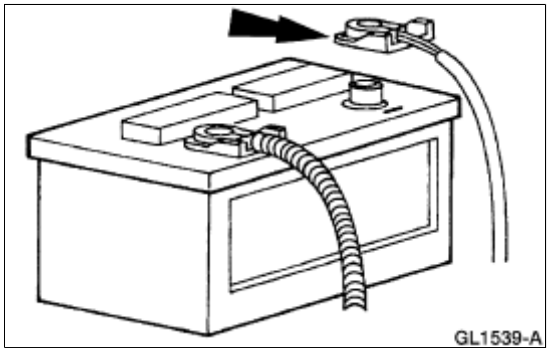
2. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   Connect the battery ground cable.

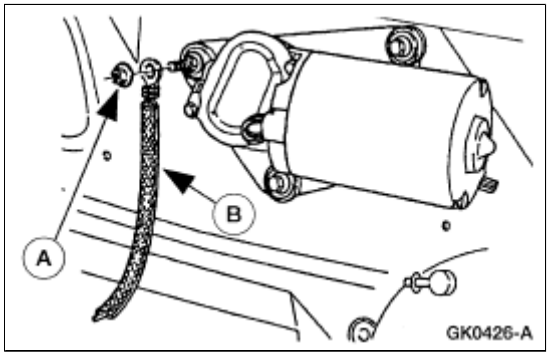
Ground Strap

Removal

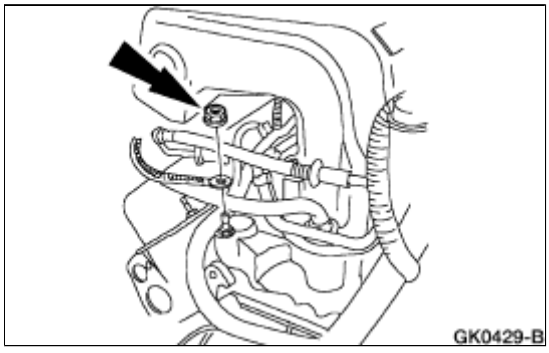
1. Disconnect the battery ground cable (14301).



2. Remove the nut and washer (A) attaching the ground strap (B) to the stud.



3. Remove the fastener from the rear of the intake manifold on 5.0L (shown), rear of the left cylinder head on 4.0L (push rod), or rear of the right cylinder head on 4.0L (SOHC), and ensure that the mounting surfaces of the studs are free of dirt and corrosion.

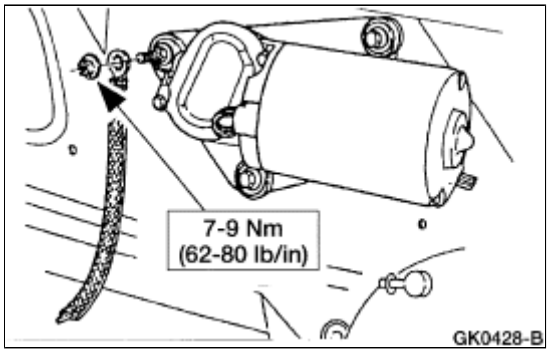


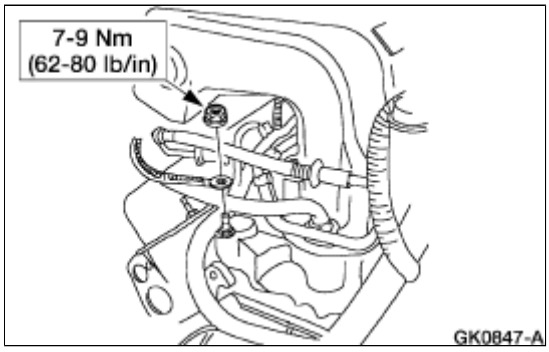
Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms

may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



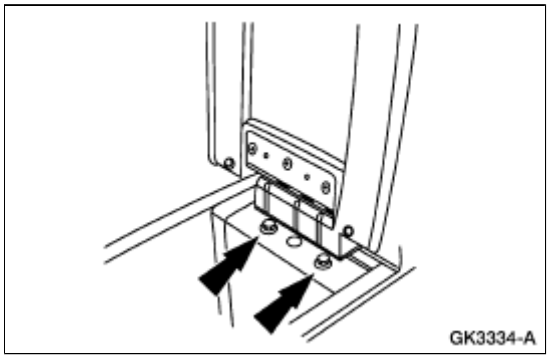


Compact Disc (CD) Changer

Removal

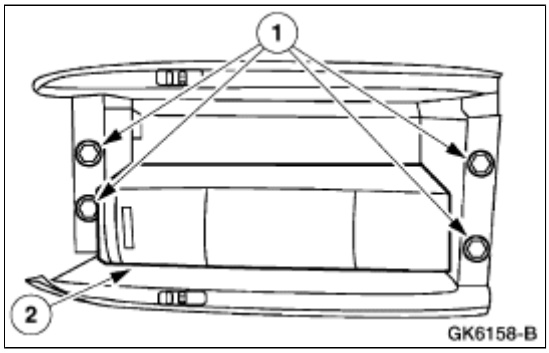
1. Disconnect the battery ground cable.

2. Remove the console compartment trim panel.
   - Remove the screws.
   - Remove the console compartment trim panel.

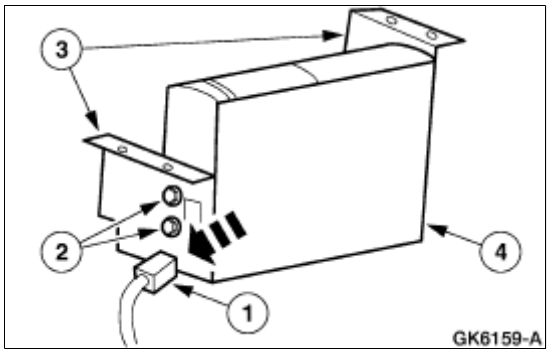


3. Remove the coin holder/tissue box holder.

4. Position the CD changer (18C830) aside.
   1. Remove the screws.
   2. Position aside the CD changer.

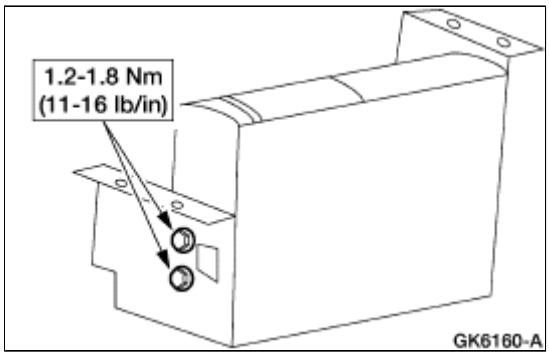


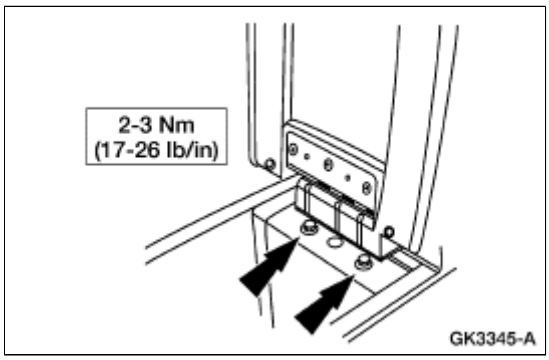
5. Remove the CD changer.
   1. Disconnect the connector.
   2. Remove the screws.
   3. Remove the CD changer brackets.
   4. Remove the CD changer.



Installation

1. To install, reverse the removal procedure.





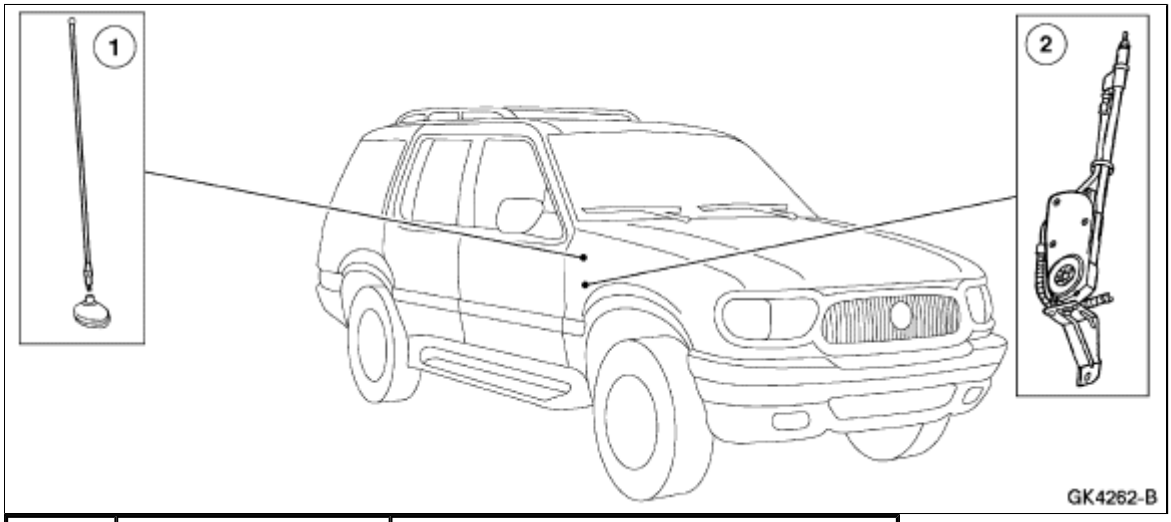
Torque Specifications

Description	Nm	lb-ft	lb-in
Radio Antenna Nut	9.5-10.5	—	84-93
Lower Antenna Mounting Screw	4.5-6.3	—	40-56
Radio Antenna Mast	3.4-3.6	—	30-31
Battery Ground Cable	7-10	—	62-89
Front Fender Apron Bolts	12	9	—

Antenna

All vehicles are equipped with a standard antenna. A power antenna is optional with the audiophile system.

Antenna



Item	Part Number	Description
1	—	Fixed mast antenna
2	18850	Electric antenna (optional)

Antenna

Refer to Section 415-00 .

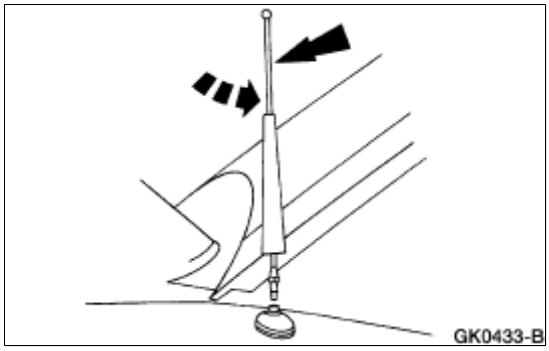
Cable —Fixed Antenna

Removal

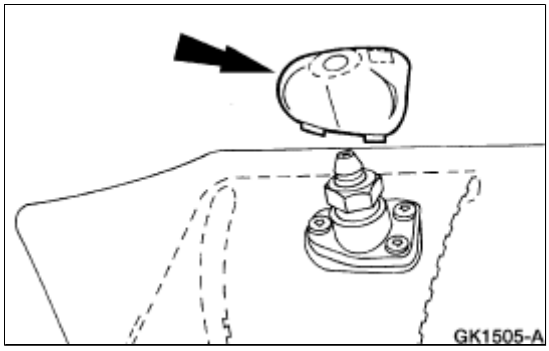
NOTE: The antenna base and the antenna cable are removed as an assembly.

1. Disconnect the battery ground cable (14301).

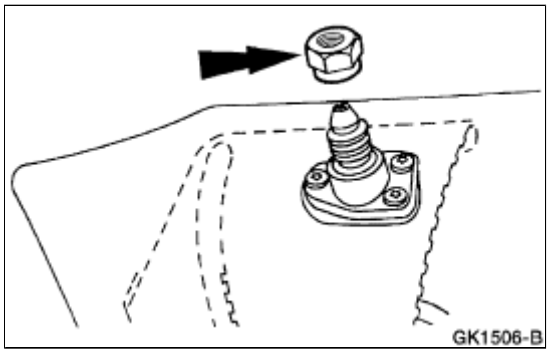
2. Remove the radio antenna mast (18A886).
   - Slide the wind deflector up.
   - Remove the radio antenna mast by turning it counterclockwise.



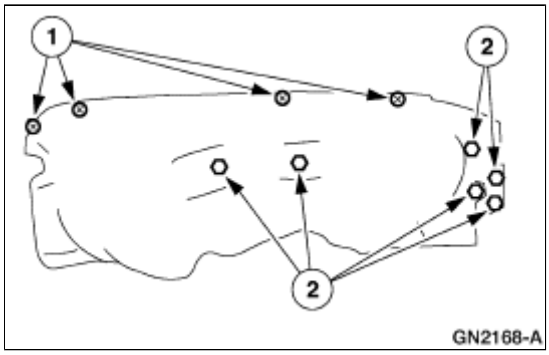
3. Unsnap the radio antenna base cap (18A927).



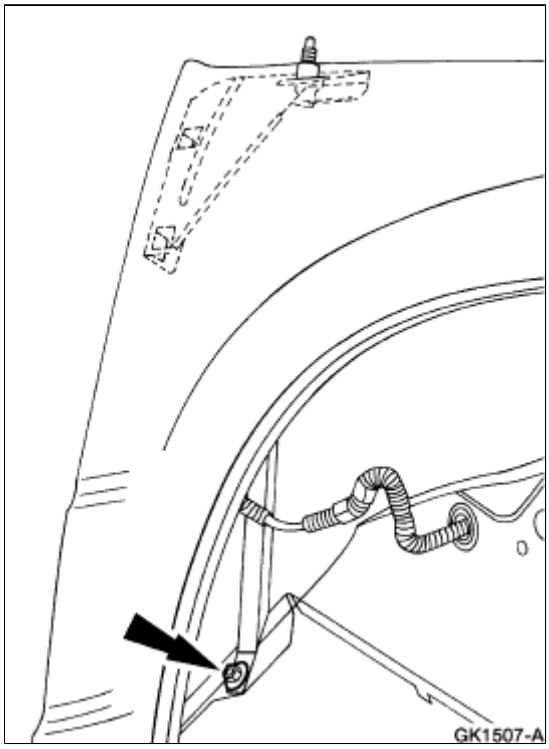
4. Remove the radio antenna nut.



5. Remove the front fender apron.
    1. Remove the screws.
    2. Remove the bolts.



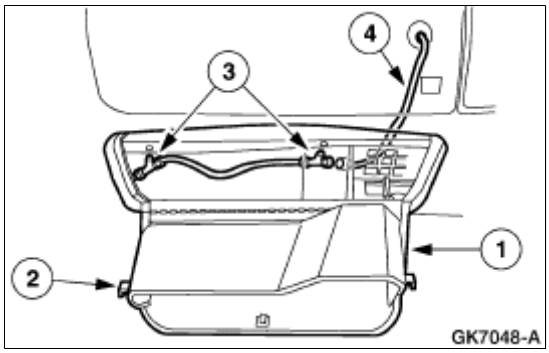
6. Remove the lower antenna mounting screw.



7. Remove the RH cowl side trim panel. For additional information, refer to Section 501-05 .

8. Remove the audio unit. For additional information, refer to Section 415-01 .

9. Position the antenna lead-in cable into the engine compartment.
    1. Open the glove compartment door.
    2. Release the tabs and lower the glove compartment to the full open position.
    3. Release the antenna lead-in cable locators.
    4. Push the antenna lead-in cable into the engine compartment.



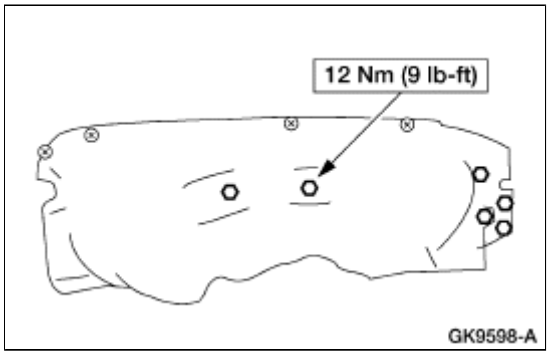
10. Remove the antenna base and the antenna lead-in cable.

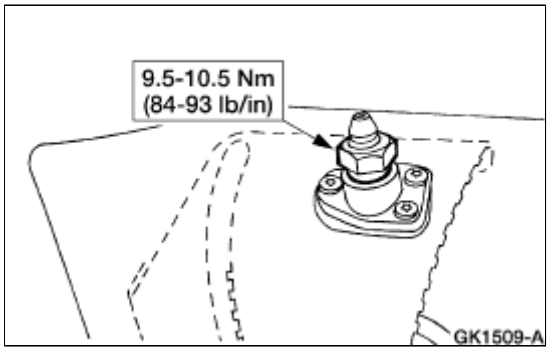
Installation

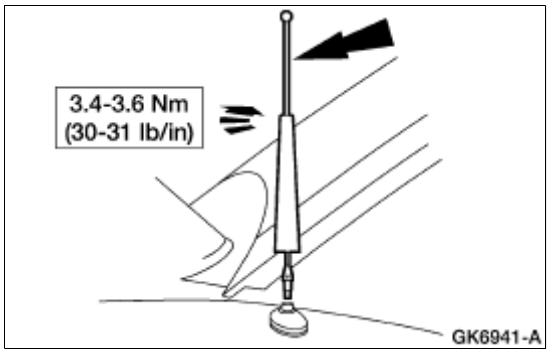
NOTE: The antenna base and the antenna cable are installed as an assembly.

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.





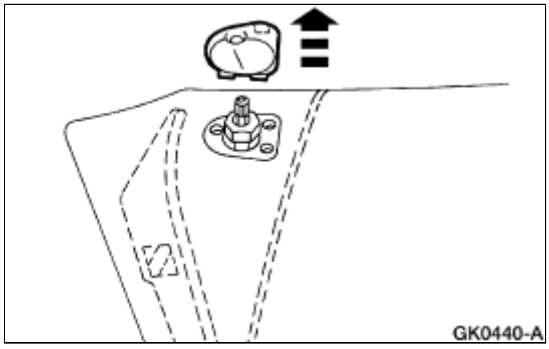

3.4-3.6 Nm
(30-31 lb/in)
GK6941-A

Cable —Power Antenna

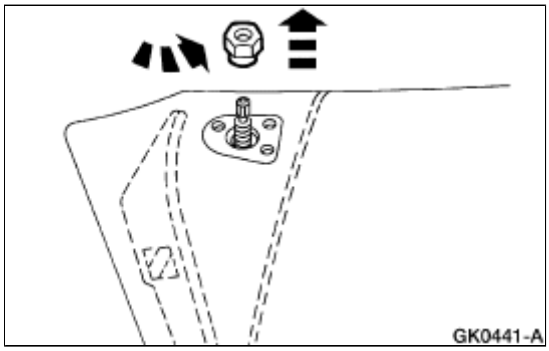
Removal

NOTE: The power antenna cable and the antenna mast are removed as an assembly.

1. Unsnap the radio antenna base cap (18A927).



2. Remove the radio antenna nut (18865).



3. Remove the antenna mast and cable.
   - Turn the ignition switch (11572) to the ACC position.
   - Turn the radio chassis (18806) ON/OFF switch to ON.
   - Firmly pull the antenna mast and cable out of the electric antenna motor.

Installation

NOTE: The power antenna cable and antenna mast are installed as an assembly.

1. **NOTE:** Check the end of the plastic antenna drive cable for a slight taper. If the drive cable is broken, a section of cable may be inside the electric antenna motor. Remove the broken cable. Refer to Antenna—Motor .

   Position the cable so the teeth are facing the front of the vehicle.

2. Insert the antenna.

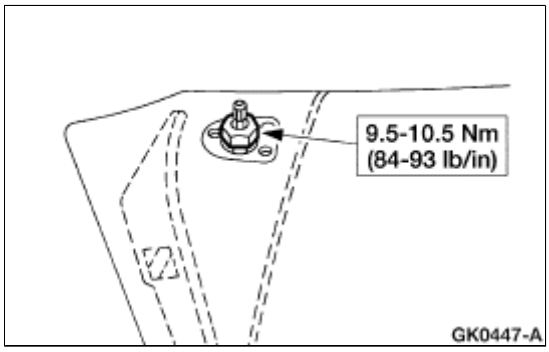
- Manually extend the antenna.
- Insert the cable until resistance is felt.
- Turn the cable slightly left and right to fully engage the cable into the motor gear.

3. Have an assistant turn the ignition switch to ACC and turn the radio chassis ON/OFF switch from ON to OFF.

4. Apply light downward pressure to the antenna as the electric antenna motor starts retracting the cable.

5. Guide the antenna in as the motor winds the cable into the drive unit and retracts the antenna sections.

6. Install the radio antenna nut.



7. Install the radio antenna base cap.

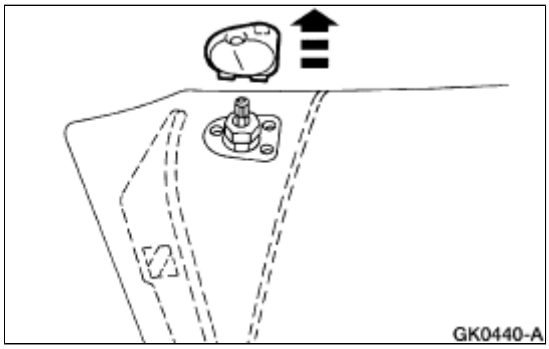
8. Cycle the electric antenna motor several times to ensure the antenna is extending and retracting correctly.

Antenna —Motor

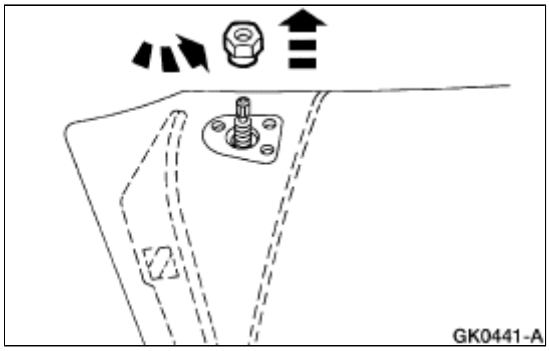
Removal

NOTE: The antenna motor and the antenna cable is removed as an assembly.

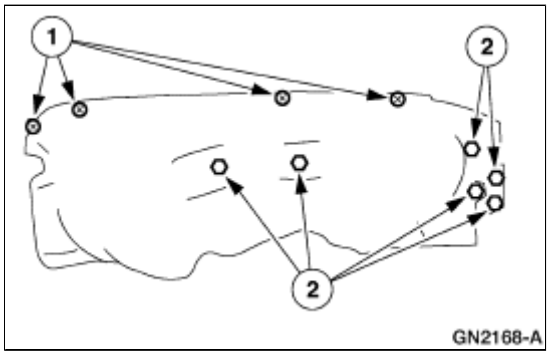
1. Disconnect the battery ground cable (14301).
2. Unsnap the radio antenna base cap (18A927).



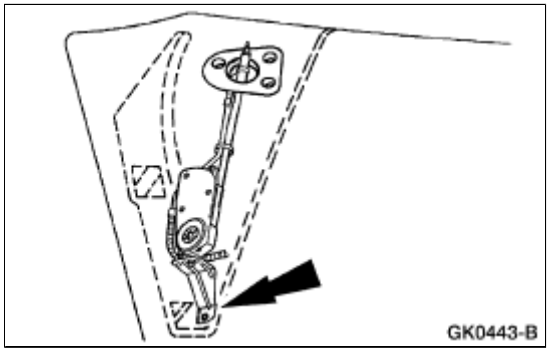
3. Remove the radio antenna nut.



4. Remove the front fender apron.
    1. Remove the screws.
    2. Remove the bolts.

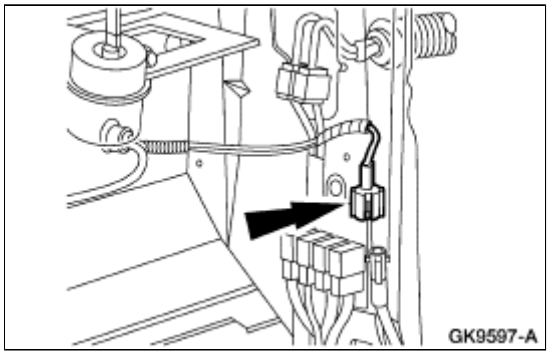


5. Remove lower antenna mounting screw.



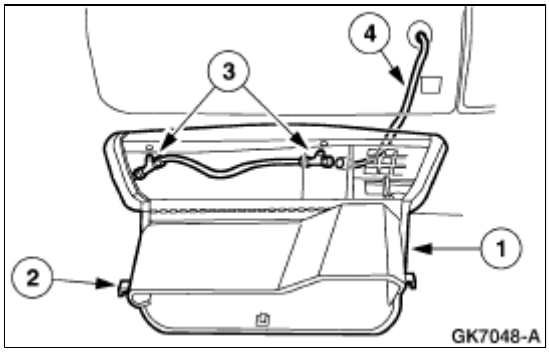
6. Remove the RH cowl side trim panel. For additional information, refer to Section 501-05 .

7. Disconnect the antenna motor electrical connector.

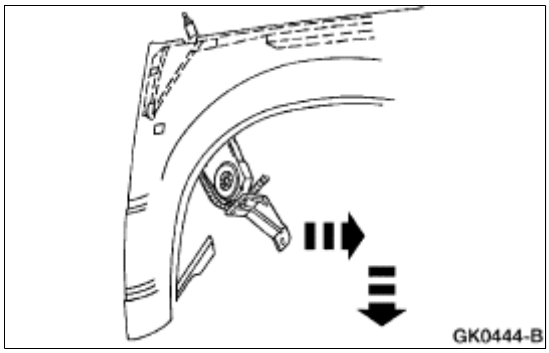


8. Remove the audio unit. For additional information, refer to Section 415-01 .

9. Position the antenna lead in cable into the engine compartment.
    1. Open the glove compartment door.
    2. Release the tabs and lower the glove compartment to the full open position.
    3. Release the antenna lead in cable wire locators.
    4. Push the antenna lead in cable into the engine compartment.



10. Move the electric antenna motor forward and down to remove.



11. If necessary, to remove a broken section of plastic antenna drive cable, remove the cover and drive mechanism.

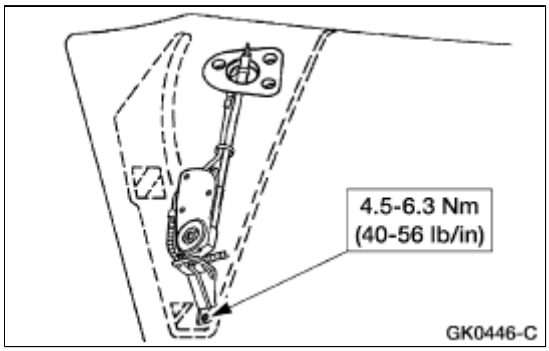
12. Locate and remove the broken piece of drive cable.

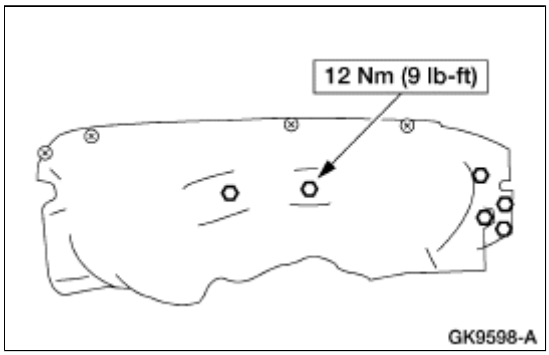
Installation

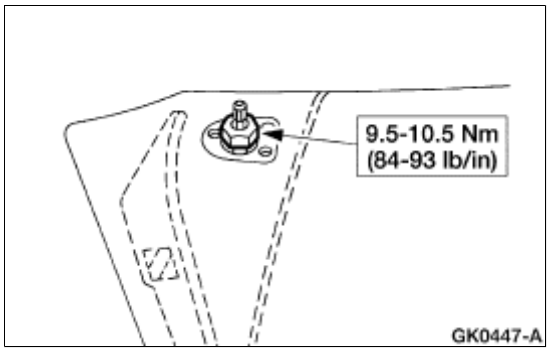
NOTE: The antenna motor and antenna cable are installed as an assembly.

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.






9.5-10.5 Nm
(84-93 lb/in)
GK0447-A

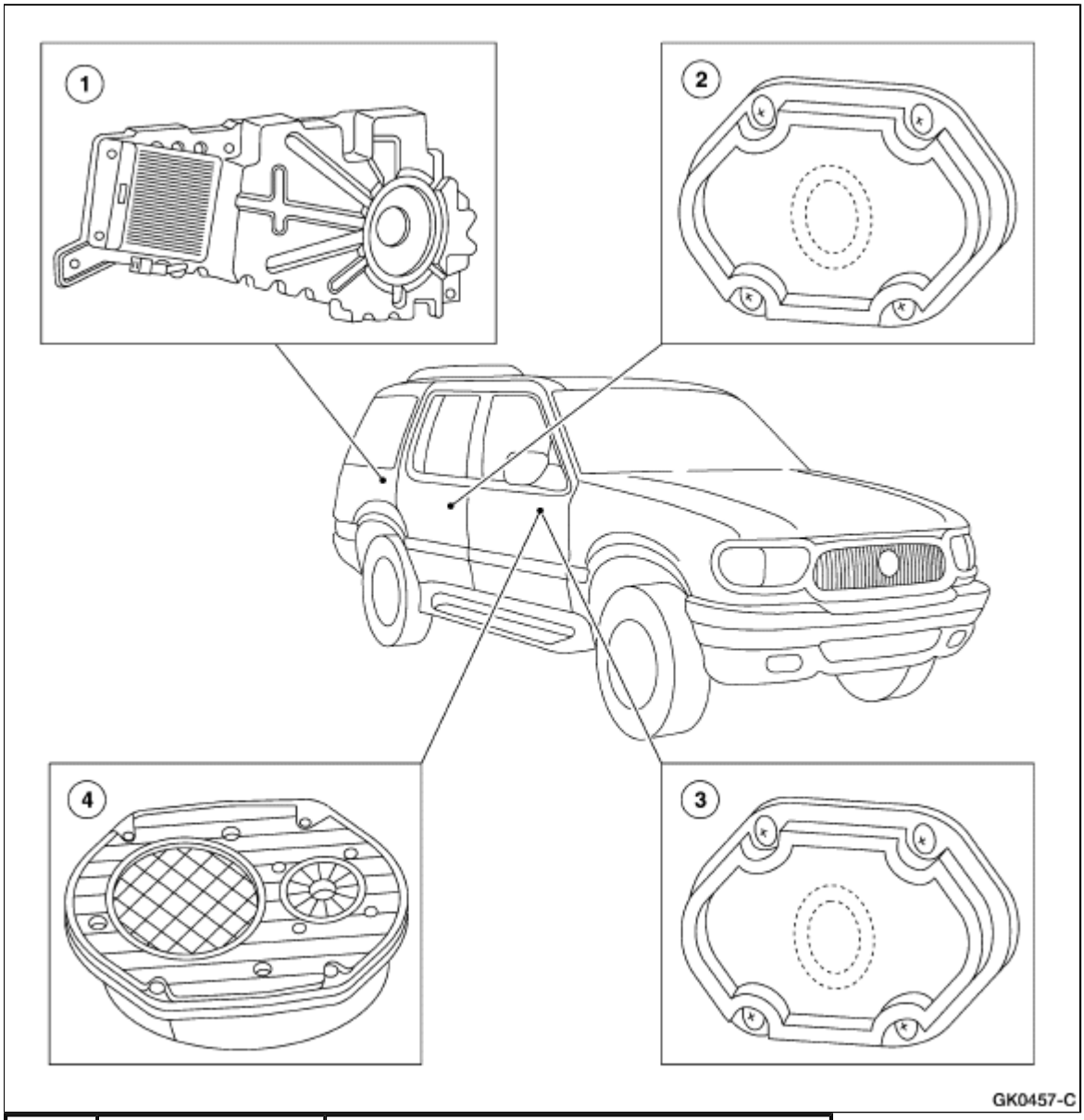
Torque Specifications

Description	Nm	lb-in
Battery Ground Cable	10	89
Speaker Screws	2	18
Subwoofer Screws	6.8-9.2	61-82

Speakers

The Explorer and Mountaineer are equipped with four premium radio speakers and an optional subwoofer. Rear radio speakers are mounted in the rear doors in four-door models or in the quarter panel in two-door models. Front radio speakers are mounted in the front doors. The optional MACH sound system replaces the front door premium radio speakers with audiophile radio speakers.

Radio Speaker System (4-door shown, 2-door similar)



Item	Part Number	Description
1	18C804	Optional subwoofer
2	18808-A	Rear door speaker (Premium)

3	18808-A	Front door speaker (Premium)
4	18808-C	Front door speaker (Audiophile)

Speakers

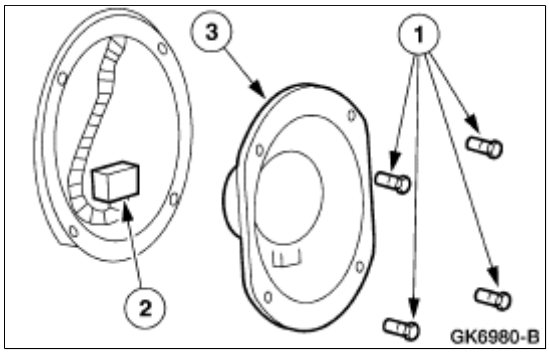
Refer to Section 415-00 .

Speakers —Door Mounted

Removal

1. Remove the front door trim panels (239420). For additional information, refer to Section 501-05 .

2. Remove the speakers (18808).
    1. Remove the screws.
    2. Disconnect the electrical connectors.
    3. Remove the speakers.



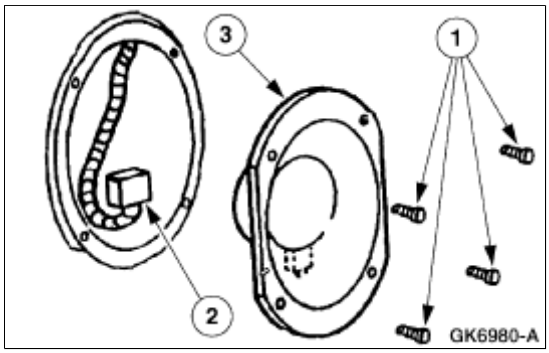
Installation

1. To install, reverse the removal procedure.

Speaker —Rear (2 Door)

Removal

1. Remove the quarter trim panel; refer to Section 501-05 .
2. Remove the speaker.
    1. Remove the screws.
    2. Disconnect the electrical connector.
    3. Remove the speaker.



Installation

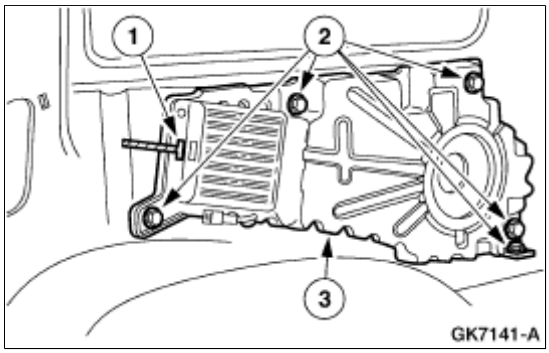
1. To install, reverse the removal procedure.

Speaker —Subwoofer

Removal

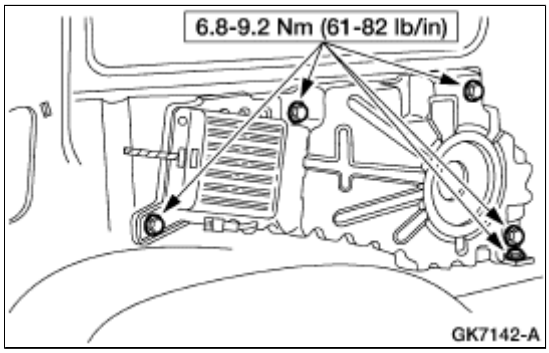
1. Remove the quarter trim panel; refer to Section 501-05 .

2. Remove the subwoofer.
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the subwoofer.



Installation

1. To install, reverse the removal procedure.



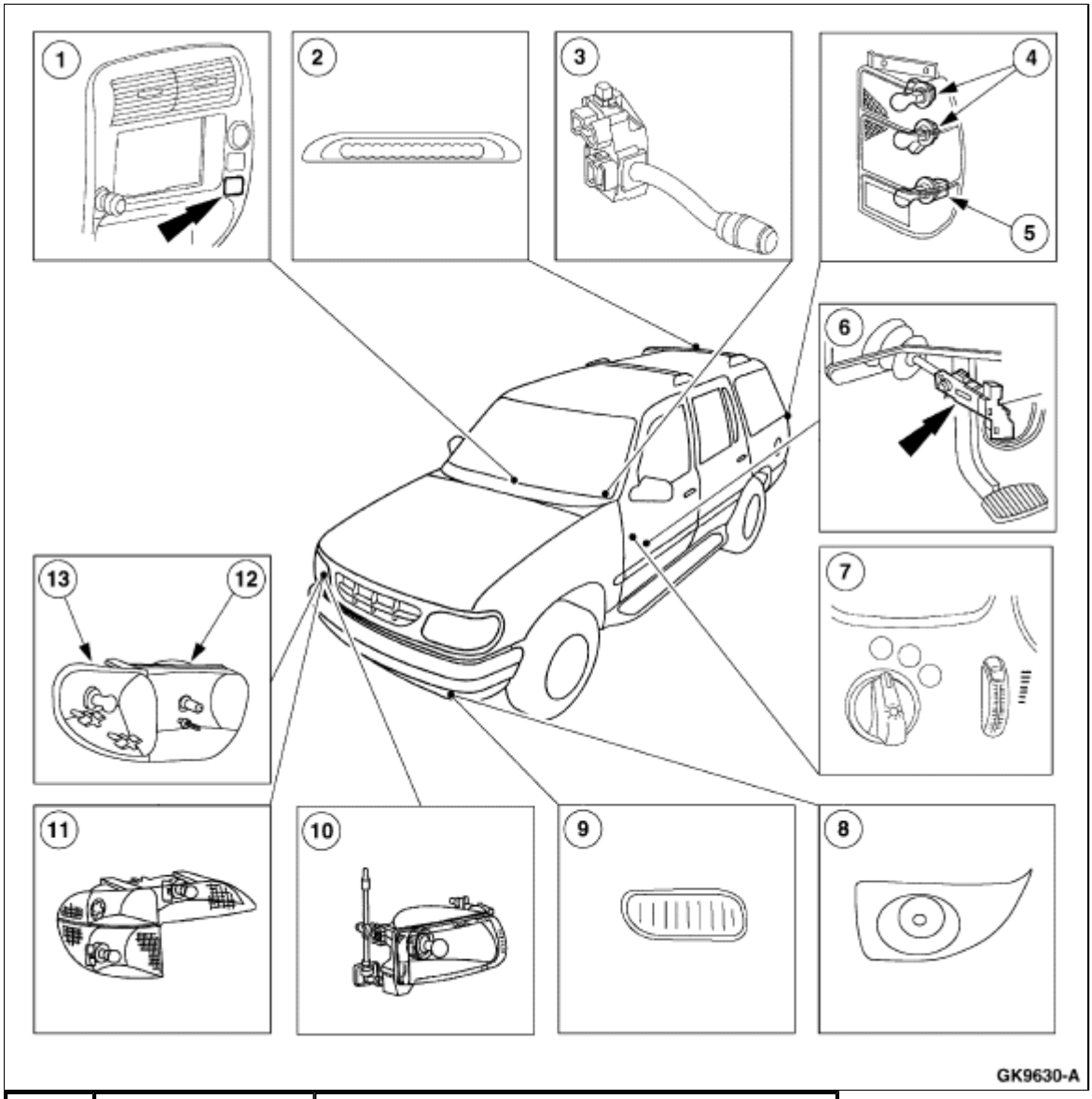
Torque Specifications

Description	Nm	lb-ft	lb-in
Backup lamp switch	25-35	18-26	—
Battery ground cable nut	7-10	—	62-88
Bumper cover strut bolt	12	9	—
Center instrument panel finish panel screws	2-3	—	18-26
Fog lamp bolts (Explorer)	34	25	—
Fog lamp bolts (Mountaineer)	12	9	—
Fog lamp switch mounting bezel screws	2-3	—	18-26
Headlamp switch screws	2-3	—	18-26
High-mounted stoplamp nuts	2.7-3.7	—	24-34
Hood release screws	2.7-3.7	—	25-33
Instrument cluster finish panel screws	2-3	—	18-26
Instrument panel steering column cover screws	2.1-2.9	—	19-25
Instrument panel steering column opening cover reinforcement bolts	7.6-10.4	—	67-92
Parking brake release screws	2.7-3.7	—	25-33
Parking lamp assembly screws (Explorer)	1.7-2.1	—	15-18
Parking lamp assembly screw (Mountaineer)	2.2-3.0	—	19.5-26.5
Rear lamp assembly screws	1.6-2.2	—	14-19

Exterior Lighting

The exterior lighting system consists of:

Exterior Lighting System Components



Item	Part Number	Description
1	15A214	Fog lamp switch
2	13A613	High-mounted stoplamp
3	13K359	Multi-function switch
4	13404	Rear lamp
5	15500	Reversing lamp

6	13480	Brake pedal position (BPP) switch
7	11654	Headlamp switch
8	15200	Fog lamp (Explorer only)
9	—	Fog lamp (Mountaineer only)
10	13008	Headlamp (Explorer only)
11	13200	Parking lamp—(Explorer only)
12	—	Headlamp (Mountaineer only)
13	—	Parking Lamp (Mountaineer only)

The headlamp switch (11654) is a three position switch that controls the headlamps and the exterior lamps.

The multi-function switch (13K359) controls the turn signals, high beams, and hazard lamps.

The brake pedal position (BPP) switch controls the brake lamps and the high-mounted stoplamp.

The optional autolamp system provides light sensitive automatic on-off control of the exterior lamps normally controlled by the headlamp switch. The autolamp system keeps the lamps on for a preselected period of time after the ignition switch (11572) is turned off. The pre-selected time lapse is adjustable up to approximately three minutes.

The fog lamps (15200) are controlled by the fog lamp switch (15A214). The fog lamps can only be operated with the headlamp switch in the ON position and the multi-function switch lever in the low beam position.

Headlamps

Refer to Wiring Diagrams Cell 85 , Headlamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the headlamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

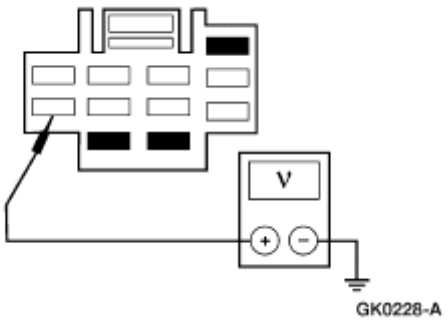
Condition	Possible Sources	Action
• Both Headlamps Are Inoperative	• Fuse(s). • Headlamp switch (11654). • Circuitry. • Multi-function switch (13K359).	• GO to Pinpoint Test A .
• The Low Beams Are Inoperative	• Circuitry. • Multi-function switch.	• GO to Pinpoint Test B .
• The High Beams Are Inoperative	• Fuse(s). • Circuitry. • Multi-function switch.	• GO to Pinpoint Test C .

• One Low Beam Headlamp Is Inoperative	• Fuse(s). • Headlamp bulb (13007). • Circuitry.	• GO to Pinpoint Test D .
• One High Beam Headlamp Is Inoperative	• Headlamp bulb. • Circuitry.	• GO to Pinpoint Test E .
• The Headlamps Are On Continuously	• Headlamp switch. • Multi-function switch.	• GO to Pinpoint Test F .
• The Flash-to-Pass Feature Is Inoperative	• Multi-function switch.	• REPLACE the multi-function switch.

Pinpoint Tests

PINPOINT TEST A: BOTH HEADLAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK POWER DISTRIBUTION BOX MINI-FUSE 12 (30A)	
1 2 Power Distribution Box Mini-Fuse 12 (30A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to A2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, GO to A5 .
A2 CHECK THE VOLTAGE TO THE HEADLAMP SWITCH	
1 Headlamp Switch C216 2	2 Measure the voltage between headlamp switch C216-6, circuit 196 (DB/OG), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A3 .

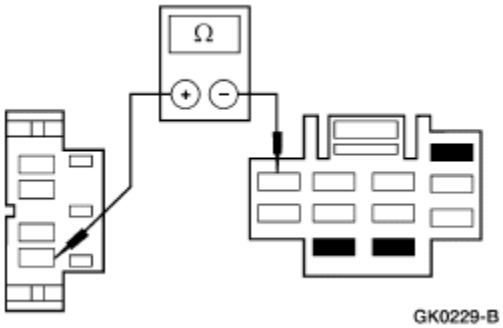
→ **No**
REPAIR circuit 196 (DB/OG). TEST the system for normal operation.

A3 CHECK CIRCUIT 15 (RD/YE) FOR OPEN

1

Multi-Function Switch C210

2



2 Measure the resistance between headlamp switch C216-2, circuit 15 (RD/YE), and multi-function switch C210-15, circuit 15 (RD/YE).

- **Is the resistance less than 5 ohms?**

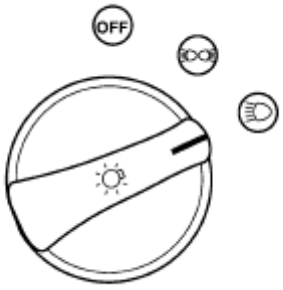
→ **Yes**
RECONNECT the headlamp switch; GO to A4 .

→ **No**
REPAIR circuit 15 (RD/YE). TEST the system for normal operation.

A4 CHECK THE VOLTAGE TO THE MULTI-FUNCTION SWITCH

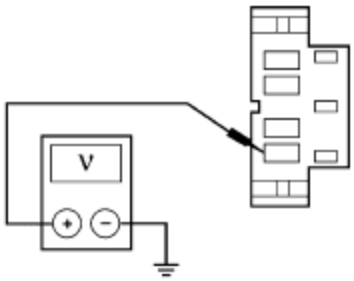
1

1 Place the headlamp switch in the ON position.



K26996-A

2



GK0230-B

2 Measure the voltage between multi-function switch C210-15, circuit 15 (RD/YE), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the multi-function switch. TEST the system for normal operation.

→ **No**
REPLACE the headlamp switch. TEST the system for normal operation.

A5 CHECK CIRCUIT 196 (DB/OG) FOR SHORT TO GROUND

1

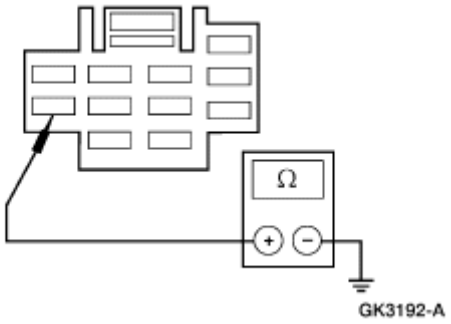
Headlamp Switch C216

2

Multi-Function Switch C210

3

3 Measure the resistance between headlamp switch C216-6, circuit 196 (DB/OG), and ground.



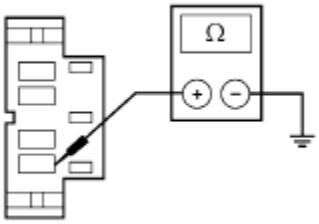
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to A6 .

→ **No**
REPAIR circuit 196 (DB/OG). TEST the system for normal operation.

A6 CHECK CIRCUIT 15 (RD/YE) FOR SHORT TO GROUND

1



1 Measure the resistance between multi-function switch C210-15, circuit 15 (RD/YE), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
RECONNECT the headlamp switch. REPLACE power distribution box mini-fuse 12 (30A). GO to A7 .

→ **No**
REPAIR circuit 15 (RD/YE). TEST the system for normal operation.

A7 RECHECK POWER DISTRIBUTION BOX MINI-FUSE 12 (30A)

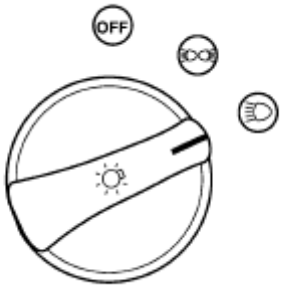
1

Power Distribution Box Mini-Fuse 12 (30A)

	• **Is the fuse OK?** → **Yes** REPLACE the multi-function switch. TEST the system for normal operation. → **No** REPLACE the headlamp switch. TEST the system for normal operation.

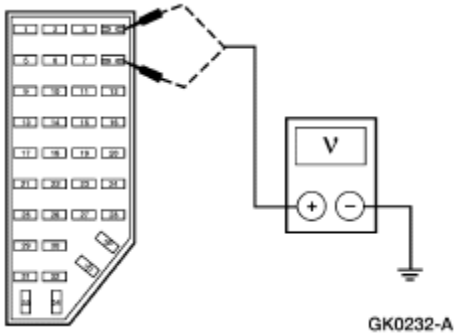
PINPOINT TEST B: THE LOW BEAMS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE FUSE(S)	
1 Fuse Junction Panel Fuse 4 (10A) 2 Fuse Junction Panel Fuse 8 (10A)	• **Are fuses OK?** → **Yes** GO to B2 . → **No** GO to B4 .
B2 CHECK THE VOLTAGE TO FUSE JUNCTION PANEL FUSE 4 (10A) AND FUSE JUNCTION PANEL FUSE 8 (10A)	
1 2	2 Place the headlamp switch in the ON position.



K26996-A

3



GK0232-A

3 Measure the voltage between I/P fuse panel fuse 4, pin 2, and ground; and between I/P fuse panel fuse 8, pin 2, and ground.

- **Are the voltages greater than 10 volts?**

→ **Yes**
Place the headlamp switch in the OFF position.
GO to B4 .

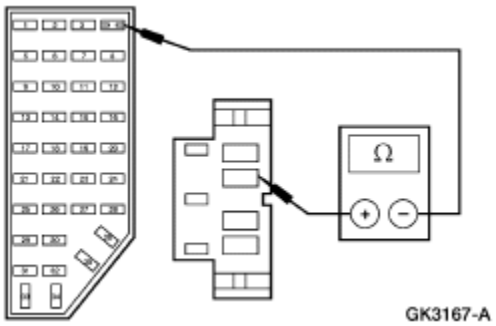
→ **No**
GO to B3 .

B3 CHECK CIRCUIT 13 (RD/BK) FOR OPEN

1

Multi-Function Switch C210

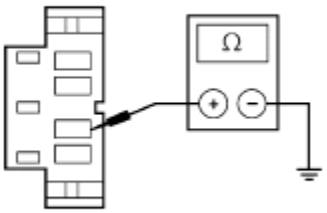
2



GK3167-A

2 Measure the resistance between multi-function switch C210-507, circuit 13 (RD/BK), and I/P fuse panel fuse 4, pin 2, circuit 13 (RD/BK).

- **Is the resistance less than 5 ohms?**

	→ **Yes** REPLACE the multi-function switch. TEST the system for normal operation. → **No** REPAIR circuit 13 (RD/BK). TEST the system for normal operation.
B4 CHECK CIRCUIT 13 (RD/BK) FOR SHORT TO GROUND	
1 Multi-Function Switch C210 2  GK3168-A	2 Measure the resistance between multi-function switch C210-507, circuit 13 (RD/BK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the multi-function switch. TEST the system for normal operation. → **No** REPAIR circuit 13 (RD/BK). TEST the system for normal operation.

PINPOINT TEST C: THE HIGH BEAMS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE FUSE	
1 2	

Fuse Junction Panel Fuse 33 (15A)

- **Is the fuse OK?**

→ **Yes**
GO to C2 .

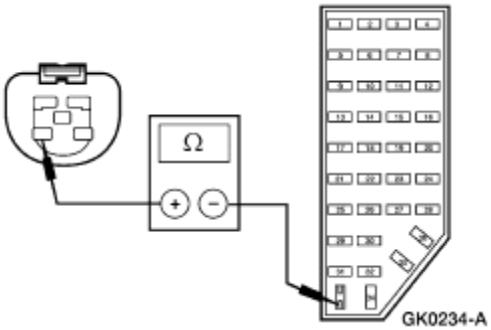
→ **No**
REPLACE the fuse. If the fuse fails again, GO to C5 .

C2 CHECK CIRCUIT 12 (LG/BK) FOR OPEN

1

LH Headlamp C136

2



2 Measure the resistance between LH headlamp C136-2, circuit 12 (LG/BK), and I/P fuse panel fuse 33, pin 2.

- **Is the resistance less than 5 ohms?**

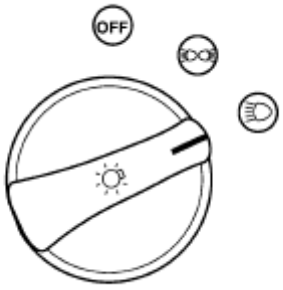
→ **Yes**
RECONNECT the LH headlamp. GO to C3 .

→ **No**
REPAIR circuit 12 (LG/BK). TEST the system for normal operation.

C3 CHECK THE VOLTAGE TO FUSE JUNCTION PANEL FUSE 33 (15A)

1

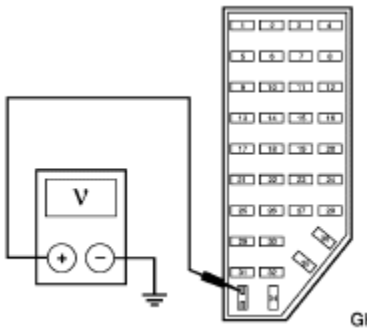
1 Place the headlamp switch in the ON position.



K26996-A

2 Verify the multi-function switch is in the high beam position.

3



GK0235-A

3 Measure the voltage between I/P fuse panel fuse 33, pin 1, and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the headlamp bulbs. TEST the system for normal operation.

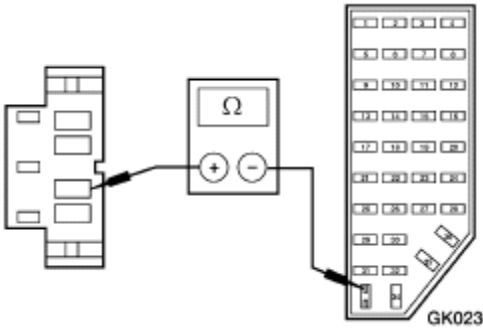
→ **No**
GO to C4 .

C4 CHECK CIRCUIT 632 (GY/OG)

1

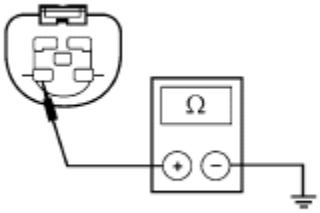
Multi-Function Switch C210

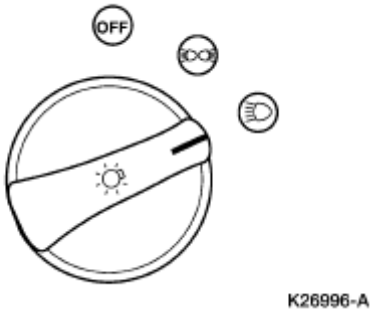
2



GK0236-A

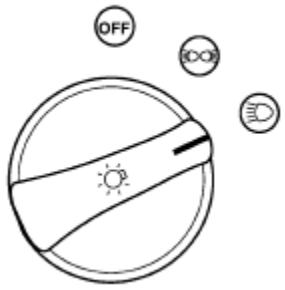
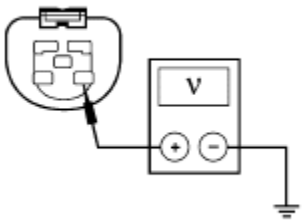
2 Measure the resistance between multi-function switch C210-12, circuit 632 (GY/OG), and I/P fuse panel fuse 33, pin 1.

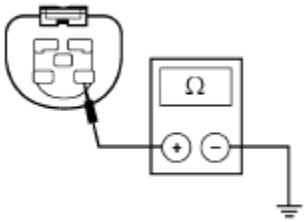
	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the multi-function switch. TEST the system for normal operation. → **No** REPAIR circuit 632 (GY/OG). TEST the system for normal operation.
C5 CHECK CIRCUIT 12 (LG/BK) FOR SHORT TO GROUND	
1 LH Headlamp C136 2 RH Headlamp C131 3  GK3169-A	3 Measure the resistance between LH headlamp C136-2, circuit 12 (LG/BK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** RECONNECT the LH headlamp bulb. REPLACE fuse junction panel fuse 33 (15A). GO to C6 . → **No** REPAIR circuit 12 (LG/BK). TEST the system for normal operation.
C6 RECHECK THE FUSE	
1	1 Place the headlamp switch in the ON position.

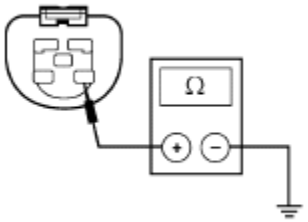
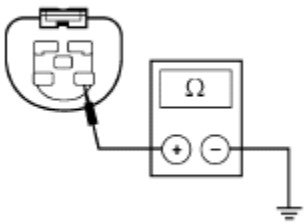
 K26996-A 2 Fuse Junction Panel Fuse 33 (15A)	• **Is the fuse OK?** → **Yes** REPLACE the RH headlamp bulb. TEST the system for normal operation. → **No** REPLACE the LH headlamp bulb. TEST the system for normal operation.

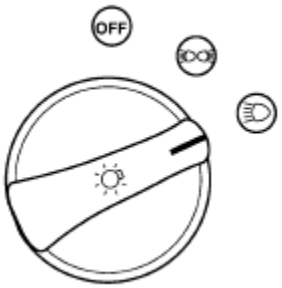
PINPOINT TEST D: ONE LOW BEAM HEADLAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE FUSE(S)	
1 2 Fuse Junction Panel Fuse 4 (10A) 3 Fuse Junction Panel Fuse 8 (10A)	• **Are the fuse(s) OK?**

	→ **Yes** REINSTALL the fuse(s). GO to D2 . → **No** REPLACE the fuse. If fuse junction panel fuse 4 (10A) fails again, GO to D3 . If fuse junction panel fuse 8 (10A) fails again and the vehicle is not equipped with DRL, GO to D4 . If the vehicle is equipped with DRL, GO to D5 .
D2 CHECK THE VOLTAGE TO THE INOPERATIVE HEADLAMP BULB	
1  K26996-A	1 Place the headlamp switch in the ON position.
2	Verify the headlamps are in low beam.
3 Inoperative Headlamp	
4  GK0237-A	4 Measure the voltage between RH headlamp C131-3, circuit 1056 (DB/LG), and ground; or between LH headlamp C136-3, circuit 1055 (WH/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the headlamp (13008). TEST the system for normal operation.

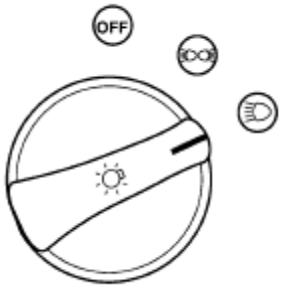
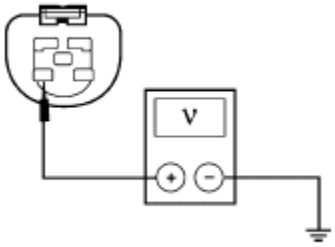
	→ **No** REPAIR circuit 1056 (DB/LG) and/or circuit 1055 (WH/LG). TEST the system for normal operation.
D3 CHECK CIRCUIT 1055 (WH/LG) FOR SHORT TO GROUND	
1 LH Headlamp C136 2 Fuse Junction Panel Fuse 4 (10A) 3  GK3171-A	3 Measure the resistance between LH headlamp C136-3, circuit 1055 (WH/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the LH headlamp bulb. TEST the system for normal operation. → **No** REPAIR circuit 160 (DB/WH) or circuit 1055 (WH/LG). TEST the system for normal operation.
D4 CHECK CIRCUIT 1056 (DB/LG) AND CIRCUIT 161 (DG/OG) FOR SHORT TO GROUND	
1 RH Headlamp C131 2 	

Fog Lamp Relay (If Equipped) 3  GK3171-A	3 Measure the resistance between RH headlamp C131-3, circuit 1056 (DB/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the RH headlamp bulb. TEST the system for normal operation. → **No** REPAIR circuit 1056 (DB/LG) or circuit 161 (DG/OG). TEST the system for normal operation.
D5 CHECK CIRCUIT 1056 (DB/LG) FOR SHORT TO GROUND (DRL)	
1 RH Headlamp C131 2 DRL Module 3  GK3171-A	3 Measure the resistance between RH headlamp C131-3, circuit 1056 (DB/LG), and ground. • **Is the resistance greater than 10,000 ohms?**

	→ **Yes** RECONNECT the DRL module. REPLACE fuse junction panel fuse 8 (10A). GO to D6 . → **No** REPAIR circuit 1056 (DB/LG). TEST the system for normal operation.
D6 RECHECK THE FUSE	
1  K26996-A 2 Fuse Junction Panel Fuse 8 (10A)	1 Place the headlamp switch in the ON position. • **Is the fuse OK?** → **Yes** REPLACE the RH headlamp bulb. TEST the system for normal operation. → **No** . REPLACE the DRL control (if equipped). If not equipped with DRL, REPAIR circuit 161 (DG/OG) or circuit 1056 (DB/LG). TEST the system for normal operation.

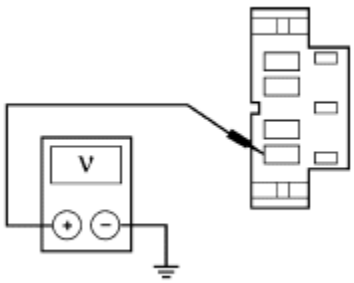
PINPOINT TEST E: ONE HIGH BEAM HEADLAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE VOLTAGE TO THE INOPERATIVE HEADLAMP BULB	
1 	

2  K26996-A	2 Place the headlamp switch in the ON position.
	3 Verify the headlamps are in high beam.
4 Inoperative Headlamp	
5  GK0240-A	5 Measure the voltage between RH headlamp C131-2, circuit 12 (LG/BK), and ground; or between LH headlamp C136-2, circuit 12 (LG/BK), and ground.
	• **Is the voltage greater than 10 volts?** → **Yes** REPLACE the headlamp bulb. TEST the system for normal operation. → **No** REPAIR circuit 12 (LG/BK). TEST the system for normal operation.

PINPOINT TEST F: THE HEADLAMPS ARE ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE HEADLAMP SWITCH	
1 	

2 Headlamp Switch C216	• **Are the headlamps illuminated?** → **Yes** GO to F2 . → **No** REPLACE the headlamp switch. TEST the system for normal operation.
F2 CHECK THE MULTI-FUNCTION SWITCH	
1 Multi-Function Switch C210	• **Are the headlamps illuminated?** → **Yes** GO to F4 . → **No** GO to F3 .
F3 CHECK CIRCUIT 15 (RD/YE) FOR SHORT TO POWER	
1  GK0230-B	1 Measure the voltage between multi-function switch C210-15, circuit 15 (RD/YE), and ground. • **Is voltage present?** → **Yes** REPAIR circuit 15 (RD/YE). TEST the system for normal operation. → **No** REPLACE the multi-function switch. TEST the

	system for normal operation.
F4 CHECK CIRCUIT 13 (RD/BK)	
	1 Verify the high beams are illuminated. • **Are the headlamp high beams illuminated?** → **Yes** GO to F5 . → **No** REPAIR circuit 13 (RD/BK). TEST the system for normal operation.
F5 CHECK CIRCUIT 632 (GY/OG) AND CIRCUIT 12 (LG/BK) FOR SHORT TO POWER	
1 Fuse Junction Panel Fuse 33 (15A)	• **Are the headlamps illuminated?** → **Yes** If equipped with daytime running lamps (DRL), GO to F6 . If not equipped with DRL, REPAIR circuit 12 (LG/BK). TEST the system for normal operation. → **No** REPAIR circuit 632 (GY/OG). TEST the system for normal operation.
F6 RECHECK CIRCUIT 12 (LG/BK)	
1 DRL Module C134	• **Are the headlamps illuminated?** → **Yes** REPAIR circuit 12 (LG/BK). TEST the system for normal operation. → **No** REPLACE the DRL module. TEST the system for normal operation.

Autolamps

Refer to Wiring Diagrams Cell 87 , Autolamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter 105-R0051 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the autolamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections • Relay(s)

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

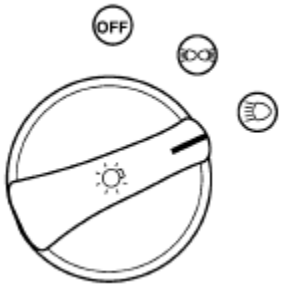
Symptom Chart

Condition	Possible Sources	Action
• The Autolamps Are Inoperative	• Headlamp switch. • Fuse(s). • Headlamp relay. • Circuitry. • Light sensor amplifier.	• Go To Pinpoint Test G .
• The Autolamps Are On Continuously	• Circuitry. • Headlamp relay. • Light sensor	• Go To Pinpoint Test H .

	amplifier.	
• The Autolamp Time Delay Is Inoperative	• Fuse(s). • Light sensor amplifier. • Headlamp switch. • Circuitry.	• VERIFY parking lamp operation. If OK, REPLACE the light sensor amplifier. If any parking lamp concerns exist, Parking, Rear and License Lamps REFER to Parking, Rear or License Lamps.

Pinpoint Tests

PINPOINT TEST G: THE AUTOLAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK MANUAL HEADLAMP SWITCH	
1 2  K26996-A	2 Place the headlamp switch in the ON position. • **Did the headlamps illuminate?** → **Yes** GO to G2 . → **No** Go To Pinpoint Test A .
G2 CHECK THE FUSES	
1 Power Distribution Box Fuse 11 (15A) 2	

Fuse Junction Panel Fuse 11 (7.5A)

3

Fuse Junction Panel Fuse 36 (7.5A)

- **Are the fuse(s) OK?**

→ **Yes**
GO to G3 .

→ **No**
REPLACE the failed fuse(s).

If fuse junction panel fuse 36 (7.5A) failed, GO to G11 .

If fuse junction panel fuse 11 (7.5A) failed, GO to G12 .

If power distribution box fuse 11 (15A) failed, REPAIR circuit 195 (TN/WH). TEST the system for normal operation.

G3 COMPONENT TEST OF HEADLAMP RELAY

1

Headlamp Relay

2 Perform the Relay Component Test; refer to Component Test.

- **Is the relay OK?**

→ **Yes**
GO to G4 .

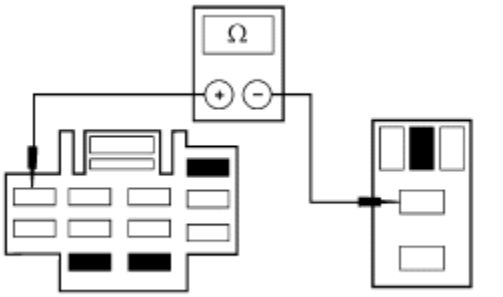
→ **No**
REPLACE the headlamp relay. TEST the system for normal operation.

G4 CHECK CIRCUIT 15 (RD/YE) FOR OPEN

1

Headlamp Switch C216

2



2 Measure the resistance between headlamp relay connector pin 5, circuit 15 (RD/YE), and headlamp switch C216-2, circuit 15 (RD/YE).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to G5 .

→ **No**
REPAIR circuit 15 (RD/YE). TEST the system for normal operation.

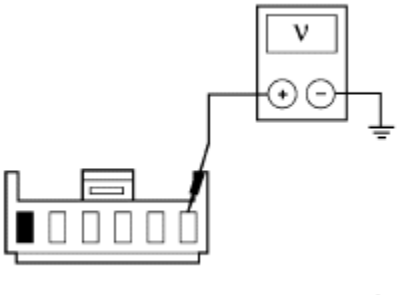
G5 CHECK CIRCUIT 640 (RD/YE) FOR VOLTAGE

1

Light Sensor Amplifier C341

2

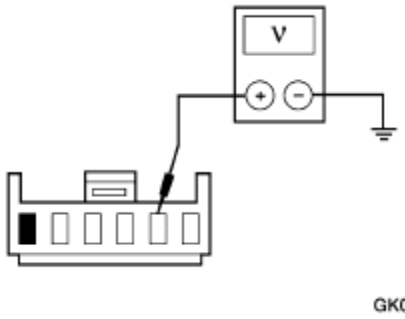
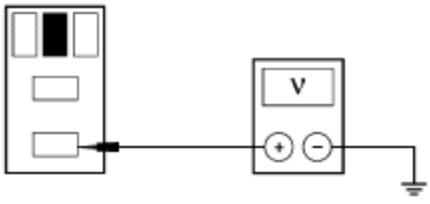
3

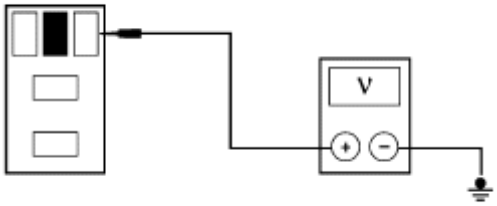


3 Measure the voltage between light sensor amplifier C341-6, circuit 640 (RD/YE), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to G6 .

	→ **No** REPAIR circuit 640 (RD/YE). TEST the system for normal operation.
G6 CHECK CIRCUIT 54 (LG/YE) FOR VOLTAGE	
1  GK0243-A	1 Measure the voltage between light sensor amplifier C341-5, circuit 54 (LG/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to G7 . → **No** REPAIR circuit 54 (LG/YE). TEST the system for normal operation.
G7 CHECK CIRCUIT 196 (DB/OG) FOR VOLTAGE	
1  GK0110-A	1 Measure the voltage between headlamp relay connector pin 3, circuit 196 (DB/OG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to G8 . → **No** REPAIR circuit 196 (DB/OG). TEST the system for normal operation.
G8 CHECK CIRCUIT 195 (TN/WH) FOR VOLTAGE	
1	1 Measure the voltage between headlamp relay connector pin 1, circuit 195 (TN/WH), and ground.



GK0105-A

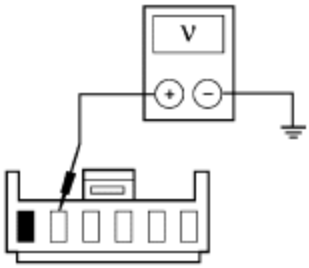
- **Is the voltage greater than 10 volts?**

→ **Yes**
RECONNECT the headlamp relay. GO to G9 .

→ **No**
REPAIR circuit 195 (TN/WH). TEST the system for normal operation.

G9 CHECK CIRCUIT 218 (WH/VT) FOR VOLTAGE

1



GK0246-A

1 Measure the voltage between light sensor amplifier C341-2, circuit 218 (WH/VT), and ground.

- **Is the voltage greater than 10 volts?**

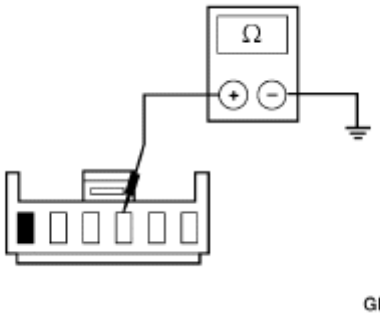
→ **Yes**
GO to G10 .

→ **No**
REPAIR circuit 218 (WH/VT). TEST the system for normal operation.

G10 CHECK CIRCUIT 57 (BK) FOR OPEN

1

1 Measure the resistance between light sensor amplifier C341-4, circuit 57 (BK), and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the light sensor amplifier. TEST the system for normal operation.

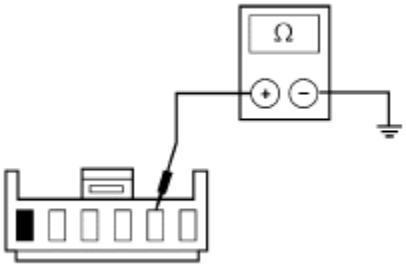
→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

G11 CHECK CIRCUIT 54 (LG/YE) FOR SHORT TO GROUND

1

Light Sensor Amplifier C341

2



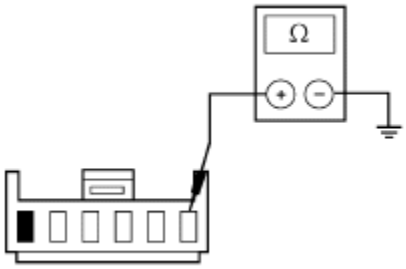
2 Measure the resistance between light sensor amplifier C341-5, circuit 54 (LG/Y), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the light sensor amplifier. TEST the system for normal operation.

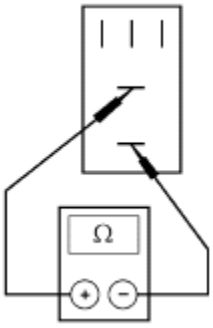
→ **No**
REPAIR circuit 54 (LG/YE). TEST the system for normal operation.

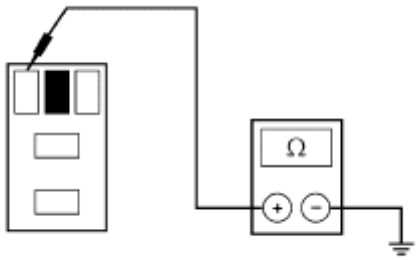
G12 CHECK CIRCUIT 640 (RD/YE) FOR SHORT TO GROUND

1 Light Sensor Amplifier C341 2  	2 Measure the resistance between light sensor amplifier C341-6, circuit 640 (RD/YE), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the light sensor amplifier. TEST the system for normal operation. → **No** REPAIR circuit 640 (RD/YE). TEST the system for normal operation.

PINPOINT TEST H: THE AUTOLAMPS ARE ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE HEADLAMP SWITCH FOR PROPER OPERATION	
1 2 Headlamp Switch C216	3 Place the autolamp time delay switch in the OFF position. • **Are the headlamps off?** → **Yes**

	REPLACE the headlamp switch. TEST the system for normal operation. → **No** GO to H2 .
H2 CHECK THE HEADLAMP RELAY	
1 Headlamp Relay 2  GK0251-A	2 Measure the resistance between headlamp relay terminal 3 and terminal 5. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to H3 . → **No** REPLACE the headlamp relay. TEST the system for normal operation.
H3 CHECK CIRCUIT 218 (WH/VT) FOR SHORT TO GROUND	
1 Light Sensor Amplifier C341 2 Parking Lamp Relay 3	3 Measure the resistance between headlamp relay connector pin 2, circuit 218 (WH/VT), and ground.



GK0096-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the light sensor amplifier. TEST the system for normal operation.

→ **No**
REPAIR circuit 218 (WH/VT). TEST the system for normal operation.

Stoplamps

Refer to Wiring Diagrams Cell 90 , Turn/Stop/Hazard Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the stoplamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections • Bulb(s)

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

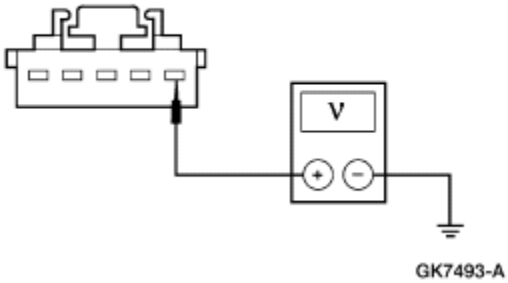
Symptom Chart

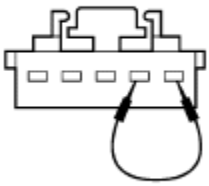
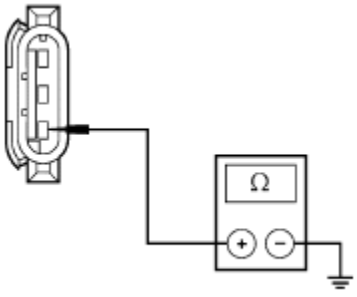
Symptom Chart

Condition	Possible Sources	Action
• The Stoplamps Are Inoperative	• Fuse(s). • Brake pedal position (BPP) switch. • Circuitry. • Lamp outage module (if equipped).	• GO to Pinpoint Test J .
• One or More Stoplamps Are Inoperative	• Stoplamp bulb. • Circuitry.	• GO to Pinpoint Test K .
• The Stoplamps Are On Continuously	• BPP switch.	• REPLACE the brake pedal position (BPP) switch.

Pinpoint Tests

PINPOINT TEST J: THE STOPLAMPS ARE INOPERATIVE

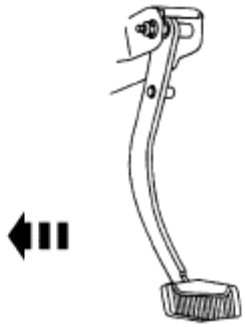
CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE FUSE	
1 2 Fuse Junction Panel Fuse 13 (20A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to J2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK the system for short to ground. REPAIR as necessary.
J2 CHECK THE VOLTAGE TO THE BRAKE PEDAL POSITION (BPP) SWITCH	
1 BPP Switch C224 2  GK7493-A	2 Measure the voltage between BPP switch C224-5, circuit 10 (LG/RD), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** GO to J3 . → **No** REPAIR circuit 10 (LG/RD). TEST the system for normal operation.
J3 CHECK THE BPP SWITCH OPERATION	
1  GK7494-A	1 Connect a jumper wire between BPP switch C224-5, circuit 10 (LG/RD), and BPP switch C224-4, circuit 511 (LG). • **Do the stoplamps illuminate?** → **Yes** REPLACE the BPP switch. TEST the system for normal operation. → **No** GO to J4 .
J4 CHECK CIRCUIT 57 (BK) FOR OPEN	
1 LH Rear Stop/Park Lamp C400	
2  GK0278-A	2 Measure the resistance between LH rear stop/park lamp C400, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?**

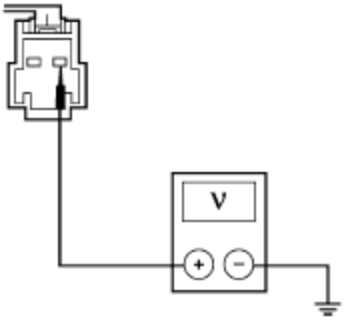
	→ **Yes** REPAIR circuit 511 (LG). TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST K: ONE OR MORE STOPLAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 DETERMINE THE INOPERATIVE STOPLAMP	
1 GF0022-A	1 Apply the brake.
	2 Verify which stoplamp is inoperative. • **Is the rear hi-mount lamp (13A613) inoperative?** → **Yes** GO to K2 . → **No** GO to K4 .
K2 CHECK THE VOLTAGE AT THE LAMP CONNECTOR	
1 Hi-Mount Stoplamp C410 2	2 Apply the brake.


GF0022-A

3



GK9648-A

3 Measure the voltage between hi-mount stoplamp C410, circuit 569 (DG), and ground.

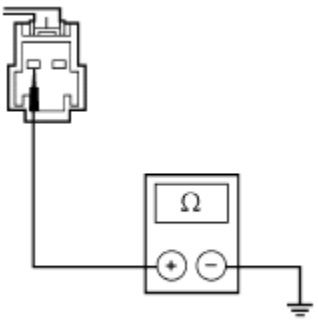
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to K3 .

→ **No**
REPAIR circuit 569 (DG). TEST the system for normal operation.

K3 CHECK CIRCUIT 57 (BK) FOR OPEN

1



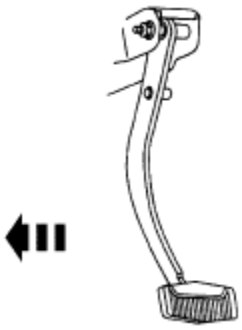
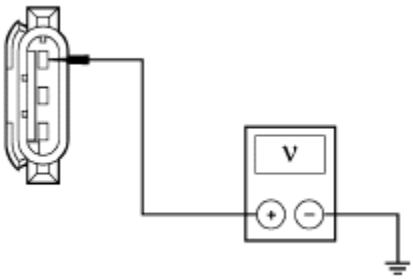
GK9649-A

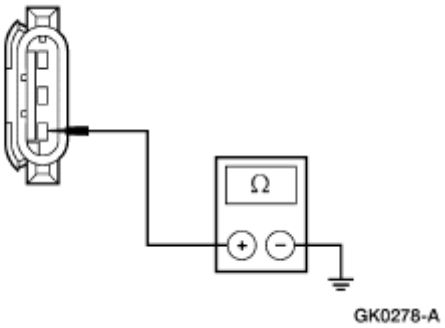
1 Measure the resistance between hi-mount lamp C410, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the hi-mount stoplamp bulb. TEST the system for normal operation.

→ **No**

	REPAIR circuit 57 (BK). TEST the system for normal operation.
K4 CHECK THE RH OR LH REAR STOP/PARK LAMP FOR VOLTAGE	
1 2 Inoperative Rear Stop/Park Lamp 3  GF0022-A 4  GK0264-A	3 Apply the brake. 4 Measure the voltage between inoperative rear stop/park lamp C400 (LH) or C415 (RH), circuit 511 (LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to K5 . → **No** REPAIR circuit 511 (LG). TEST the system for normal operation.
K5 CHECK CIRCUIT 57 (BK) FOR OPEN	
1	1 Measure the resistance between inoperative rear stop/park lamp C400 (LH) or C415 (RH), circuit 57 (BK), and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the inoperative rear stop/park lamp bulb. TEST the system for normal operation.

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

Turn Signal and Hazard Lamps

Refer to Wiring Diagrams Cell 90 , Turn/Stop/Hazard Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the turn signal/hazard flasher lamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

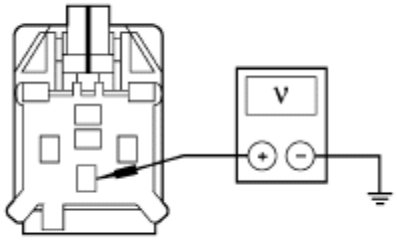
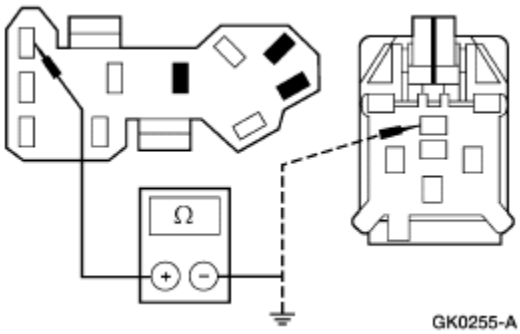
Condition	Possible Sources	Action
• The Turn Signal Lamps Are Never On	• Fuse(s). • Circuitry. • Multi-function switch (13K359). • Indicator flasher (13350).	• GO to Pinpoint Test L .
• The Hazard Flasher Lamps Are Never On	• Fuse(s). • Circuitry. • Multi-function switch. • Indicator flasher.	• GO to Pinpoint Test M .

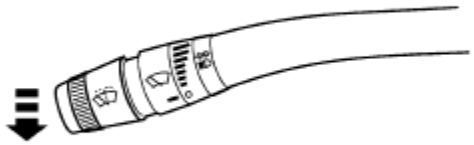
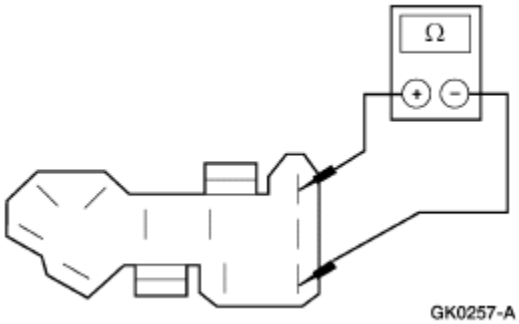
• One Turn Signal/Hazard Lamp Is Never On	• Turn signal/hazard flasher lamp. • Circuitry.	• GO to Pinpoint Test N .
• The Turn Signal Lamps Are Always On	• Multi-function switch.	• REPLACE the multi-function switch.
• The Hazard Flasher Lamps Are Always On	• Multi-function switch.	• REPLACE the multi-function switch.

Pinpoint Tests

PINPOINT TEST L: THE TURN SIGNAL LAMPS ARE NEVER ON

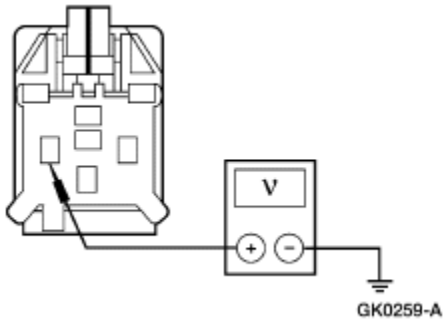
CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK THE FUSE	
1 2 Fuse Junction Panel Fuse 21 (15A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to L2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary.
L2 CHECK THE VOLTAGE TO THE INDICATOR FLASHER	
1 Indicator Flasher C214 2 	

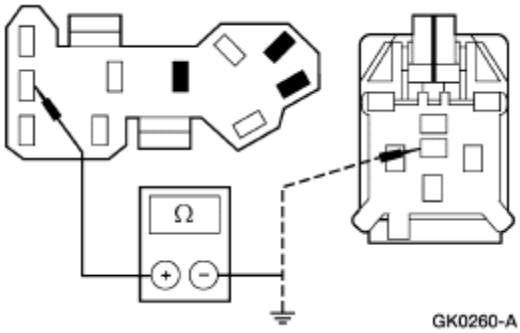
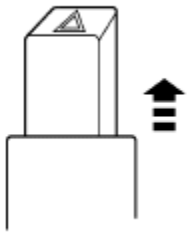
3  GK0254-A	3 Measure the voltage between indicator flasher C214-5, circuit 8 (OG/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to L3 . → **No** REPAIR circuit 8 (OG/YE). TEST the system for normal operation.
L3 CHECK CIRCUIT 44 (LB) FOR SHORT AND OPEN	
1 2 Multi-Function Switch C217 3  GK0255-A	3 Measure the resistance between multi-function switch C217-44, circuit 44 (LB), and indicator flasher C214-1, circuit 44 (LB); and between multi-function switch C217-44, circuit 44 (LB), and ground. • **Is the resistance less than 5 ohms between the multi-function switch and the indicator flasher, and greater than 10,000 ohms between the multi-function switch and ground?** → **Yes**

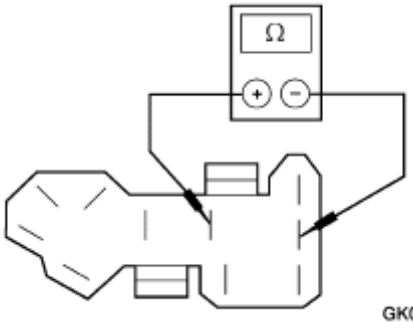
	GO to L4 . → **No** REPAIR circuit 44 (LB). TEST the system for normal operation.
L4 CHECK THE MULTI-FUNCTION SWITCH CONTINUITY	
1  GK0256-A	1 Place the multi-function switch in the left turn position.
2  GK0257-A	2 Measure the resistance between multi-function switch terminal 3 and terminal 44 (component side). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the indicator flasher. TEST the system for normal operation. → **No** REPLACE the multi-function switch. TEST the system for normal operation.

PINPOINT TEST M: THE HAZARD FLASHER LAMPS ARE NEVER ON

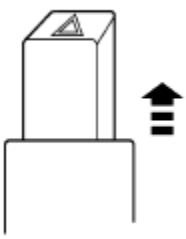
CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK THE FUSE	
1 	

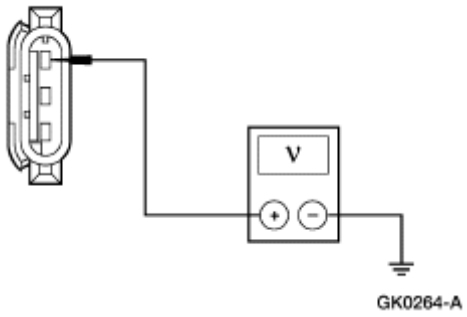
2 Fuse Junction Panel Fuse 21 (15A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to M2 . → **No** REPLACE fuse junction panel fuse 21 (15A). TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary.
M2 CHECK THE VOLTAGE TO THE INDICATOR FLASHER	
1 Indicator Flasher C214 2  	2 Measure the voltage between indicator flasher C214-2, circuit 383 (RD/WH), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to M3 . → **No** REPAIR circuit 383 (RD/WH). TEST the system for normal operation.
M3 CHECK CIRCUIT 385 (WH/RD) FOR SHORT AND OPEN	
1 Multi-Function Switch C217	

2  	2 Measure the resistance between multi-function switch C217-385, circuit 385 (WH/RD), and indicator flasher C214-3, circuit 385 (WH/RD); and between multi-function switch C217-385, circuit 385 (WH/RD), and ground. • **Is the resistance less than 5 ohms between the multi-function switch and the indicator flasher, and greater than 10,000 ohms between the multi-function switch and ground?** → **Yes** GO to M4 . → **No** REPAIR circuit 385 (WH/RD). TEST the system for normal operation.
M4 CHECK THE MULTI-FUNCTION SWITCH CONTINUITY	
1 2  3	2 Place the hazard switch in the ON position. 3 Measure the resistance between multi-function switch terminal 2 and terminal 385 (component side).

 GK0261-A	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the indicator flasher. TEST the system for normal operation. → **No** REPLACE the multi-function switch. TEST the system for normal operation.

PINPOINT TEST N: ONE TURN SIGNAL/HAZARD LAMP IS NEVER ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP	
1 	
2 Inoperative Turn Signal/Hazard Lamp	
3  GK0262-A	3 Place the hazard switch in the ON position.
4	4 Measure the voltage between the following lamp connectors and ground:



- LH front circuit 3 (LG/WH).
- LH side circuit 3 (LG/WH).
- RH front circuit 2 (WH/LB).
- RH side circuit 2 (WH/LB).
- LR circuit 9 (LG/OG).
- RR circuit 5 (OG/LB).

- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the turn signal/hazard lamp in question. TEST the system for normal operation.

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation.

Parking, Rear and License Lamps

Refer to Wiring Diagrams Cell 92 , Exterior Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the parking lamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged switch(es)	• Fuse(s) • Damaged wiring harness • Loose or corroded connections • Relay(s)

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

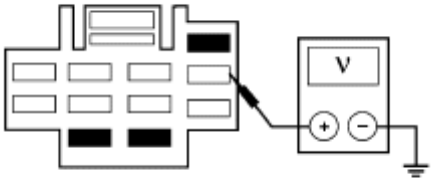
Condition	Possible Sources	Action
• The Parking, Rear or License Lamps Are Inoperative	• Fuse(s). • Circuitry. • Headlamp switch (11654).	• GO to Pinpoint Test P .
• The Autolamps Operate, but Parking, Rear or License Lamps Are Inoperative	• Fuse(s). • Parking lamp relay. • Circuitry.	• GO to Pinpoint Test Q .

• One or More Parking, Rear or License Lamps Is Inoperative	• Parking, rear or license lamp. • Circuitry.	• GO to Pinpoint Test R .
• The Parking, Rear or License Lamps Are On Continuously	• Headlamp switch. • Parking lamp relay.	• GO to Pinpoint Test S .
• The Parking, Rear or License Lamps Are Inoperative — Rear Stop/Tail Lamps Inoperative	• Stop/Tail Lamps. • Circuitry.	• GO to Pinpoint Test T .

Pinpoint Tests

PINPOINT TEST P: THE PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK THE FUSE	
1 2 Fuse Junction Panel Fuse 3 (15A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to P2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary.
P2 CHECK THE VOLTAGE TO THE HEADLAMP SWITCH	
1 Headlamp Switch C216 2	2 Measure the voltage between headlamp switch C216-5, circuit 195 (TN/WH), and



GK0268-A

ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
RECONNECT the headlamp switch. If equipped with anti-theft, GO to P3 .

If not equipped with anti-theft, GO to P6 .

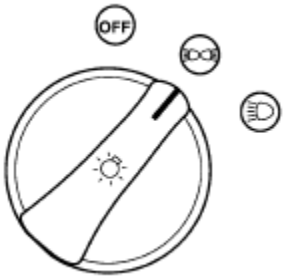
→ **No**
REPAIR circuit 195 (TN/WH). TEST the system for normal operation.

P3 CHECK THE VOLTAGE TO THE PARKING LAMP RELAY

1

Parking Lamp Relay

2

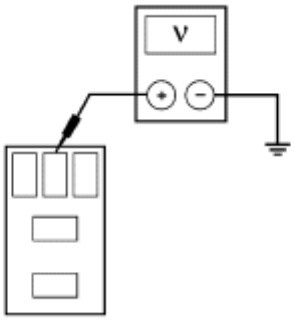


GK0272-A

2 Place the headlamp switch in the ON position.

3

3 Measure the voltage between the parking lamp relay connector pin 4, circuit 1032 (WH/BK), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to P5 .

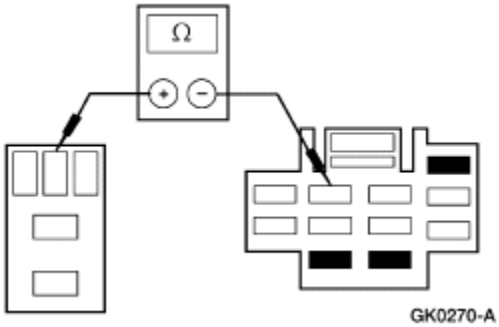
→ **No**
GO to P4 .

P4 CHECK CIRCUIT 1032 (WH/BK) FOR OPEN

1

Headlamp Switch C216

2



2 Measure the resistance between headlamp switch C216-3, circuit 1032 (WH/BK), and parking lamp relay connector pin 4, circuit 1032 (WH/BK).

- **Is the resistance less than 5 ohms?**

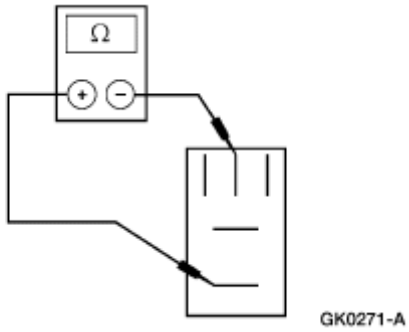
→ **Yes**
REPLACE the headlamp switch. TEST the system for normal operation.

→ **No**
REPAIR circuit 1032 (WH/BK). TEST the system for normal operation.

P5 CHECK THE PARKING LAMP RELAY FOR OPEN

1

1 Measure the resistance between parking lamp relay terminal 4 and terminal 3.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 14 (BN). TEST the system for normal operation.

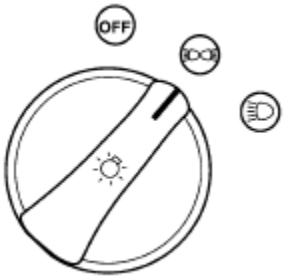
→ **No**
REPLACE the parking lamp relay. TEST the system for normal operation.

P6 CHECK VOLTAGE TO THE INOPERATIVE LAMP

1

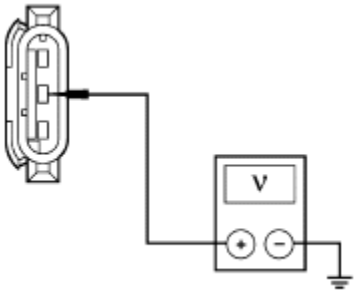
Inoperative Lamp

2

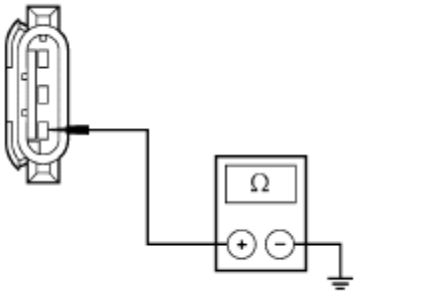


2 Place the headlamp switch in the ON position.

3

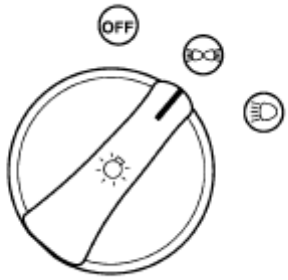


3 Measure the voltage between inoperative lamp, circuit 14 (BN), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** GO to P7 . → **No** REPAIR circuit 14 (BN). TEST the system for normal operation.
P7 CHECK CIRCUIT 57 (BK)	
1  GK0278-A	1 Measure the resistance between inoperative lamp, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the inoperative lamp bulb. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST Q: THE AUTOLAMPS OPERATE, BUT PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK PARKING LAMPS MANUALLY	
1 2	2 Place the headlamp switch in the parking lamps ON position.



GK0272-A

- **Do the parking lamps illuminate?**

→ **Yes**
GO to Q2 .

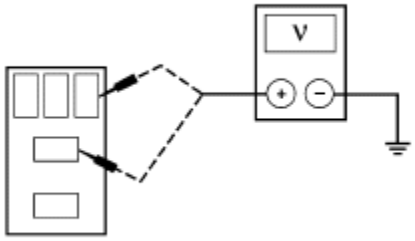
→ **No**
GO to Pinpoint Test P .

Q2 CHECK THE VOLTAGE TO THE PARKING LAMP RELAY

1

Parking Lamp Relay

2



GK0275-A

2 Measure the voltage between parking lamp relay connector pin 1, circuit 195 (TN/WH), and ground; and between parking lamp relay connector pin 5, circuit 195 (TN/WH), and ground.

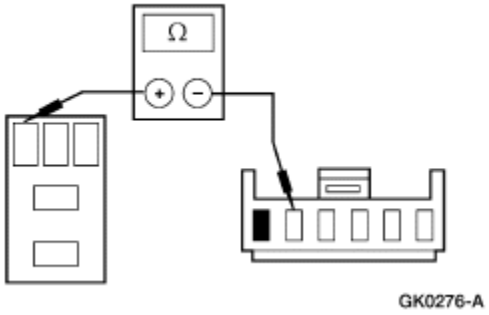
- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to Q3 .

→ **No**
REPAIR circuit 195 (TN/WH). TEST the system for normal operation.

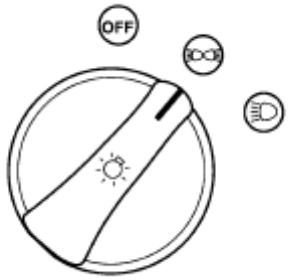
Q3 CHECK THE CONTINUITY OF CIRCUIT 218 (WH/VT)

1

 Light Sensor Amplifier C341 2 	2 Measure the resistance between light sensor amplifier C341-2, circuit 218 (WH/VT), and parking lamp relay connector pin 2, circuit 218 (WH/VT). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the parking lamp relay. TEST the system for normal operation. → **No** REPAIR circuit 218 (WH/VT). TEST the system for normal operation.

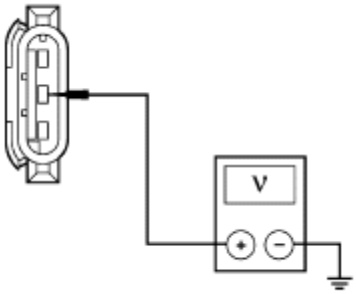
PINPOINT TEST R: ONE OR MORE PARKING, REAR OR LICENSE LAMPS IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP(S)	
1 2 Inoperative Lamp(s) 3	3 Place the headlamp switch in the parking lamps ON position.



GK0272-A

4



GK0277-A

4 Measure the voltage between inoperative lamp connector, circuit 14 (BN), and ground.

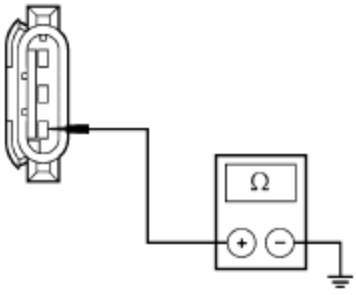
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to R2 .

→ **No**
REPAIR circuit 14 (BN). TEST the system for normal operation.

R2 CHECK CIRCUIT 57 (BK) FOR OPEN

1



GK0278-A

1 Measure the resistance between inoperative rear lamp, circuit 57 (BK), and ground.

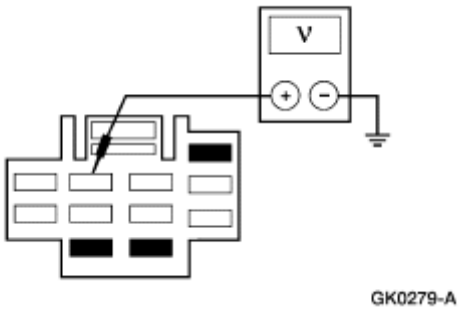
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the inoperative parking, rear or license lamp bulb. TEST the system for normal operation.

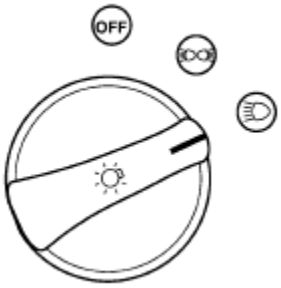
	→ **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

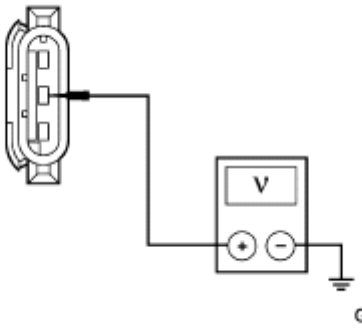
PINPOINT TEST S: THE PARKING, REAR OR LICENSE LAMPS ARE ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
S1 CHECK CIRCUIT 14 (BN)	
1 2 Headlamp Switch	1 • **Are the parking lamps illuminated?** → **Yes** If equipped with anti-theft, GO to S2 . If not equipped with anti-theft, REPAIR circuit 14 (BN). TEST the system for normal operation. → **No** REPLACE the headlamp switch. TEST the system for normal operation.
S2 CHECK CIRCUIT 14 (BN) FOR SHORT	
1 Parking Lamp Relay	• **Are the parking lamps illuminated?** → **Yes** REPAIR circuit 14 (BN). TEST the system for normal operation. → **No** GO to S3 .
S3 CHECK CIRCUIT 1032 (WH/BK) FOR VOLTAGE	
1	1 Measure the voltage between headlamp

	switch C216-3, circuit 1032 (WH/BK), and ground. • **Is voltage indicated?** → **Yes** REPAIR circuit 1032 (WH/BK). TEST the system for normal operation. → **No** REPLACE the parking lamp relay. TEST the system for normal operation.

PINPOINT TEST T: THE PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE — REAR STOP/TAIL LAMPS

CONDITIONS	DETAILS/RESULTS/ACTIONS
T1 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP	
1 Inoperative Lamp	
2 	2 Place the headlamp switch in the ON position.
3	3 Measure the voltage between the inoperative lamp, circuit 14 (BN), and ground.



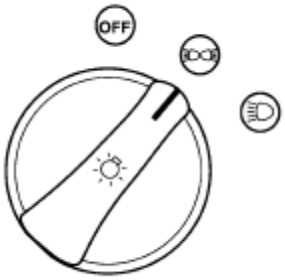
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to T2 .

→ **No**
REPAIR circuit 14 (BN). TEST the system for normal operation.

T2 CHECK CIRCUIT 57 (BK)

1



1 Measure the resistance between inoperative lamp, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the inoperative lamp bulb. TEST the system for normal operation.

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

Fog Lamps

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the fog lamps.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged fog lamp switch	• Central junction box (CJB) Fuse 33 (15A) • CJB Fuse 4 (15A) • Damaged wiring harness • Loose or corroded connections • Damaged relay(s)

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

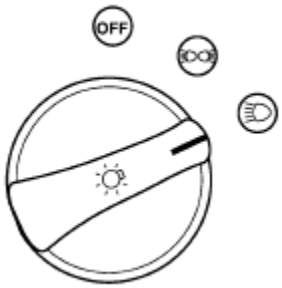
Symptom Chart

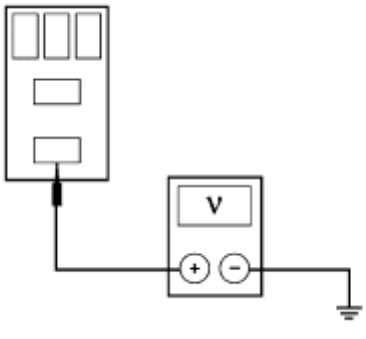
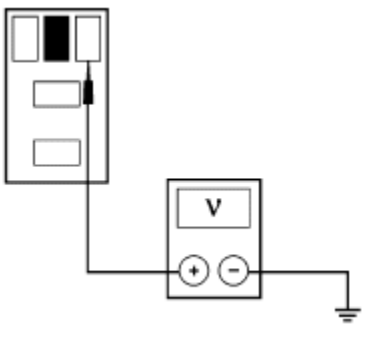
Condition	Possible Sources	Action
• The Fog Lamps Are Inoperative	• CJB Fuse 4 (15A). • CJB Fuse 33 (15A) • Bulbs. • Circuitry. • Fog lamp relay. • Fog lamp isolation relay. • Fog lamp switch.	• GO to Pinpoint Test U .

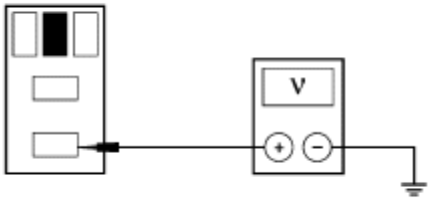
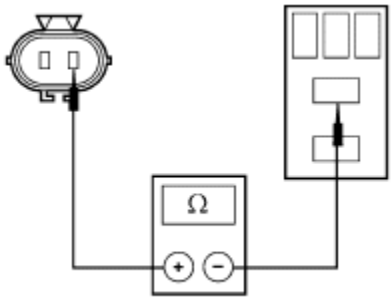
• The Individual Fog Lamp Is Inoperative	• Bulb. • Circuitry.	• GO to Pinpoint Test V .
• The Fog Lamps Are On Continuously	• Fog lamp relay. • Fog lamp switch. • Circuitry.	• GO to Pinpoint Test W .

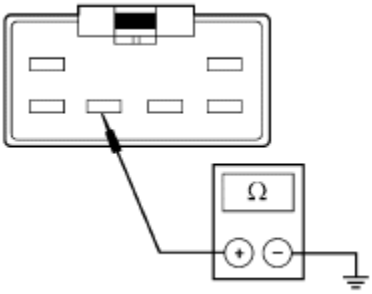
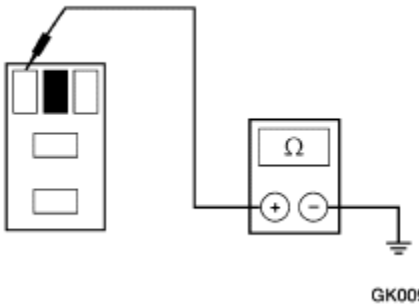
Pinpoint Tests

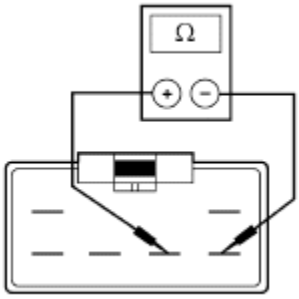
PINPOINT TEST U: THE FOG LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
U1 CHECK THE HEADLAMPS MANUALLY	
1 2  K26996-A	2 Place the headlamp switch (11654) in the ON position. 3 Verify that the headlamps are in low beam. • **Do the headlamps illuminate?** → **Yes** GO to U2 . → **No** REFER to Headlamps
U2 CHECK THE VOLTAGE TO THE FOG LAMP ISOLATION RELAY	
1 Fog Lamp Isolation Relay 2	2 Measure the voltage between fog lamp isolation relay connector pin 3, circuit 1032

	(WH/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to U3 . → **No** REPAIR the circuit. TEST the system for normal operation.
U3 CHECK THE FOG LAMP ISOLATION RELAY	
	1 Check the fog lamp isolation relay. Refer to Component Test. • **Is the relay OK?** → **Yes** REINSTALL the fog lamp isolation relay.GO to U4 . → **No** REPLACE the fog lamp isolation relay. TEST the system for normal operation.
U4 CHECK THE VOLTAGE TO THE FOG LAMP RELAY COIL SIDE	
1 Fog Lamp Relay	
2 	2 Measure the voltage between the fog lamp relay connector pin 1, circuit 474 (LG/OG), and ground.

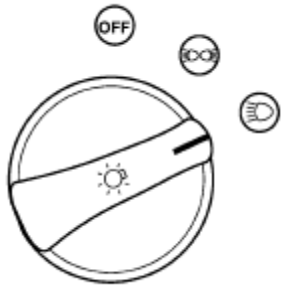
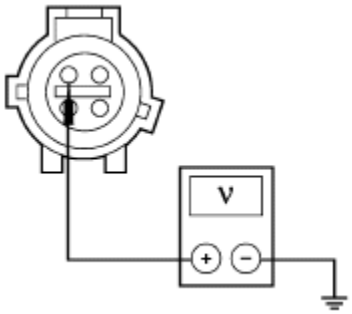
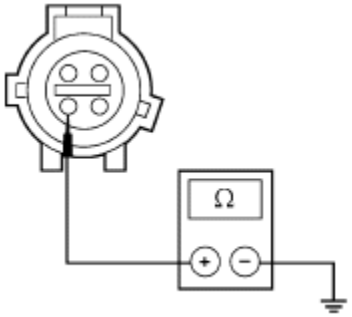
	• **Is the voltage greater than 10 volts?** → **Yes** GO to U5 . → **No** REPAIR the circuit. TEST the system for normal operation.
U5 CHECK THE VOLTAGE TO THE FOG LAMP RELAY	
1  GK0110-A	1 Measure the voltage between fog lamp relay connector pin 3, circuit 175 (BK/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to U6 . → **No** REPAIR the circuit. TEST the system for normal operation.
U6 CHECK CIRCUIT 478 (TN/OG) FOR OPEN	
1 Fog Lamps 2  GK9664-A	2 Measure the resistance between fog lamp relay connector pin 5, circuit 478 (TN/OG), and LH fog lamp C192, circuit 478 (TN/OG); and between fog lamp relay connector pin 5, circuit 478 (TN/OG), and RH fog lamp C193, circuit 478 (TN/OG). • **Are the resistances less than 5 ohms?**

	→ **Yes** GO to U7 . → **No** REPAIR the circuit. TEST the system for normal operation.
U7 CHECK FOG LAMP SWITCH GROUND CIRCUIT 57 (BK) FOR OPEN	
1 Fog Lamp Switch C268 2  GK3191-A	2 Measure the resistance between fog lamp switch C268 Pin 4, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** RECONNECT the fog lamp switch. GO to U8 . → **No** REPAIR the circuit. TEST the system for normal operation.
U8 CHECK CIRCUIT 477 (LB/BK) CONTINUITY	
2  GK0096-A	1 Place the fog lamp switch in the ON position. 2 Measure the resistance between fog lamp relay pin 2, circuit 477 (LB/BK), and ground. • **Is the resistance less than 5 ohms?**

	→ **Yes** REPLACE the fog lamp relay. TEST the system for normal operation. → **No** GO to U9 .
U9 CHECK THE CONTINUITY OF THE FOG LAMP SWITCH	
1 Fog Lamp Switch C268 2  GK0284-A	2 Measure the resistance between fog lamp switch terminal 3 (component side) and terminal 4 (component side). • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 477 (LB/BK). TEST the system for normal operation. → **No** REPLACE the fog lamp switch. TEST the system for normal operation.

PINPOINT TEST V: THE INDIVIDUAL FOG LAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
V1 CHECK THE VOLTAGE TO THE FOG LAMP	
1 2 Inoperative Fog Lamp	

3  K26996-A	3 Place the headlamp switch in the ON position.
	4 Verify the headlamps are in the low beam position. 5 Place the fog lamp switch in the ON position.
6  GK9651-A	6 Measure the voltage between inoperative fog lamp C192 or C193, circuit 478 (TN/OG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to V2 . → **No** REPAIR the circuit. TEST the system for normal operation.
V2 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GK9652-A	1 Measure the resistance between inoperative fog lamp C192 or C193, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?**

	→ **Yes** REPLACE the inoperative fog lamp bulb. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST W: THE FOG LAMPS ARE ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
W1 CHECK CIRCUIT 478 (TN/OG) FOR SHORT TO BATTERY	
1 2 Fog Lamp Relay	• **Are the fog lamps illuminated?** → **Yes** REPAIR circuit 478 (TN/OG). TEST the system for normal operation. → **No** REINSTALL the fog lamp relay. GO to W2 .
W2 CHECK FOG LAMP SWITCH	
1 Fog Lamp Switch	• **Are the fog lamps illuminated?** → **Yes** GO to W3 . → **No** REPLACE the fog lamp switch. TEST the system for normal operation.
W3 CHECK THE FOG LAMP RELAY	
	1 Check the fog lamp relay. Refer to Component Test.

	• **Is the relay OK?** → **Yes** REPAIR circuit 477 (LB/BK). TEST the system for normal operation. → **No** REPLACE the fog lamp relay. TEST the system for normal operation.

Reversing Lamps

Refer to Wiring Diagrams Cell 93 , Backup Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the backup lamps.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Fuse(s) • Damaged wiring harness • Loose or corroded connections • Bulb(s)

3. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

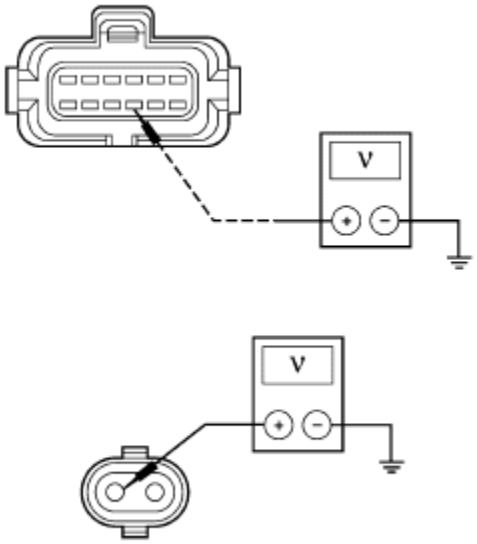
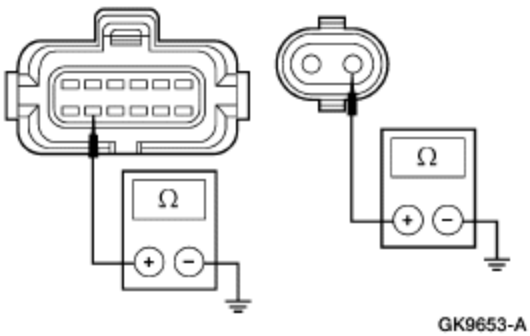
Condition	Possible Sources	Action
• The Backup Lamps Are Inoperative	• Fuse(s). • Circuitry. • Digital transmission range (DTR) sensor (A/T). • Backup lamp switch (M/T).	• GO to Pinpoint Test X .
• The Individual Backup Lamp Is Inoperative	• Backup lamp. • Circuitry.	• GO to Pinpoint Test Y .
• The Backup Lamps Are On	• Circuitry.	• GO to Pinpoint

Continuously	• Digital transmission range (DTR) sensor (A/T). • Backup lamp switch (M/T).	Test Z .

Pinpoint Tests

PINPOINT TEST X: THE BACKUP LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
X1 CHECK THE FUSE	
1 Fuse Junction Panel Fuse 27 (15A)	• **Is the fuse OK?** → **Yes** REINSTALL the fuse. GO to X2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, GO to X4 .
X2 CHECK CIRCUIT 298 (VT/OG) FOR OPEN	
1 2 DTR Sensor (A/T) 3 Backup Lamp Switch (M/T) 4 	

5  GK5850-A	5 Measure the voltage between DTR sensor C112-9, circuit 298 (VT/OG) (A/T), and ground; or between backup lamp switch C172, circuit 298 (VT/OG) (M/T), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to X3 . → **No** REPAIR circuit 298 (VT/OG). TEST the system for normal operation.
X3 CHECK CIRCUIT 140 (BK/PK) CONTINUITY	
1 2  GK9653-A	2 Measure the resistance between DTR sensor C112-11, circuit 140 (BK/PK) (A/T), and ground; or between backup lamp switch C172, circuit 140 (BK/PK) (M/T), and ground. • **Is the resistance less than 5 ohms?**

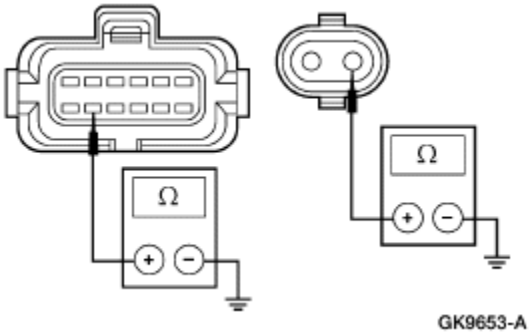
	→ **Yes** REPLACE the DTR (A/T) or backup lamp switch (M/T). TEST the system for normal operation. → **No** REPAIR circuit 140 (BK/PK). TEST the system for normal operation.
X4 CHECK CIRCUIT 298 (VT/OG) FOR SHORT TO GROUND	
1 DTR Sensor (A/T) 2 Backup Lamp Switch (M/T) 4 5 Fuse Junction Panel Fuse 27 (15A)	3 Replace fuse junction panel fuse 27 (15A). • **Is the fuse OK?** → **Yes** GO to X5 . → **No** REPAIR circuit 298 (VT/OG). TEST the system for normal operation.
X5 CHECK CIRCUIT 140 (BK/PK) FOR SHORT TO GROUND	
1 2	

LH Backup Lamp

3

RH Backup Lamp

4



GK9653-A

4 Measure the resistance between DTR sensor C112-11, circuit 140 (BK/PK) (A/T), and ground; or between backup lamp switch C172, circuit 140 (BK/PK) (M/T), and ground.

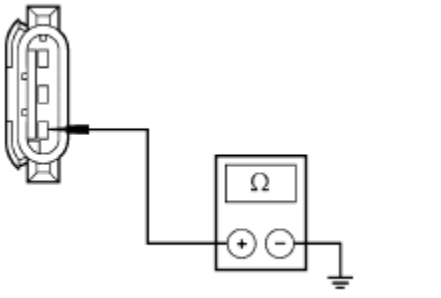
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to X6 .

→ **No**
REPAIR circuit 140 (BK/PK). TEST the system for normal operation.

X6 CHECK CIRCUIT 57 (BK) FOR SHORT TO GROUND

1



GK0278-A

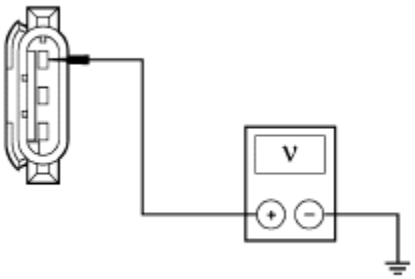
1 Measure the resistance between LH backup lamp C401, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the DTR sensor (A/T) or backup lamp switch (M/T). TEST the system for normal operation.

	→ **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST Y: THE INDIVIDUAL BACKUP LAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
Y1 CHECK THE VOLTAGE AT THE INOPERATIVE LAMP	
1 2 Inoperative Backup Lamp 3 5  GK0264-A	4 Place the transmission in REVERSE. 5 Measure the voltage between inoperative backup lamp C401 (LH) or C416 (RH), circuit 140 (BK/PK), and ground.
	• **Is the voltage greater than 10 volts?** → **Yes** REPLACE the inoperative backup lamp. TEST the system for normal operation. → **No** REPAIR circuit 140 (BK/PK). TEST the system for normal operation.

PINPOINT TEST Z: THE BACKUP LAMPS ARE ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
Z1 CHECK THE DTR SENSOR (A/T) OR BACKUP LAMP SWITCH (M/T)	
1 2 DTR Sensor (A/T) 3 Backup Lamp Switch (M/T)	• **Are the backup lamps illuminated?** → **Yes** REPAIR circuit 140 (BK/PK). TEST the system for normal operation. → **No** REPLACE the DTR sensor (A/T) or backup lamp switch (M/T). TEST the system for normal operation.

Trailer Lamps

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the trailer tow lights.
2. Verify the exterior lighting system of the vehicle is operating properly. If not, refer to the appropriate pinpoint test in this section.
3. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Central junction box (CJB) Fuse 3 (7.5A) • CJB Fuse 7 (7.5A) • CJB Fuse 30 (15A) • Loose or corroded connections • Damaged circuity • Damaged relays • Failed bulb(s)

4. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

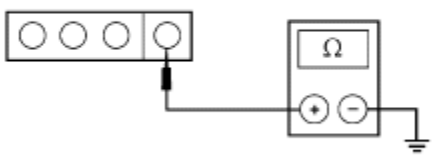
Symptom Chart

Condition	Possible Sources	Action
• The Trailer Lamps Are Inoperative	• Fuse. • Circuitry.	• GO to Pinpoint Test AA .
• The Trailer Lamps Are Inoperative — Both	• Circuitry.	• GO to

Trailer Turn Signals/Stoplamps/Hazard Lamps		Pinpoint Test AB .
• The Trailer Lamps Are Inoperative — RH Trailer Turn Signals/Stoplamps/Hazard Lamps	• Circuitry.	• GO to Pinpoint Test AC .
• The Trailer Lamps Are Inoperative — LH Trailer Turn Signals/Stoplamps/Hazard Lamps	• Circuitry.	• GO to Pinpoint Test AD .
• The Trailer Lamps Are Inoperative — Parking Lamps	• Circuitry. • Relay.	• GO to Pinpoint Test AE .

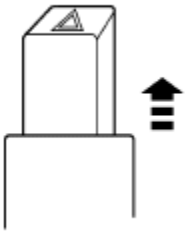
Pinpoint Tests

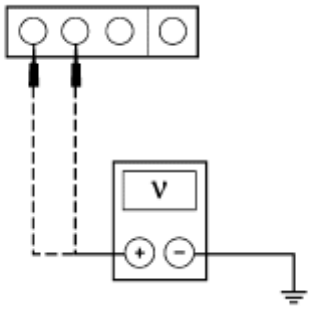
PINPOINT TEST AA: THE TRAILER LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
AA1 CHECK THE FUSE	
1 CJB Fuse 30 (15A)	• **Is the fuse OK?** → **Yes** GO to AA2 . → **No** REPLACE the fuse. If the fuse fails again, CHECK for short to ground. REPAIR as necessary. TEST the system for normal operation.
AA2 CHECK TRAILER TOW GROUND	
1  GK0450-A	1 Measure the resistance between trailer tow C408-4, circuit 206 (WH), and ground.

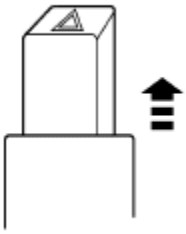
	• **Is the resistance less than 5 ohms?** → **Yes** The vehicle is operating properly. HAVE the trailer repaired by an authorized camper/trailer repair center. → **No** REPAIR circuit 206 (WH). TEST the system for normal operation.

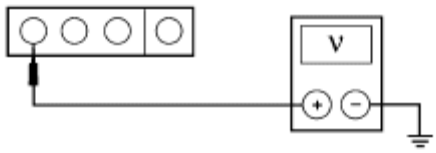
PINPOINT TEST AB: THE TRAILER LAMPS ARE INOPERATIVE — BOTH TRAILER TURN SIGNALS/STOPLAMPS/HAZARD LAMPS

CONDITIONS	DETAILS/RESULTS/ACTIONS
AB1 CHECK VEHICLE	
1 Trailer Tow C408	1 Check vehicle turn signals, stop lamps, and hazard lamps. • **Do the lamps operate correctly?** → **Yes** GO to AB2 . → **No** REFER to Turn Signal and Hazard Lamps Stoplamps
AB2 CHECK VOLTAGE TO THE TRAILER TOW CONNECTOR.	
1  GK0262-A	1 Place the hazard lamp switch in the ON position.
2	2 Check the voltage between trailer tow C408 Pin 1 circuit 64 (DG) and ground; and trailer tow C408 Pin 2 circuit 52 (YE) and ground

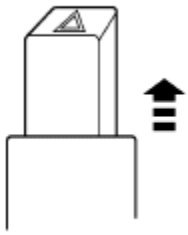
 GK9665-A	• **Does the voltage alternate between 0 volts and greater than 10 volts on each circuit?** → **Yes** The vehicle is operating properly. HAVE the trailer repaired by an authorized camper/trailer repair center. → **No** REPAIR the circuits in question. TEST the system for normal operation.

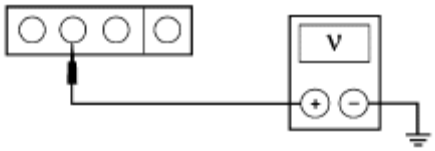
PINPOINT TEST AC: THE TRAILER LAMPS ARE INOPERATIVE — RH TRAILER TURN SIGNALS/STOPLAMPS/HAZARD LAMPS

CONDITIONS	DETAILS/RESULTS/ACTIONS
AC1 CHECK VOLTAGE TO RH TURN, STOP AND HAZARD TRAILER TOW CONNECTOR	
1 Trailer Tow C408	
2  GK0262-A	2 Place the hazard lamp switch in the ON position.
3	3 Measure the voltage between trailer tow C408 Pin 1, circuit 64 (DG), and ground.

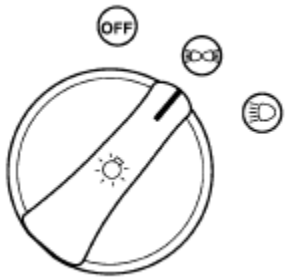
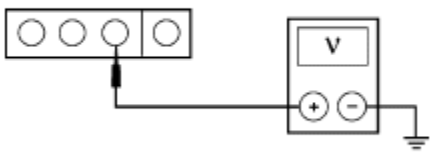
 GK0451-A	• **Does the voltage alternate between 0 volts and greater than 10 volts?** → **Yes** The vehicle is operating properly. HAVE the trailer repaired by an authorized camper/trailer repair center. → **No** REPAIR the circuit. TEST the system for normal operation.

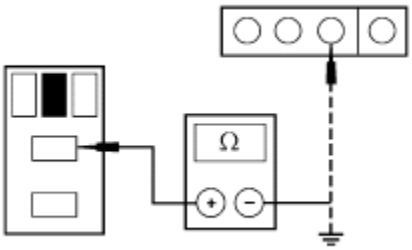
PINPOINT TEST AD: THE TRAILER LAMPS ARE INOPERATIVE — LH TRAILER TURN SIGNALS/STOPLAMPS/HAZARD LAMPS

CONDITIONS	DETAILS/RESULTS/ACTIONS
AD1 CHECK VOLTAGE TO LH TURN, STOP AND HAZARD TRAILER TOW CONNECTOR	
1  GK0262-A	1 Place the hazard lamp switch in the ON position.
2	2 Measure the voltage between trailer tow C408 Pin 2, circuit 52 (YE), and ground.

 GK0453-A	• **Does the voltage alternate between 0 volts and greater than 10 volts?** → **Yes** The vehicle is operating properly. HAVE the trailer repaired by an authorized camper/trailer repair center. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST AE: THE TRAILER LAMPS ARE INOPERATIVE — PARKING LAMPS

CONDITIONS	DETAILS/RESULTS/ACTIONS
AE1 CHECK VOLTAGE TO PARK LAMPS TRAILER TOW CONNECTOR	
1  GK0272-A	1 Place the headlamp switch (11654) in the ON position.
2  GK0455-A	2 Measure the voltage between trailer tow C408 Pin 3, circuit 962 (BR/WH), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** The vehicle is operating properly. HAVE the trailer repaired by an authorized camper/trailer repair center. → **No** PLACE the headlamp switch in the OFF position. GO to AE2 .
AE2 CHECK CIRCUIT 962 (BR/WH) FOR OPEN AND SHORT	
1 Trailer Park Lamps Relay 2  GK0456-A	2 Measure the resistance between trailer park lamps relay connector pin 5, circuit 962 (BR/WH), and trailer tow C408 Pin 3, circuit 962 (BR/WH); and between trailer park lamps relay connector pin 5, circuit 962 (BR/WH), and ground. • **Is the resistance less than 5 ohms between the trailer park lamps relay connector and the trailer tow connector and greater than 10,000 ohms between the trailer park lamps relay connector and chassis ground?** → **Yes** REPLACE the trailer park lamps relay. TEST the system for normal operation. → **No** REPAIR the circuit . TEST the system for normal operation.

Component Test

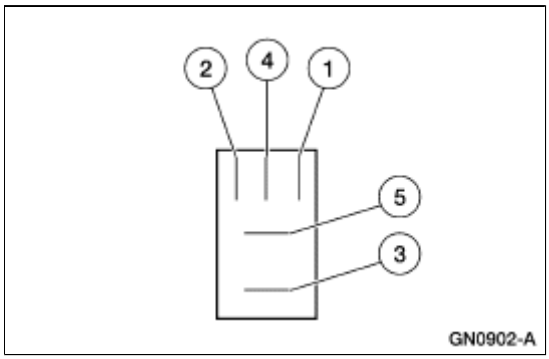
Relay

Testing an ISO relay can be accomplished through the use of three No. 10 (or larger gauge) jumper wires and 73 Digital Multimeter. Remove the relay to be tested from the power distribution box, fuse junction panel or individual connector.

Micro ISO Relay

Use 73 Digital Multimeter to check for continuity between terminal 2 and all other terminals. If resistance is 5 ohms or less between terminal 2 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue the test. Use two jumper wires to connect relay terminals 1 and 3 directly to the positive battery terminal. Set 73 Digital Multimeter in volts position and check for voltage at terminal 4. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect the third jumper wire to terminal 2, and ground the jumper wire to chassis ground. Check for voltage at terminal 5. If battery voltage is not indicated, replace the relay.

Relay Pin Layout Micro ISO Bottom View



Headlamp Adjustment

Headlamp Aiming

1. The headlamp aiming procedure depends on the type of beam pattern the headlamp is equipped with. Vehicles may come equipped with visual optical right (VOR), visual optical left (VOL), or SAE only (includes sealed beam type) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
    - SAE
    - VOR or SAE
    - VOL or SAE

2. Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods as applicable.
    - Photometric aimers can aim SAE, VOR and VOL type headlamps. This is the preferred method of headlamp aiming.
    - Visual or screen method aiming can be used to aim SAE, VOR and VOL type headlamps.
    - Mechanical aimers can be used only with SAE type headlamps. Lamps that can be aimed mechanically will have three nibs molded into the lens of the lamp.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer instruction manual.

Screen Method Aiming

All headlamp types

NOTE: Horizontal aim is not necessary for VOR or VOL headlamps.

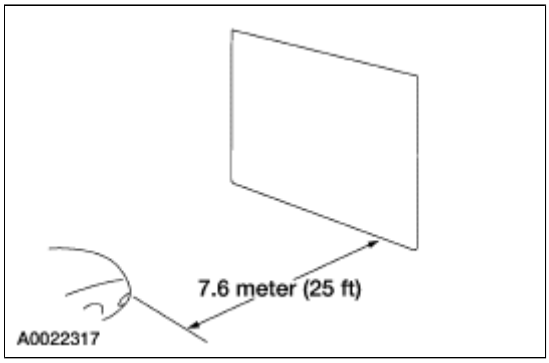
NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

NOTE: The sight shield may need to be positioned or removed for access to the adjusters.

1. Before starting headlamp adjustment:
    - Check the tire inflation.
    - Check that no other load is in the vehicle other than a half tank of fuel.
    - Check that the headlamps are clean.
    - Check for correct headlamp operation.
    - Check that the vehicle is on level ground.
    - If the vehicle is equipped with air suspension, make sure that the switch is on.

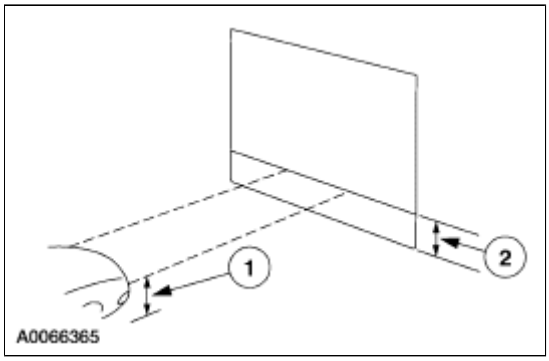
2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 meters (8 feet) wide.

   Park the vehicle on a level surface approximately 7.6 meters (25 feet) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked by a 3 mm (0.12 in) circle on the headlamp lens.

   Mark a horizontal reference line on the vertical wall or screen.
   1. Measure the center of the headlamp height to ground and record.
   2. Make a 2.4 meter (8 foot) horizontal mark (masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

   Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

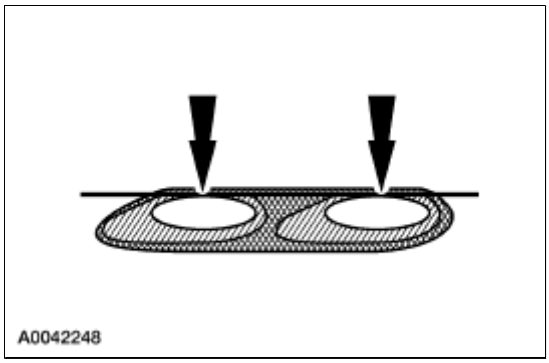
5. **NOTE:** For SAE type headlamps, the appearance of the beam pattern may vary between vehicles.

   On the wall or screen, locate the high intensity area of the beam pattern. Place the top edge of the high intensity zone even with the horizontal reference line.

VOR type headlamps

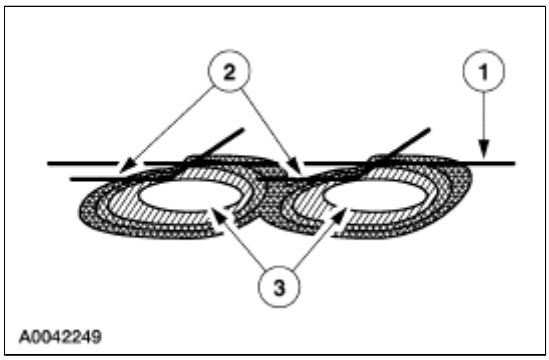
6. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

   Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam will need to be adjusted.



VOL type headlamps

7. For VOL type headlamps, there will be a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line.
    1. Horizontal reference line.
    2. Top edge of the beam pattern.
    3. High intensity zone.



Mechanical Aiming

1. For the mechanical aiming procedure, refer to the appropriate mechanical headlamp aimer instruction manual.

Bulb —Headlamp

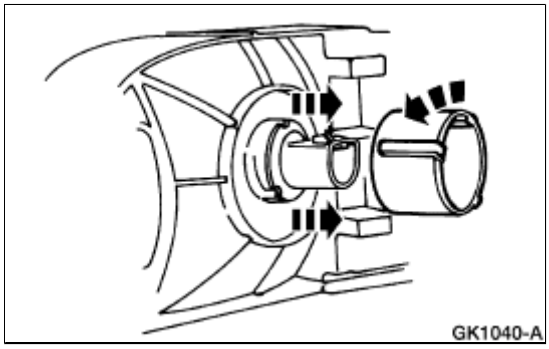
Removal

WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb carefully. Grasp the bulb only by its base. Avoid touching the glass envelope.

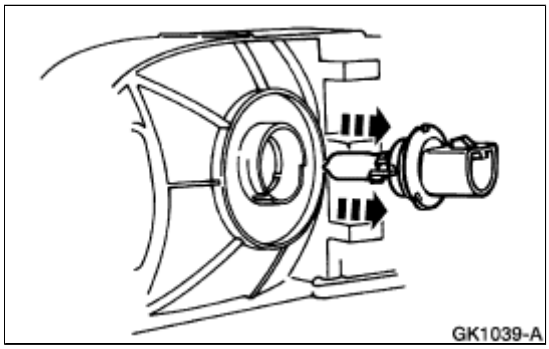
NOTE: The headlamp bulb should not be removed from the headlamp until just before a replacement bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn the headlamps on with the bulb removed.

1. Remove the headlamp assembly. Refer to Lamp Assembly—Headlamp (Explorer) or Lamp Assembly—Headlamp (Mountaineer) .

2. Rotate the headlamp bulb retainer counterclockwise and remove.



3. Remove the headlamp bulb.



Installation

1. **WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb carefully. Grasp the bulb only by its base. Avoid touching the glass envelope.**

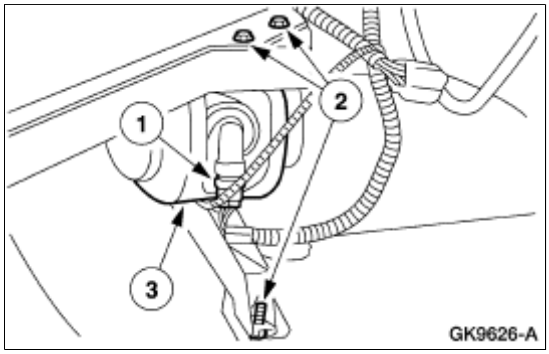
NOTE: Never turn the headlamps on with the bulb removed.

To install, reverse the removal procedure.

Lamp Assembly —Fog Lamp (Explorer)

Removal

1. Remove the fog lamp assembly.
    1. Disconnect the fog lamp bulb electrical connector.
    2. Remove the bolts.
    3. Remove the fog lamp assembly.
        - If necessary, transfer the fog lamp bulb to the new fog lamp assembly.



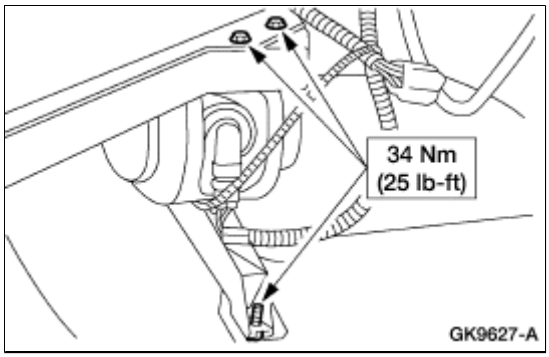
Installation

WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.

NOTE: The fog lamp bulb should not be removed from the fog lamp until just before a replacement bulb is installed. Removing the bulb for an extended period of time may affect fog lamp bulb performance. Contaminants may enter the fog lamp where they can settle on the lens and reflector. Never turn on the fog lamps with the bulb removed.

1. **WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.**

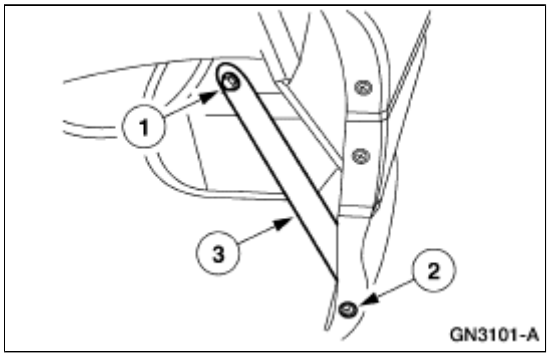
   To install, reverse the removal procedure.


34 Nm
(25 lb-ft)
GK9627-A

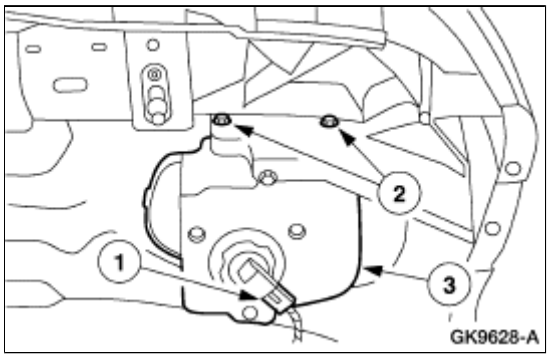
Lamp Assembly —Fog Lamp (Mountaineer)

Removal

1. Remove the bumper cover strut.
    1. Remove the bolt.
    2. Remove the screw.
    3. Remove the bumper cover strut.



2. Remove the fog lamp assembly.
    1. Disconnect the electrical connector.
    2. Remove the bolts.
    3. Remove the fog lamp assembly.
        - If necessary, transfer the fog lamp bulb to the new fog lamp assembly.

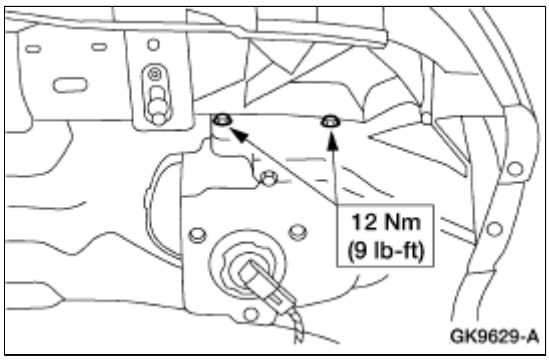


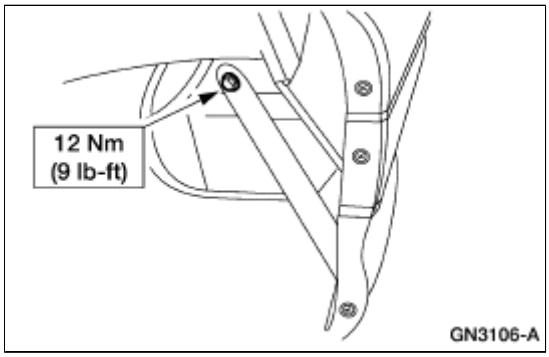
Installation

WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.

NOTE: The fog lamp bulb should not be removed from the fog lamp until just before a replacement bulb is installed. Removing the bulb for an extended period of time may affect fog lamp bulb performance. Contaminants may enter the fog lamp where they can settle on the lens and reflector. Never turn on the fog lamps with the bulb removed.

1. To install, reverse the removal procedure.





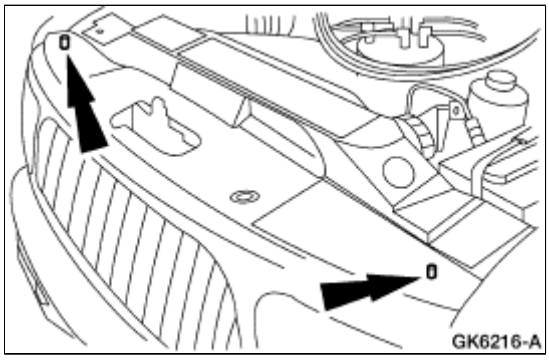
Lamp Assembly —Parking (Explorer)

Removal

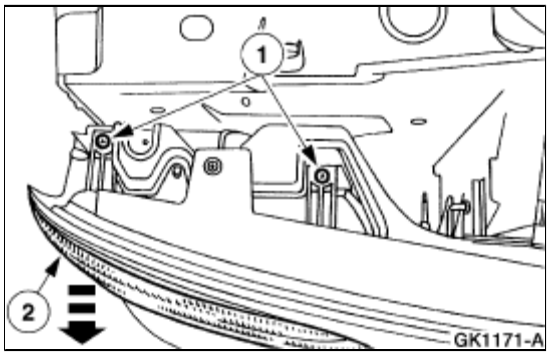
1. **NOTE:** Make sure that the headlamps switch and the ignition switch are in the OFF position.

   Raise and support the hood.

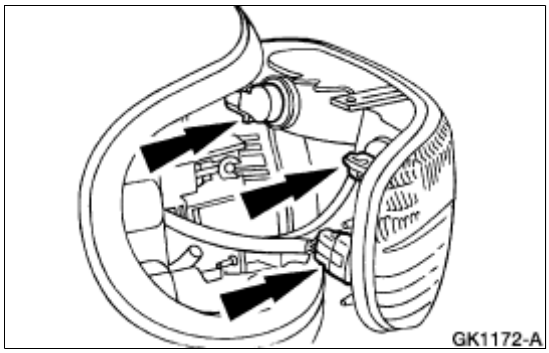
2. Depress the locking tab and open the radiator sight shield access door.



3. Remove the parking lamp assembly.
   1. Remove the screws.
   2. Remove the parking lamp assembly.

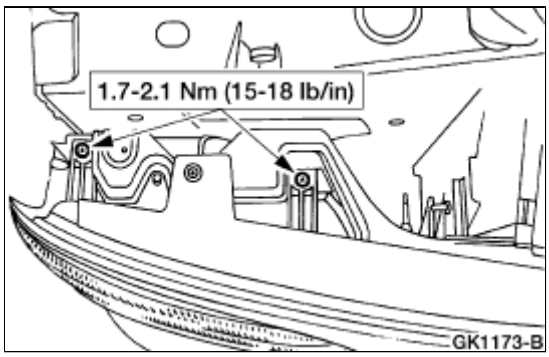


4. Disconnect the electrical connectors.
   - If necessary, transfer the parking lamp bulbs to the new parking lamp assembly.



Installation

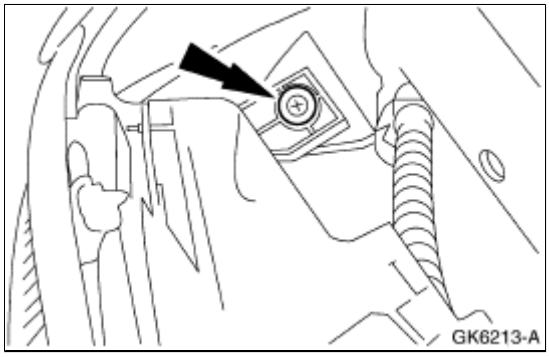
1. To install, reverse the removal procedure.
    - If necessary, adjust the headlamps. For additional information, refer to Headlamp Adjustment in this section.



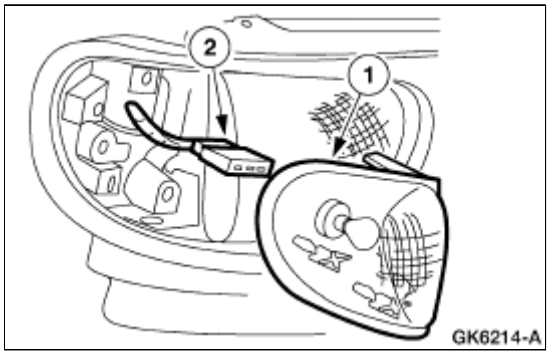
Lamp Assembly —Parking (Mountaineer)

Removal

1. Remove the parking lamp assembly screw.

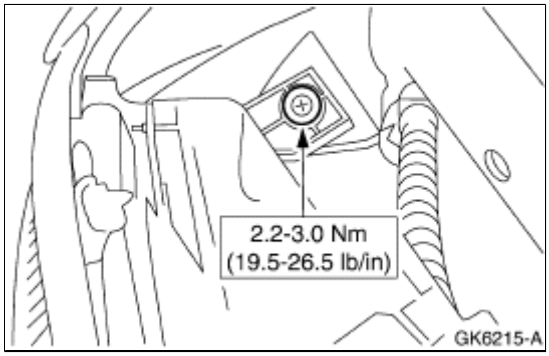


2. Remove the parking lamp assembly.
    1. Pull the lamp assembly forward just enough to expose the electrical connector.
    2. Disconnect the connector and remove the parking lamp assembly.



Installation

1. To install, reverse the removal procedure.



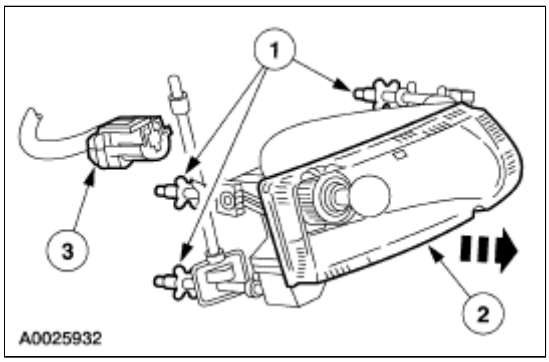
Lamp Assembly —Headlamp (Explorer)

Removal

1. **NOTE:** Make sure that the headlamp switch and the ignition switch are in the OFF position.

   Remove the parking lamp assembly. Refer to Lamp Assembly—Parking (Explorer) or Lamp Assembly—Parking (Mountaineer) .

2. Remove the headlamp assembly.
   1. Compress the self-locking tabs.
   2. Remove the headlamp assembly.
   3. Disconnect the electrical connector.



Installation

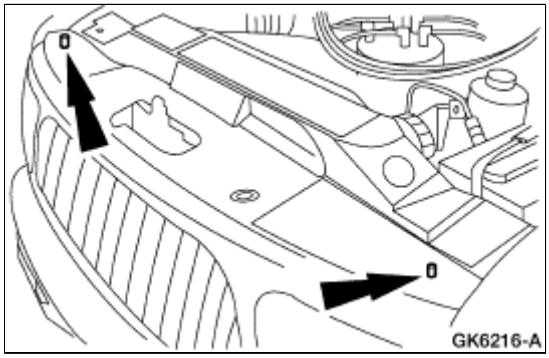
1. To install, reverse the removal procedure.
   - If necessary, adjust the headlamps. For additional information, refer to Headlamp Adjustment in this section.

Lamp Assembly —Headlamp (Mountaineer)

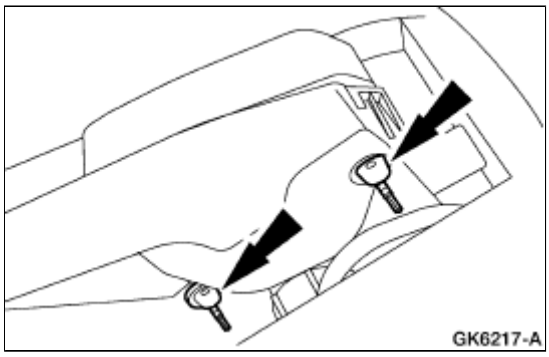
Removal

1. **NOTE:** Make sure that the headlamp switch and the ignition switch are in the OFF position.

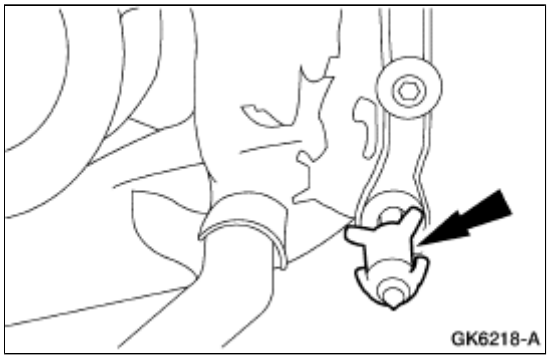
   Depress the locking tab and open the upper radiator sight shield access door.



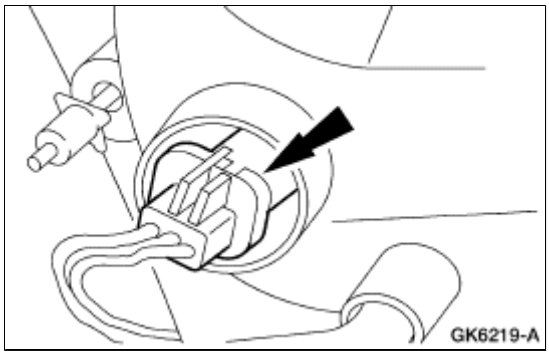
2. Remove the headlamp assembly clips.



3. Use a 14 mm quarter-drive, deep well socket to release the headlamp assembly retaining clip.



4. Remove the headlamp assembly.
   - Disconnect the electrical connector.



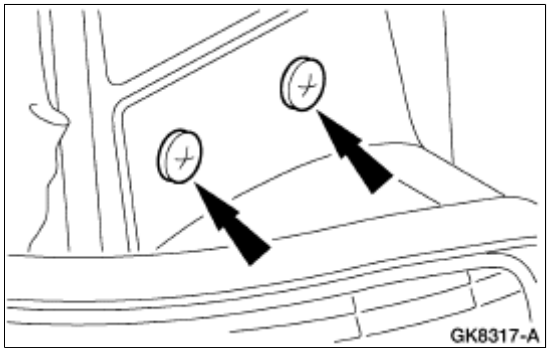
Installation

1. To install, reverse the removal procedure.
    - If necessary, adjust the headlamps. For additional information, refer to Headlamp Adjustment in this section.

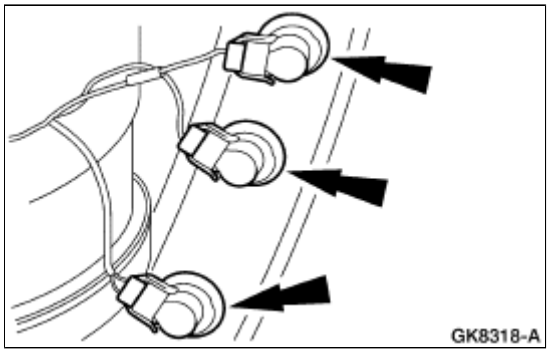
Lamp Assembly —Rear

Removal

1. Raise the liftgate and remove the rear lamp screws.

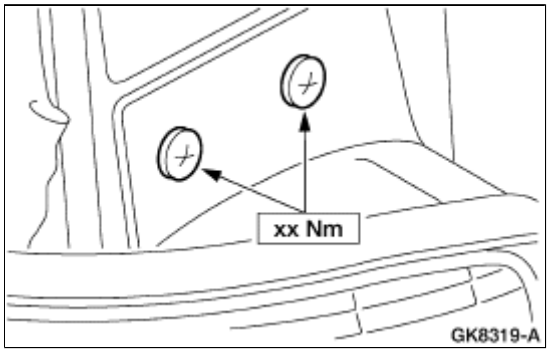


2. Remove the rear lamp.
   - Disconnect the electrical connectors.



Installation

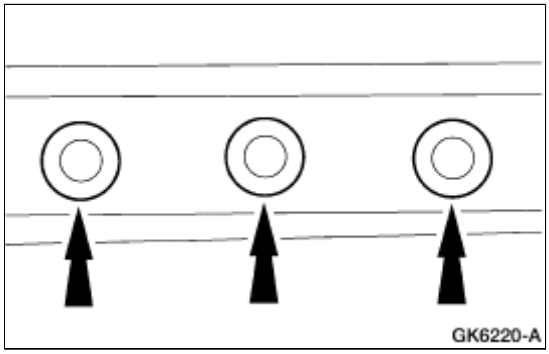
1. To install, reverse the removal procedure.



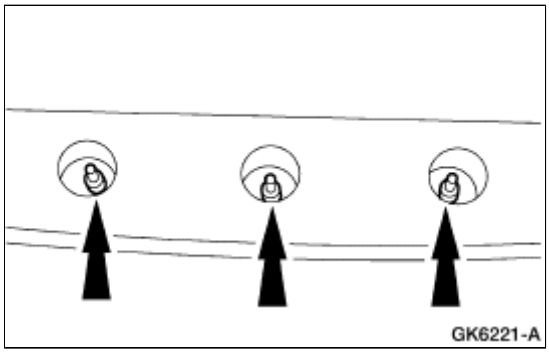
Lamp Assembly —High Mounted Stoplamp

Removal

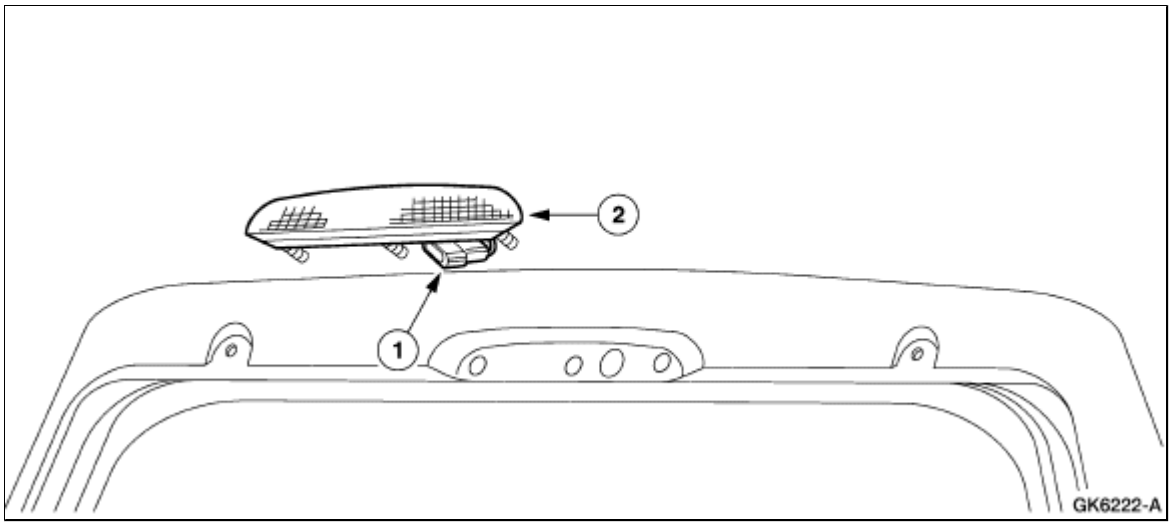
1. Remove the liftgate glass. Refer to Section 501-11 .
2. Remove the plugs.



3. Remove the nuts.

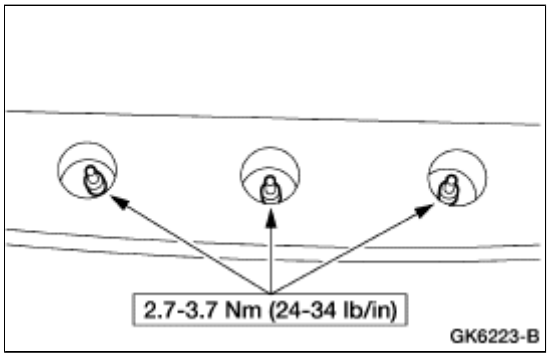


4. Remove the high-mounted stoplamp.
    1. Disconnect the electrical connector.
    2. Remove the high-mounted stoplamp.



Installation

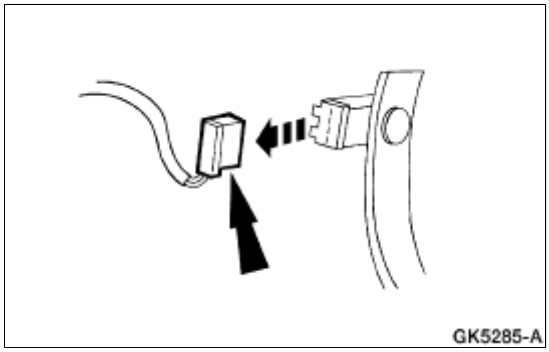
1. To install, reverse the removal procedure.



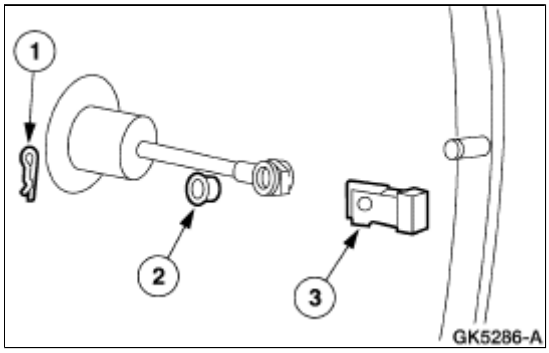
Lamp Switch —Brake Pedal Position (BPP)

Removal

1. Disconnect the brake pedal position (BPP) switch connector.



2. Remove the BPP switch
    1. Remove the self-locking pin.
    2. Remove the spacer.
    3. Remove the BPP switch.



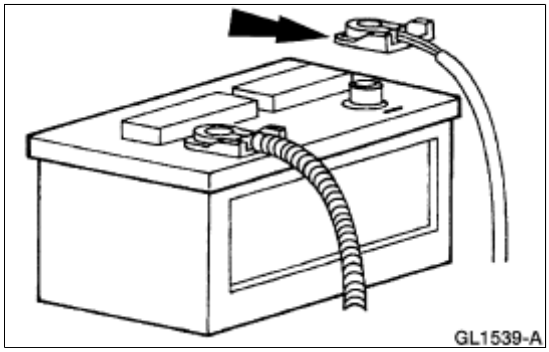
Installation

1. To install, reverse the removal procedure.

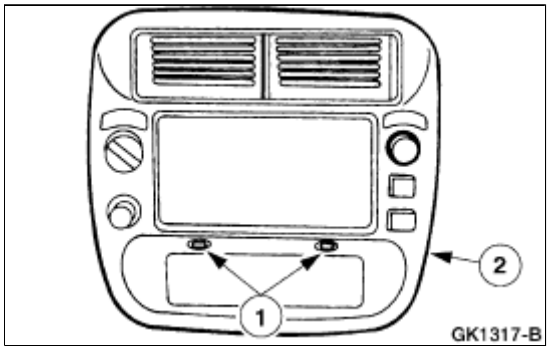
Lamp Switch —Fog

Removal

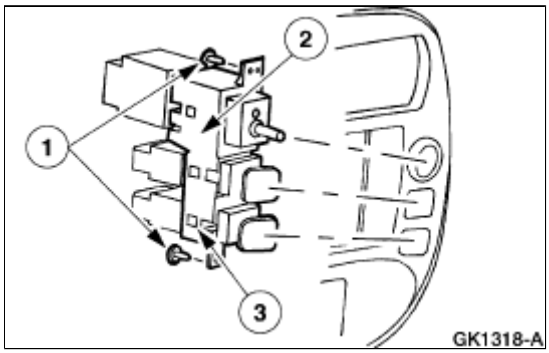
1. Disconnect the battery ground cable (14301).



2. Remove the instrument panel finish panel (044D70).
    1. Remove the screws.
    2. Remove the center instrument panel finish panel.
        - Disconnect the electrical connectors.



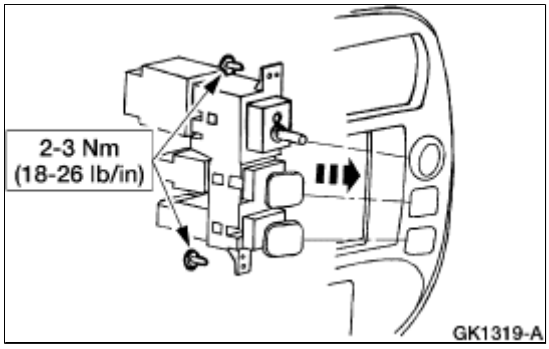
3. Remove the fog lamp switch (15A214).
    1. Remove the screws.
    2. Remove the mounting bezel.
    3. Release the two tabs and remove the fog lamp switch.

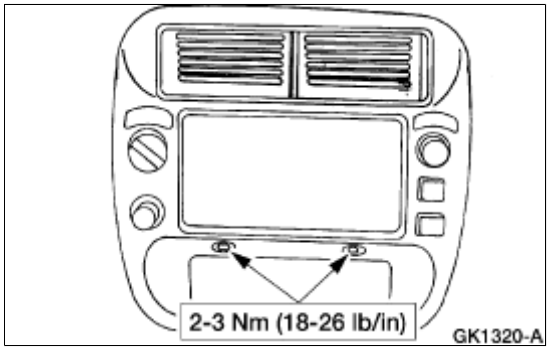


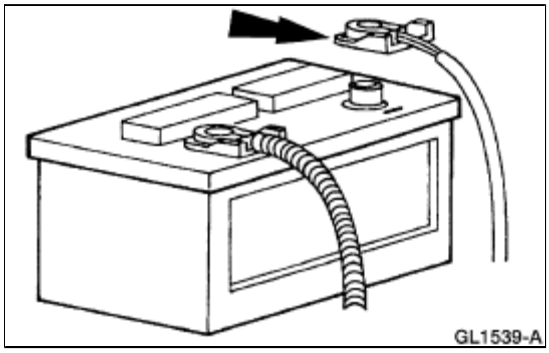
Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.







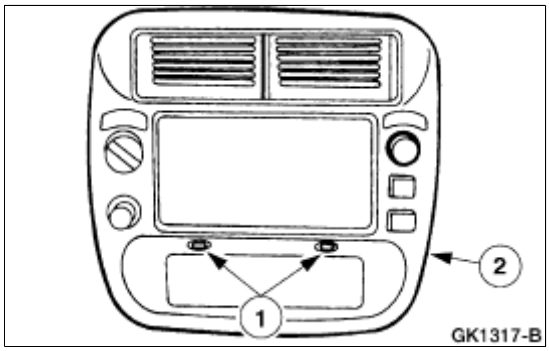
Lamp Switch —Headlamp

Removal

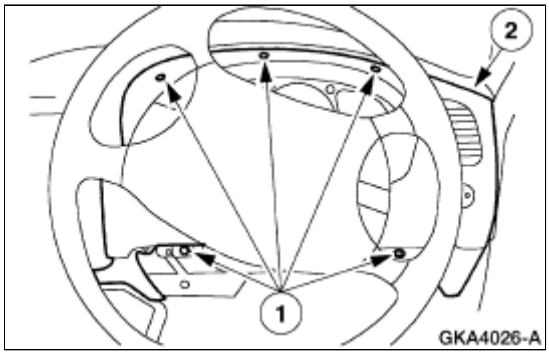
1. Disconnect the battery ground cable (14301).

2. Remove the instrument panel steering column opening cover reinforcement (04502) ; refer to Section 501-12 .

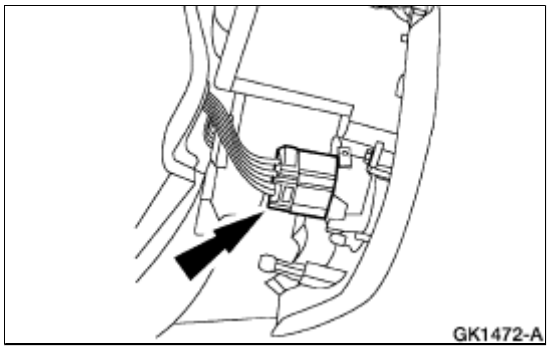
3. Remove the center instrument panel finish panel (04338).
   1. Remove the screws.
   2. Remove the instrument panel finish panel.



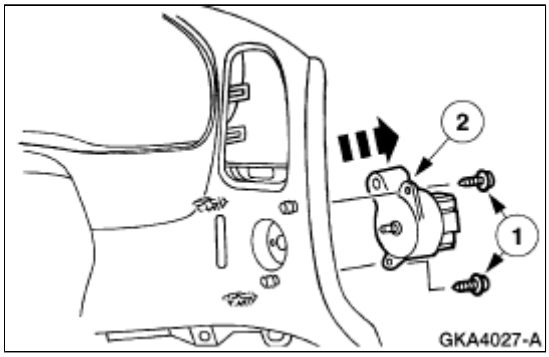
4. Remove the instrument cluster finish panel.
   1. Remove the screws.
   2. Remove the cluster instrument panel finish panel (044D70).



5. Disconnect the headlamp switch electrical connectors and remove the headlamp switch knob.



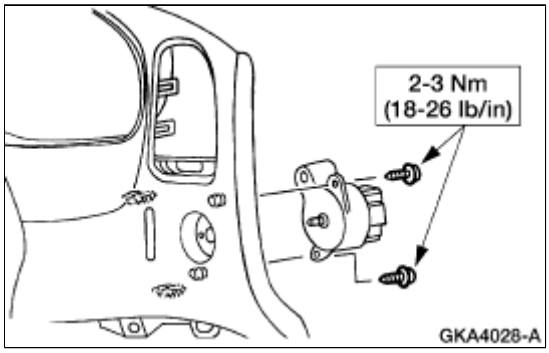
6. Remove the headlamp switch (11654).
    1. Remove the screws.
    2. Remove the headlamp switch.

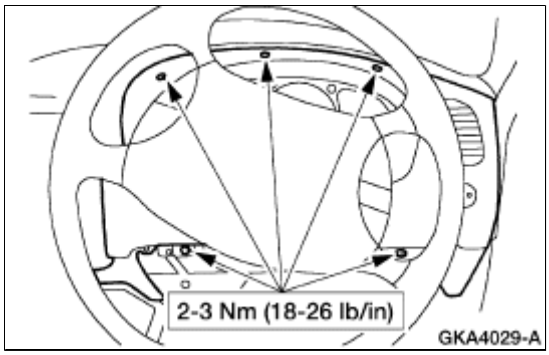


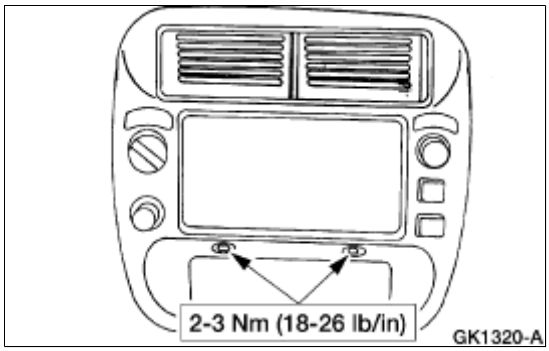
Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

    To install, reverse the removal procedure.



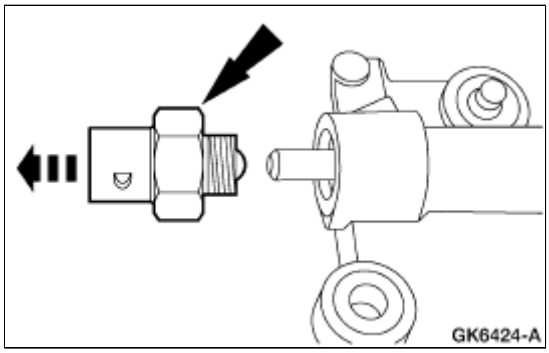

2-3 Nm (18-26 lb/in)
GKA4029-A


2-3 Nm (18-26 lb/in)
GK1320-A

Lamp Switch —Backup (Manual Transmission)

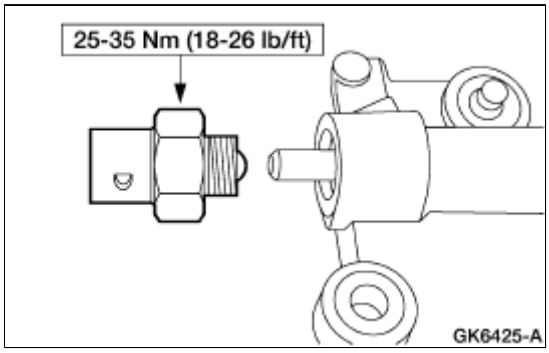
Removal

1. Raise and support the vehicle; refer to Section 100-02 .
2. Disconnect the backup lamp switch electrical connector.
3. Remove the backup lamp switch (15520).



Installation

1. To install, reverse the removal procedure.



Lamp Switch —Backup (Automatic Transmission)

Removal and Installation

For additional information, refer to Section 307-01B .For additional information, refer to Section 307-01A .

Torque Specifications

Description	Nm	lb-in
Battery ground cable nut	7-10	62-89
Dome/map lamp screw	1.5-1.9	14-16
Sun visor screw	0.9-1.3	8-11

Interior Lighting

The interior lighting system consists of the following:

- dome/map lamp
- rear dome/cargo lamp
- overhead console/map lamp
- RH/LH vanity mirror
- ash receptacle lamp
- puddle lamps
- interior lamp switches
- interior lamp relay
- dimmer module
- battery saver relay
- generic electronic module (GEM)

Generic Electronic Module (GEM)/Central Timer Module (CTM) Controlled Functions

The generic electronic module (GEM) is equipped on four-wheel drive vehicles with power windows. The central timer module (CTM) is equipped only on two-wheel drive vehicles without power windows.

NOTE: GEM/CTM diagnostics are compatible with the scan tool.

The GEM/CTM incorporates the functions of several different modules into one, and offers diagnostics to easily locate and repair concerns affecting the subsystems that it controls.

The GEM/CTM constantly monitors the systems it controls and reports a concern in the form of a diagnostic trouble code (DTC). A DTC can be retrieved with the scan tool through the communication link.

The scan tool is a menu-driven tester that allows the user to run specific tests. The scan tool can isolate faults in the GEM/CTM subsystems through a symptom-driven diagnostic procedure. Connecting the scan tool to the GEM/CTM communication link will not alert the GEM/CTM. If the GEM/CTM is "asleep" when the diagnostic connector is plugged in, the GEM/CTM must be "awakened". If the communication link cannot be established, turn the ignition to RUN.

NOTE: The GEM/CTM has a sleep function to minimize battery consumption. During the sleep mode, the GEM/CTM turns off all outputs and monitors only the following:

- door ajar (driver door, passenger door, liftgate, LH rear and RH rear doors).
- key-in-ignition.
- key in RUN or ACC.
- two-step unlock switch (unarm switch).
- digital TR sensor.
- illuminated entry request (remote anti-theft personality [RAP] module).

If a change of status occurs at one of these inputs while the GEM/CTM is "asleep", the GEM/CTM will "wake

up." When the GEM/CTM awakens, it carries out an internal self-test, and begins normal operation. At this point, the GEM/CTM will have all of its functions operational.

The GEM/CTM will go into the sleep mode immediately after both of the following conditions have been met:

- key in OFF or key not in ignition.
- after 45 minutes with no change in any wake-up input.

The GEM/CTM control system has two modes of operation; the normal operating mode and the tester-dependent diagnostics mode.

Normal operation of the GEM/CTM can detect errors. An integral part of normal GEM/CTM operation is continuous diagnostic capability. Continuous diagnostics detects errors and changes the GEM/CTM control strategy. There is no warning lamp for the GEM/CTM; therefore, a DTC concern will direct you to the GEM/CTM. Examples of faults that may be detected during normal operation include:

NOTE: The GEM/CTM can only detect open circuit/short to GRD faults when the GEM/CTM is not energizing a load, and short to battery faults when the GEM/CTM is attempting to energize a load.

- GEM/CTM continuous self-test (RAM, ROM, EEPROM, A/D checking).
- output driver monitoring (open circuit/short to ground [GRD], short to power).

- illogical combinations of input signals.

Interior Lighting

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell 89 , Courtesy Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter 105-R0057
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

1. **NOTE:** The generic electronic module (GEM)/central timer module (CTM) must be reconfigured upon replacement. Refer to the diagnostic tool help screen on the configuration card to program the tire size and axle ratio; refer to Section 418-01 .

   The interior lighting system is a GEM/CTM controlled system; refer to Section 419-10 .

2. Verify the customer concern by operating the system in question.

3. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Switch(es)	• Fuse(s) 1 (60A), 25 (7.5A), 26 (10A), and 10 (7.5A) • Damaged wiring harness • Loose or corroded connections • Lamp(s) • Circuitry

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic

tool menu. If the diagnostic tool does not communicate with the vehicle:
- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

6. Carry out the DATA LINK DIAGNOSTIC test. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for GEM/CTM, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM/CTM.

7. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle speed signal circuit failure	GEM	REFER to Section 308-07A .
B1302	Accessory delay relay coil circuit failure	GEM	REFER to Section 501-11 .
B1304	Accessory delay relay coil circuit short to battery	GEM	REFER to Section 501-11 .
B1313	Battery saver relay coil circuit failure	GEM/CTM	GO to Pinpoint Test F .
B1315	Battery saver relay coil circuit short to battery	GEM/CTM	GO to Pinpoint Test B .
B1317	Battery voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door ajar LF circuit short to ground	GEM/CTM	GO to Pinpoint Test D .
B1323	Door ajar lamp circuit failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door ajar lamp circuit short to battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door ajar RF circuit short to ground	GEM/CTM	GO to Pinpoint Test D .

B1334	Decklid ajar rear door circuit short to ground	GEM/CTM	GO to Pinpoint Test D .
B1338	RR door ajar circuit short to ground	GEM/CTM	GO to Pinpoint Test D .
B1340	Chime input request circuit short to ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated backlite input circuit short to ground	GEM	REFER to Section 501-11 .
B1347	Heated backlite relay circuit failure	GEM	REFER to Section 501-11 .
B1349	Heated backlite relay circuit short to battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In circuit failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN circuit failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC circuit failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated entry relay circuit failure	GEM/CTM	GO to Symptom Chart.
B1373	Interior lamp relay coil circuit short to battery	GEM/CTM	GO to Pinpoint Test B .
B1398	Power window driver one-touch window relay circuit failure	GEM	REFER to Section 501-11 .
B1400	Power window driver one-touch window relay coil circuit short to battery	GEM	REFER to Section 501-11 .
B1404	Power window driver down circuit open	GEM	REFER to Section 501-11 .
B1405	Driver power window down circuit to battery	GEM	REFER to Section 501-11 .
B1410	Power window driver motor circuit failure	GEM	REFER to Section 501-11 .
B1426	Seat belt lamp circuit short to battery	GEM/CTM	REFER to Section 413-01 .
B1428	Safety belt lamp output failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper brake/run relay — circuit failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper brake/run relay short to battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo speed relay — circuit failure	GEM/CTM	REFER to Section 501-16 .

B1436	Wiper Hi/Lo speed relay circuit short to battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper mode select switch circuit failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper mode select switch input short to ground	GEM/CTM	REFER to Section 501-16 .
B1446	Wiper park sense circuit failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/washer interval delay switch input circuit failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/washer interval delay switch input short to ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/washer pump motor relay circuit failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/washer pump motor relay coil short to battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat belt switch circuit failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo speed not switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo speed circuit motor short to battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper low speed circuit motor failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory delayed relay contacts short to battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper high speed circuit motor failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake pedal input circuit failure	GEM	REFER to Section 308-07A .
B1485	Brake pedal input short circuit to battery	GEM	REFER to Section 308-07A .
B1574	LR door ajar circuit short to ground	GEM/CTM	GO to Pinpoint Test D .
B1577	Lamp/park input short circuit to battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated entry input (from RAP module) circuit short to ground	GEM	GO to Pinpoint Test D .
B1611	Wiper rear mode select switch circuit	GEM	REFER to Section 501-16 .

	failure		
B1614	Wiper rear mode select switch circuit short to ground	GEM	REFER to Section 501-16 .
B1814	Wiper rear motor down relay circuit failure	GEM	REFER to Section 501-16 .
B1816	Wiper rear motor down relay coil circuit short to battery	GEM	REFER to Section 501-16 .
B1818	Wiper rear motor up relay coil circuit failure	GEM	REFER to Section 501-16 .
B1820	Rear wiper motor up relay circuit short to battery	GEM	REFER to Section 501-16 .
B1833	Door unlock switch circuit short to ground	GEM	REFER to Section 501-14B .
B1834	Door unlock disarm output circuit failure	GEM	REFER to Section 501-14B .
B1836	Door unlock disarm output circuit short to battery	GEM	REFER to Section 501-14B .
B1839	Wiper rear rear motor circuit failure	GEM	REFER to Section 501-16 .
B1840	Wiper front power circuit failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper rear motor speed sense circuit failure	GEM	REFER to Section 501-16 .
B2105	Throttle position input (TPI) signal out of range low	GEM	REFER to Section 308-07A .
B2106	Throttle position input (TPI) signal out of range high	GEM	REFER to Section 308-07A .
B2141	NVM configuration failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the diagnostic tool help screen on the configuration card to program the tire size and axle ratio; Section 418-01 . TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
B2554	Dome lamp relay coil open circuit or short to ground	GEM	GO to Pinpint Test H.
P1763	Transmission neutral in tow indicator circuit short to battery	GEM	REFER to Section 413-09 .
P1764	Transmission neutral in tow indicator circuit	GEM	REFER to Section 413-09 .

	fault		
P1804	4WD high indicator circuit failure	GEM	REFER to Section 308-07A .
P1806	4WD high indicator short circuit to battery	GEM	REFER to Section 308-07A .
P1808	4WD low indicator circuit failure	GEM	REFER to Section 308-07A .
P1810	4WD low indicator short circuit to battery	GEM	REFER to Section 308-07A .
P1812	4WD mode select circuit failure	GEM	REFER to Section 308-07A .
P1815	4WD mode select short circuit to ground	GEM	REFER to Section 308-07A .
P1820	Transfer case CW shift relay coil circuit failure	GEM	REFER to Section 308-07A .
P1822	Transfer case CW shift relay coil short to power	GEM	REFER to Section 308-07A .
P1824	4WD electric clutch relay circuit failure	GEM	REFER to Section 308-07A .
P1826	4WD low clutch relay short to battery	GEM	REFER to Section 308-07A .
P1828	Transfer case CCW shift relay circuit failure	GEM	REFER to Section 308-07A .
P1830	Transfer case shift relay coil short to battery	GEM	REFER to Section 308-07A .
P1836	Transfer case front shaft speed sensor circuit failure	GEM	REFER to Section 308-07A .
P1837	Transfer case rear shaft speed sensor circuit failure	GEM	REFER to Section 308-07A .
P1838	Transfer case shift motor circuit failure	GEM	REFER to Section 308-07A .
P1846	Transfer case CONTACT PLATE "A" circuit failure	GEM	REFER to Section 308-07A .
P1850	Transfer case CONTACT PLATE "B" circuit failure	GEM	REFER to Section 308-07A .
P1854	Transfer case CONTACT PLATE "C" circuit failure	GEM	REFER to Section 308-07A .
P1858	Transfer case CONTACT PLATE "D" circuit failure	GEM	REFER to Section 308-07A .

P1866	Transfer case system concern	GEM	REFER to Section 308-07A .
P1867	Transfer case contact plate general circuit failure	GEM	REFER to Section 308-07A .
P1874	Automatic hall effect sensor power circuit failure	GEM	REFER to Section 308-07A .
P1875	Automatic hall effect sensor power circuit short to battery	GEM	REFER to Section 308-07A .
P1891	Transfer case contact plate ground return open circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Left Front Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Right Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, ON-B-, OFFO-G
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV

4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	FWD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One-Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-

R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE-TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE-TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery voltage HIGH	GEM/CTM
B1318	Battery voltage LOW	GEM/CTM

B1322	Door ajar LF circuit short to ground	GEM/CTM
B1330	Door ajar RF circuit short to ground	GEM/CTM
B1352	Ignition key-in circuit failure	GEM/CTM
B1410	Power window LF motor circuit failure	GEM
B1438	Wiper mode select switch circuit failure	GEM/CTM
B1441	Wiper mode select switch input short to ground	GEM/CTM
B1446	Wiper park sense circuit failure	GEM/CTM
B1450	Wiper/washer interval delay switch input circuit failure	GEM/CTM
B1453	Wiper/washer interval delay switch input short to ground	GEM/CTM
B1462	Seat belt switch circuit failure	GEM/CTM
B1577	Lamp/park input short circuit to battery	GEM/CTM
B1610	Illuminated entry input (from RAP module) circuit short to ground	GEM
B1833	Door unlock disarm switch circuit short to ground	GEM
B1614	Wiper rear mode select switch circuit short to ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the module — generic electronic module/central timer module	• GEM/CTM. • Fuse(s) 1 (60A) and 25 (7.5A). • Circuitry.	• GO to Pinpoint Test A .
• The courtesy lamps are inoperative	• Fuse 26 (10A). • Circuitry. • GEM/CTM. • Battery saver relay. • Interior lamp relay. • DTC B1315. • DTC B1371. • DTC B1373.	• GO to Pinpoint Test B .
• The courtesy lamps do not turn on with one door open	• Circuitry. • GEM/CTM. • Door ajar switch.	• GO to Pinpoint Test C .
• The courtesy lamps stay on continuously	• Circuitry. • GEM/CTM. • Ignition switch. • Interior lamp relay. • Dimmer module. • Door ajar switch. • DTC B1322. • DTC B1330. • DTC B1334. • DTC B1338. • DTC B1371. • DTC B1574.	• GO to Pinpoint Test D .

	• DTC B1610.	
• The illuminated entry is inoperative when using the remote transmitter	• Circuitry. • GEM. • Remote anti-theft personality (RAP) module.	• GO to Pinpoint Test E.
• The battery saver does not deactivate after timeout	• Circuitry. • Ignition switch. • GEM/CTM. • Battery saver relay.	• GO to Pinpoint Test F.
• An individual demand lighting lamp is inoperative	• Circuitry. • Switch.	• GO to Pinpoint Test G.
• An individual courtesy lamp is inoperative	• Circuitry. • Courtesy lamp.	• GO to Pinpoint Test H.
• The courtesy lamps are inoperative — when the liftgate is open	• Circuitry. • Switch. • GEM/CTM.	• GO to Pinpoint Test J.
• The illumination entry is inoperative when using the key cylinder	• Door disarm switch. • GEM. • RAP module. • Circuitry. • DTC B1833. • DTC B1834. • DTC B1836.	• REFER to Section 501-14B.
• The courtesy lamps are inoperative — when the liftgate glass is open	• Circuitry. • Switch. • GEM/CTM.	• GO to Pinpoint Test K.

Pinpoint Tests

CAUTION: Before removing and installing the GEM/CTM or its connectors, disconnect the battery. Failure to follow this caution will result in the GEM/CTM storing many erroneous DTCs and may result in the GEM/CTM exhibiting erratic operation after installation.

CAUTION: Be careful when probing the fuse junction panel, battery junction box or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

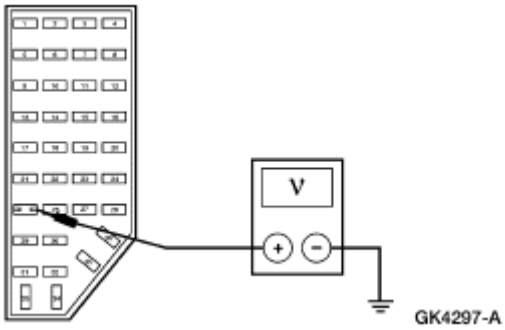
CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when carrying out the Pinpoint Tests, an intermittent concern may be the cause. Always check for loose connections and corroded pins.

NOTE: Complete the entire Pinpoint Test related to the symptom before replacing the GEM/CTM.

PINPOINT TEST A: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE/CENTRAL TIMER MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK BATTERY JUNCTION BOX MAXI FUSE 1 (60A)	
1 Fuse 1 (60A)	• **Is the fuse OK?** → **Yes** GO to A2. → **No** INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK Circuit 1052 (TN/BK) for a short to ground. REPAIR as necessary.
A2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to A3. → **No** INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK Circuit 1001 (WH/YE) for a short to ground. REPAIR as necessary.
A3 CHECK CIRCUIT 1052 (TN/BK) FOR VOLTAGE	
1	1 Measure the voltage between fuse junction panel Fuse 25 (7.5A), Pin 2, Circuit 1052 (TN/BK), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A4 .

→ **No**
REPAIR Circuit 1052 (TN/BK). CLEAR the DTCs. TEST the system for normal operation.

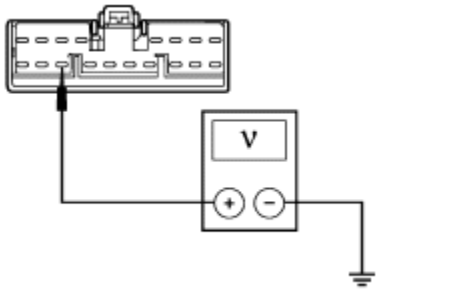
A4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (WH/YE)

1

2

GEM/CTM C283

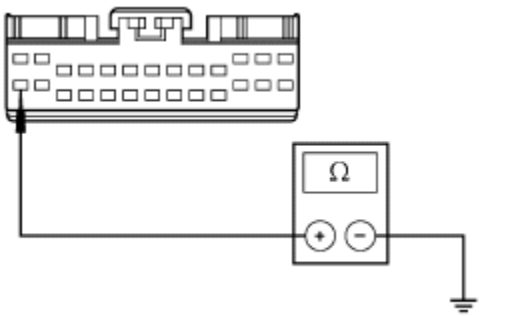
3 Measure the voltage between GEM/CTM C283-11, Circuit 1001 (WH/YE), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A5 .

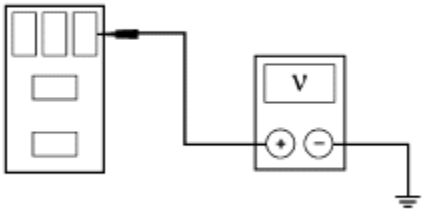
→ **No**
REPAIR Circuit 1001 (WH/YE). CLEAR the DTCs. TEST the system for normal operation.

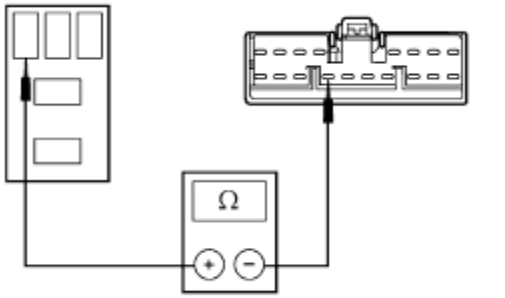
A5 CHECK CIRCUIT 570 (BK/WH) FOR OPEN	
1 GEM/CTM C280 2  	2 Measure the resistance between GEM/CTM C280-14, Circuit 570 (BK/WH), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR Circuit 570 (BK/WH). CLEAR the DTCs. TEST the system for normal operation.

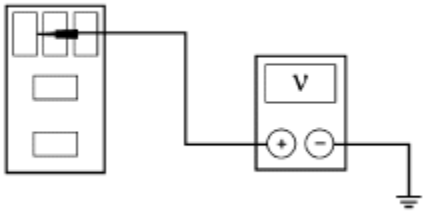
PINPOINT TEST B: THE COURTESY LAMPS ARE INOPERATIVE

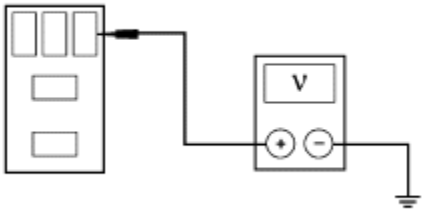
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Diagnostic Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions.

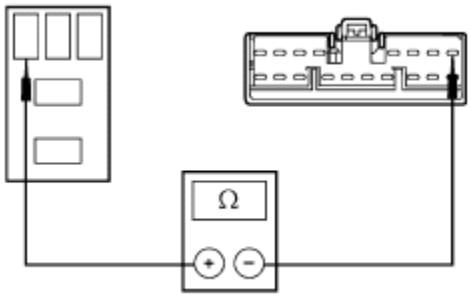
	• **Do the PID values agree with the ignition switch positions?** → **Yes** GO to B2 . → **No** GO to Pinpoint Test C .
B2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM On-Demand Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1315, GO to B9 . If DTC B1371, GO to B3 . If DTC B1373, GO to B3 . If DTC B1342, INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B3 .
B3 CHECK THE INTERIOR LAMP RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID INTLMP	
1 	1 **NOTE:** The battery saver relay must be activated ON when carrying out this step. Monitor the GEM/CTM PID INTLMP while triggering the GEM/CTM active command INT LAMPS ON and OFF.

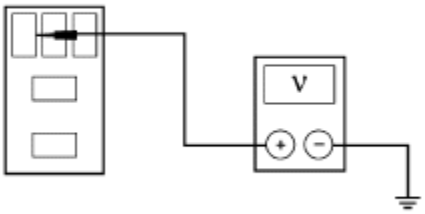
	• **Does the GEM/CTM PID INTLMP value agree with the command mode?** → **Yes** GO to B9 . → **No** If the GEM/CTM PID INTLMP displays OFFO-G, GO to B4 . If the GEM/CTM PID INTLMP displays ON-B-, GO to B7 .
B4 CHECK THE VOLTAGE TO THE INTERIOR LAMP RELAY COIL — CIRCUIT 402 (OG/LG)	
1 2 Interior Lamp Relay 3  GN1458-A	3 **NOTE:** The battery saver relay must be activated ON and the panel dimmer switch must be in the normal (mid-range) position when carrying out this step. Measure the voltage between interior lamp relay connector Pin 1, Circuit 402 (OG/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B5 . → **No** GO to B17 .
B5 CHECK THE INTERIOR LAMP RELAY	
	1 Check the interior lamp relay; refer to Wiring Diagrams cell 149. • **Is the interior lamp relay OK?** → **Yes**

	GO to B6 . → **No** INSTALL a new interior lamp relay. CLEAR the DTCs. TEST the system for normal operation.
B6 CHECK CIRCUIT 1008 (LG/OG) FOR OPEN	
1 GEM/CTM C283 2  GK6025-A	2 Measure the resistance between interior lamp relay connector Pin 2, Circuit 1008 (LG/OG), and GEM/CTM C283-12, Circuit 1008 (LG/OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 1008 (LG/OG). CLEAR the DTCs. TEST the system for normal operation.
B7 CHECK THE INTERIOR LAMP RELAY	
1 2 Interior Lamp Relay	3 Check the interior lamp relay; refer to Wiring Diagrams cell 149. • **Is the interior lamp relay OK?**

	→ **Yes** GO to B8 . → **No** INSTALL a new interior lamp relay. CLEAR the DTCs. TEST the system for normal operation.
B8 CHECK CIRCUIT 1008 (LG/OG) FOR SHORT TO POWER	
1 GEM/CTM C283 2 3  GN1460-A	3 Measure the voltage between interior lamp relay connector Pin 2, Circuit 1008 (LG/OG), and ground. • **Is any voltage indicated?** → **Yes** REPAIR Circuit 1008 (LG/OG). CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
B9 CHECK THE BATTERY SAVER RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID BATSAV	
1 2 	2 Monitor the GEM/CTM PID BATSAV while triggering the GEM active command BATT SAVR ON and OFF.

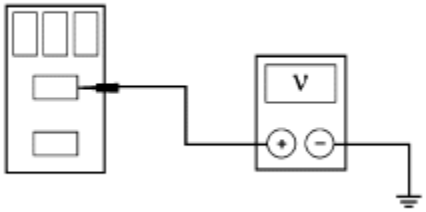
	• **Does the GEM/CTM PID BATSAV value agree with the command mode?** → **Yes** GO to B15 . → **No** If the GEM/CTM PID BATSAV displays OFFO-G, GO to B10 . If the GEM/CTM PID BATSAV displays ON-B-, GO to B13 .
B10 CHECK THE VOLTAGE TO THE BATTERY SAVER COIL — CIRCUIT 792 (TN/YE)	
1 2 Battery Saver Relay 3  GN1458-A	3 Measure the voltage between battery saver relay connector Pin 1, Circuit 792 (TN/YE), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B11 . → **No** REPAIR Circuit 792 (TE/YE). CLEAR the DTCs. TEST the system for normal operation.
B11 CHECK THE BATTERY SAVER RELAY	
	1 Check the battery saver relay; refer to Wiring Diagrams cell 149. • **Is the battery saver relay OK?**

	→ **Yes** GO to B12 . → **No** INSTALL a new battery saver relay. CLEAR the DTCs. TEST the system for normal operation.
B12 CHECK CIRCUIT 1005 (VT/OG) FOR OPEN	
1 GEM/CTM C283 2  GK6026-A	2 Measure the resistance between battery saver relay connector Pin 2, Circuit 1005 (VT/OG), and GEM/CTM C283-8, Circuit 1005 (VT/OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 1005 (VT/OG). CLEAR the DTCs. TEST the system for normal operation.
B13 CHECK THE BATTERY SAVER RELAY	
1 2 Battery Saver Relay	3 Check the battery saver relay; refer to Wiring Diagrams cell 149.

	• **Is the battery saver relay OK?** → **Yes** GO to B14 . → **No** INSTALL a new battery saver relay. CLEAR the DTCs. TEST the system for normal operation.
B14 CHECK CIRCUIT 1005 (VT/OG) FOR SHORT TO POWER	
1 GEM/CTM C283 2 3  GN1460-A	3 Measure the voltage between battery saver relay connector Pin 2, Circuit 1005 (VT/OG), and ground. • **Is any voltage indicated?** → **Yes** REPAIR Circuit 1005 (VT/OG). CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
B15 CHECK THE VOLTAGE TO THE INTERIOR LAMP RELAY SWITCH — CIRCUIT 705 (LG/OG)	
1 2	

Interior Lamp Relay

3



GN1457-A

3 Measure the voltage between interior lamp relay connector Pin 5, Circuit 705 (LG/OG), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B16 .

→ **No**
REPAIR Circuit 705 (LG/OG). CLEAR the DTCs. TEST the system for normal operation.

B16 CHECK THE INTERIOR LAMP RELAY

1 Check the interior lamp relay; refer to Wiring Diagrams cell 149.

- **Is the interior lamp relay OK?**

→ **Yes**
REPAIR Circuit 53 (BK/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
INSTALL a new interior lamp relay. CLEAR the DTCs. TEST the system for normal operation.

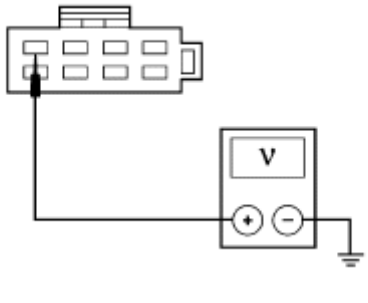
B17 CHECK THE VOLTAGE INPUT TO THE DIMMER MODULE — CIRCUIT 705 (LG/OG)

1

Dimmer Module C219

2

3



3 Measure the voltage between dimmer module C219-1, Circuit 705 (LG/OG), and ground.

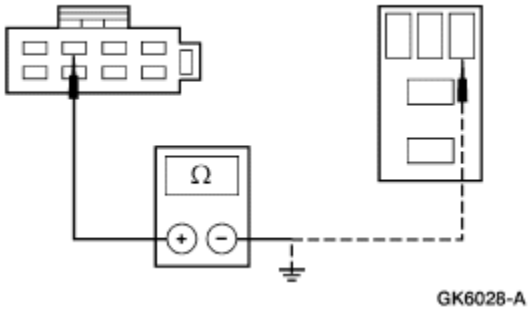
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B18 .

→ **No**
GO to B19 .

B18 CHECK CIRCUIT 402 (OG/LG) FOR OPEN AND SHORT TO GROUND

1



1 Measure the resistance between dimmer module C219-2, Circuit 402 (OG/LG), and interior lamp relay connector Pin 1, Circuit 402 (OG/LG); and between dimmer module C219-2, Circuit 402 (OG/LG), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the dimmer module connector and ground?**

→ **Yes**
INSTALL a new dimmer module. CLEAR the DTCs. TEST the system for normal operation.

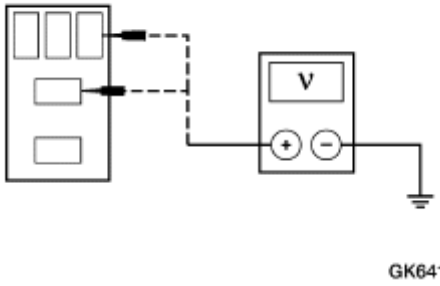
→ **No**
REPAIR Circuit 402 (OG/LG). CLEAR the DTCs. TEST the system for normal operation.

B19 CHECK THE VOLTAGE TO THE BATTERY SAVER RELAY — CIRCUIT 792 (TN/YE)

1

Battery Saver Relay

2

 GK6416-A	2 Measure the voltage between battery saver relay connector Pin 1, Circuit 792 (TN/YE), and ground; and between battery saver relay connector Pin 5, Circuit 792 (TN/YE), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to B20 . → **No** CHECK Fuse 26 (10A). If Fuse 26 (10A) is OK, REPAIR Circuit 792 (TN/YE). If Fuse 26 (10A) is not OK, REPLACE Fuse 26 (10A). CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
B20 CHECK THE BATTERY SAVER RELAY	
	1 Check the battery saver relay; refer to Wiring Diagrams cell 149. • **Is the battery saver relay OK?** → **Yes** REPAIR Circuit 705 (LG/OG). CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new battery saver relay. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST C: THE COURTESY LAMPS DO NOT TURN ON WITH ONE DOOR OPEN

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE GEM/CTM DOOR AJAR PIDS	
1 2	

Diagnostic Tool

3

3 Monitor the following GEM/CTM PIDs:

- P_DR_SW while opening and closing the RF door.
- RRDR_SW while opening and closing the RR door.
- LRDR_SW while opening and closing the LR door.
- D_DR_SW while opening and closing the LF door.

- **Do the GEM/CTM PID values indicate AJAR when the door is open and CLOSED when the door is closed?**

→ **Yes**
INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

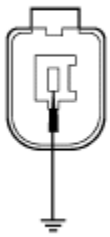
→ **No**
GO to C2 .

C2 CHECK THE INOPERATIVE DOOR AJAR SWITCH

1

Inoperative Door Ajar Switch

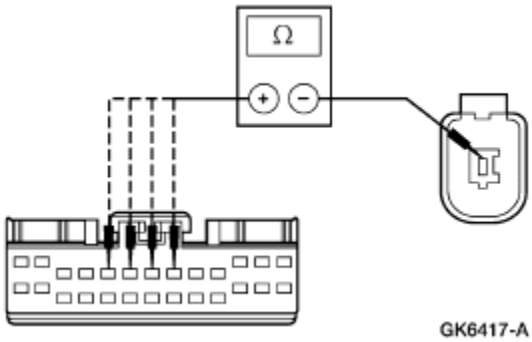
2



GK0092-A

2 Connect a jumper wire between the inoperative door ajar switch connector and ground.

	Door Ajar Switch	Circuit
Driver	C512	765 (YE/BK)
Passenger	C612	761 (GY/RD)
LR	C712	759 (LG/YE)
RR	C812	760 (PK/LB)

	• **Do the courtesy lamps illuminate?** → **Yes** INSTALL a new door ajar switch in question; REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C3 .
C3 CHECK THE CIRCUIT BETWEEN THE INOPERATIVE DOOR AJAR SWITCH AND THE GEM/CTM	
1 GEM/CTM C280 2  	2 Measure the resistance between inoperative door ajar switch and GEM/CTM C280. **Inoperative Door Ajar Switch** / **GEM** / **Circuit** Driver: C512 / C280-8 / 765 (YE/BK) Passenger: C612 / C280-7 / 761 (GY/RD) LR: C712 / C280-5 / 759 (LG/YE) RR: C812 / C280-6 / 760 (PK/LB) • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: THE COURTESY LAMPS STAY ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	

1 2 NGS 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to D2 . → **No** REFER to Section 211-05 .
D2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1322, GO to D4 . If DTC B1330, GO to D6 . If DTC B1334, GO to D8 . If DTC B1338, GO to D10 . If DTC B1371, GO to D14 . If DTC B1574, GO to D12 . If DTC B1610, GO to D17 . → **No** GO to D3 .

D3 CHECK ALL DOOR AND DECKLID AJAR PID'S

1. Make sure every door and decklid is closed.
2. Monitor the following GEM/CTM PID's
   - D_DR_SW
   - P_DR_SW
   - LRDR_SW
   - RRDR_SW
   - LGATESW
3. View the PID's and record readings
   - **Does any GEM/CTM PID indicate AJAR?**

→ **Yes**
If D_DR_SW is ajar, GO to D4.

If P_DR_SW is ajar,GO to D6.

If LRDR_SW is ajar,GO to D12.

If RRDR_SW is ajar,GO to D10.

If LGATESW is ajar,GO to D8.

→ **No**
GO to D14.

D4 CHECK THE DRIVER DOOR AJAR SWITCH — MONITOR THE GEM/CTM PID D_DR_SW

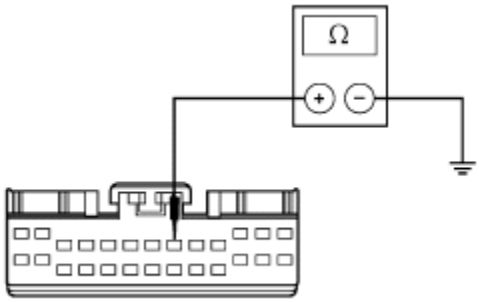
1.
2.

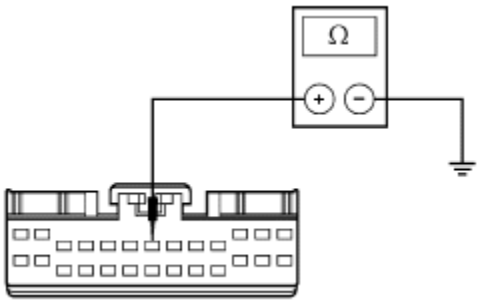
Driver Door Ajar Switch C512

3.
3. Monitor the GEM/CTM PID D_DR_SW.
   - **Does the GEM/CTM PID D_DR_SW indicate AJAR?**

→ **Yes**
GO to D5.

→ **No**
INSTALL a new driver door ajar switch; REFER

	to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.
D5 CHECK CIRCUIT 765 (YE/BK) FOR SHORT TO GROUND	
1 GEM/CTM C280	
2  GK6418-A	2 Measure the resistance between GEM/CTM C280-8, Circuit 765 (YE/BK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new GEM/CTM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 765 (YE/BK). CLEAR the DTCs. TEST the system for normal operation.
D6 CHECK THE PASSENGER DOOR AJAR SWITCH — MONITOR THE GEM/CTM PID P_DR_SW	
1 	
2 Passenger Door Ajar Switch C612	
3 	3 Monitor the GEM/CTM PID P_DR_SW. • **Does the GEM/CTM PID P_DR_SW**

	indicate AJAR? → **Yes** GO to D7 . → **No** INSTALL a new passenger door ajar switch; REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.
D7 CHECK CIRCUIT 761 (GY/RD) FOR SHORT TO GROUND	
1 GEM/CTM C280 2  GK6419-A	2 Measure the resistance between GEM/CTM C280-7, Circuit 761 (GY/RD), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new GEM/CT. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 761 (GY/RD). CLEAR the DTCs. TEST the system for normal operation.
D8 CHECK THE LIFTGATE WARNING SWITCH(S) — MONITOR THE GEM/CTM PID LGATESW	
1 2 LH Liftgate Ajar Switch C438	

3

RH Liftgate Ajar Switch C439

4

Liftgate Wiper Disable Switch C419

5

5 Monitor the GEM/CTM PID LGATESW.

- **Does the GEM/CTM PID LGATESW indicate AJAR?**

→ **Yes**
GO to D9 .

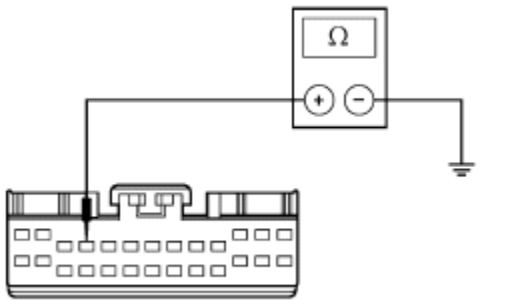
→ **No**
GO to D20 .

D9 CHECK CIRCUIT 700 (WH/VT) FOR SHORT TO GROUND

1

GEM/CTM C280

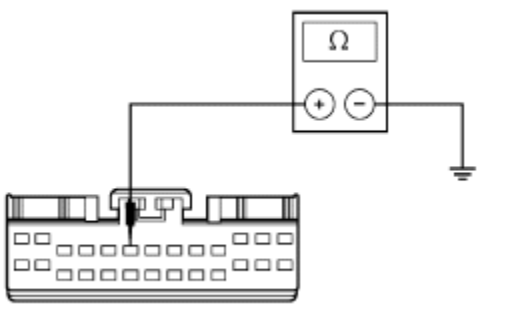
2



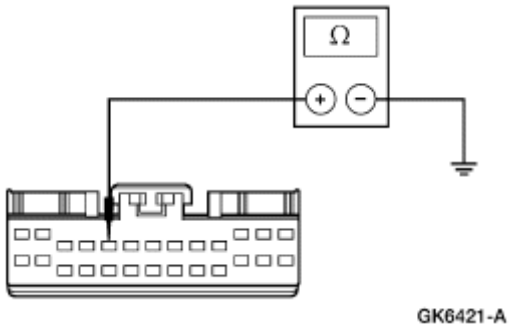
2 Measure the resistance between GEM/CTM C280-4, Circuit 700 (WH/VT), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new GEM/CTM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** REPAIR Circuit 700 (WH/VT). CLEAR the DTCs. TEST the system for normal operation.
D10 CHECK THE RR DOOR AJAR SWITCH — MONITOR THE GEM/CTM PID RRDR_SW	
1 2 RR Door Ajar C812 3 	3 Monitor the GEM/CTM PID RRDR_SW. • **Does the GEM/CTM PID RRDR_SW indicate AJAR?** → **Yes** GO to D11 . → **No** INSTALL a new RR door ajar switch. REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.
D11 CHECK CIRCUIT 760 (PK/LB) FOR SHORT TO GROUND	
1 GEM/CTM C280 2  GK6420-A	2 Measure the resistance between GEM/CTM C280-6, Circuit 760 (PK/LB), and ground. • **Is the resistance greater than 10,000**

	ohms? → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 760 (PK/LB). CLEAR the DTCs. TEST the system for normal operation.
D12 CHECK THE LR DOOR AJAR SWITCH — MONITOR THE GEM/CTM PID LRDR_SW	
1 2 LR Door Ajar Switch C712 3 	3 Monitor the GEM/CTM PID LRDR_SW. • **Does the GEM/CTM PID LRDR_SW indicate AJAR?** → **Yes** GO to D13 . → **No** INSTALL a new LR door ajar switch; REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.
D13 CHECK CIRCUIT 759 (LG/YE) FOR SHORT TO GROUND	
1 GEM/CTM C280 2	2 Measure the resistance between GEM/CTM C280-5, Circuit 759 (LG/YE), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new GEM/CTM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR Circuit 759 (LG/YE). CLEAR the DTCs. TEST the system for normal operation.

D14 CHECK THE INTERIOR LAMP RELAY

1

2

Interior Lamp Relay

3 Check the interior lamp relay. Refer to Wiring Diagrams Cell 149.

- **Is the interior lamp relay OK?**

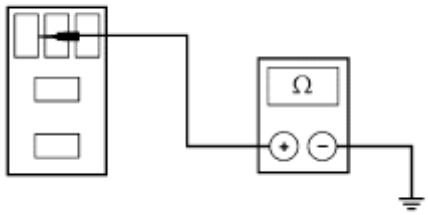
→ **Yes**
GO to D15 .

→ **No**
INSTALL a new interior lamp relay. CLEAR the DTCs. TEST the system for normal operation.

D15 CHECK FOR A FAULTY GEM

1

1 Measure the resistance between interior lamp relay Pin 2, Circuit 1008 (LG/OG), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to D17 .

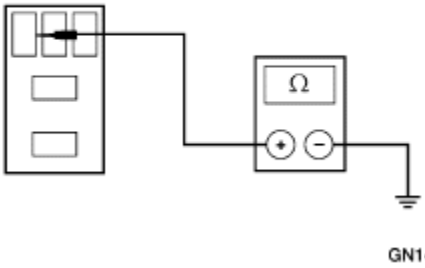
→ **No**
GO to D16 .

D16 CHECK CIRCUIT 1008 (LG/OG) FOR SHORT TO GROUND

1

GEM/CTM C283

2



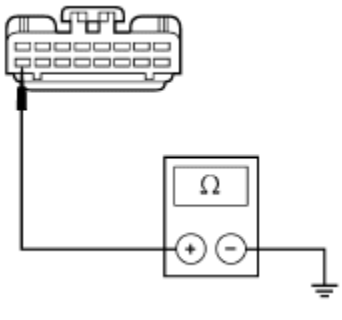
2 Measure the resistance between interior lamp relay connector Pin 2, Circuit 1008 (LG/OG), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new GEM/CTM. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR Circuit 1008 (LG/OG). CLEAR the DTCs. TEST the system for normal operation.

D17 CHECK THE RAP MODULE FOR SHORT TO GROUND

1 2 RAP Module C338	• **Do the courtesy lamps turn off?** → **Yes** INSTALL a new RAP module. REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D18 .
D18 CHECK CIRCUIT 1013 (BN/LG) FOR SHORT TO GROUND	
1 GEM/CTM C281 2  GK6035-A	2 Measure the resistance between GEM/CTM C281-9, Circuit 1013 (BN/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to D19 . → **No** REPAIR Circuit 1013 (BN/LG). CLEAR the DTCs. With the ignition switch in the OFF position or the key out of the ignition, TEST the system for normal operation.
D19 CHECK THE DIMMER MODULE	

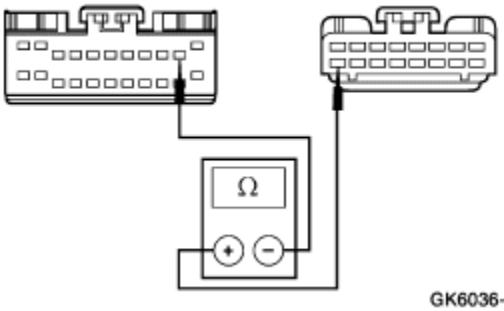
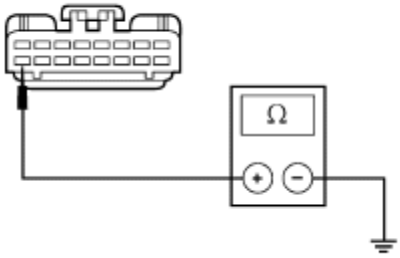
1 Dimmer Module C219	• **Do the courtesy lamps turn off?** → **Yes** INSTALL a new dimmer module. REFER to Section 413-00 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 53 (BK/LB). CLEAR the DTCs. TEST the system for normal operation.
D20 CHECK THE LIFTGATE WIPER DISABLE SWITCH — MONITOR THE GEM/CTM PID LGATESW	
1 Liftgate Wiper Disable Switch C419 2 	2 Monitor the GEM/CTM PID LGATESW. • **Does the GEM/CTM PID LGATESW indicate AJAR?** → **Yes** INSTALL a new liftgate wiper disable switch. REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D21 .
D21 CHECK THE LH LIFTGATE DOOR AJAR SWITCH — MONITOR THE GEM/CTM PID LGATESW	
1 LH Liftgate Ajar Switch C438 2	2 Monitor the GEM/CTM PID LGATESW.

	• **Does the GEM/CTM PID LGATESW indicate AJAR?** → **Yes** INSTALL a new LH liftgate ajar switch. REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation. → **No** INSTALL a new RH liftgate ajar switch. REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST E: THE ILLUMINATED ENTRY IS INOPERATIVE WHEN USING THE REMOTE TRANSMITTER

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Diagnostic Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to E2 . → **No** GO to Pinpoint Test C .
E2 MEASURE GEM ILLUMINATED ENTRY INPUT VOLTAGE	

1 2 GEM C281 3 Diagnostic Tool 4	3 Do not disconnect scan tool power supply. Disconnect scan tool from the DLC only. 4 Digital Measurement, Voltmeter, Auto Range, REC. 5 **NOTE:** Do not disconnect the RAP module. Use scan tool to capture the RAP module illuminated entry request voltage between GEM C281-9, Circuit 1013 (BN/LG), and ground, while pressing the UNLOCK button on the keyless entry remote transmitter. • **Was the MIN voltage captured when the pulse was transmitted less than 1.3 volts?** → **Yes** GO to E3 . → **No** CLEAR MIN voltage and REPEAT E2 to confirm high voltage. If the voltage is still high, INSTALL a new RAP module; REFER to Section 419-10 . TEST the system for normal operation.
E3 MEASURE GEM ILLUMINATED ENTRY PULSE WIDTHS	
1	1 Digital Measurement, Pulse Width Meter, Low Level. 2 Press the unlock button on the keyless entry remote transmitter. • **Is the PULSE WIDTH captured between**

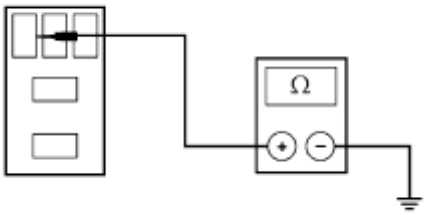
	190 and 210 m? → **Yes** GO to E4 . → **No** INSTALL a new RAP module; REFER to Section 419-10 . TEST the system for normal operation.
E4 CHECK GEM/CTM ILLUMINATED ENTRY REQUEST CIRCUIT 1013 (BN/LG) FOR OPEN AND SHORT TO GROUND	
1 RAP C338	
2  GK6036-A	2 Measure the resistance between GEM C281-9, Circuit 1013 (BN/LG), and RAP module C338-10, Circuit 1013 (BN/LG).
3  GK6128-A	3 Measure the resistance between GEM C281-9, Circuit 1013 (BN/LG), and ground. • **Is the resistance less than 5 ohms between GEM and RAP module, and greater than 10,000 ohms between the GEM and ground?** → **Yes** INSTALL a new GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 1013 (BN/LG). TEST the

	system for normal operation.

PINPOINT TEST F: THE BATTERY SAVER DOES NOT DEACTIVATE AFTER TIMEOUT

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Diagnostic Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to F2 . → **No** GO to Pinpoint Test D .
F2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM On-Demand Self-Test	1 Retrieve and document continuous DTCs.

	• **Are any DTCs recorded?** → **Yes** If DTC B1342, INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. For any other DTCs refer to the DTC Chart. → **No** GO to F3 .
F3 CHECK THE BATTERY SAVER RELAY	
1 2 Battery Saver Relay	3 Check the battery saver relay; refer to Wiring Diagrams cell 149. • **Is the battery saver relay OK?** → **Yes** GO to F4 . → **No** INSTALL a new battery saver relay. TEST the system for normal operation.
F4 CHECK CIRCUIT 1005 (VT/OG) FOR SHORT TO GROUND	
1 GEM/CTM C283 2	2 Measure the resistance between battery saver relay connector Pin 2, Circuit 1005 (VT/OG), and ground.



GN1455-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to F5 .

→ **No**
REPAIR Circuit 1005 (VT/OG). TEST the system for normal operation.

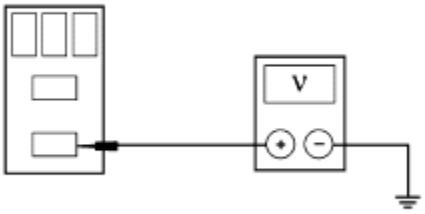
F5 CHECK CIRCUIT 705 (LG/OG) FOR SHORT TO POWER

1

Dimmer Module C219

2

3 Measure the voltage between battery saver relay connector Pin 3, Circuit 705 (LG/OG), and ground.



GN1456-A

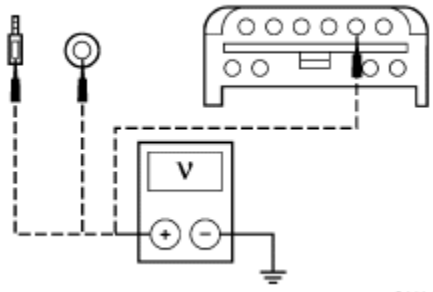
- **Is any voltage indicated?**

→ **Yes**
REPAIR Circuit 705 (LG/OG). TEST the system for normal operation.

→ **No**

	INSTALL a new GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.

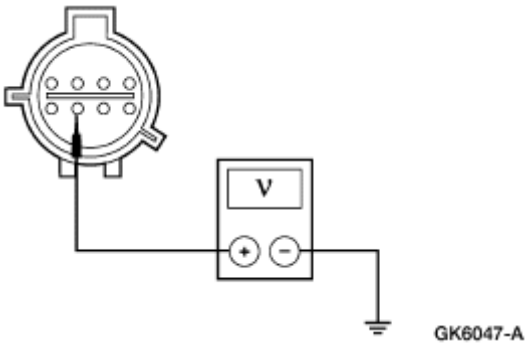
PINPOINT TEST G: AN INDIVIDUAL DEMAND LIGHTING LAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE DEMAND LIGHTING FOR PROPER OPERATION	
	1 **NOTE:** The battery saver relay must be activated on and the panel dimmer switch must be in the normal (mid-range) position. Activate all demand lights to the ON position. • **Do all demand lights operate properly?** → **Yes** System is OK. → **No** GO to G2 .
G2 CHECK VOLTAGE TO THE INOPERATIVE LAMP — CIRCUIT 705 (LG/OG)	
1 2 Inoperative Lamp 3  GK6037-A	2 Disconnect the inoperative lamp (driver vanity mirror C304, passenger vanity mirror C303, front map lamp C305, rear map lamp C367 or compass/outside air temperature module C342 [if equipped]). 3 Measure the voltage between the inoperative demand lighting lamp connector Pin, Circuit 705 (LG/OG), and ground. • **Is the voltage greater than 10 volts?** → **Yes**

	If the compass/outside air temperature module courtesy lamp is inoperative, REFER to Section 419-11 . If any other lamp is inoperative, INSTALL a new lamp assembly. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 705 (LG/OG). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST H: AN INDIVIDUAL COURTESY LAMP IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE COURTESY LIGHTING FOR PROPER OPERATION	
	1 **NOTE:** The battery saver relay must be activated on and the panel dimmer switch must be in the normal (mid-range) position. Open the driver door to activate the courtesy lamps. • **Do all courtesy lamps illuminate?** → **Yes** System is OK. → **No** If the puddle lamps are inoperative, GO to H2 . If any other courtesy lamp is inoperative, GO to H4 .
H2 CHECK CIRCUIT 55 (BK/PK) FOR VOLTAGE	
1 2 Inoperative Power/Heated Mirror 3 4	4 **NOTE:** The battery saver relay must be activated on and the panel dimmer switch must be in the normal (mid-range) position.



Measure the voltage between driver power/heated mirror C509-7, Circuit 55 (BK/PK), and ground; or between passenger power/heated mirror C606-7, Circuit 55 (BK/PK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
CHECK the power/heated mirror for proper operation. If OK, INSTALL a new lamp assembly. If not OK, REFER to Section 501-09 .

→ **No**
GO to H3 .

H3 CHECK CIRCUIT 53 (BK/LB) FOR VOLTAGE

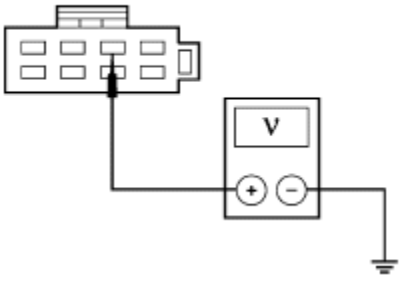
1

2

Dimmer Module C219

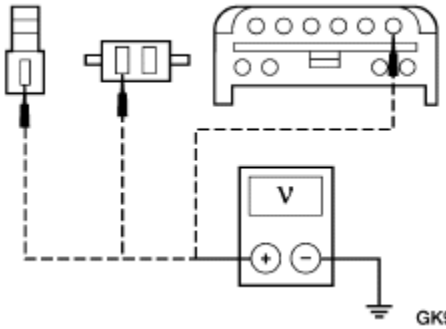
3

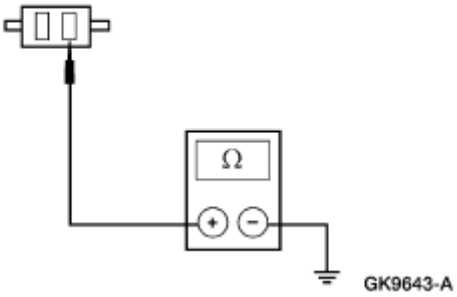
4



4 Measure the voltage between dimmer module C219-3, Circuit 53 (BK/LB), and ground.

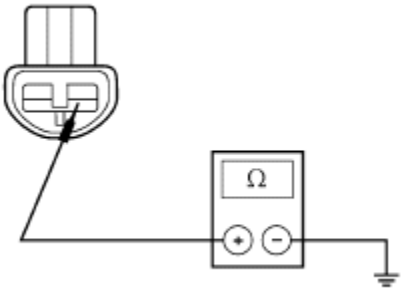
- **Is the voltage greater than 10 volts?**

	→ **Yes** INSTALL a new dimmer module. REFER to Section 413-00 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 53 (BK/LB). CLEAR the DTCs. TEST the system for normal operation.
H4 CHECK VOLTAGE TO THE INOPERATIVE COURTESY LAMP — CIRCUIT 53 (BK/LB)	
1 2 Inoperative Lamp 3  	2 Disconnect the inoperative lamp (driver door courtesy lamp C503, passenger door courtesy lamp C603, cargo lamp C319, compass/outside air temperature module C342 [if equipped], dome lamp C334 [if equipped], or rear dome lamp). 3 **NOTE:** The battery saver relay must be activated on and the panel dimmer switch must be in the normal (mid-range) position. Measure the voltage between the inoperative courtesy lamp connector Pin, Circuit 53 (BK/LB), and ground. • **Is the voltage greater than 10 volts?** → **Yes** If the front or rear dome courtesy lamp is inoperative, INSTALL a new lamp assembly. CLEAR the DTCs. TEST the system for normal operation. If the compass/outside air temperature module courtesy lamp is inoperative, REFER to Section 419-11 . If any other courtesy lamp is inoperative, GO to H5 . → **No** REPAIR Circuit 53 (BK/LB). CLEAR the DTCs. TEST the system for normal operation.
H5 CHECK CIRCUIT 57 (BK) FOR OPEN	
1	1 Measure the resistance between the inoperative courtesy lamp connector Pin, Circuit 57 (BK), and ground.

	• **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new inoperative lamp assembly. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST J: THE COURTESY LAMPS ARE INOPERATIVE — WHEN THE LIFTGATE IS OPEN

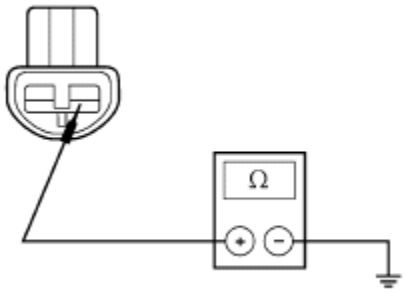
CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE GEM/CTM — MONITOR THE GEM/CTM PID LGATESW	
1 2 Diagnostic Tool 3 	3 Monitor the GEM/CTM PID LGATESW. 4 Open the liftgate. • **Does the GEM/CTM PID LGATESW indicate AJAR?** → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system

	for normal operation. → **No** GO to J2 .
J2 CHECK THE GROUNDS TO THE LIFTGATE AJAR SWITCHES FOR OPEN — CIRCUIT 57 (BK)	
1 2 LH Liftgate Ajar Switch C438 3 RH Liftgate Ajar Switch C439 4  GK3226-A	4 Measure the resistance between LH liftgate ajar switch C438, Circuit 57 (BK), and ground; and between RH liftgate ajar switch C439, Circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** GO to J3 . → **No** REPAIR Circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
J3 CHECK THE LH LIFTGATE AJAR SWITCH	
1	1 Connect a jumper wire between LH liftgate ajar switch C438, Circuit 700 (WH/VT), and ground.

 GK4357-A	• **Do the courtesy lamps illuminate?** → **Yes** INSTALL a new LH liftgate ajar switch. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to J4 .
J4 CHECK THE RH LIFTGATE AJAR SWITCH	
1 GK4357-A	1 Connect a jumper wire between RH liftgate ajar switch C439, Circuit 700 (WH/VT), and ground. • **Do the courtesy lamps illuminate?** → **Yes** INSTALL a new RH liftgate ajar switch. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 700 (WH/VT). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST K: THE COURTESY LAMPS ARE INOPERATIVE — WHEN THE LIFTGATE GLASS IS OPEN

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE GEM/CTM — MONITOR THE GEM/CTM PID LGATESW	

1 2 Diagnostic Tool 3 	3 Monitor the GEM/CTM PID LGATESW. 4 Open the liftgate glass. • **Does the GEM/CTM PID LGATESW indicate AJAR?** → **Yes** INSTALL a new GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to K2 .
K2 CHECK THE GROUND TO THE LIFTGATE WIPER DISABLE SWITCH — CIRCUIT 57 (BK)	
1 2 Liftgate Wiper Disable Switch C419 3  GK3226-A	3 Measure the resistance between liftgate wiper disable switch C419, Circuit 57 (BK), and ground.

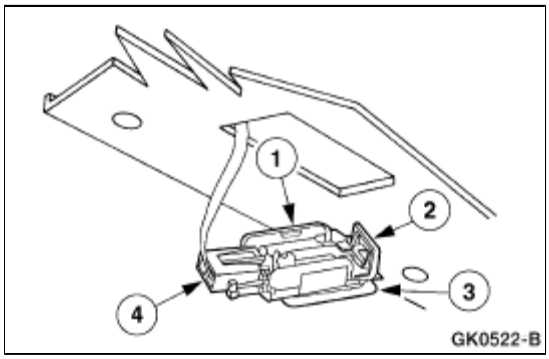
	• **Is the resistance less than 5 ohms?** → **Yes** GO to K3 . → **No** REPAIR Circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
K3 CHECK THE LIFTGATE WIPER DISABLE SWITCH	
1 GK4357-A	1 Connect a jumper wire between liftgate wiper disable switch C419, Circuit 700 (WH/VT), and ground. • **Do the courtesy lamps illuminate?** → **Yes** INSTALL a new liftgate wiper disable switch; REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit 700 (WH/VT). CLEAR the DTCs. TEST the system for normal operation.

Lamp Assembly —Rear Dome/Cargo

Removal

1. Disconnect the battery ground cable (14301).

2. Remove the lamp assembly.
    1. Use a thin bladed tool to carefully pry the lamp assembly to the left.
    2. Press the locking tab inward.
    3. Lower the lamp assembly.
    4. Disconnect electrical connector.



Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

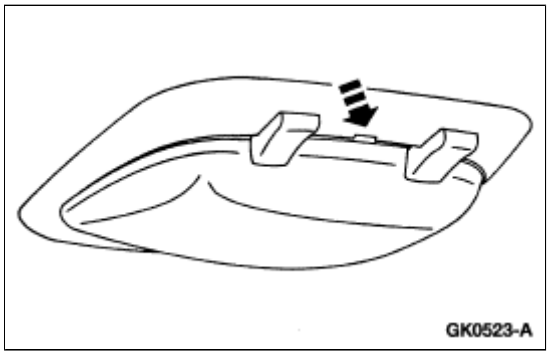
    To install, reverse the removal procedure.

Lamp Assembly —Front Dome/Map

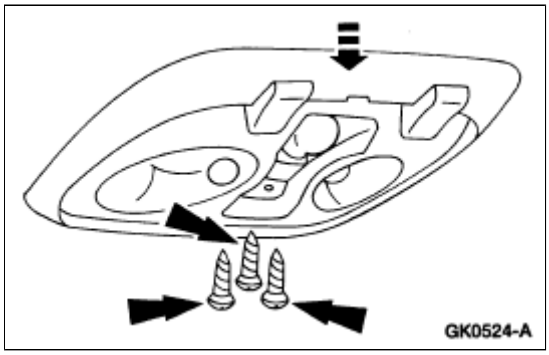
Removal

1. Disconnect the battery ground cable (14301).

2. Use a thin bladed tool to carefully pry the dome lamp lens out.
   - Replace the bulb if necessary.



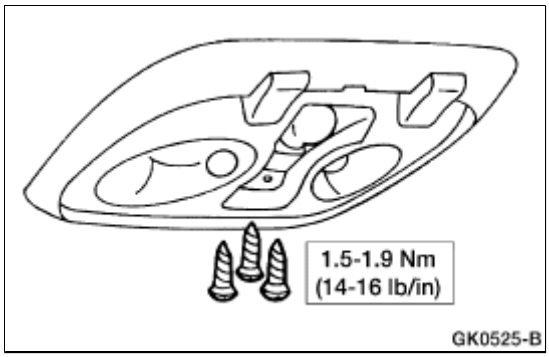
3. Remove the screws and lower the lamp assembly.



Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

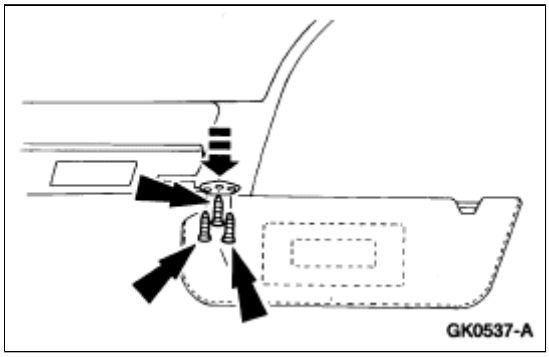

1.5-1.9 Nm
(14-16 lb/in)
GK0525-B

Lamp Assembly —Vanity Mirror/Sun Visor

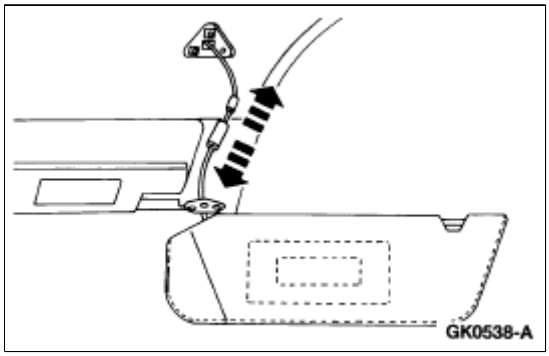
Removal

1. Disconnect the battery ground cable (14301).

2. Remove the sun visor.
   - Position the sun visor as necessary.
   - Remove the sun visor screws.



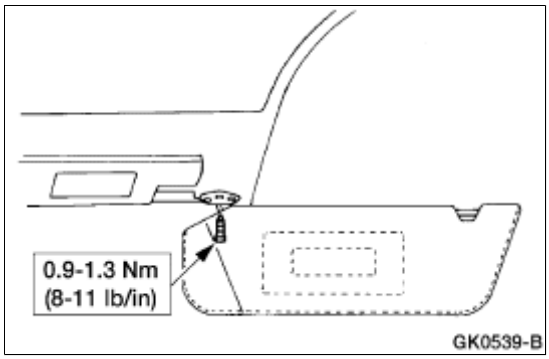
3. Lower the sun visor and disconnect the electrical connector.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

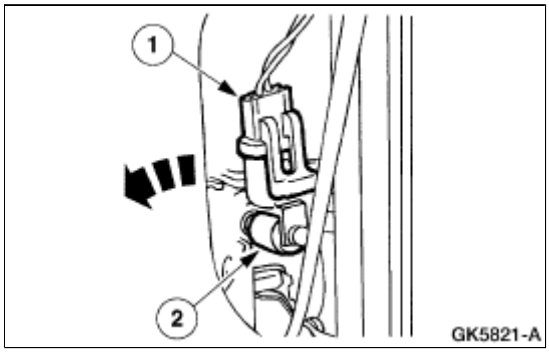

0.9-1.3 Nm
(8-11 lb/in)
GK0539-B

Switch —Interior Lamp (Door)

Removal

1. Remove the front door trim panel; refer to Section 501-05 .

2. Remove the interior lamp switch.
    1. Disconnect the interior lamp switch electrical connector.
    2. Remove the interior lamp switch.
        - Push inward; rotate counterclockwise.



Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Daytime running lamps control module bolts	3	27

Daytime Running Lamps (DRL)

The daytime running lamps (DRL) system consists of a DRL module that is located behind the front bumper and is mounted to the radiator support.

Daytime Running Lamps (DRL)

Refer to Wiring Diagrams Cell 97 , Daytime Running Lamps for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Principles of Operation

Daytime Running Lamps (DRL)

The daytime running lamps (DRL) system operates the low beam headlamps at a reduced intensity. The DRL module (15A270) supplies pulse width modulated (PWM) voltage, approximately 75%-92% of battery voltage, to the lowbeam headlamps when the following conditions are met:

- The parking brake control is released.
- The high beam headlamps are disabled.
- The ignition switch (11572) is in the RUN position.

The DRL module remains enabled when the low beam headlamps are turned on.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged DRL module • Damaged parking brake signal switch and bracket (15A851)	• Blown battery junction box (BJB) Mini-Fuse 4 (15A) • Damaged wiring harness • Loose or corroded connection • Damaged DRL module • Damaged parking brake signal switch and bracket

3. Verify the headlamps are operating correctly. Correct any concerns before proceeding to the next step. For additional information, refer to Section 417-01 .

4. Verify the parking brake control is fully released.

5. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

6. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

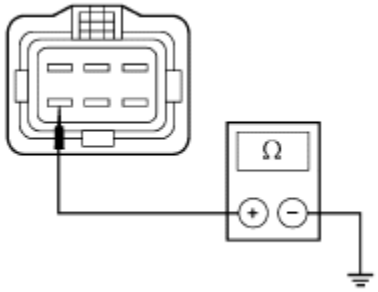
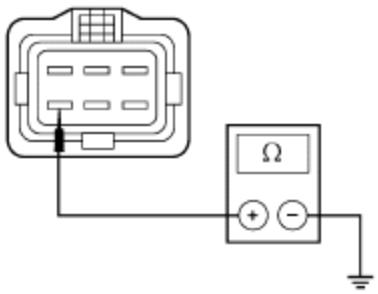
Symptom Chart

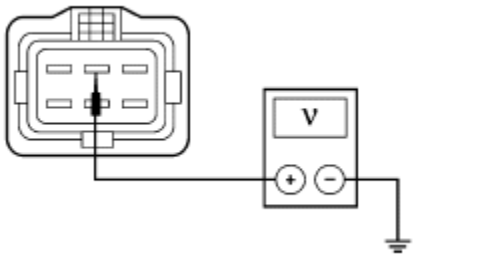
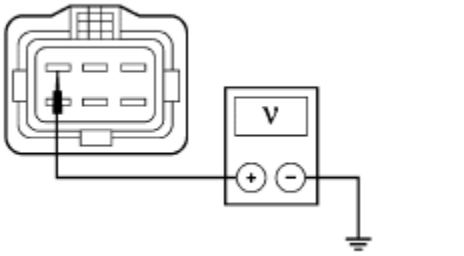
Condition	Possible Sources	Action
• The daytime running lamps are inoperative	• BJB Mini-Fuse 4 (15A). • Circuitry. • Parking brake signal switch and bracket. • DRL module.	• GO to Pinpoint Test A .
• The daytime running lamps are on with the parking brake set	• Circuitry. • Parking brake signal switch and bracket. • DRL module.	• GO to Pinpoint Test B .
• The daytime running lamps are on with the ignition switch off	• Circuitry. • Ignition switch. • DRL module.	• GO to Pinpoint Test C .
• The low beam headlamps are on at full intensity in DRL mode	• Circuitry. • Headlamp switch. • DRL module.	• GO to Pinpoint Test D .
• The low beam headlamps are on at reduced intensity with the headlamp switch on	• Circuitry. • Headlamp switch.	• REFER to Section 417-01 .

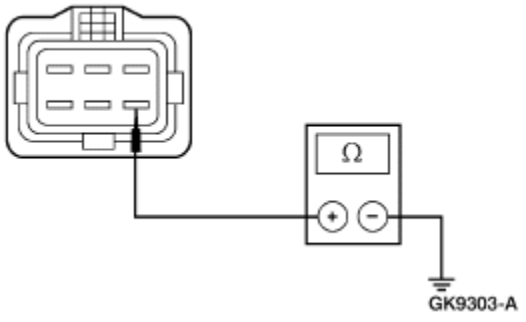
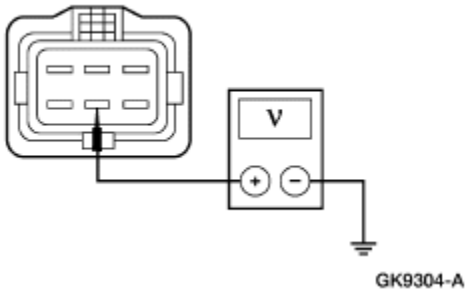
Pinpoint Tests

PINPOINT TEST A: THE DAYTIME RUNNING LAMPS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE PARKING BRAKE SWITCH SIGNAL CIRCUIT TO THE DRL MODULE FOR SHORT TO GROUND	
NOTE: Verify the parking brake control is fully released for this step.	
1	

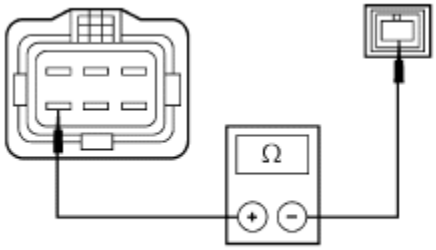
 2 DRL Module C134 3  GK9107-A	3 Measure the resistance between DRL module C134 Pin 6, Circuit 977 (VT/WH), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to A3 . → **No** GO to A2 .
A2 CHECK THE PARKING BRAKE SWITCH	
1 Parking Brake Switch C211 2  GK9107-A	2 Measure the resistance between DRL module C134 Pin 6, Circuit 977 (VT/WH), harness side and ground. • **Is the resistance greater than 10,000 ohms?**

	→ **Yes** INSTALL a new parking brake signal switch and bracket. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK VOLTAGE TO THE DRL MODULE	
1  GK9108-A	1 Measure the voltage between DRL module C134 Pin 2, Circuit 54 (LG/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A4 . → **No** REPAIR the circuit. TEST the system for normal operation.
A4 CHECK IGNITION SENSE INPUT	
1 	
2  GK9109-A	2 Measure the voltage between DRL module C134 Pin 3, Circuit 298 (VT/OG), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes**

	GO to A5 . → **No** REPAIR the circuit. TEST the system for normal operation.
A5 CHECK THE DRL MODULE GROUND — CIRCUIT 57 (BK)	
1  	1 Measure the resistance between DRL module C134 Pin 4, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to A6 . → **No** REPAIR the circuit. TEST the system for normal operation.
A6 CHECK THE HIGH BEAM DISABLE INPUT CIRCUIT FOR SHORT TO BATTERY — CIRCUIT 12 (LG/BK)	
1  	1 Measure the voltage between DRL module C134 Pin 5, Circuit 12 (LG/BK), harness side and ground. • **Is voltage indicated?** → **Yes** REPAIR the circuit. TEST the system for normal operation. → **No** INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation.

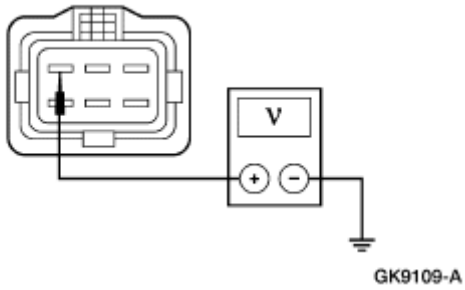
PINPOINT TEST B: THE DAYTIME RUNNING LAMPS ARE ON WITH THE PARKING BRAKE SET

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE PARKING BRAKE SWITCH	
1 2 Parking Brake Switch C211 3 GK9110-A 4 	3 Connect a 10A fused jumper wire between parking brake switch C211, Circuit 162 (LG/RD), harness side and ground. • **Do the DRL turn off?** → **Yes** INSTALL a new parking brake signal switch and bracket. TEST the system for normal operation. → **No** GO to B2 .
B2 CHECK THE PARKING BRAKE SWITCH SIGNAL CIRCUIT	
1 2	

 DRL Module C134 3  GK9111-A	3 Measure the resistance between parking brake switch C211, Circuit 162 (LG/RD), harness side and DRL module C134 Pin 6, Circuit 977 (VT/WH), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST C: THE DAYTIME RUNNING LAMPS ARE ON WITH THE IGNITION SWITCH OFF

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE IGNITION SWITCH INPUT TO THE DRL MODULE FOR VOLTAGE	
1 2 DRL Module C134 3	3 Measure the voltage between DRL module C134 Pin 3, Circuit 298 (VT/OG), harness side and ground.

	• **Is voltage indicated?** → **Yes** GO to C2 . → **No** INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation.
C2 CHECK THE IGNITION SWITCH	
	1 Check the ignition switch; refer to the Wiring Diagrams Cell 149. • **Is the ignition switch OK?** → **Yes** REPAIR Circuit 298 (VT/OG) for short to battery. TEST the system for normal operation. → **No** INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.

PINPOINT TEST D: THE LOW BEAM HEADLAMPS ARE ON AT FULL INTENSITY IN DRL MODE

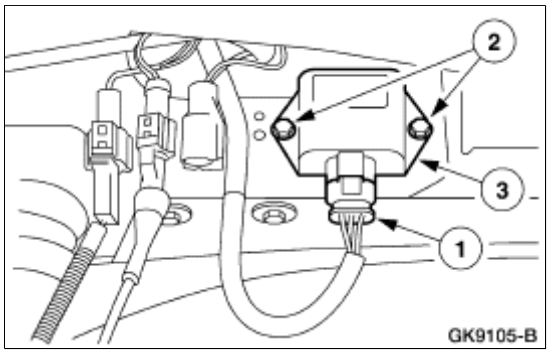
CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE LOW BEAM HEADLAMPS INPUT	
1 DRL Module C134	• **Are the low beam headlamps still on at full intensity?**

	→ **Yes** REFER to Section 417-01 . → **No** INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation.

Module —Daytime Running Lamps (DRL)

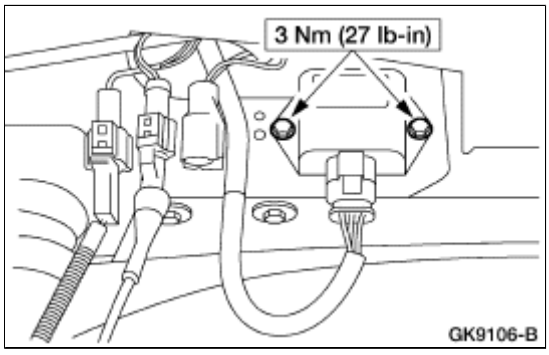
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the daytime running lamps (DRL) control module.
    1. Disconnect the electrical connector.
    2. Remove the bolts.
    3. Remove the DRL control module.



Installation

1. To install, reverse the removal procedure.

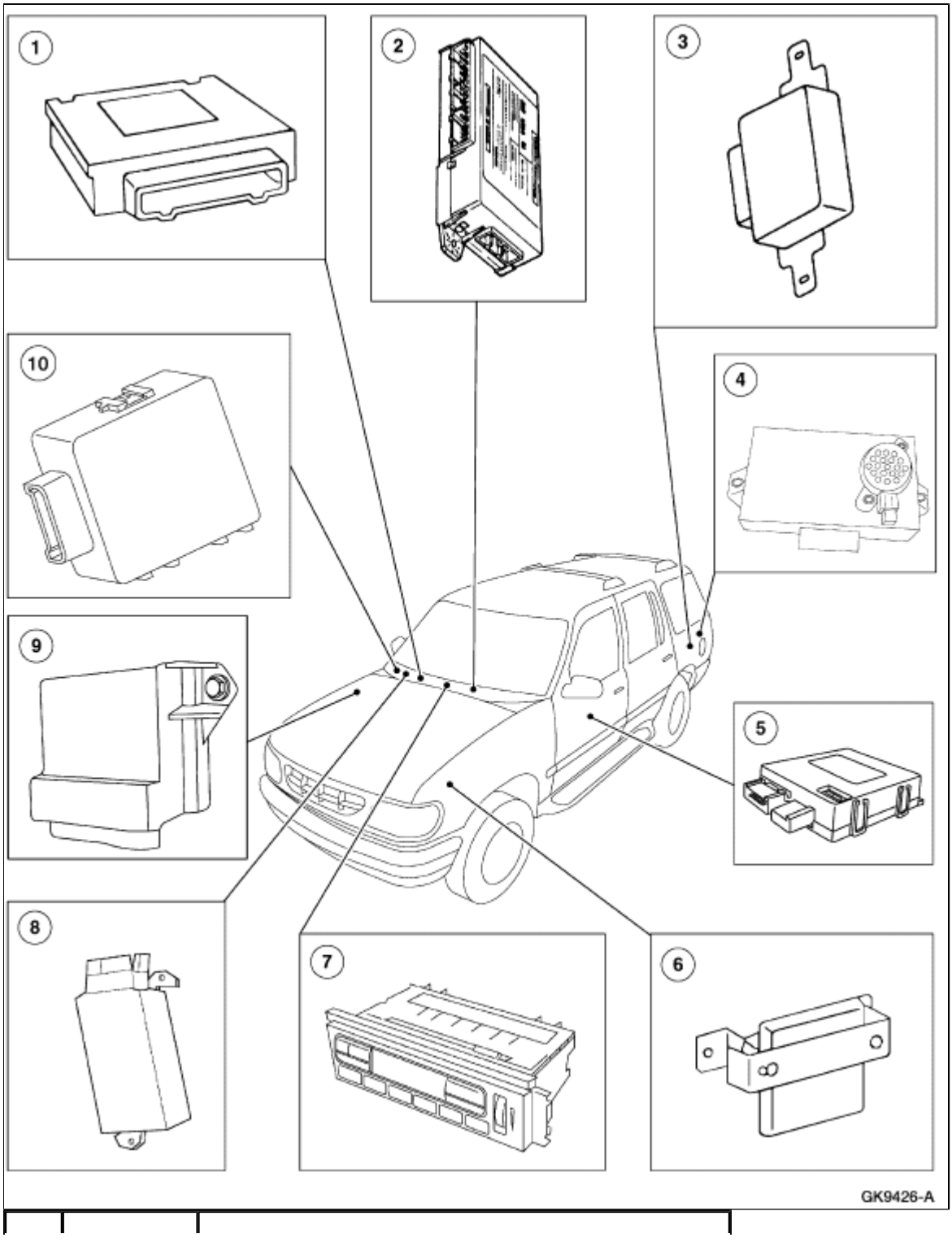


General Specifications

Item	Specification
Heat shrink tube overlap mm (inch)	12.7 (0.5)
Wire insulation removal length (twist side) mm (inch)	37.2 (1.5)
Wire insulation removal length (receiving side) mm (inch)	19.5 (0.75)
Raychem SCT® Heat Shrink Tubing, Motorcraft part number WT-5627	ESB-M99D56-A2

Communications Network

Module Communication Network Components



Item	Part Number	Description
1	12A650	Powertrain control module (PCM)
2	14B205	Generic electronic module (GEM)/central timer module (CTM)
3	15K600	Remote anti-theft personality (RAP) module
4	—	Parking aid module (PAM)
5	—	Driver seat module (DSM)
6	2C018	4-Wheel anti-lock brake control module
7	19880	Electronic automatic temperature control (EATC) module
8	5A919	Air suspension control module
9	—	Restraint control module (RCM)
10	—	Passive anti-theft system (PATS) module

The vehicle has two separate module communication networks. The standard corporate protocol (SCP) which is an unshielded twisted pair cable (data bus plus, circuit 914 [T/O] and data bus minus, circuit 915 [P/LB]) and the International Standards Organization (ISO) 9141 Network via a single wire (circuit 70 [LB/W]). Both networks can be connected to scan tool at one connector called the data link connector (DLC). This makes troubleshooting these systems easier by allowing one smart tester to be able to diagnose and control any module on the two networks from one connector. The DLC can be found under the instrument panel between the steering column and the radio.

The ISO 9141 communication network does not permit inter-module communication. When the scan tool communicates to modules on the ISO 9141 communication network, the scan tool must ask for all information; the modules cannot initiate communications.

The SCP will remain operational even with the severing of one of the bus wires. Communications will also continue if one of the bus wires is shorted to ground or battery positive voltage (B+) or a termination resistor is lost. This faulted condition is detected and reported to the host by the module's network bus interface circuits.

Unlike the SCP, the ISO 9141 communication network will not function if the wire is shorted to ground or battery positive voltage (B+). Also, if one of the modules on the ISO 9141 communication network loses power or shorts internally, communications to that module will fail.

There are three modules linked to the SCP communication network and seven modules linked to the ISO 9141 communication network.

SCP Communication Network

The powertrain control module (PCM) (12A650) is on the SCP communication network. The PCM controls the engine for better fuel economy, emissions control and failure mode detection and storage. For additional information, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3 for diagnosis and testing.

The passive anti-theft system (PATS) module is on the SCP communication network. The PATS module contains circuitry to connect the vehicle electrical system, the transceiver module, the vehicle module communications network and the vehicle theft indicator located in the instrument cluster (10849). The PATS

module uses a microprocessor to control the system functions. The PATS module microprocessor stores the ignition key codes in non-volatile memory. The PATS module can be diagnosed through the data link connector. For additional information, refer to Section 419-01 .

The electronic automatic temperature control (EATC) module is linked to the SCP communication network. The EATC module controls automatic climate functions that maintain the interior at a constant temperature setting. For additional information, refer to Section 412-00 .

ISO 9141 Communication Network

The restraint control module (RCM) module is on the ISO 9141 communication network. The RCM controls the deployment of the air bags based on sensor input. For additional information, refer to Section 501-20B .

The parking aid module (PAM) is on the ISO 9141 communication network. The PAM controls the parking aid system For additional information, refer to Section 413-13 .

The generic electronic module (GEM)/central timer module (CTM) is on the ISO 9141 communication network. The GEM is equipped on vehicles with four-wheel drive or vehicles with power windows. The CTM is equipped on vehicles with two-wheel drive or vehicles without power windows. The GEM controls a variety of systems:

- 4x4
- Windshield wipers
- Courtesy lamps
- One touch down power windows, etc
- Warning chimes/lamps

For additional information, refer to Section 419-10 .

The remote anti-theft personality (RAP) module is on the ISO 9141 communication network. The RAP module controls the keyless remote entry and active anti-theft of the vehicle. For additional information, refer to Section 501-14B and Section 419-01 .

The 4-wheel anti-lock brake control module is on the ISO 9141 communication network. The 4-wheel anti-lock brake control module controls the brake pressure to the four wheels to keep the vehicle under control while braking. For additional information, refer to Section 206-09 .

The air suspension system is a computer controlled suspension system. The rear shock absorber contains an integrated air spring. The rear air springs provide automatic load leveling and a ride adjustment with a total span of 50 mm (2 in).

The air suspension control module programming has a time delay compensation for normal suspension travel over rough roads so the air suspension system will not attempt to continuously adjust vehicle ride height.

There is one height sensor mounted in the rear of the vehicle. The height sensors have a total travel range of 80 mm (3 in). For additional information, refer to Section 204-05 .

The driver seat module (DSM) is connected on the SCP communication network. The DSM controls the power seat and memory functions. For additional information, refer to Section 501-10 .

Communications Network

Refer to Wiring Diagrams Cell 14 , Multiplex Communication Network for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Central junction box (CJB) Fuse 5 (10A) • Damaged wiring harness • Loose or corroded connectors • 4-wheel anti-lock brake control module • Restraint control module (RCM) • Generic electronic module (GEM)/central timer module (CTM) • Powertrain control module (PCM) • Parking aid module (PAM) (optional) • Remote anti-theft personality (RAP) module (optional) • Air suspension control module (optional) • Passive anti-theft system (PATS) module • Driver seat module (DSM) (optional) • Electronic automatic temperature control (EATC) module (optional)

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If

the scan tool does not communicate with the vehicle:

- check that the program card is properly installed.
- check the connections to the vehicle.
- check the ignition switch position is in RUN.

If the scan tool still does not communicate with the vehicle, go to Pinpoint Test M.

4. Go to Pinpoint Test PC.

System Precheck

PINPOINT TEST PC: DATA LINK DIAGNOSTICS NETWORK TEST

CONDITIONS	DETAILS/RESULTS/ACTIONS
PC1 DATA LINK DIAGNOSTICS NETWORK TEST	
1	2 Run the Data Link Diagnostics Network Test. • **Is SYSTEM PASSED obtained?** → **Yes** Test PASSED. RETURN to the Symptom Chart of the section for the module in question. → **No** If no response from the scan tool, GO to Pinpoint Test M . If CKT70, CKT914, or CKT915 = SOME ECUS NO RESP/NOT EQUIP, REFER to the Symptom Chart. If CKT70 = ALL ECUS NO RESP/NOT EQUIP, GO to Pinpoint Test K. If CKT914 = ALL ECUS NO RESP/NOT EQUIP, GO to Pinpoint Test L . If CKT915 = ALL ECUS NO RESP/NOT EQUIP, GO to Pinpoint Test L . If module in question is NO RESPONSE/NOT EQUIPPED, REFER to the Symptom Chart. If module in question is NO RESPONSE ON CKT914 (BUS+) or NO RESPONSE ON CKT915 (BUS-), REFER to Symptom Chart.

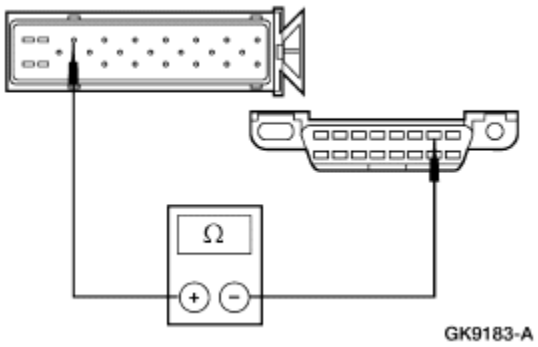
Symptom Chart

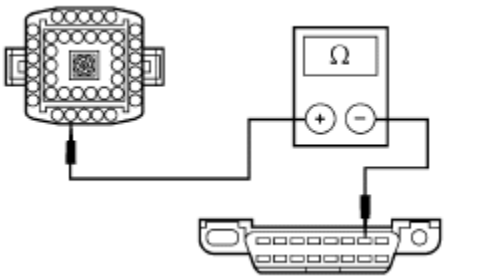
Symptom Chart

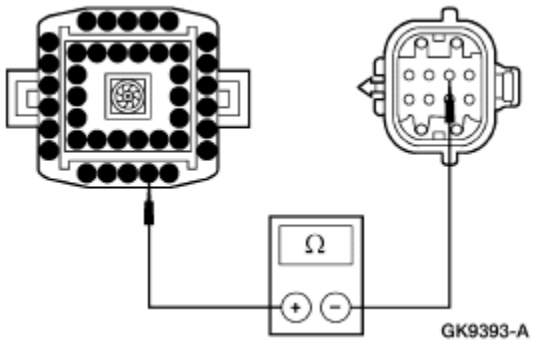
Condition	Possible Sources	Action
• The module does not respond to the scan tool — 4-wheel anti-lock brake control module	• Circuit or connection in International Standards Organization (ISO) 9141 network. • 4-wheel anti-lock brake control module.	• GO to Pinpoint Test A .
• The module does not respond to the scan tool — generic electronic module (GEM)/central timer module (CTM)	• Circuit or connection in ISO 9141 network. • GEM/CTM.	• GO to Pinpoint Test B .
• The module does not respond to the scan tool — restraint control module (RCM)	• Circuit or connection in ISO 9141 network. • RCM.	• GO to Pinpoint Test C .
• The module does not respond to the scan tool — remote anti-theft personality (RAP) module	• Circuit or connection in ISO 9141 network. • RAP module (optional).	• GO to Pinpoint Test D .
• The module does not respond to the scan tool — powertrain control module (PCM)	• Circuit or connection in Standard Corporate Protocol (SCP) network. • PCM.	• GO to Pinpoint Test E .
• The module does not respond to the scan tool — air suspension control module	• Circuit or connection in ISO 9141 network. • Air suspension control module (optional).	• GO to Pinpoint Test F .
• The module does not respond to the scan tool — electronic automatic temperature control (EATC) module	• Circuit or connection in SCP network. • EATC module (optional).	• GO to Pinpoint Test G .
• The module does not respond to the scan tool — driver seat module (DSM)	• Circuit or connection in ISO 9141 network. • DSM (optional).	• GO to Pinpoint Test H .
• The module does not respond to the scan tool — parking aid module (PAM)	• Circuit or connection in ISO 9141 network. • PAM (optional).	• GO to Pinpoint Test I .
• The module does not respond to the scan tool — passive anti-theft system (PATS) module	• Circuit or connection in SCP network. • PATS module.	• GO to Pinpoint Test J .
• No module/network communication — ISO 9141 network	• Circuit or connection in ISO 9141 network. • ISO 9141 networked modules.	• GO to Pinpoint Test K .
• No module/network communication — SCP network	• Circuit or connection in SCP network. • SCP networked modules.	• GO to Pinpoint Test L .
• No module/network communication — no power to the scan tool	• DLC. • CJB Fuse 5 (10A). • Circuitry. • Scan tool.	• GO to Pinpoint Test M .

Pinpoint Tests

PINPOINT TEST A: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — 4-WHEEL ANTI-LOCK BRAKE CONTROL MODULE

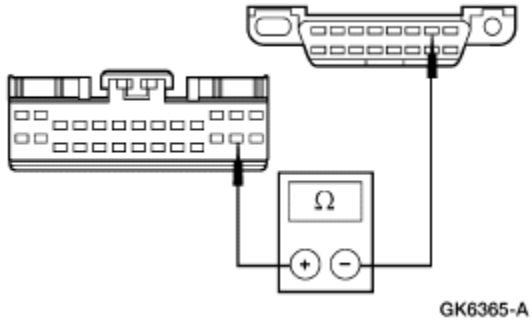
CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK CIRCUIT 70 (LB/WH) AT 4-WHEEL ANTI-LOCK BRAKE CONTROL MODULE C186-23 FOR DAMAGE	
1 2 4-Wheel Anti-Lock Brake Control Module C186	3 Inspect 4-wheel anti-lock brake control module C186 for damage. • **Is the 4-wheel anti-lock brake control module C186 OK?** → **Yes** GO to A2 . → **No** REPAIR the 4-wheel anti-lock brake control module C186. TEST the system for normal operation.
A2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291 AND 4-WHEEL ANTI-LOCK BRAKE CONTROL MODULE C186 FOR OPEN	
1  GK9183-A	1 Measure the resistance between 4-wheel anti-lock brake control module C186-23, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new 4-wheel anti-lock brake control module. For additional information, REFER to

	Section 206-09 . TEST the system for normal operation. → **No** GO to A3 .
A3 CHECK IN-LINE C148 FOR DAMAGE	
1 In-Line C148	2 Inspect in-line C148M and C148F for damage. • **Is the in-line C148M and C148F OK?** → **Yes** GO to A4 . → **No** REPAIR the damaged in-line C148. TEST the system for normal operation.
A4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C148F and DLC C291 FOR OPEN	
1  GK6363-A	1 Measure the resistance between in-line C148F-16, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** GO to A5 . → **No** REPAIR circuit 70 (LB/WH) between DLC C291 and in-line C148F. TEST the system for normal operation.
A5 CHECK IN-LINE C140 FOR DAMAGE	
1 	

In-Line C140	2 Inspect in-line C140M and C140F for damage. • **Is the in-line C140M and C140F OK?** → **Yes** GO to A6 . → **No** REPAIR the damaged in-line C140. TEST the system for normal operation.
A6 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C148M AND IN-LINE C140F FOR OPEN	
1  	1 Measure the resistance between in-line C148M-16, circuit 70 (LB/WH), and in-line C140F-8, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C140F and 4-wheel anti-lock brake control module C186. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C148M and in-line C140F. TEST the system for normal operation.

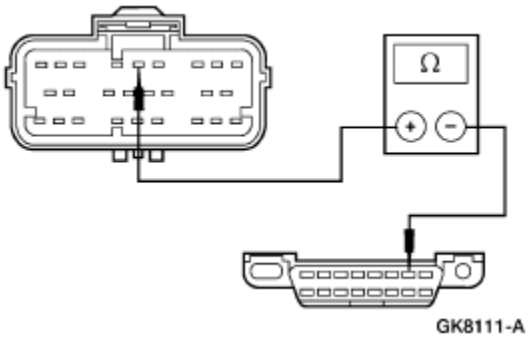
PINPOINT TEST B: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — GENERIC ELECTRONIC MODULE (GEM)/CENTRAL TIMER MODULE (CTM)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK GEM/CTM C280 FOR DAMAGE	
1 2	

 GEM/CTM C280	3 Inspect GEM/CTM C280 for damage. • **Is the GEM/CTM C280 OK?** → **Yes** GO to B2 . → **No** REPAIR the GEM/CTM C280. TEST the system for normal operation.
B2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291 AND GEM/CTM C280 FOR OPEN	
1  GK6365-A	1 Measure the resistance between GEM/CTM C280-25, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new GEM/CTM. For additional information, REFER to Section 419-10 . TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH). TEST the system for normal operation.

PINPOINT TEST C: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — RESTRAINT CONTROL MODULE (RCM)

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK RCM C232 FOR DAMAGE	
1 	

3 RCM C232	2 Deactivate the air bag system; REFER to Section 501-20B . 4 Inspect RCM C232 for damage. • **Is the RCM C232 OK?** → **Yes** GO to C2 . → **No** REPAIR the RCM C232. TEST the system for normal operation.
C2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291-7 AND RCM C232-5 FOR OPEN	
1  GK8111-A	1 Measure the resistance between RCM C232-5, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new RCM; REFER to Section 501-20B . TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH). TEST the system for normal operation.

PINPOINT TEST D: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — REMOTE ANTI-THEFT PERSONALITY (RAP) MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK RAP MODULE C336 FOR DAMAGE	
1	

2

RAP Module C336

3 Inspect RAP module C336 for damage.

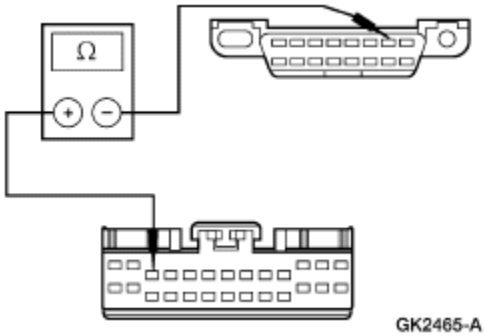
- **Is the RAP module C336 OK?**

→ **Yes**
GO to D2 .

→ **No**
REPAIR the RAP module C336. TEST the system for normal operation.

D2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291-7 AND RAP MODULE C336-3 FOR OPEN

1



1 Measure the resistance between RAP module C336-3, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH).

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new RAP module. For additional information, REFER to Section 419-10 . TEST the system for normal operation.

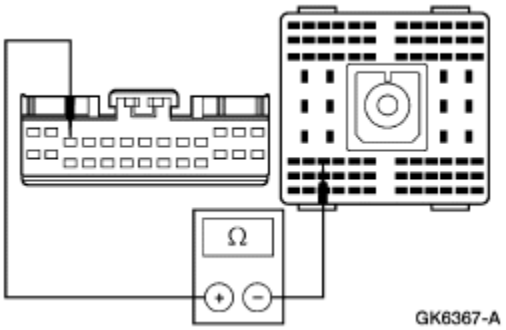
→ **No**
GO to D3 .

D3 CHECK IN-LINE C212 FOR DAMAGE

1

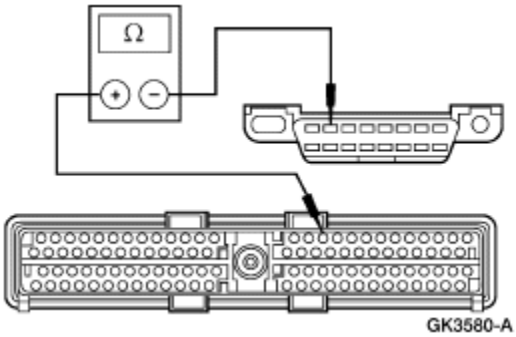
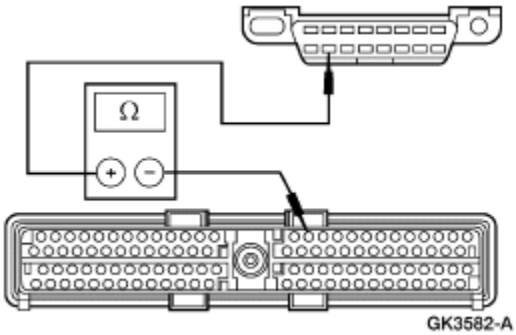
In-Line C212

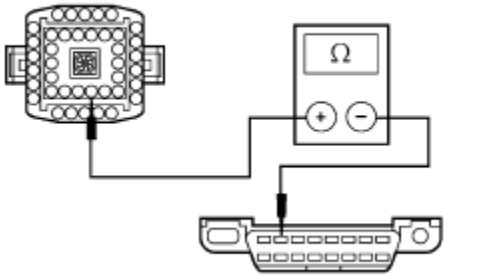
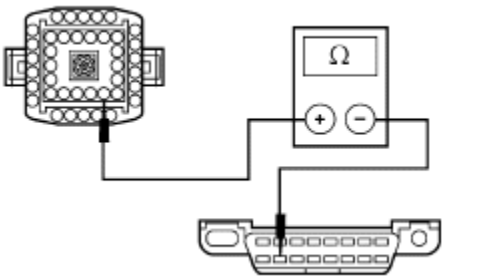
2 Inspect in-line C212M and C212F for damage.

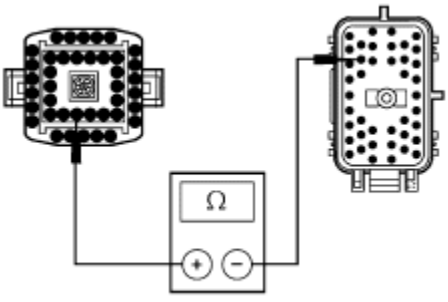
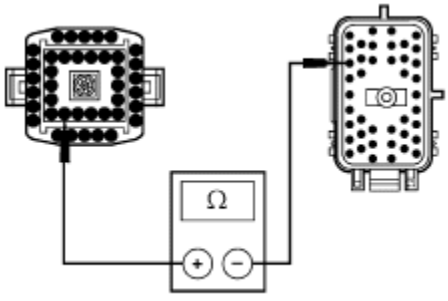
	• **Is the in-line C212M and C212F OK?** → **Yes** GO to D4 . → **No** REPAIR the damaged in-line C212. TEST the system for normal operation.
D4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C212M AND RAP MODULE C336 FOR OPEN	
1  	1 Measure the resistance between RAP module C336-3, circuit 70 (LB/WH), and in-line C212M-51, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C212F and DLC C291. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C212M and RAP module C336. TEST the system for normal operation.

PINPOINT TEST E: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — POWERTRAIN CONTROL MODULE (PCM)

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK PCM C202-15 AND C202-16	
1 2 	

PCM C202	3 Inspect PCM C202-15 and C202-16 for damage. • **Is the PCM C202 OK?** → **Yes** GO to E2 . → **No** REPAIR PCM C202. TEST the system for normal operation.
E2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE PCM C202 AND THE DLC C291 FOR OPEN	
1 2 PCM C202 3  GK3580-A 4  GK3582-A	3 Measure the resistance between PCM C202-16, circuit 914 (TN/OG), and DLC C291-2, circuit 914 (TN/OG). 4 Measure the resistance between PCM C202-15, circuit 915 (PK/LB), and DLC C291-10, circuit 915 (PK/LB). • **Are the resistances less than 5 ohms?**

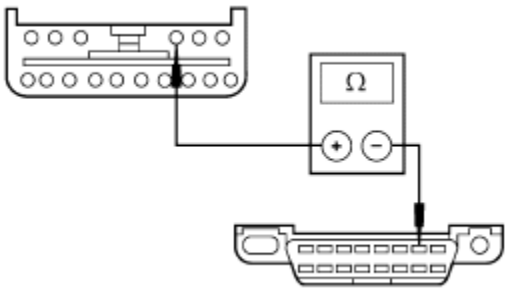
	→ **Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3 for diagnosis and testing. → **No** GO to E3.
E3 CHECK IN-LINE C147 FOR DAMAGE	
1 In-Line C147	2 Inspect in-line C147M and C147F for damage. • **Is the in-line C147M and C147F OK?** → **Yes** GO to E4. → **No** REPAIR the damaged in-line C147. TEST the system for normal operation.
E4 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C147F and DLC C291 FOR OPEN	
1  GK6368-A	1 Measure the resistance between in-line C147F-21, circuit 914 (TN/OG), and DLC C291-2, circuit 914 (TN/OG).
2  GK6369-A	2 Measure the resistance between in-line C147F-25 circuit 915 (PK/LB), and DLC C291-10, circuit 915 (PK/LB). • **Are the resistances less than 5 ohms?**

	→ **Yes** GO to E5 . → **No** REPAIR the circuit in question between in-line C147F and DLC C291. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.
E5 CHECK IN-LINE C115 FOR DAMAGE	
1 In-Line C115	2 Inspect in-line C115M and C115F for damage. • **Is the in-line C115M and C115F OK?** → **Yes** GO to E6 . → **No** REPAIR the damaged in-line C115. TEST the system for normal operation.
E6 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C147F AND IN-LINE C115M FOR OPEN	
1  GK6370-A	1 Measure the resistance between in-line C147M-21, circuit 914 (TN/OG), and in-line C115M-11, circuit 914 (TN/OG).
2  GK6371-A	2 Measure the resistance between in-line C147M-25, circuit 915 (PK/LB), and in-line C115M-3, circuit 915 (PK/LB).

	• **Are the resistances less than 5 ohms?** → **Yes** REPAIR the circuit in question between PCM C202 and in-line C115F. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation. → **No** REPAIR the circuit in question between in-line C147M and in-line C115M. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.

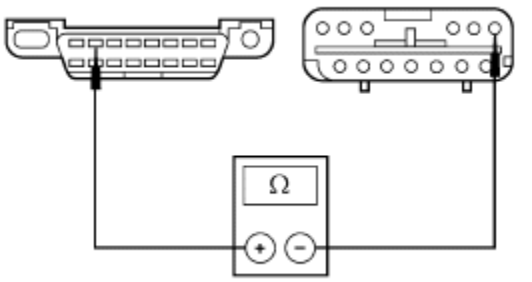
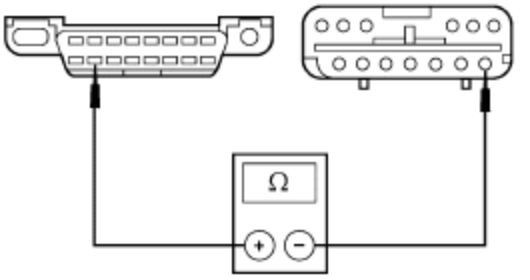
PINPOINT TEST F: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — AIR SUSPENSION CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE AIR SUSPENSION CONTROL MODULE C2000 FOR DAMAGE	
1 2 Air Suspension Control Module C2000	3 Inspect air suspension control module C2000 for damage. • **Is the air suspension control module C2000 OK?** → **Yes** GO to F2 . → **No** REPAIR air suspension control module C2000. TEST the system for normal operation.
F2 CHECK THE RESISTANCE BETWEEN DLC C291 AND AIR SUSPENSION CONTROL MODULE C2000 — CIRCUIT 70 (LB/WH)	
1	

 2 Air Suspension Control Module C2000 3  GK6488-A	3 Measure the resistance between air suspension control module C2000-29, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new air suspension control module. For additional information, REFER to Section 204-05 . TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH). TEST the system for normal operation.

PINPOINT TEST G: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL —ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (EATC) MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK EATC C297 FOR DAMAGE	
1 2 EATC Module C297	3 Inspect EATC module C297 for damage.

	• **Is the EATC module C297 OK?** → **Yes** GO to G2 . → **No** REPAIR EATC C297. TEST the system for normal operation.
G2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR OPEN	
1  GK6489-A	1 Measure the resistance between DLC C291-2, circuit 914 (TN/OG), and EATC module C297-15, circuit 914 (TN/OG).
2  GK6490-A	2 Measure the resistance between DLC C291-10, circuit 915 (PK/LB), and EATC module C297-1, circuit 915 (PK/LB).
	• **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new EATC module. REFER to Section 412-00 . TEST the system for normal operation. → **No** REPAIR the circuit in question. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.

PINPOINT TEST H: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — DRIVER SEAT MODULE (DSM)

CONDITIONS	DETAILS/RESULTS/ACTIONS

H1 CHECK DSM C337 FOR DAMAGE

1

2

DSM C337

3 Inspect DSM C337 for damage.

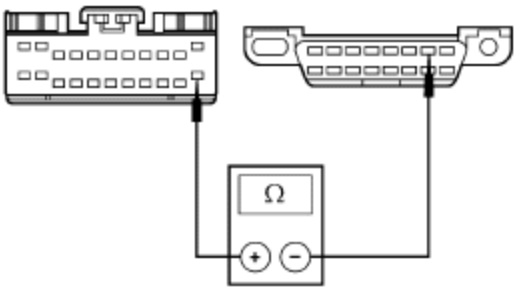
- **Is the DSM C337 OK?**

→ **Yes**
GO to H2.

→ **No**
REPAIR the DSM C337. TEST the system for normal operation.

H2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291-7 AND DSM C337-22 FOR OPEN

1



GK6491-A

1 Measure the resistance between DSM C337-22, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH).

- **Is the resistance less than 5 ohms?**

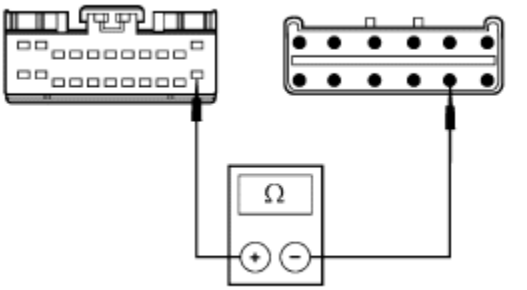
→ **Yes**
INSTALL a new DSM. For additional information, REFER to Section 501-10. TEST the system for normal operation.

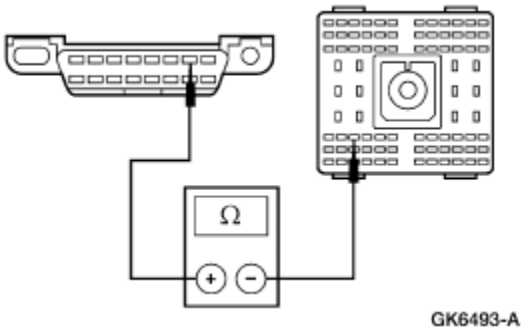
→ **No**
GO to H3.

H3 CHECK IN-LINE C346 FOR DAMAGE

1

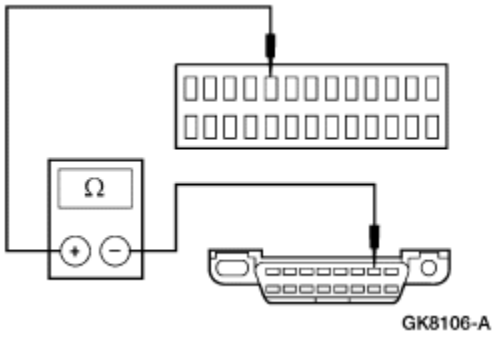
In-Line C346

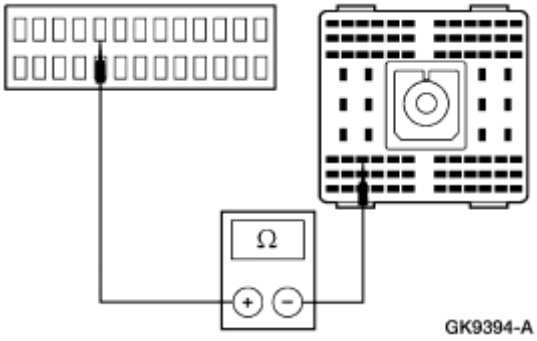
	2 Inspect in-line C346M and C346F for damage. • **Is the in-line C346M and C346F OK?** → **Yes** GO to H4 . → **No** REPAIR the damaged in-line C346. TEST the system for normal operation.
H4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C346M AND DSM C337 FOR OPEN	
1  	1 Measure the resistance between DSM C337-22, circuit 70 (LB/WH), and in-line C346M-11, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** GO to H5 . → **No** REPAIR circuit 70 (LB/WH) between in-line C346M and DSM C337. TEST the system for normal operation.
H5 CHECK IN-LINE C212 FOR DAMAGE	
1 In-Line C212	2 Inspect in-line C212M and C212F for damage. • **Is the in-line C212M and C212F OK?** → **Yes** GO to H6 . → **No** REPAIR the damaged in-line C212. TEST the system for normal operation.

H6 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C212F AND DLC C291 FOR OPEN	
1  GK6493-A	1 Measure the resistance between DLC C291-7, circuit 70 (LB/WH), and in-line C212F-51, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C212M and in-line C346F. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C212F and DLC C291. TEST the system for normal operation.

PINPOINT TEST I: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL — PARKING AID MODULE (PAM)

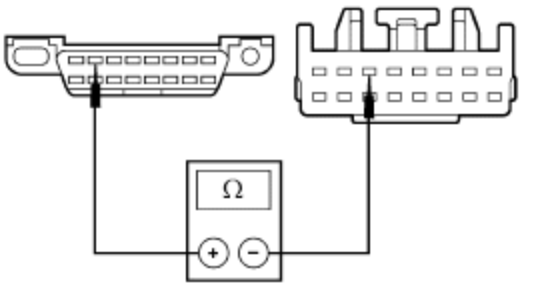
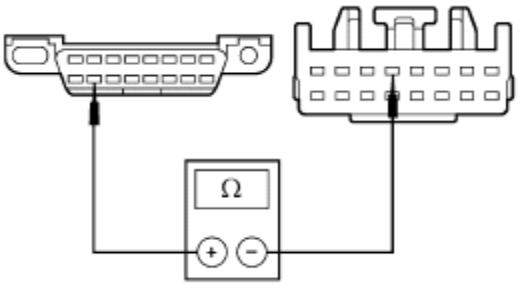
CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CHECK PAM C440 FOR DAMAGE	
1 2 PAM C440	3 Inspect PAM C440 for damage. • **Is the PAM C440 OK?** → **Yes** GO to I2 . → **No** REPAIR the PAM C440. TEST the system for

	normal operation.
I2 CHECK CIRCUIT 70 (LB/WH) BETWEEN DLC C291-7 AND PAM C440-5 FOR OPEN	
1  	1 Measure the resistance between PAM C440-5, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new PAM. For additional information, REFER to Section 413-13 . TEST the system for normal operation. → **No** GO to I3 .
I3 CHECK IN-LINE C212 FOR DAMAGE	
1 In-Line C212	2 Inspect in-line C212M and C212F for damage. • **Is the in-line C212M and C212F OK?** → **Yes** GO to I4 . → **No** REPAIR the damaged in-line C212. TEST the system for normal operation.
I4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C212M AND PAM C440 FOR OPEN	
1	1 Measure the resistance between PAM C440-5, circuit 70 (LB/WH), and in-line C212M-51, circuit 70 (LB/WH).

	• **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C212F and DLC C291. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C212M and PAM C440. TEST the system for normal operation.

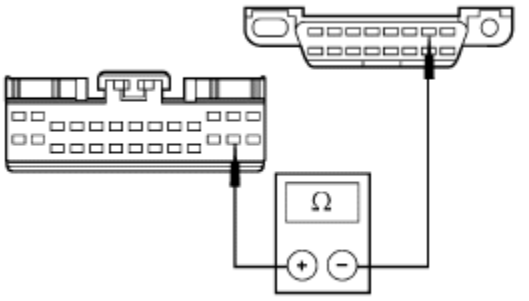
PINPOINT TEST J: THE MODULE DOES NOT RESPOND TO THE SCAN TOOL —PASSIVE ANTI-THEFT SYSTEM (PATS) MODULE

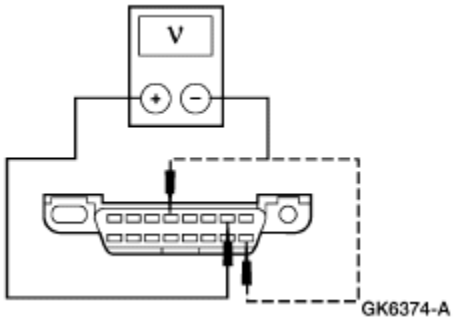
CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK PATS C222 FOR DAMAGE	
1 2 PATS Module C222	3 Inspect PATS module C222 for damage. • **Is the PATS module C222 OK?** → **Yes** GO to J2 . → **No** REPAIR PATS C222. TEST the system for normal operation.
J2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR OPEN	

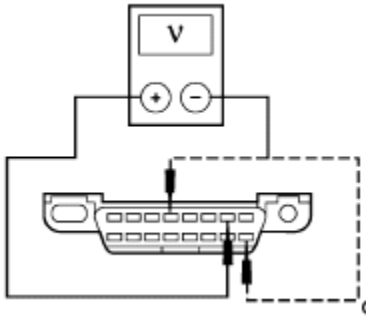
1  GK6494-A	1 Measure the resistance between PATS module C222-6, circuit 914 (TN/OG), and DLC C291-2, circuit 914 (TN/OG).
2  GK6495-A	2 Measure the resistance between PATS module C222-5, circuit 915 (PK/LB), and DLC C291-10, circuit 915 (PK/LB). • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new PATS module. For additional information, REFER to Section 419-01 . TEST the system for normal operation. → **No** REPAIR the circuit in question. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.

PINPOINT TEST K: NO MODULE / NETWORK COMMUNICATION— ISO 9141 NETWORK

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE SCAN TOOL FOR DAMAGE	
	1 Inspect scan tool pin 7 for damage. • **Is the scan tool OK?** → **Yes** GO to K2 . → **No** REPAIR the scan tool. TEST the system for

	normal operation.
K2 CHECK THE DLC C291 FOR DAMAGE	
1 	2 Inspect DLC C291 pin 7 and the wire (circuit 70 [LB/W]) leading to pin 7. • **Is DLC C291 OK?** → **Yes** GO to K3 . → **No** REPAIR the DLC C291. TEST the system for normal operation.
K3 CHECK CIRCUIT 70 (LB/WH) FOR OPEN	
1 GEM/CTM C280 2  GK6365-A	2 Measure the resistance between GEM/CTM C280-25, circuit 70 (LB/WH), and DLC C291-7, circuit 70 (LB/WH). • **Is the resistance less than 5 ohms?** → **Yes** CONNECT the GEM/CTM. GO to K4 . → **No** REPAIR circuit 70 (LB/WH) between the DLC C291 and GEM/CTM C280-25. TEST the system for normal operation.
K4 CHECK VEHICLE FOR THE RAP MODULE, PAM, OR THE DSM	
	1 Check the vehicle for a RAP module,PAM, or DSM.

	• **Is the vehicle equipped with the RAP module, PAM, or the DSM?** → **Yes** GO to K5. → **No** GO to K6.
K5 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH IN-LINE C212 DISCONNECTED	
1 2 In-Line C212 3 4  	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K6. → **No** If the vehicle is equipped with the RAP module only, GO to K18. If the vehicle is equipped with the PAM only, GO to K19. If the vehicle is equipped with the DSM only,

	GO to K20 . If equipped with a combination of the following modules: RAP module, PAM or DSM, GO to K11 .
K6 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH IN-LINE C148 DISCONNECTED	
1 2 In-Line C148 3 In-Line C212 4 5 	5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K7 . → **No** GO to K22 .
K7 CHECK VEHICLE FOR AIR SUSPENSION CONTROL MODULE OPTION	
1	

2

In-Line C148

3 Check the vehicle for the air suspension control module.

- **Is the vehicle equipped with the air suspension control module?**

→ **Yes**
GO to K8 .

→ **No**
GO to K9 .

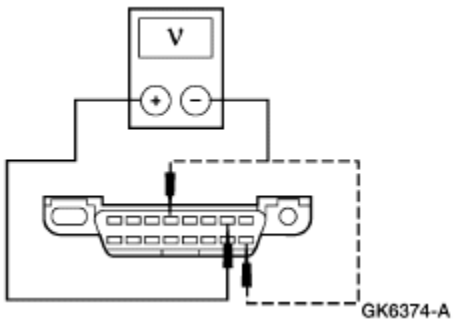
K8 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH AIR SUSPENSION CONTROL MODULE C2000 DISCONNECTED

1

Air Suspension Control Module C2000

2

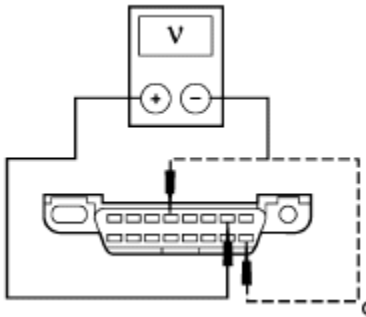
3

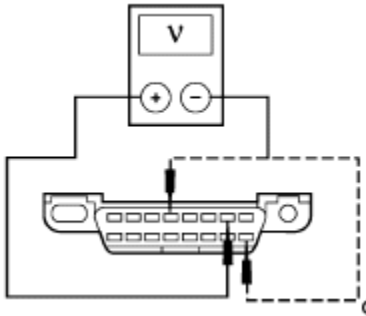


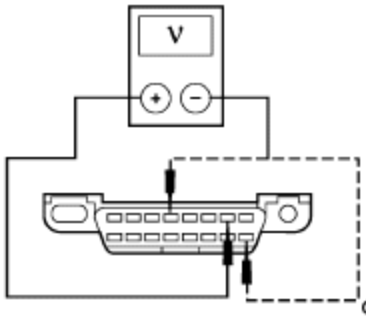
3 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK).

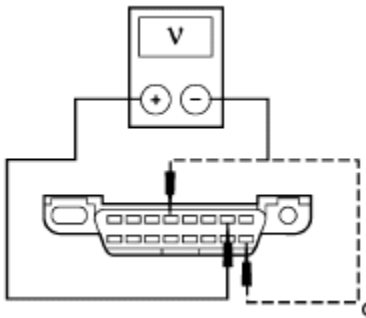
- **Is any voltage indicated for either measurement?**

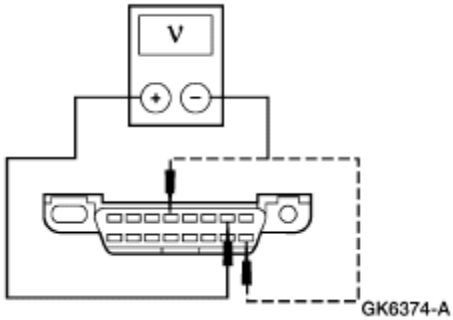
→ **Yes**
CONNECT the air suspension control module C2000, GO to K9 .

	→ **No** INSTALL a new air suspension control module. For additional information, REFER to Section 204-05 . TEST the system for normal operation.
K9 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE GEM/CTM DISCONNECTED	
1 2 GEM/CTM C280 3 4  	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** CONNECT the GEM/CTM C280, GO to K10 . → **No** INSTALL a new GEM/CTM. For additional information, REFER to Section 419-10 . TEST the system for normal operation.
K10 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE RCM DISCONNECTED	
1	

 3 RCM C232 4 5  GK6374-A	2 Deactivate the air bag system; refer to Section 501-20B . 5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** REPAIR circuit 70 (LB/WH). TEST the system for normal operation. → **No** INSTALL a new RCM. REFER to Section 501-20B . TEST the system for normal operation.
K11 CHECK THE VEHICLE FOR THE RAP MODULE	
1 2 In-Line C212	3 Check if the vehicle is equipped with the RAP

	module • **Is the vehicle equipped with a RAP module?** → **Yes** GO to K12 . → **No** GO to K13 .
K12 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE RAP MODULE DISCONNECTED	
1 RAP Module C336 2 3  	3 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K12 . → **No** INSTALL a new RAP module. For additional information, REFER to Section 419-10 . TEST the system for normal operation.
K13 CHECK THE VEHICLE FOR THE PAM	
	1 Check if the vehicle is equipped with the PAM • **Is the vehicle equipped with a PAM?**

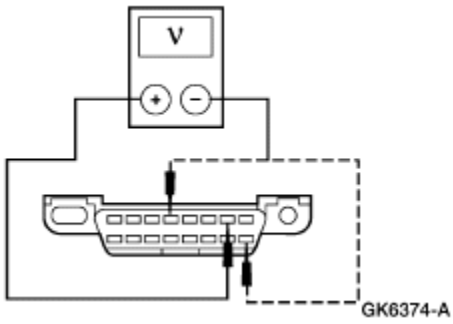
	→ **Yes** GO to K14 . → **No** GO to K15 .
K14 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE PAM DISCONNECTED	
1 2 PAM C440 3 4  	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K15 . → **No** INSTALL a new PAM. For additional information, REFER to Section 413-13 . TEST the system for normal operation.
K15 CHECK THE VEHICLE FOR THE DSM	
	1 Check if the vehicle is equipped with the DSM • **Is the vehicle equipped with a DSM?** → **Yes**

	GO to K16 . → **No** GO to K17 .
K16 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE DSM DISCONNECTED	
1 2 DSM C337 3 4  GK6374-A	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K17 . → **No** INSTALL a new DSM. For additional information, REFER to Section 501-10 . TEST the system for normal operation.
K17 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH IN-LINE C346 DISCONNECTED	
1 2	

In-Line C346

3

4



4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK).

- **Is the voltage indicated for either measurement zero volts?**

→ **Yes**
REPAIR circuit 70 (LB/WH) between in-line C212, in-line C346 (if equipped with DSM), PAM C440 (if equipped) and the RAP module C336 (if equipped). TEST the system for normal operation.

→ **No**
REPAIR circuit 70 (LB/WH) between in-line C346 and DSM C337. TEST the system for normal operation.

K18 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE RAP MODULE DISCONNECTED

1

2

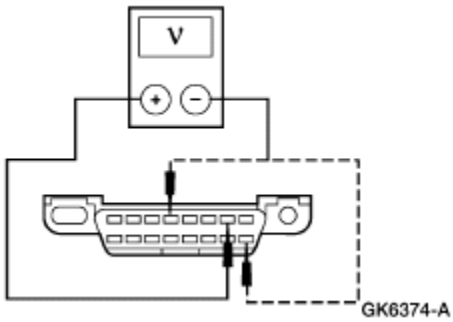
In-Line C212

3

RAP Module C336

4

5



5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK).

- **Is the voltage indicated for either measurement zero volts?**

→ **Yes**
REPAIR circuit 70 (LB/WH) between in-line C212 and RAP module C336. TEST the system for normal operation.

→ **No**
INSTALL a new RAP module. For additional information, REFER to Section 419-10 . TEST the system for normal operation.

K19 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE PAM DISCONNECTED

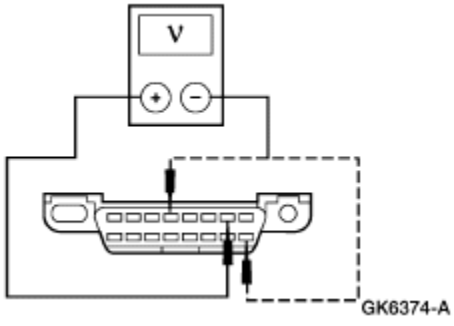
1

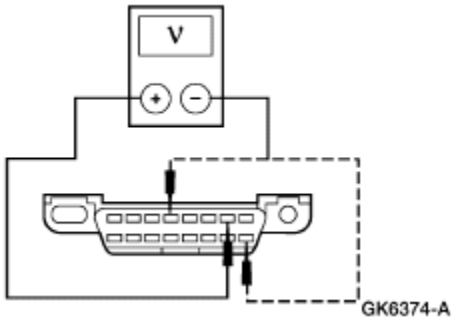
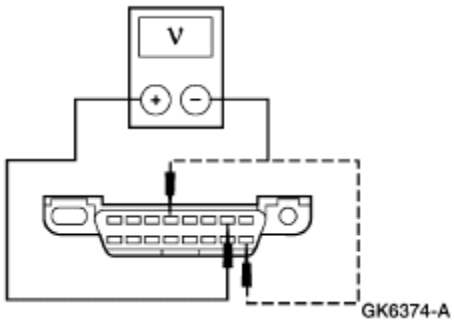
2

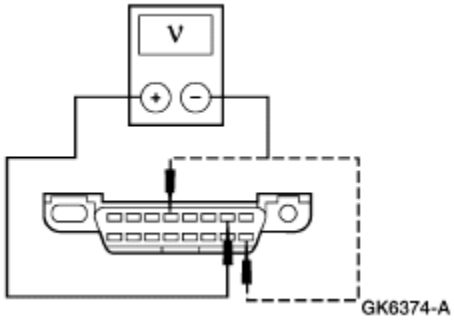
In-Line C212

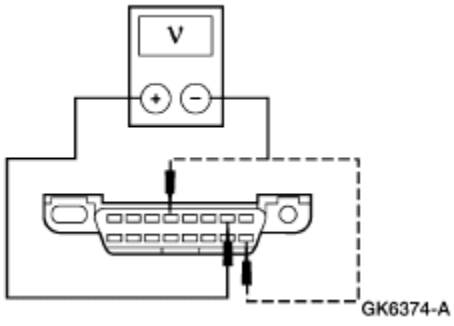
3

PAM C440

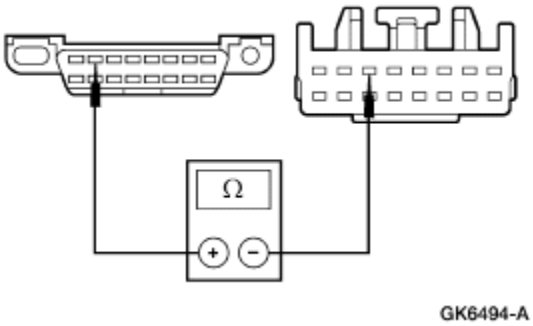
4 5  	5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C212 and PAM C440. TEST the system for normal operation. → **No** INSTALL a new PAM. For additional information, REFER to Section 413-13 . TEST the system for normal operation.
K20 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE DSM DISCONNECTED	
1 2 In-Line C212 3 DSM C337 4 	

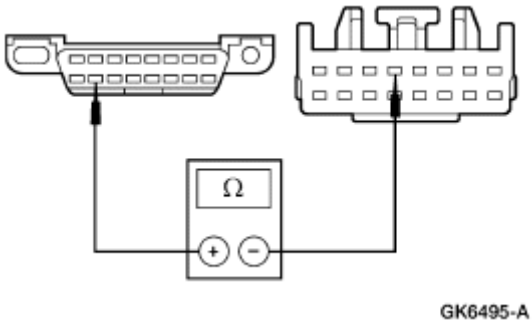
5  	5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K21 . → **No** INSTALL a new DSM. For additional information, REFER to Section 501-10 . TEST the system for normal operation.
K21 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH IN-LINE C346 DISCONNECTED	
1 2 In-Line C346 3 4  	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK).

	• **Is the voltage indicated for either measurement zero volts?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C212 and in-line C346. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C346 and DSM C337. TEST the system for normal operation.
K22 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH THE 4-WHEEL ANTI-LOCK BRAKE CONTROL MODULE DISCONNECTED	
1 2 In-Line C148 3 4-Wheel Anti-Lock Brake Control Module C186 4 5  	5 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** GO to K23 .

	→ **No** INSTALL a new 4-wheel anti-lock brake control module. For additional information, REFER to Section 206-09 . TEST the system for normal operation.
K23 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO POWER AND SHORT TO GROUND WITH IN-LINE C140 DISCONNECTED	
1 2 In-Line C140 3 4  GK6374-A	4 Measure the voltage between DLC C291-7, circuit 70 (LB/WH), and DLC C291-16, circuit 693 (OG); and between DLC C291-7, circuit 70 (LB/WH), and DLC C291-4, circuit 57 (BK). • **Is the voltage indicated for either measurement zero volts?** → **Yes** REPAIR circuit 70 (LB/WH) between in-line C148 and in-line C140. TEST the system for normal operation. → **No** REPAIR circuit 70 (LB/WH) between in-line C140 and 4-wheel anti-lock brake control module C186. TEST the system for normal operation.

PINPOINT TEST L: NO MODULE / NETWORK COMMUNICATION— SCP NETWORK

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK SCAN TOOL PINS 2 AND 10 FOR DAMAGE	
	1 Inspect scan tool Pins 2 and 10 for damage. • **Is the scan tool OK?** → **Yes** GO to L2 . → **No** REPAIR scan tool. TEST the system for normal operation.
L2 CHECK DLC C291 PINS 2 AND 10 FOR DAMAGE	
1	2 Inspect DLC C291 pins 2 and 10 and the wires leading to the pins for damage. • **Is the DLC C291 OK?** → **Yes** GO to L3 . → **No** REPAIR DLC C291. TEST the system for normal operation.
L3 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR OPEN	
1 PATS C222 2  GK6494-A 3	2 Measure the resistance between PATS C222-6, circuit 914 (TN/OG), and DLC C291-2, circuit 914 (TN/OG). 3 Measure the resistance between PATS C222-5, circuit 915 (PK/LB), and DLC C291-10,



circuit 915 (PK/LB).

- **Are the resistances less than 5 ohms?**

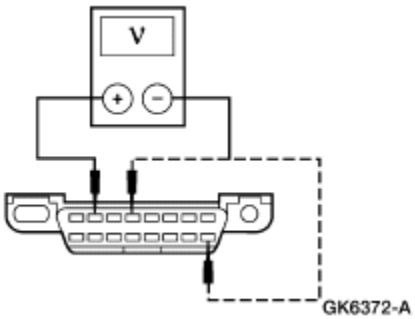
→ **Yes**
GO to L4 .

→ **No**
REPAIR the circuit in question between PATS C222 and DLC C291-10. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.

L4 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR SHORT TO BATTERY AND SHORT TO GROUND WITH THE PATS MODULE DISCONNECTED

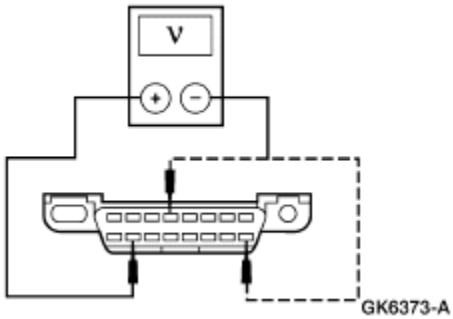
1

2

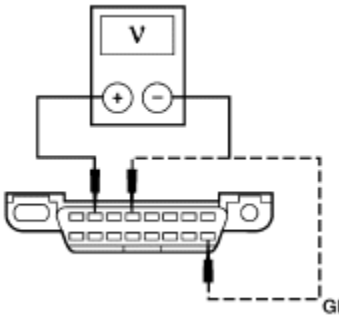
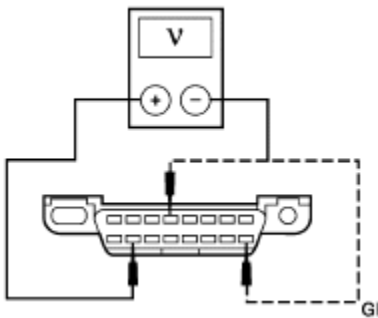


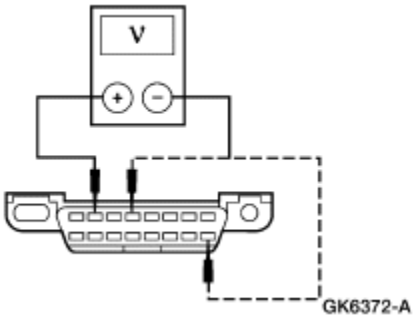
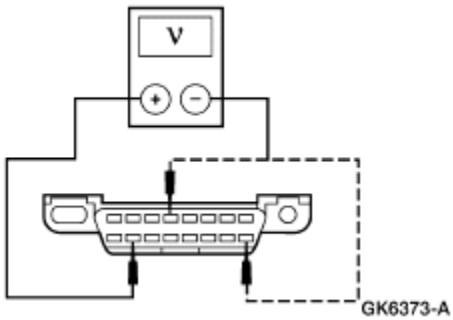
2 Measure the voltage between DLC C291-2, circuit 914 (TN/OG), and C291-4, circuit 57 (BK); and between DLC C291-2, circuit 914 (TN/OG), and C291-16, circuit 693 (OG).

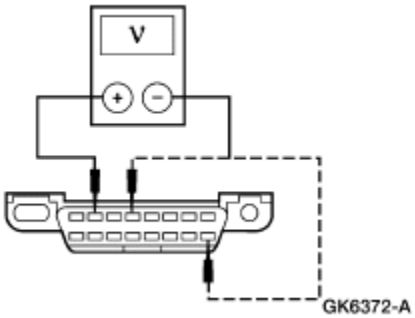
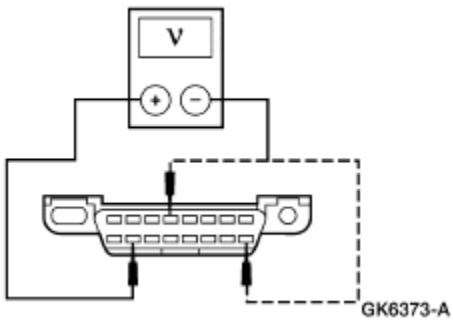
3

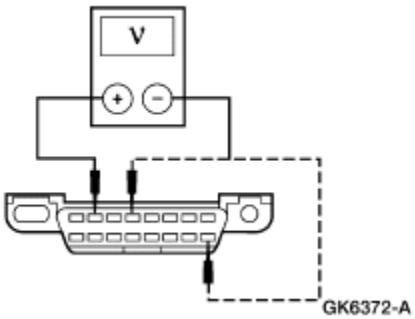


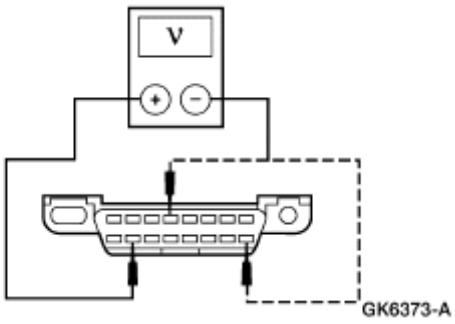
3 Measure the voltage between DLC C291-10, circuit 915 (PK/LB), and C291-4, circuit 57 (BK); and between DLC C291-10, circuit 915 (PK/LB), and C291-16, circuit 693 (OG).

	• **Is the voltage indicated in any measurement zero volts?** → **Yes** CONNECT the PATS module C222, GO to L5 . → **No** INSTALL a new PATS Module. For additional information, REFER to Section 419-01 . TEST the system for normal operation.
L5 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR SHORT TO BATTERY AND SHORT TO GROUND WITH THE PCM DISCONNECTED	
1 2 PCM C202 3 4  GK6372-A 5  GK6373-A	4 Measure the voltage between DLC C291-2, circuit 914 (TN/OG), and C291-4, circuit 57 (BK); and between DLC C291-2, circuit 914 (TN/OG), and C291-16, circuit 693 (OG). 5 Measure the voltage between DLC C291-10, circuit 915 (PK/LB), and C291-4, circuit 57 (BK); and between DLC C291-10, circuit 915 (PK/LB), and C291-16, circuit 693 (OG).

	• **Is the voltage indicated in any measurement zero volts?** → **Yes** If the vehicle is equipped with the EATC module, GO to L6 . If the vehicle is not equipped with the EATC module, GO to L7 . → **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3 for diagnosis and testing.
L6 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR SHORT TO BATTERY AND SHORT TO GROUND WITH THE EATC MODULE DISCONNECTED	
1 2 EATC Module C297 3 4  5  	4 Measure the voltage between DLC C291-2, circuit 914 (TN/OG), and C291-4, circuit 57 (BK); and between DLC C291-2, circuit 914 (TN/OG), and C291-16, circuit 693 (OG). 5 Measure the voltage between DLC C291-10, circuit 915 (PK/LB), and C291-4, circuit 57 (BK); and between DLC C291-10, circuit 915 (PK/LB), and C291-16, circuit 693 (OG).

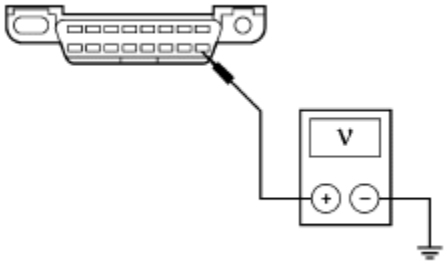
	• **Is the voltage indicated in any measurement zero volts?** → **Yes** GO to L7 . → **No** INSTALL a new EATC module. For additional information, REFER to Section 412-00 . TEST the system for normal operation.
L7 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR SHORT TO BATTERY AND SHORT TO GROUND WITH THE IN-LINE C147 DISCONNECTED	
1 2 In-Line C147 3 4  GK6372-A 5  GK6373-A	4 Measure the voltage between DLC C291-2, circuit 914 (TN/OG), and C291-4, circuit 57 (BK); and between DLC C291-2, circuit 914 (TN/OG), and C291-16, circuit 693 (OG). 5 Measure the voltage between DLC C291-10, circuit 915 (PK/LB), and C291-4, circuit 57 (BK); and between DLC C291-10, circuit 915 (PK/LB), and C291-16, circuit 693 (OG).

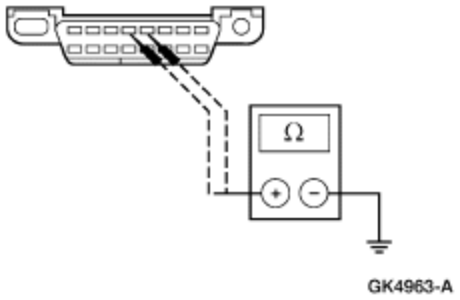
	• **Is the voltage indicated in any measurement zero volts?** → **Yes** REPAIR the circuit in question between in-line C147, DLC C291-2, PATS module C222, and EATC module C297 (if equipped). For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation. → **No** GO to L8 .
L8 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR SHORT TO BATTERY AND SHORT TO GROUND WITH THE IN-LINE C115 DISCONNECTED	
1 2 In-Line C147 3 In-Line C115 4 5  6	5 Measure the voltage between DLC C291-2, circuit 914 (TN/OG), and C291-4, circuit 57 (BK); and between DLC C291-2, circuit 914 (TN/OG), and C291-16, circuit 693 (OG). 6 Measure the voltage between DLC C291-10, circuit 915 (PK/LB), and C291-4, circuit 57 (BK); and between DLC C291-10, circuit 915 (PK/LB), and C291-16, circuit 693 (OG).

	• **Is the voltage indicated in any measurement zero volts?** → **Yes** REPAIR the circuit in question between in-line C147 and in-line C115. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation. → **No** REPAIR the circuit in question between in-line C115, and the PCM C202. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.

PINPOINT TEST M: NO MODULE/NETWORK COMMUNICATION — NO POWER TO THE SCAN TOOL

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK SCAN TOOL CONNECTOR	
1 	1 Inspect scan tool pins for damage. • **Are the pins OK?** → **Yes** GO to M2 . → **No**

	REPAIR the scan tool connector. TEST the system for normal operation.
M2 CHECK DLC C291 FOR DAMAGE	
1 2 GK2633-A	2 Inspect DLC C291 pins for damage. • **Are the pins OK?** → **Yes** GO to M3 . → **No** REPAIR DLC C291. TEST the system for normal operation.
M3 CHECK VOLTAGE TO SCAN TOOL — CIRCUIT 693 (OG).	
1  GK2634-A	1 Measure the voltage between DLC C291-16, circuit 693 (OG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to M4 . → **No** REPAIR circuit 693 (OG). TEST the system for normal operation.
M4 CHECK THE DLC GROUND — CIRCUIT 57 (BK) AND CIRCUIT 570 (BK/W)	

1  GK4963-A	1 Measure the resistance between DLC C291-4, circuit 57 (BK); C291-5, circuit 570 BK/W, and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPAIR the scan tool. TEST the system for normal operation. → **No** REPAIR the circuit in question. TEST the system for normal operation.

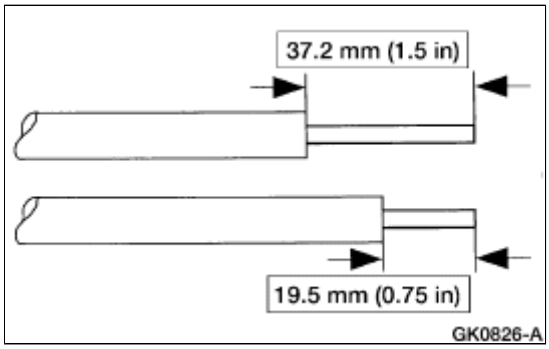
Communication Circuit Wiring Repair

Special Tool(s)

ST1171-A	Heat Gun 107-R0300 or equivalent

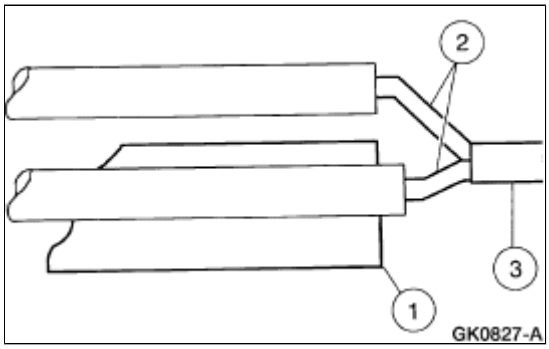
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01.

2. Strip the wires.



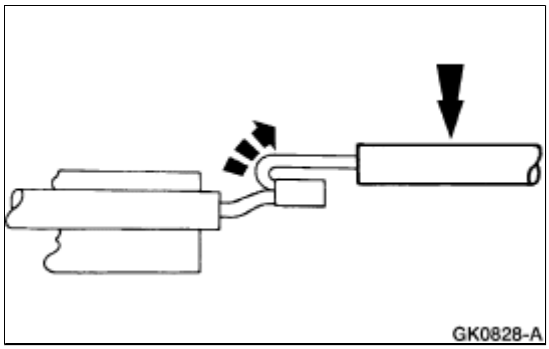
3. **NOTE:** Use rosin core mildly activated (RMA) solder, not acid core solder.

   Solder the wires.
   1. Install the heat shrink tube.
   2. Twist the wires together.
   3. Solder the wires together.

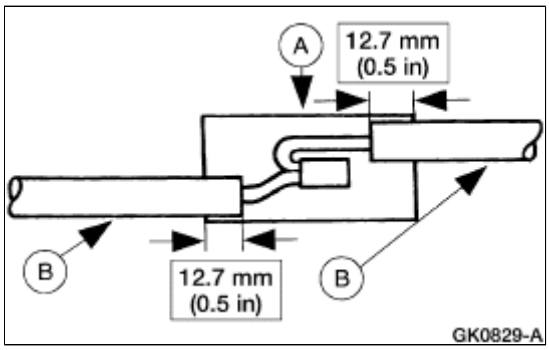


4. **NOTE:** Wait for the solder to cool before moving the wires.

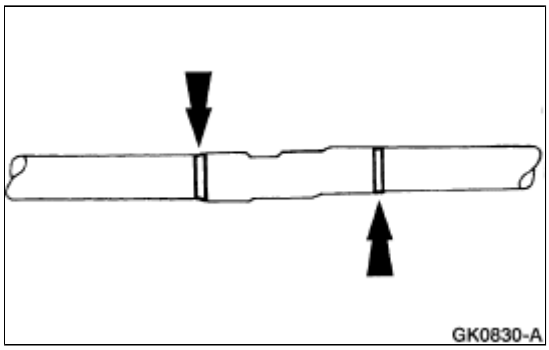
   Bend the wires back in a straight line.



5. Position the (A) heat shrink tube over the (B) wire repair.
    - Overlap the heat shrink tube on both wires.



6. Use the heat gun to heat the repaired area until adhesive flows out both ends of the heat shrink tube.



7. Reconnect the battery ground cable.

Module Configuration

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1270-A	Flash Cable 418-F120 (007-00531) or equivalent

Principles of Operation

Some modules support the ability to change specified factory configuration settings and preset preference items. The process used to change the settings and customer preference items is module configuration. The methods of module configuration used on these vehicles are:

- Tire Size and Axle Ratio
- Operational Strategy (4x2/4x4)

Customer Preference Items

This method is used to enable or disable module-controlled items or systems to suit the preference of the customer. Not all features controlled by the module are listed in this configuration method. Refer to the Module Configuration Index in this section for a list of features per module.

Inspection and Verification

1. Visually inspect for obvious signs of electrical damage. Refer to the following chart:

Visual Inspection Chart

Electrical
• Damaged wiring harness • Loose or corroded connectors • 4-wheel anti-lock brake control module (4WABS) • Generic electronic module (GEM)

2. If the concern remains after inspection, connect the scan tool to the data link connector (DLC) located

beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch is in RUN position.

3. If the scan tool still does not communicate with the vehicle, refer to Section 418-00 .

4. Refer to the Symptom Chart.

Module Configuration Index

NOTE: Do not contact the As-Built Data Center unless the scan tool instructs you to do so. The scan tool will not allow you to use as-built data information unless the scan tool first prompts you for the As-Built Data Center information.

Module Configuration Index

Module	Configuration Method	Customer Preference Items	Manufacturer Options	As-Built Data Center
4WABS	Tire Size and Axle Ratio Operational Strategy (4x2/4x4 - Refer to Operational Strategy in this section.)	• Tire Size and Axle Ratio (Refer to the Tire Size and Axle Ratio Index in this section.)	—	Not Supported
GEM	Tire Size and Axle Ratio	• Tire Size and Axle Ratio (Refer to the Tire Size and Axle Ratio Index in this section.)	—	Not Supported

Scan Tool Message Index

Scan Tool Message Index

Scan Tool Message	Explanation	Action
Unable to Retrieve VIN from vehicle - Enter the VIN below.	PCM VIN area blank.	Enter VIN using scan tool.
This module has not been configured - Reinstall original module to retrieve config. data - If old module is not available, continue for backup data.	A new module was installed before retrieving configuration data from suspect module. DTC B2477 should be set.	Install the original module and retrieve configuration data. If original module is currently in the vehicle continue with the routine to retrieve backup data from the PCM. Continue with routine to extract backup data from the PCM.
Data previously stored for the	The scan tool has configuration	Make sure that data already stored on

following vehicle VIN# - Data will be lost if you continue - Press trigger to continue.	data stored for the same module that could be overwritten.	scan tool is not needed, then continue with routine to retrieve configuration data.
The module is not configurable - Refer to service manual for info	The module has no configuration information.	Make sure module supports Programmable Module Installation. Refer to Module Configuration Index.
Unable to retrieve (XXX) data from (XXX) module. Unable to locate (XXX) backup data in PCM. Call As-Built Data Center. PCM requires programming.	The suspect module returned DTC B2477 and the PCM did not have backup data.	Make sure module is listed on the Module Configuration Index and that it supports as-built data. Only if As-Built Data Center supports the module, contact the As-Built Data Center.
No data available for module - Select retrieve module config. to obtain vehicle data.	The restore routine was run without retrieving configuration data. The scan tool memory storing configuration data has expired.	Use Programmable Module Installation to retrieve module configuration data.
Unable to retrieve VIN from vehicle - Enter the last five characters of VIN below.	Scan tool was unable to extract VIN for verification.	Enter the last five characters of the VIN.
VIN mismatch for stored data. VIN ##### Current VIN ##### - If you continue, data may not match intended configuration.	The VIN was entered incorrectly. The VIN assigned to the data stored in the scan tool does not match the VIN number of the vehicle that is attempting to utilize the configuration data.	Exit the routine and attempt to retrieve module configuration data entering the correct VIN.
Entered data is not valid	Vehicle data was incorrectly entered. Module configuration data was incorrectly entered.	Refer to As-Built Data Center information and enter the correct module configuration.
Unable to verify download - Refer to service manual for info.	The module will not allow the scan tool to verify the correct information was configured.	Exit the routine and verify correct information manually.
Block data is not valid for the vehicle - Clear block 1 and re-enter.	Block data entered for the module is not correct.	Refer to As-Built Data Center information and enter correct data for each block.
Data is not valid for the entered VIN - Check VIN and re-enter.	The VIN was entered incorrectly.	Exit the routine and repeat the routine entering the correct VIN.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Unable to configure the new module	• Module is not programmable. • Module. • Circuitry.	• Make sure the module is listed on the module configuration index. • GO to Pinpoint Test A .

Pinpoint Tests

PINPOINT TEST A: UNABLE TO CONFIGURE THE NEW MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 INITIATE DATA LINK DIAGNOSTICS	
1 2 3 4 	4 Carry out the DATA LINK DIAGNOSTICS test. • **Does the module in question appear on the results screen as no response/not equipped?** → **Yes** REFER to Section 418-00 . → **No** GO to A2 .
A2 CHECK FOR COMMUNICATION WITH THE MODULE	
1 	1 Carry out the suspect module self-test. • **Did the module self-test function correctly?** → **Yes** RECORD the DTCs and GO to A3 . → **No** For the GEM, REFER to Section 417-02 .

	For the 4WABS, REFER to Section 206-09 .
A3 VERIFY THE PROGRAMMABLE ITEM	
	1 Check for the item to be programmed on the module configuration index in this section. • **Does the item appear on the index under the module?** → **Yes** CARRY OUT the configuration method on the module in question and follow the text screens. REFER to the corresponding configuration method under General Procedures in this section. If the module does not accept configuration, INSTALL a different programmable module. → **No** The item is not configurable.

Customer Preference Items

Customer Preference Items

NOTE: If using the WDS, select Module Configuration and Programming, then follow the screen prompts.

NOTE: Make sure module is listed as supporting customer preference items and supports the specific item to be configured in the Module Configuration Index in this section.

1. Select Service Bay Functions on the scan tool.
2. Select the module that contains the customer preference item to be programmed. Refer to the Module Configuration Index in this section.
3. Select Customer Preference Items on the scan tool.
4. Select Module Option Content.
5. Select the item to be enabled or disabled.
6. Enable or disable the item as necessary to reflect the customer preference.

Tire Size and Axle Ratio

NOTE: If using the WDS, select Module Configuration and Programming, then follow the screen prompts.

NOTE: Make sure module is listed as supporting tire size and axle ratio configuration in the Module Configuration Index in this section.

1. Select Service Bay Functions on the scan tool.
2. Select the module that contains the Tire Size and Axle Ratio configuration.
3. Select Customer Preference Items.
4. Select Tire Size and Axle Ratio on the scan tool.
5. Select the vehicle.
6. Enter the correct value for the vehicle according to the following chart and finish the routine. If the tire size is not listed on the chart, Go to step 7.

Tire Size and Axle Ratio Index

Feature	Explorer/Mountaineer

Tire Size	P225/70R15SL BSW - ENTER - 00761 rev/mile P235/75R15SL A/T OWL - ENTER - 00721 rev/mile P255/70R16 A/T OWL - ENTER - 00690 rev/mile P255/70HR16 A/S BSW - ENTER - 00693 rev/mile P255/70R16 A/T OWL (SD) - ENTER - 00691 rev/mile
Tone Ring Size	8.8" AXLE - ENTER - 00108 teeth
Option	4-WHEEL ANTILOCK BRAKES - ENTER - $80
Vehicle	Explorer, Mountaineer

7. **NOTE:** The following steps will calculate tire revolutions per mile. This will provide the number that needs to be entered on the scan tool.

   Position the vehicle on level ground. Make sure the load weight is within the specific vehicle application.

8. **NOTE:** Tire pressure must be set when the tires are cold.

   Inflate the tires to the specified rating.

9. Measure the rear tire height from the ground to the top of the tire in inches.

10. Divide 20,168 by the tire height measurement. This is the revolutions per mile.

11. Enter the revolutions per mile (rev/mile) on the scan tool and finish the routine.

Operational Strategy

NOTE: If using the WDS, select Module Configuration and Programming, then follow the screen prompts.

NOTE: Make sure module is listed as supporting tire size and axle ratio configuration in the Module Configuration Index in this section.

1. Select Service Bay Functions on the scan tool.

2. Select the module that contains the Operational Strategy to be programmed. Refer to the Module Configuration Index in this section.

3. Select Operational Strategy.

4. Select the vehicle.

5. Select 4x4 for a 4x4 vehicle.
   Select 4x2 for a 4x2 vehicle.

Torque Specifications

Description	Nm	lb-in
Battery ground cable bolt	7-10	62-89
Hood latch release handle screws	2.7-3.7	25-33
Instrument panel steering column opening cover reinforcement screws	7.6-10.4	—
Passive anti-theft transceiver module screw	1.8-2.6	—

Anti-Theft —Passive Anti-Theft System (PATS)

The passive anti-theft system (PATS) contains the following components:

- theft indicator
- encoded ignition key
- transceiver module
- PATS control module (located behind the passenger side air bag module)
- powertrain control module (PCM)
- standard corporate protocol (SCP) communication network

The passive anti-theft system (PATS) uses radio frequency identification technology to deter a driveaway theft. Passive means that it does not require any activity from the user. This system is known as SecuriLock® in North America, Safeguard® in the U.K., and PATS in continental Europe. This information can be found in customer literature such as the Owners Guide.

The PATS uses a specially-encoded ignition key. Each encoded ignition key contains a permanently installed electronic device called a transponder. Each transponder contains a unique electronic identification code out of over 72 million billion combinations.

Each encoded ignition key must be programmed into a vehicle's PATS module before it can be used to start the engine. There are special diagnostic repair procedures outlined in this manual that must be performed if the encoded ignition keys need to be replaced.

The encoded key is larger than a traditional ignition key. The key does not require batteries and should last the life of the vehicle.

The transceiver module communicates with the encoded ignition key. This module is located behind the steering column shroud, and contains an antenna connected to a small electronics module. During each vehicle start sequence, the transceiver module reads the encoded ignition key identification code and sends the data to the PATS module.

The control functions are contained in the PATS module. This module performs all of the PATS functions such as receiving the identification code from the encoded ignition key and controlling engine enable. The PATS module initiates the key interrogation sequence when the vehicle ignition switch is turned to RUN or START.

PATS uses the p owertrain control module (PCM) to enable or disable the engine. The PATS module communicates with the PCM over the SCP communication network in order to enable engine operation. The PATS module and the PCM use sophisticated messages in order to prevent a theft. The PATS and the PCM share security data when first installed together, making them a matched pair. After this security data sharing, these modules will not function in other vehicles. The PCM shared security ID is remembered even if the battery is disconnected. The PATS module also stores the vehicle's key identification code, even if the battery is disconnected. There are special diagnostic repair procedures outlined in this workshop manual that may be carried out if either the PATS module or the PCM needs replacement.

All the elements of PATS must be functional before the engine is allowed to start. If any of the components are not working correctly, the vehicle will not start.

PATS uses a visual theft indicator. This indicator will prove out for three seconds when the ignition switch is turned to RUN or START under normal operation. If there is a PATS problem, this indicator will either flash

rapidly or glow steadily when the ignition switch is turned to RUN or START. PATS also "blips" the theft indicator every two seconds at ignition OFF to act as a visual theft deterrent.

PATS differs from the perimeter anti-theft system in that PATS enables and disables the engine from starting. If equipped, the perimeter anti-theft system protects the perimeter of the vehicle (doors, hood and trunk) and sounds an alarm.

The PATS is not compatible with aftermarket remote start systems, which allow the vehicle to be started from outside the vehicle. These systems may reduce the vehicle security level, and also may cause no-start issues. Remote start systems must be removed before investigation of PATS-related No Start issues.

The passive vehicle protection system will be activated and will disable the vehicle from starting if there is a:

- damaged encoded key.
- unprogrammed key.
- non-encoded key (key has no electronics).
- wiring concern.
- transceiver concern.
- PCM concern.
- module communications network concern.

Anti-Theft —Passive Anti-Theft System (PATS)

Refer to Wiring Diagrams Cell 112 , Anti-Theft (PATS) for schematic and connector information.

Refer to Wiring Diagrams Cell 62 , Instrument Cluster for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Inspection and Verification

NOTE: The PATS module must be reconfigured after replacement. Refer to Section 418-01 .

1. Verify the customer concern by duplicating the condition.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Ignition lock cylinder
• Encoded ignition key (PATS key)
• Use of non-encoded ignition key (key without the molded plastic head, non-PATS key)
• Use of a non-programmed encoded ignition key
	• Fuse:
	  ▪ Fuse 24 (7.5A)
	  ▪ Fuse 25 (7.5A)
	  ▪ Fuse 19 (25A)
	• PATS transceiver module
	• Connectors
	• Ignition switch

3. If the concern remains after the inspection connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.

- check the connections to the vehicle.
- check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for PATS module, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the PATS module.

6. If the DTCs retrieved are related to the concern, go to PATS Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

PATS Diagnostic Trouble Code (DTC) Index

PATS Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
B1213	Anti-Theft Number of Programmed Encoded Ignition Keys Below Minimum	GO to Pinpoint Test B1213 .
B2103 or B1232	Antenna Not Connected Defective Transceiver	GO to Pinpoint Test B2103 .
B1600	No Key Code Received — Damaged Encoded Ignition Key or Use of Non-PATS Encoded Ignition Key	GO to Pinpoint Test B1600 .
B1601	Unprogrammed Encoded Ignition Key (Keycode Format OK)	GO to Pinpoint Test B1601 .
B1602	Invalid Key Code Format From Encoded Ignition Key Transponder (Partial Key Read)	GO to Pinpoint Test B1602 .
B1681	PATS Transceiver Signal Is Not Received (Not Connected, Damaged, or Wiring)	GO to Pinpoint Test B1681 .
B2139	PCM ID Does Not Match Between PATS and PCM	GO to Pinpoint Test B2139 .
B2141	No Security ID Exchange Between PATS and PCM	GO to Pinpoint Test B2141 .
U1147	Faulty SCP Link or Incorrect PCM Calibration	GO to Pinpoint Test U1147 .
U1262	Missing SCP Message	REFER to Section 418-00 .

PATS Parameter Identification (PID) Index

PATS Parameter Identification (PID) Index

Display	Description	Expected Value
CCNTPATS	Number of Continuous DTCs On PATS	One Count Per DTC
IGN_PAT	Ignition Switch	RUN, OFF
NUMKEYS	Number of Encoded Ignition Key Codes Programmed	BCD (valid range 0-8)
M_KEY	Is This A Programmed Encoded Ignition Key	YES, NO
ENABL_S	Has PATS Enabled the Vehicle	ENABLED, DISABLED
ACCESS	Security Access Status	TIMED, CODED
MIN#KEY	Minimum Number of Programmed Keys Required to Start Vehicle	BCD (valid range 2-8)
ANTISCN	Time-Out for Unprogrammed PATS Key (Active Will Last Up to 20 Seconds)	ACTIVE, notACT
PCM_ID	Is PCM ID Stored in PATS Module	STORED, notSTR
SPARE_KY	Can Spare Encoded Ignition Keys Be Added With Two Programmed Encoded Ignition Keys	YES, NO
PCM_VFY	PCM ID Matches Between PCM and PATS Module	YES, NO

PATS Active Command Index

PATS Active Command Index

Active Command	Display	Action
PATS ANTI-THEFT INDICATOR	THEFT LAMP	ON, OFF
TRANSMIT SIGNAL COMMAND	TRANSMIT	ON, OFF

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the module — PATS module	• Fuses. • Circuitry. • Passive anti-theft system module.	• GO to Pinpoint Test A .
• The anti-theft indicator is always/never on — no 3 second anti theft indicator prove out	• Passive anti-theft system module. • Circuitry. • Fuse. • Theft indicator.	• GO to Pinpoint Test B .
• The vehicle does not start — theft indicator proves out for 3 seconds as normal	• Less than two keys programmed to the system. • Transceiver not	• CARRY OUT VIC on-demand self-test. RETRIEVE DTCs. If DTCs are present, GO to VIC

	connected/defective. • Circuitry. • Transceiver internal antenna damaged. • NON-PATS key, damaged key or no code received. • Partial key read of PATS key. • Unprogrammed PATS key.	Diagnostics Trouble Code (DTC) Index. If no DTCs are retrieved, check for other possible No-Start causes.
	• No PCM ID stored in PATS. • PATS/PCM ID do not match. • Problem with SCP communication network.	• Clear the stored DTCs. Cycle the ignition key from OFF to RUN. Retrieve continuous DTCs. If DTCs are present, GO to VIC Diagnostics Trouble Code (DTC) Index. If no DTCs are retrieved, check for other possible causes.
• The alarm system does not operate correctly — the vehicle starts but flashes a fault code on theft indicator at key ON	• Incorrect PCM calibration.	• GO to Pinpoint Test U1147 .

Pinpoint Tests

PINPOINT TEST B1213: ANTI-THEFT NUMBER OF PROGRAMMED ENCODED IGNITION KEYS BELOW MINIMUM

CONDITIONS	DETAILS/RESULTS/ACTIONS
B12131 RETRIEVE THE DTCS	
1 2 Scan Tool 3 	3 Retrieve and document continuous DTCs.

4 Clear Continuous DTCs 5 PATS On-Demand Self-Test	• **Is DTC B1213 the only DTC retrieved?** → **Yes** GO to B12132 . → **No** REPAIR the other DTCs PATS retrieved. CLEAR the DTCs. REPEAT the PATS On-Demand Self Test. TEST the system for normal operation.
B12132 CHECK FOR PROGRAMMED ENCODED IGNITION KEYS—MONITOR THE PATS PID NUMKEYS	
1 	1 Monitor the PATS PID NUMKEYS. • **Does the PATS PID NUMKEYS display less than two encoded ignition keys programmed?** → **Yes** GO to B12133 . → **No** System is OK.
B12133 PROGRAM ENCODED IGNITION KEYS	
2 	1 **NOTE:** Two programmed encoded ignition keys must be available to start the vehicle. Cut a new encoded ignition key. 3 Program the new encoded ignition key. • **Does the theft indicator illuminate for three seconds and then go out?**

	→ **Yes** CLEAR the DTCs. CARRY OUT PATS On-Demand Self-Test to verify all codes have been cleared. TEST the system for normal operation. → **No** If the theft indicator is on continuously, REPEAT DTC B1213-3 with a second new encoded ignition key. If the theft indicator is flashing, RETRIEVE DTC stored for new fault and REPAIR the other DTCs retrieved.

PINPOINT TEST B2103: ANTENNA NOT CONNECTED — DEFECTIVE TRANSCEIVER

CONDITIONS	DETAILS/RESULTS/ACTIONS
B21031 INSPECT ANTENNA FOR CORRECT INSTALLATION	
1 	
	2 Verify the PATS transceiver is correctly installed; refer to Module—Passive Anti-Theft Transceiver .
3 Scan Tool	
4 	4 Retrieve and document continuous DTCs.
5 Clear Continuous DTCs	
6 PATS On-Demand Self Test	
	• **Is DTC B1232 or B2103 retrieved?** → **Yes** INSTALL a new PATS transceiver module; REFER to Module—Passive Anti-Theft Transceiver . CLEAR the DTCs. REPEAT the PATS On-Demand Self-

	Test. TEST the system for normal operation. → **No** System is OK.

PINPOINT TEST B1600: NO KEY CODE RECEIVED—DAMAGED ENCODED IGNITION KEY OR USE OF NONPATS KEY

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Large metallic objects or devices such as the Mobil Speedpass or a second ignition key on the same keyring as the PATS ignition key may cause vehicle starting problems and record this DTC under certain conditions. If a fault cannot be identified, examine the customer's keyring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if the are too close to the key during engine start. If a problem occurs, turn ignition off and restart the engine with all other objects on the keyring held away from the ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).	
B16001 RETRIEVE THE DTCS	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 PATS On-Demand Self Test	3 Retrieve and document continuous DTCs. • **Is DTC B1600 retrieved?**

→ **Yes**
GO to B16002 .

→ **No**
If other DTCs are retrieved, REFER to PATS Module Diagnostic Trouble Code (DTC) Index. If no DTCs are retrieved, system is OK.

B16002 INSTALL A NEW ENCODED IGNITION KEY

1

2 **NOTE:** Check to make sure the customer and replacement encoded ignition keys are approved Ford encoded PATS ignition keys. Unapproved PATS keys do not always operate correctly over different temperature ranges (encoded ignition keys from Rotunda, Ilco, or Strattec are approved encoded ignition keys).

Cut a new encoded ignition key.

3

4 Program the new encoded ignition key; refer to Key Programming—Erase All Key Codes and Program Two Keys .

5

PATS On-Demand Self-Test

- **Is DTC B1600 still present?**

→ **Yes**
GO to B16003 .

→ **No**
If no other DTCs are retrieved, system is OK.

If other DTCs are retrieved, REFER to PATS Module Diagnostic Trouble Code (DTC) Index.

B16003 INSTALL A NEW PATS TRANSCEIVER

1

2 INSTALL a new PATS transceiver; refer to Module—Passive Anti-Theft Transceiver .

3 4 PATS On-Demand Self-test	4 **NOTE:** Use the customer original encoded ignition key, not the encoded ignition key that was cut in the previous step. • **Is DTC B1600 retrieved?** → **Yes** INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. → **No** System is OK.

PINPOINT TEST B1601: UNPROGRAMMED ENCODED IGNITION KEY (KEYCODE FORMAT OK)

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Large metallic objects or devices such as the Mobil Speedpass or a second ignition key on the same keyring as the PATS ignition key may cause vehicle starting problems and record this DTC under certain conditions. If a fault cannot be identified, examine the customer's keyring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if the are too close to the key during engine start. If a problem occurs, turn ignition off and restart the engine with all other objects on the keyring held away from the ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).	
B16011 RETRIEVE THE DTCS	
1 2 Scan Tool 3	3 Retrieve and document continuous DTCs.

4 Clear Continuous DTCs 5 PATS On-Demand Self-Test	• **Is DTC B1601 retrieved?** → **Yes** GO to B16012 . → **No** System is OK. CHECK all customer encoded ignition keys with PATS On-Demand Self-Test to verify all other encoded ignition keys are programmed.
B16012 CHECK FOR PROGRAMMED ENCODED IGNITION KEYS—MONITOR THE PATS PID NUMKEYS	
1 	1 Monitor the PATS PID NUMKEYS. • **Does the PATS PID NUMKEYS display 8?** → **Yes** ERASE and REPROGRAM the key codes; REFER to Key Programming—Erase All Key Codes and Program Two Keys . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B16013 .
B16013 CHECK THE NUMBER OF PROGRAMMED ENCODED IGNITION KEYS AVAILABLE	
	1 Verify there are at least two currently programmed encoded ignition keys available with the vehicle. • **Are at least two currently programmed encoded ignition keys available with the vehicle?** → **Yes** GO to B16014 . → **No** CUT new encoded ignition key so that at least two encoded ignition keys are

	available. PROGRAM the encoded ignition keys; REFER to Key Programming—Erase All Key Codes and Program Two Keys . GO to B16014 .
B16014 VERIFY THE PATS PID SPARE_KY INDICATES ENABLE	
1 	1 Monitor the PATS PID SPARE_KY. • **Does the PATS PID SPARE_KY indicate ENABLE?** → **Yes** REFER to Key Programming—Erase All Key Codes and Program Two Keys . TEST the system for normal operation. GO to B16015 . → **No** REFER to Key Programming—Spare Key Programming Switch to enable the PATS PID SPARE KEY to enable. TEST the system for normal operation. Once completed, GO to B16015 .
B16015 CHECK THE ENCODED IGNITION KEYS FOR CORRECT OPERATION	
1 	
2 	2 Start the vehicle using the first encoded ignition key.
3 	
4 	4 Start the vehicle with the second ignition key.
5 	• **Does the vehicle start correctly using both encoded ignition keys?** → **Yes** System is OK. If there are additional keys that need to be programmed, REFER to Key Programming—Program a Key Using Two Programmed Keys . → **No**

	GO to B16016 .
B16016 RETRIEVE THE DTCS — CHECK FOR DTC B1601	
1 2 Clear Continuous DTCs 3 	1 Retrieve and document continuous DTCs. 3 Perform a self-test using both ignition keys from Step B1601-5. • **Is DTC B1601 retrieved?** → **Yes** INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. → **No** System is OK. If other DTCs are retrieved, REFER to PATS Module Diagnostic Trouble Code (DTC) Index.

PINPOINT TEST B1602: INVALID KEY CODE FORMAT FROM ENCODED IGNITION KEY TRANSPONDER (PARTIAL KEY READ)

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Large metallic objects or devices such as the Mobil Speedpass or a second ignition key on the same keyring as the PATS ignition key may cause vehicle starting problems and record this DTC under certain conditions. If a fault cannot be identified, examine the customer's keyring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if the are too close to the key during engine start. If a problem occurs, turn ignition off and restart the engine with all other objects on the keyring held away from the ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).	
B16021 RETRIEVE THE DTCS	
1	

 2 Scan Tool 3 4 Clear Continuous DTCs 5 PATS On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Is DTC B1602 retrieved?** → **Yes** GO to B16022 . → **No** System is OK. CHECK all customer encoded ignition keys with PATS On-Demand Self-Test to verify all other keys are programmed.
B16022 INSTALL A NEW ENCODED IGNITION KEY	
1 3	2 **NOTE:** Check to make sure the customer and replacement encoded ignition keys are approved Ford encoded PATS ignition keys. Unapproved PATS keys do not always operate correctly over different temperature ranges (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved encoded ignition keys). Cut a new encoded ignition key.

4 Program a new encoded ignition key; refer to Key Programming—Erase All Key Codes and Program Two Keys .

5

PATS On-Demand Self-Test

- **Is DTC B1602 retrieved?**

→ **Yes**
GO to B16023 .

→ **No**
System is OK. If the customer has any remaining encoded keys at home, instruct them to CARRY OUT Key Programming—Program a Key Using Two Programmed Keys on each remaining key. This procedure is detailed in the Owners Manual.

B16023 INSTALL A NEW PATS TRANSCEIVER

1

2 INSTALL a new PATS transceiver; refer to Module—Passive Anti-Theft Transceiver .

3

4

PATS On-Demand Self-Test

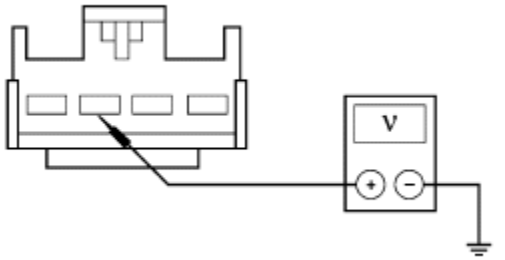
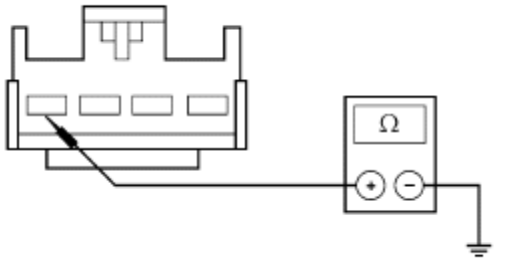
- **Are any DTCs retrieved?**

→ **Yes**
REFER to PATS Module Diagnostic Trouble Code (DTC) Index.

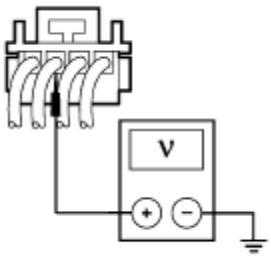
→ **No**
System is OK.

PINPOINT TEST B1681: PATS TRANSCEIVER SIGNAL IS NOT RECEIVED (NOT CONNECTED, DAMAGED, OR WIRING)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B16811 RETRIEVE THE DTCS	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 PATS On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Is DTC B1681 retrieved?** → **Yes** GO to B16812 . → **No** System is OK.
B16812 CHECK THE PATS TRANSCEIVER FOR VOLTAGE — CIRCUIT 936 (DG/W)	
1 2 PATS Transceiver C221	

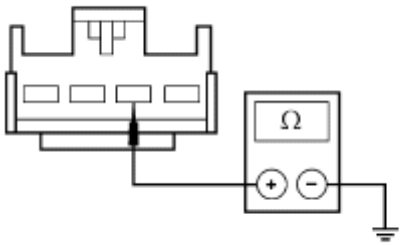
3 4  GK2493-A	4 Measure the voltage between PATS transceiver C221-2, Circuit 936 (DG/W), and ground. • **Is the voltage greater than 9 volts?** → **Yes** GO to B16813 . → **No** REPAIR Circuit 936 (DG/W). CLEAR the DTCs. TEST the system for normal operation.
B16813 CHECK THE PATS TRANSCEIVER GROUND — CIRCUIT 651 (BK/Y)	
1 2  GK2494-A	2 Measure the resistance between PATS transceiver C221-1, Circuit 651 (BK/Y), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to B16814 . → **No** REPAIR Circuit 651 (BK/Y). CLEAR the DTCs. TEST the system for normal operation.

B16814 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR VOLTAGE — CIRCUIT 1216 (GY/O)

1 PATS Transceiver C221 2 3  GK6413-A	3 Measure the voltage by back probing between PATS transceiver C221-3, Circuit 1216 (GY/O), and ground. • **Is the voltage greater than 9 volts?** → **Yes** GO to B16816 . → **No** GO to B16815 .

B16815 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR SHORT — CIRCUIT 1216 (GY/O)

1 2 PATS Transceiver C221 3	3 Measure the resistance between PATS transceiver C221-3, Circuit 1216 (GY/O), and ground.



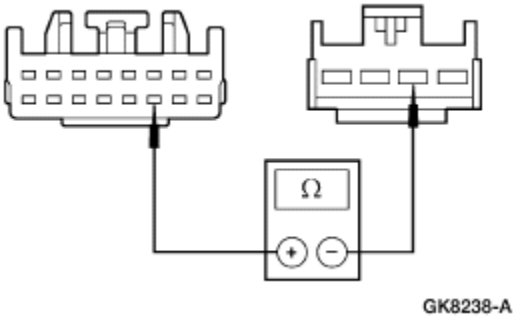
- **Is the resistance greater than 100 ohms?**

→ **Yes**
GO to B16816 .

→ **No**
CHECK Circuit 1216 (GY/O) for short to ground. If the circuit is OK, INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. If the circuit is not OK, REPAIR Circuit 1216 (GY/O). CLEAR the DTCs. TEST the system for normal operation.

B16816 CHECK CIRCUIT 1216 (GY/O) FOR OPEN

1



1 Measure the resistance between PATS transceiver C221-3, Circuit 1216 (GY/O), and PATS C222-11, circuit 1216 (GY/O).

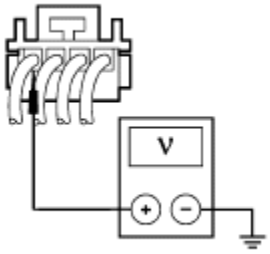
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B16817 .

→ **No**
REPAIR Circuit 1216 (GY/O). CLEAR the DTCs. TEST the system for normal operation.

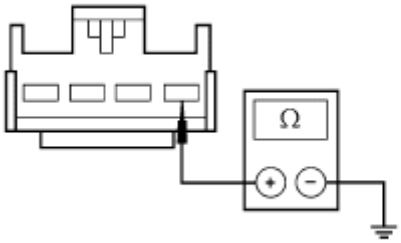
B16817 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE — CIRCUIT 1215 (W/LG)

1

 2 PATS Transceiver C221 3 4  GK6414-A	4 Measure the voltage by back probing between PATS transceiver C221-4, Circuit 1215 (W/LG), and ground. • **Is the voltage greater than 9 volts?** → **Yes** GO to B16819 . → **No** GO to B16818 .

B16818 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR OPEN — CIRCUIT 1215 (W/LG)

1 2 PATS Transceiver C221 3	3 Measure the resistance between PATS transceiver C221-4, Circuit 1215 (W/LG), and ground.



GK6405-A

- **Is the resistance greater than 100 ohms?**

→ **Yes**
GO to B16819 .

→ **No**
CHECK Circuit 1215 (W/LG) for short to ground. If the circuit is OK, INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. If the circuit is not OK, REPAIR Circuit 1215 (W/LG). CLEAR the DTCs. TEST the system for normal operation.

B16819 CHECK THE PATS TRANSMIT CIRCUIT FOR CORRECT OPERATION — CIRCUIT 1215 (W/LG)

1

PATS Transceiver C221

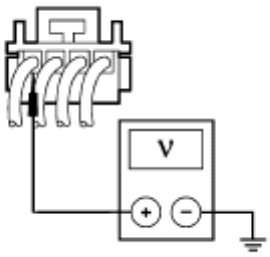
2

3

3 Trigger the PATS active command TRANSMIT SIGNAL COMMAND to ON.

4

4 Measure the voltage by back probing between PATS transceiver C221-4, Circuit 1215 (W/LG), and ground.



GK6414-A

- **Does the voltage drop from greater than 9 volts to less than 1 volt when the PATS active command is triggered on?**

→ **Yes**
GO to B168110 .

→ **No**
CHECK Circuit 1215 (W/LG) for continuity to PATS module C222-13. If the circuit is OK, INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. If the circuit is not OK, REPAIR Circuit 1215 (W/LG). CLEAR the DTCs. TEST the system for normal operation.

B168110 CHECK THE PATS SYSTEM WITH NEW PATS TRANSCEIVER

1

2 INSTALL a new PATS transceiver; refer to Module—Passive Anti-Theft Transceiver .

3

4

PATS On-Demand Self-Test

- **Is DTC B1681 retrieved?**

→ **Yes**

	GO to B168111 . → **No** System is OK.
B168111 CHECK THE PATS SYSTEM WITH NEW PATS MODULE	
1 3 4 PATS On-Demand Self-Test	2 INSTALL a new PATS module; refer to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139. CLEAR the DTCs. TEST the system for normal operation. • **Is DTC B1681 retrieved?** → **Yes** REPAIR Circuit 651 (BK/Y), 936 (DG/W), 1215 (W/LG), and 1216 (GY/O). CLEAR the DTCs. TEST the system for normal operation. → **No** If no DTCs are retrieved, the system is OK. If other DTCs are retrieved, REFER to PATS Diagnostic Trouble Code (DTC) Index.

PINPOINT TEST B2139: PCM ID DOES NOT MATCH BETWEEN PATS AND PCM

CONDITIONS	DETAILS/RESULTS/ACTIONS
B21391 RETRIEVE THE DTCS	
1 2	

Scan Tool

3

4

Clear Continuous DTCs

5

6

7

3 Retrieve and document continuous DTCs.

7 Retrieve continuous DTCs.

- **Is DTC B2139 retrieved?**

→ **Yes**
GO to B21392 .

→ **No**
System is OK.

B21392 CLEAR PCM ID FROM PATS MODULE AND PCM

1 Perform the security access procedure for the PATS Module; refer to Security Access—Procedure .

2

2 **NOTE:** Do not perform ignition key code erase.

Select PARAMETER RESET command for PATS.

3

3 Use diagnostic card for PCM Active Command Keep Alive Memory Reset.

4	
5	5 Turn the ignition switch to RUN for 30 seconds.
6	6 Clear continuous DTCs.
7	
8	8 Retrieve continuous DTCs.
	• **Is DTC B2139 retrieved?** → **Yes** VERIFY PCM calibration is correct for the vehicle. If correct, repeat Step 2. If fault code persists, INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. If DTC B2139 still exists, INSTALL a new PCM; GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. → **No** System is OK. CHECK for any other DTCs. FOLLOW Diagnostic Trouble Code (DTC) Index.

PINPOINT TEST B2141: NO SECURITY ID EXCHANGE BETWEEN PATS AND PCM

CONDITIONS	DETAILS/RESULTS/ACTIONS
B21411 RETRIEVE THE DTCS	
1 2	

Scan Tool

3

4

Clear Continuous DTCs

5

3 Retrieve and document continuous DTCs.

5 Key OFF then key ON and retrieve continuous DTCs.

- **Are any DTCs retrieved?**

→ **Yes**
If DTC B2141 only is retrieved, GO to B21412 .

If DTC U1147 is retrieved with DTC B2141, GO to Pinpoint Test U1147 .

→ **No**
System is OK.

B21412 PERFORM KEEP ALIVE MEMORY RESET FROM PCM

1

2

3

4

1 Use diagnostic card for PCM Active Command Keep Alive Memory Reset.

3 Leave key on for 30 seconds.

4 Start vehicle.

	• **Does the vehicle start?** → **Yes** System is OK. → **No** GO to B21413 .
B21413 RETRIEVE THE PATS DTCS	
1 Clear Continuous DTCs 2 3 4 5 PATS On-Demand Self-Test	• **Is DTC B2141 retrieved?** → **Yes** REPEAT B2141-2. If the fault persists, verify the PCM calibration. If the calibration is OK, INSTALL a new PATS. REFER to Section 413-01 . Cycle the ignition key to run using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. → **No** REFER to the DTC index.

PINPOINT TEST U1147: FAULTY SCP LINK OR INCORRECT PCM CALIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS

U11471 CHECK THE ANTI-THEFT INDICATOR FOR CORRECT OPERATION	
1 	2 Verify the theft indicator proves out correctly. • **Does the vehicle start once the theft indicator proves out?** → **Yes** If the vehicle starts, VERIFY correct PCM Calibration for vehicle. REFER to Section 3A in the Powertrain Control/Emissions Diagnosis (PC/ED) manual. → **No** GO to U11472 .
U11472 CHECK THE PCM DIAGNOSTIC CAPABILITY	
1 Scan Tool 2 3 Clear Continuous DTCs 4 PCM Self-Test	2 Retrieve and document continuous DTCs. • **Does scan tool communicate with the PCM?** → **Yes** GO to U11473 . → **No** DIAGNOSE the module communication network; REFER to Section 418-00 .
U11473 RETRIEVE THE PCM DTCS	
1	1 Retrieve and document continuous DTCs.

- **Is DTC P1260 retrieved?**

→ **Yes**
GO to U11474 .

→ **No**
VERIFY PCM power and ground. REFER to Section 3A in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

U11474 CHECK THE COMMUNICATION NETWORK

1 Repeat Inspection and Verification steps three through seven; refer to Inspection and Verification.

2

3 Retrieve and document continuous DTCs.

3

4

Clear Continuous DTCs

5

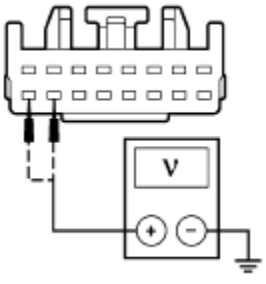
PATS On-Demand Self-Test

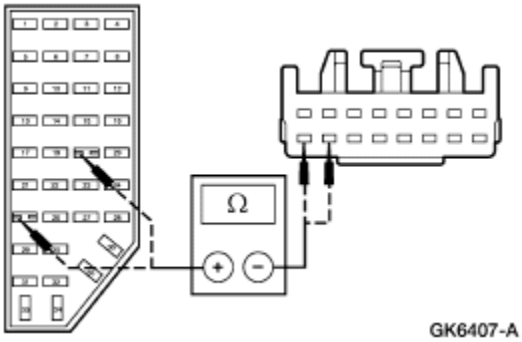
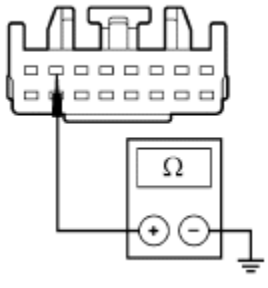
- **Is DTC U1147 retrieved?**

→ **Yes**
INSTALL a new PATS module; REFER to Module—Passive Anti-Theft System (PATS) . CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test B2139 . CLEAR the DTCs. TEST the system for normal operation. If DTC U1147 is still present, INSTALL a new PCM; GO to Pinpoint Test B2139 . CLEAR DTCs. TEST the system for normal operation.

→ **No**
System is OK.

PINPOINT TEST A: NO COMMUNICATION WITH THE MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FUSE JUNCTION PANEL FUSES 25 (7.5A), FUSE 24 (7.5A) AND FUSE 19 (25A)	
	1 Check fuse junction panel Fuse 25 (7.5A), Fuse 24 (7.5A) and Fuse 19 (25A). • **Are the fuses OK?** → **Yes** GO to A2 . → **No** INSTALL a new fuse(s). TEST the system for normal operation. If the fuse(s) fail(s) again, CHECK for short to ground. REPAIR as necessary.
A2 CHECK THE PATS MODULE FOR VOLTAGE — CIRCUITS 16 (R/LG) AND 1002 (W/Y)	
1 2 PATS Module C222 3 4  GK6406-A	4 Measure the voltage between PATS module C222-15, Circuit 1001 (W/Y), and ground; and between PATS module C222-16, Circuit 16 (R/LG), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to A4 .

	→ **No** GO to A3.
A3 CHECK CIRCUITS 16 (R/LG) AND 1001 (W/Y) FOR OPEN	
1 2 3  GK6407-A	1 Fuse junction panel Fuse 25 (7.5A). 2 Fuse junction panel Fuse 19 (25A). 3 Measure the resistance between PATS module C222-15, Circuit 1001 (W/Y), and fuse junction panel Fuse 25 (7.5A), pin 1; and between PATS module C222-16, Circuit 16 (R/LG), and fuse junction panel Fuse 19 (25A), pin 1. • **Are the resistances less than 5 ohms?** → **Yes** REPAIR Circuit(s) 1052 (T/BK) and/or 1050 (LG/P). CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR Circuit(s) 1001 (W/Y) and/or 16 (R/LG). CLEAR the DTCs. TEST the system for normal operation.
A4 CHECK CIRCUIT 570 (BK/W) FOR OPEN	
1  GK6408-A	1 Measure the resistance between PATS module C222-7, Circuit 570 (BK/W), and ground. • **Is the resistance less than 5 ohms?**

	→ **Yes** REFER to Section 418-00 . → **No** REPAIR Circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST B: THE ANTI-THEFT IS ALWAYS/NEVER ON — NO 3 SECOND ANTI-THEFT INDICATOR PROVE OUT

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE THEFT LED FOR CORRECT PROVE OUT	
1 2 	3 Observe the theft LED for at least three seconds while turning the ignition switch to RUN. • **Does the LED fail to flash every two seconds when the ignition is off, but prove out normally (remain illuminated for three seconds) when the ignition is turned to RUN?** → **Yes** REPAIR Circuit 1001 (W/Y). TEST the system for normal operation. If the indicator still does not illuminate correctly, INSTALL a new PATS module. CYCLE the ignition to run using two encoded ignition keys. GO to Pinpoint Test B2139. → **No** GO to B2 .
B2 CHECK THE THEFT INDICATOR FOR ON CONTINUOUS	
	1 Turn the ignition to run and observe the theft indicator for at least 10 seconds. • **Does the theft indicator remain illuminated?** → **Yes**

	Perform the PATS on-demand self-test and CHECK for stored DTCs. If DTCs are retrieved, REFER to PATS DTC Index. If no DTCs are retrieved, GO to B3 . → **No** GO to B5 .
B3 CHECK THE THEFT INDICATOR CIRCUIT FOR SHORT TO BATTERY	
1 2 PATS C222 3 	• **Does the theft indicator remain illuminated?** → **Yes** CHECK Circuit 343 (DB/LG) for short to power. TEST the system for normal operation. → **No** GO to B4 .
B4 CHECK THE THEFT INDICATOR USING THE ACTIVE COMMAND THEFT LAMP	
1 2 PATS C222 3 4	4 Trigger the PATS active command THEFT LMP ON and OFF.

- **Does the theft indicator illuminate when the active command is triggered ON and go off when the active command is triggered OFF?**

→ **Yes**
CARRY OUT the PATS on-demand self-test and check for stored DTCs. If DTCs are retrieved, REFER to PATS DTC Index. If no DTCs are retrieved, INSTALL a new PATS module. REFER to Module—Passive Anti-Theft Transceiver .

→ **No**
INSTALL a new PATS module. REFER to Module—Passive Anti-Theft Transceiver . CYCLE the ignition to run. GO to Pinpoint Test B2139 .

B5 ENTER THE PATS ACTIVE COMMAND MODE

1

2

2 Enter the PATS active command mode.

- **Can the PATS active command mode be entered?**

→ **Yes**
GO to B6 .

→ **No**
GO to Pinpoint Test A .

B6 CHECK THE THEFT INDICATOR — TRIGGER THE PATS ACTIVE COMMAND THEFT LMP ON

1

2

2 Trigger the PATS active command THEFT LMP ON.

- **Does the theft indicator illuminate?**

→ **Yes**
System OK.

→ **No**
GO to B7 .

B7 CHECK PATS MODULE OUTPUT TO THE THEFT INDICATOR FOR VOLTAGE — CIRCUIT 343 (DB/BK)

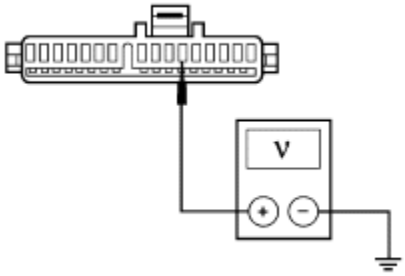
1

2

Instrument Cluster C286

3

4



GK6409-A

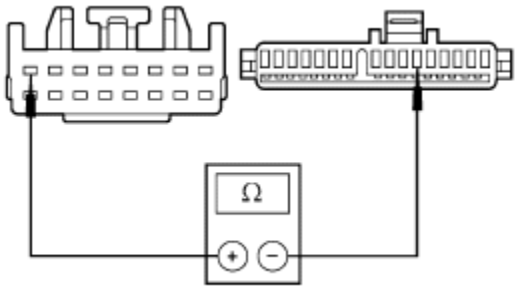
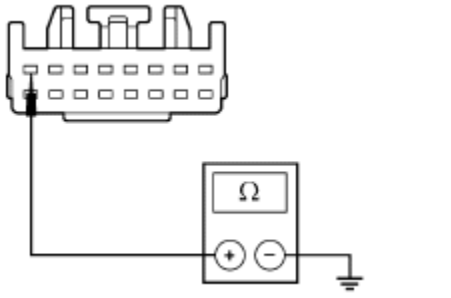
4 Measure the voltage between instrument cluster C286-6, Circuit 343 (DB/LG), and ground.

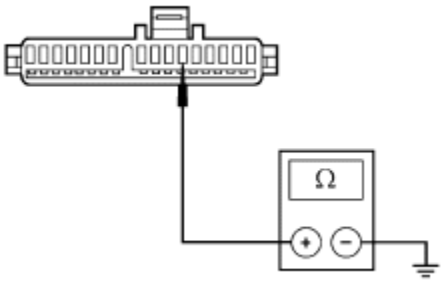
- **Is the voltage greater than 9 volts?**

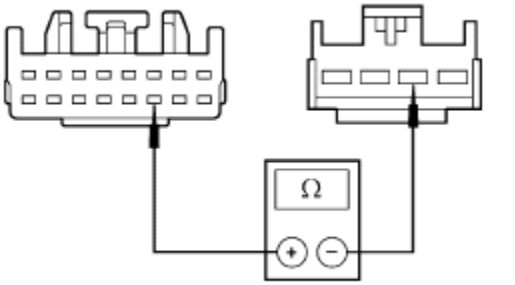
→ **Yes**
GO to B11 .

→ **No**
GO to B8 .

B8 CHECK FOR CONTINUITY BETWEEN THE THEFT INDICATOR AND PATS MODULE — CIRCUIT 343 (DB/LG)

1 2 PATS Module C222 3  GK8235-A	3 Measure the resistance between PATS module C222-8, Circuit 343 (DB/LG), and instrument cluster C286-6, Circuit 343 (DB/LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to B9 . → **No** REPAIR Circuit 343 (DB/LG). TEST the system for normal operation.
B9 CHECK FOR SHORT BETWEEN THE THEFT INDICATOR AND PATS MODULE — CIRCUIT 343 (DB/LG)	
1  GK8236-A	1 Measure the resistance between PATS module C222-8, Circuit 343 (DB/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B10 .

	→ **No** REPAIR Circuit 343 (DB/LG). TEST the system for normal operation.
B10 CHECK THE PATS MODULE FOR OUTPUT TO THE INDICATOR FOR VOLTAGE — CIRCUIT 343 (DB/LG)	
1 PATS C222 2 3 4  GK8237-A	3 Trigger the PATS active command THEFT LMP ON. 4 Measure the resistance between instrument cluster C286-6, Circuit 343 (DB/LG), and ground. • **Is the voltage greater than 9 volts?** → **Yes** GO to B11 . → **No** INSTALL a new PATS module. REFER to Module—Passive Anti-Theft Transceiver .
B11 CHECK THE THEFT INDICATOR GROUND FOR OPEN	
1 2 	

Theft Indicator 3  GK8238-A	3 Measure the resistance between instrument cluster C286, Pin 7, and theft indicator socket ground terminal. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new THEFT LED. TEST the system for normal operation. → **No** REPAIR or INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation.

Key Programming —Program a Key Using Two Programmed Keys

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

NOTE: This procedure only works if two or more programmed ignition keys are available, and it is desired to program additional key(s). If two keys are not available, refer to Key Programming—Erase All Key Codes and Program Two Keys in this section.

NOTE: PID SPARE_ KY must be enabled for this procedure to operate. If this PID is not enabled, refer to Security Access—Procedure in this section. With scan tool, select Spare Key Programming Switch: Enabled.

NOTE: If the programming procedure is successful, the new key(s) will start the vehicle and the THEFT INDICATOR will illuminate for approximately three seconds.

NOTE: If the programming procedure is not successful, the new key(s) will not start the vehicle and the THEFT INDICATOR will flash. If the programming procedure was not successful, repeat the Key Programming procedure from Step 1. If the failure repeats, refer to Diagnosis and Testing in this section to review diagnostic trouble codes (DTCs) and perform pinpoint tests as required.

NOTE: A maximum of eight ignition keys can be programmed to a passive anti-theft system (PATS) equipped vehicle. Use PID NUMKEYS to determine how many keys are programmed to the vehicle.

NOTE: If the steps are not performed as outlined, the programming procedure will end.

NOTE: Ignition keys must have correct mechanical key cut for the vehicle and must be a PATS encoded key.

1. Insert the first programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

2. Turn the ignition switch to OFF and remove the first key from the ignition lock cylinder.

3. Within five seconds of turning the ignition switch to OFF, insert the second programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

4. Turn the ignition switch to OFF and remove the second key from the ignition lock cylinder.

5. Within 10 seconds of turning the ignition lock cylinder to OFF, insert the unprogrammed ignition key (new key) into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for 1 second).

6. If it is desired to program additional key(s), repeat the applicable key programming procedure from the beginning.

Key Programming —Erase All Key Codes and Program Two Keys

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

NOTE: This procedure is used when a customer needs keys programmed into the system and does not have two programmed ignition keys available. This procedure is also useful when programmed ignition key (s) have been lost and/or the ignition switch assembly has been replaced, and it is desired to erase key(s) from the passive anti-theft system (PATS) memory.

NOTE: This procedure will erase all programmed ignition keys from the vehicle memory and the vehicle will not start until two keys have been reprogrammed to the vehicle.

NOTE: Two PATS encoded keys with the correct mechanical cut must be available to perform this procedure. One or both of them may be the customer's original keys.

NOTE: If additional keys are to be programmed, refer to Key Programming—Program a Key Using Two Programmed Keys . If the remaining keys are with the customer and are not available with the vehicle, then instruct the customer to refer to the Owner's Guide under the "Programming Spare [SecuriLock® (North America), Safeguard® (U.K.), or PATS for all other markets] Keys Procedure," for instructions on programming the remaining keys.

1. Turn the ignition switch from OFF to RUN.
2. Enter scan tool. Follow the SECURITY ACCESS PROCEDURE to obtain security access.
3. From scan tool menu, select IGNITION KEY CODE ERASE.
4. **NOTE:** DO NOT select any additional commands from this menu.

   Turn the ignition switch to OFF and disconnect scan tool.
5. Insert the first encoded key into the ignition lock cylinder and turn the switch to RUN for three seconds.
6. Insert the second encoded key into the ignition lock cylinder and turn the switch to RUN for three seconds.
7. The vehicle should now start with both ignition keys.

Key Programming —Spare Key Programming Switch

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

NOTE: The Spare Key Programming Switch is a scan tool programmable switch that provides the capability to enable/disable the Spare Key Programming Procedure. This procedure is in the Owner's Guide Spare Key Programming Procedure or in this section under Key Programming—Program a Key Using Two Programmed Keys . This programmable switch is provided as a convenience for rental company fleets or other fleet purchasers who may not want the Spare Key Programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed by PATS PID SPARE_KY.

1. Insert a programmed ignition key into the ignition lock cylinder and turn the ignition switch to RUN.

2. Enter scan tool. Follow the SECURITY ACCESS PROCEDURE to obtain security access.

3. **NOTE:** The default setting on delivery of all new vehicles is <ENABLE>.

   From scan tool menu, select SPARE KEY PROGRAMMING SWITCH selection to desired setting:
   - <ENABLE> Spare Key Programming Procedure is accessible.
   - <DISABLE> Spare Key Programming Procedure is not accessible.

Key Programming —With Diagnostic Equipment

NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but does not have two programmed keys available. This procedure is also useful when attempting to determine if an ignition key is defective, as a new key can be installed without erasing keys or without having two programmed keys available.

NOTE: Before programming, the new key must have the correct mechanical cut for the ignition lock.

NOTE: If eight keys are already programmed, this procedure will not allow any further ignition keys to be programmed without erasing all stored key codes first. The number of keys programmed into the system can be determined using the PID NUMKEYS.

1. Turn the ignition switch from the OFF position to the RUN position using the new, unprogrammed ignition key.

2. Enter scan tool using the Ford Service Function (FSF) card and enter the appropriate instrument cluster. Follow Security Access to obtain security access. For additional information, refer to Security Access—Procedure in this section.

3. From the scan tool menu, select: IGNITION KEY CODE PROGRAM.

4. Turn the ignition switch to the OFF position and disconnect the scan tool.

5. Attempt to start the engine with the new ignition key. The vehicle engine should start and run normally.

Security Access —Procedure

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

NOTE: The Security Access Procedure is utilized to obtain passive anti-theft system (PATS) security access. PATS security access must be granted to erase ignition keys, enable/disable the spare key programming switch (PID SPARE_KY) or perform a parameter reset for PATS, and may be required to program ignition keys. The Security Access Procedure invokes an inherent 10-minute time delay prior to granting security access during which scan tool must remain connected to the vehicle. Once security access has been granted, a security access command menu is displayed which offers various command options (refer to PATS Configuration Command Index).

NOTE: Select only the command required by the appropriate pinpoint test.

1. From scan tool: Using service card, select PATS. Enter SECURITY ACCESS PROCEDURE. This procedure will take 10 minutes to perform, during which the ignition switch must be in RUN and the scan tool must be connected to the vehicle.

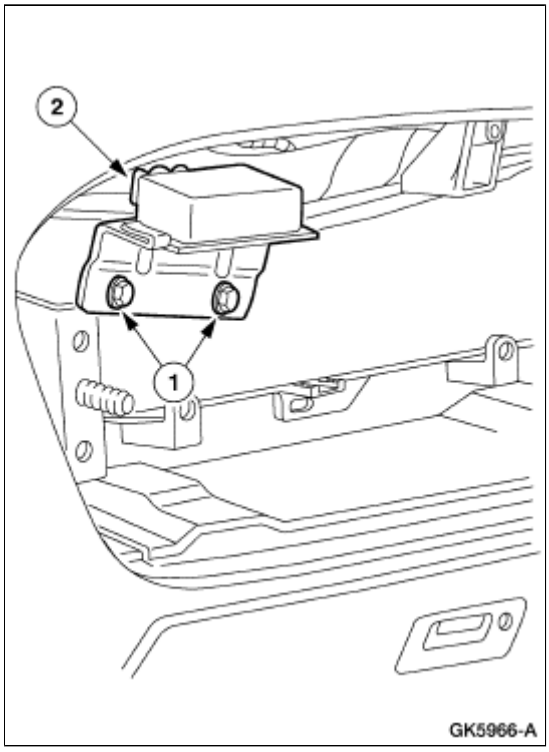
2. After the 10-minute security access procedure has been completed, a new menu will be displayed with command options. Select only those functions required before exiting out of this menu. Once exited out of this menu, the security access procedure must be performed again to perform additional commands.

Module —Passive Anti-Theft System (PATS)

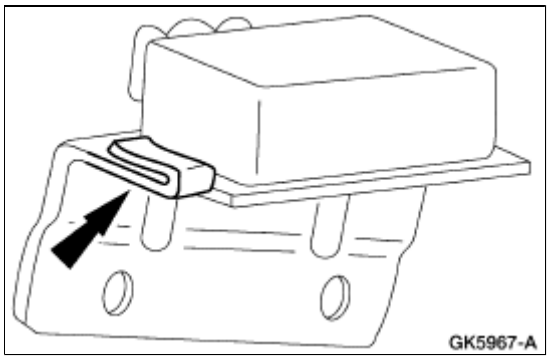
Removal

1. Remove the passenger side air bag module; refer to Section 501-20B .

2. Remove the passive anti-theft system (PATS) module and bracket.
    1. Remove the bolts.
    2. Disconnect the electrical connector.



3. Release the retainer tabs and remove the PATS module from the bracket.

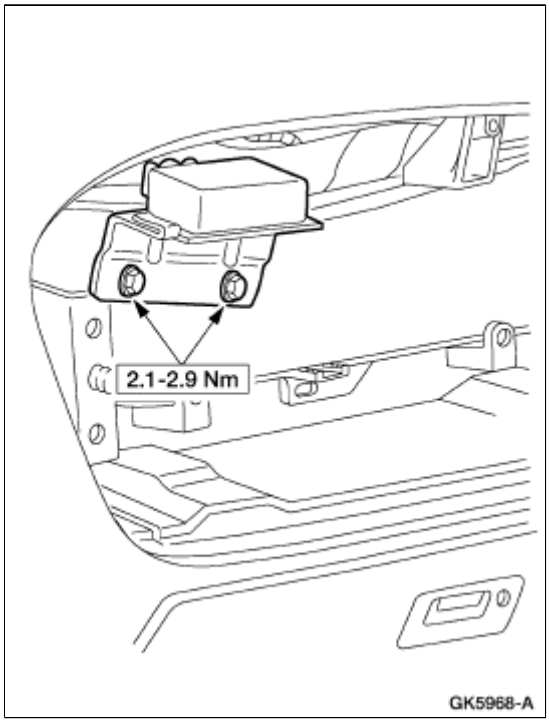


Installation

1. **NOTE:** Prior to starting the vehicle, check for PATS DTCs. Perform the appropriate pinpoint test.

   NOTE: When the PATS module is replaced, both ignition keys must be relearned and stored in memory. Insert each key in the ignition and turn to RUN for automatic programming.

   To install, reverse the removal procedure.



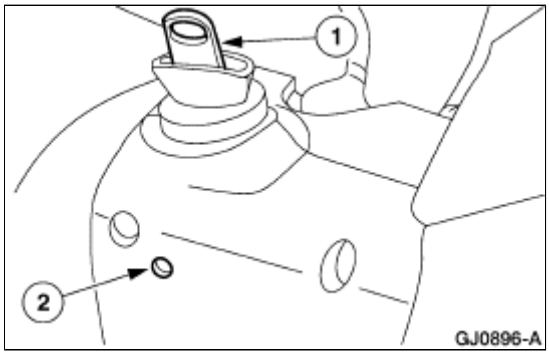
Module —Passive Anti-Theft Transceiver

Removal

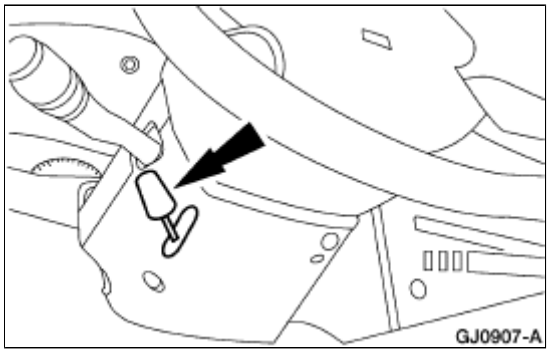
1. **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   Disconnect the battery ground cable.

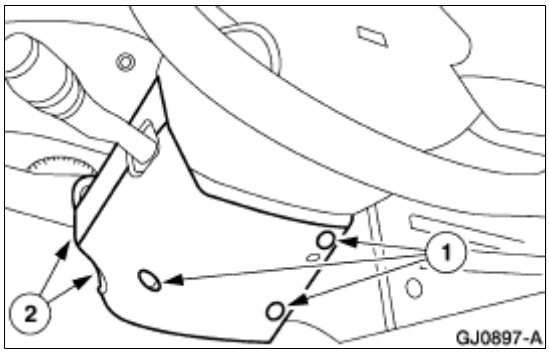
2. Remove the ignition switch lock cylinder (11582).
   1. Insert the ignition key into the ignition switch lock cylinder and turn to the RUN position.
   2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.



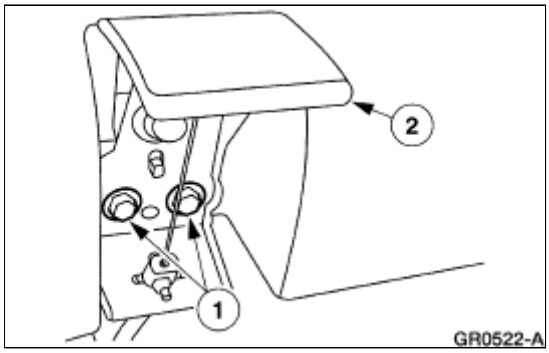
3. Twist the tilt wheel handle and shank (3F609) and remove.



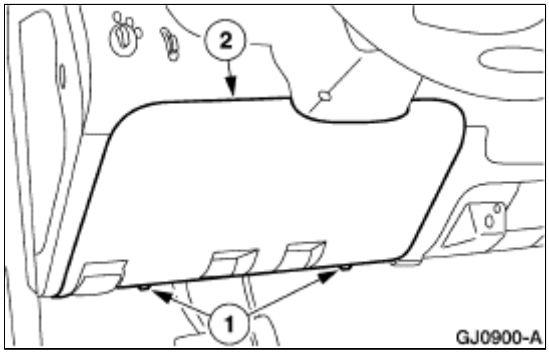
4. Remove the upper and lower steering column shrouds (3530).
   1. Remove the screws.
   2. Remove the upper and lower steering column shrouds.



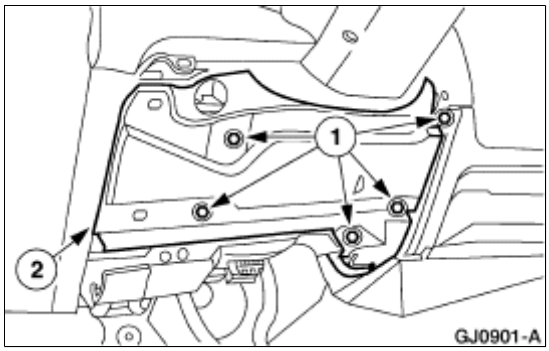
5. Remove the hood latch release handle.
    1. Remove the screws.
    2. Remove the hood latch release handle.



6. Remove the lower instrument panel steering column cover.
    1. Remove the screws.
    2. Remove the lower instrument panel steering column cover.



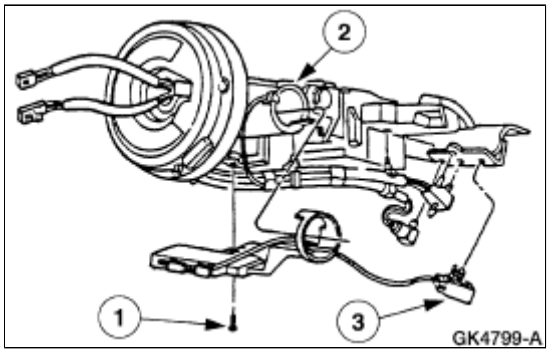
7. Remove the instrument panel steering column opening cover reinforcement (04502).
    1. Remove the screws.
    2. Remove the instrument panel steering column opening cover reinforcement.



8. **NOTE:** The steering wheel is shown removed for clarity.

   Remove the transceiver assembly.
   1. Remove the screw.
   2. **NOTE:** Only apply pressure or leverage below the key cylinder lower rib.

      Locate the rib on the steering column lock cylinder housing, and gently release the anti-theft transceiver over the rib.
   3. Disconnect the electrical connector.



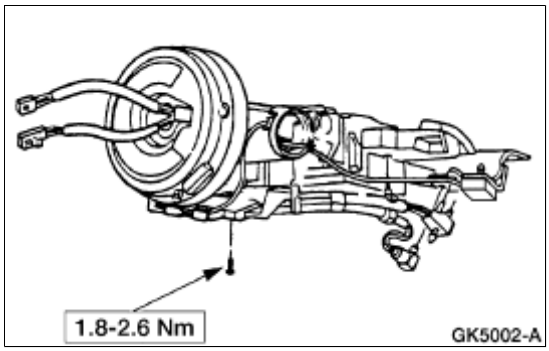
Installation

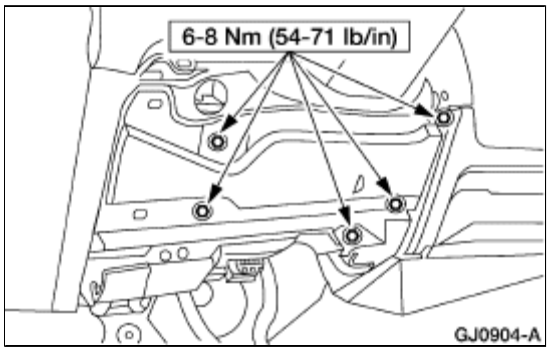
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   NOTE: No key replacement or re-initialization needs to occur with the removal or installation of a new PATS Transceiver.

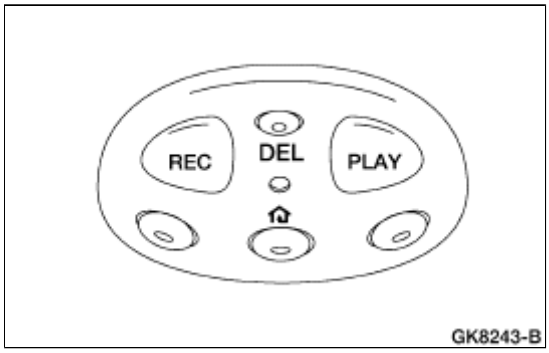
   NOTE: The steering wheel (3600) is shown removed for clarity.

   To install, reverse the removal procedure.


1.8-2.6 Nm
GK5002-A


6-8 Nm (54-71 lb/in)
GJ0904-A

Universal Transmitter



The HomeLink® with TravelNote ™ universal transmitter provides a convenient way to replace up to three hand-held transmitters with a single built-in device. The universal transmitter:

- will operate garage doors, gates and home/office lighting and security systems.
- will actually learn and transmit the radio frequency of up to three hand-held transmitters from any of the systems mentioned above.
- is an integral part of the left sun visor assembly and is powered by the vehicle battery and charging system.

In addition to the universal transmitter function, the HomeLink® with TravelNote ™ also provides a convenient built-in recording device to safely store information. For additional information, refer to the Owner's Guide.

Universal Transmitter

Refer to Wiring Diagrams Cell 89 , Courtesy Lamps for schematic and connector information.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Damaged universal transmitter • Damaged receiver

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the fault is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The universal transmitter is inoperative	• Universal transmitter. • Receiver unit.	• GO to Pinpoint Test A .
• The TravelNote ™ is inoperative—universal transmitter is operative	• TravelNote ™ .	• INSTALL a new left sun visor assembly.

Pinpoint Tests

PINPOINT TEST A: THE UNIVERSAL TRANSMITTER IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK LEFT VANITY MIRROR OPERATION	

	1 Check the illumination of the left vanity mirror lamps. • **Do the left vanity mirror lamps illuminate?** → **Yes** GO to A2 . → **No** For additional information, REFER to Section 417-02 .
A2 PROGRAM HAND-HELD TRANSMITTER INTO UNIVERSAL TRANSMITTER	
	1 **NOTE:** If the garage door is equipped with rolling codes, refer to Training a Garage Door Opener Equipped With "Rolling Codes." Program the universal transmitter; for additional information, refer to Programming . • **Did the universal transmitter program successfully?** → **Yes** The universal transmitter is OK. VERIFY receiver operation. → **No** INSTALL a new left sun visor assembly. TEST the system for normal operation.

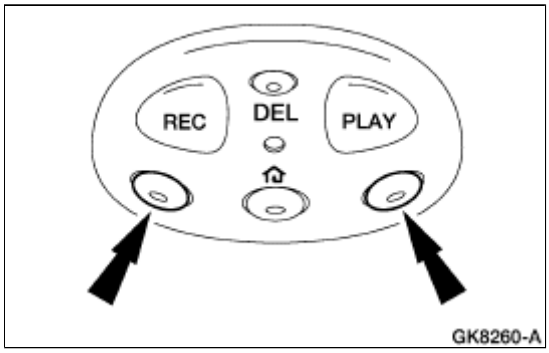
Programming

WARNING: A garage door opening system that cannot stop or reverse itself after detecting an object in its path does not meet current federal safety standards. To decrease the risk of serious injury or death, do not use this HomeLink® with TravelNote ™ transmitter with a door opening system that lacks stop and reverse features as required by federal standards. This includes any garage door opening system manufactured before April 1, 1982. For more information, call HomeLink® with TravelNote ™ customer assistance at 1-800-355-3515.

1. **CAUTION: During this procedure, the system that you are programming will be made to operate. Make sure that people or objects are clear of the garage door or gate being programmed.**

   Verify the hand-held transmitter is operative.

2. Prepare for programming the universal transmitter by erasing all three channels by holding down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

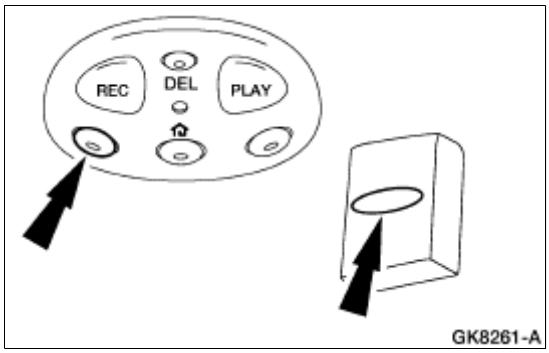


3. Select one of the three universal transmitter channels to be programmed by pressing the desired button.

4. Hold the end of the hand-held transmitter 25-51mm (1-2 in) from the front surface of the universal transmitter so that the red light can still be seen.

5. **NOTE:** During programming, the hand-held transmitter may automatically stop transmitting after two seconds, which may not be long enough to program the universal transmitter. If programming this type of hand-held transmitter, continue to hold the button on the universal transmitter while re-pressing the hand-held transmitter button every two seconds (Canada only).

   Use both hands to press the hand-held transmitter button and the desired button on the universal transmitter. Do not release either button.



6. Hold down both buttons until the red light on the universal transmitter flashes, first slowly and then rapidly. Release both buttons when the rapid flashing begins. The universal transmitter has successfully learned the new frequency signal and can be used in place of the hand-held transmitter (s).

7. **NOTE:** If the hand-held transmitter appears to program the universal transmitter but does not open the garage door, the garage door opener may have a "code protected" or "rolling code" feature.

   To operate, simply press the appropriate button on the universal transmitter. The red light is on while the signal is being transmitted.

Training a Garage Door Opener Equipped With "Rolling Codes"

8. Program the hand-held transmitter to the universal transmitter; for additional information, refer to Programming .

9. Train the garage door opener receiver to recognize the universal transmitter.
   1. Remove the cover panel from the garage door opener receiver.
   2. Locate the training button on the garage door opener receiver. Location and color of the button may vary by garage door opener manufacturer. Refer to the garage door opener instruction manual or call HomeLink® with TravelNote ™ customer assistance at 1-800-355-3515.
   3. Press the training button on the garage door opener receiver for 1-2 seconds.
   4. Press the programmed universal transmitter button for as long as the universal transmitter red light flashes (1-2 seconds). Release the button and re-press the button to confirm that the universal transmitter is trained to the receiver.
   5. The garage door opener should recognize the universal transmitter.

Erasing Channels

1. **NOTE:** Individual channels cannot be erased, but can be reprogrammed using the procedures for programming; for additional information, refer to Programming .

   To erase all three programmed channels, hold down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

Torque Specifications

Description	Nm	lb-in
Battery Ground Cable Screw	7-10	62-89
GEM/CTM Screw	1.6-2	9-18
Remote Anti-Theft Personality (RAP) Module	2.3-3.3	21-29

Module Controlled Functions

The multifunction modules consist of the following:

- generic electronic module (GEM)/central timer module (CTM)
- remote anti-theft personality (RAP) module (15K602)

The remote anti-theft personality (RAP) module controls the keyless entry, and computer operated locks systems.

The GEM/CTM controls the following features:

- wiper/washer (front/rear)
- warning chime
- battery saver
- illuminated entry and courtesy lamps
- driver one touch down power window (GEM only)
- accessory delay
- 4 wheel drive (GEM only)

Multifunction Electronic Module

For 4-wheel drive concerns, refer to Section 308-07A .

For warning chime concerns, refer to Section 413-09 .

For courtesy lamps/illuminated entry and battery saver concerns, refer to Section 417-02 .

For one-touch window concerns, refer to Section 501-11 .

For wiper/washer control and interval timer concerns, refer to Section 501-16 .

For keyless entry concerns, refer to Section 501-14B .

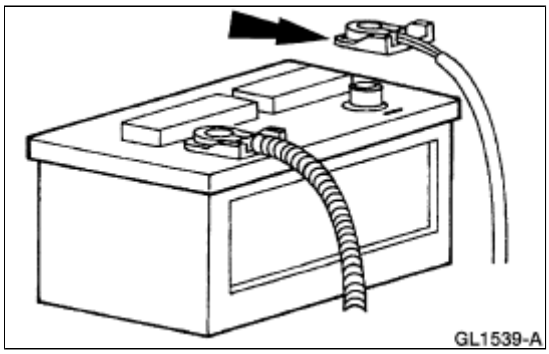
For passive anti-theft concerns, refer to Section 419-01 .

Module —Generic Electronic (GEM)/Central Timer (CTM)

Removal

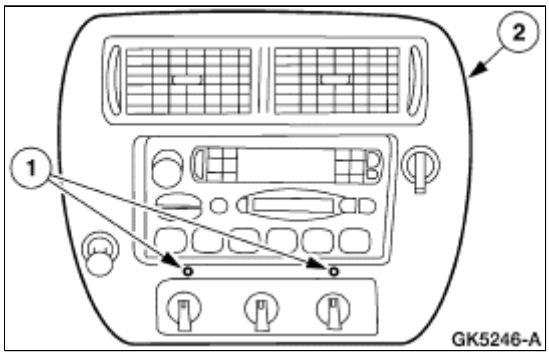
1. **CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

   Disconnect the battery ground cable (14301).

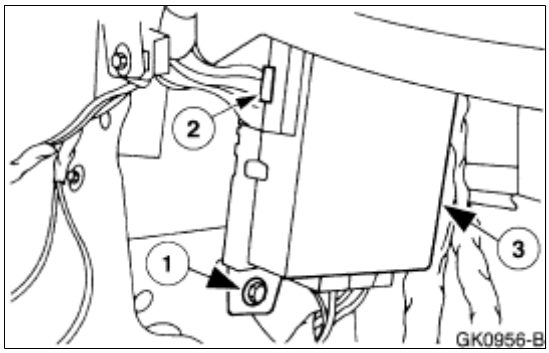


2. Remove the radio chassis (18806) ; refer to Section 415-01 .

3. Remove the center instrument panel finish panel.
   1. Remove the screws.
   2. Remove the center instrument panel finish panel.
      - Disconnect the electrical connectors.



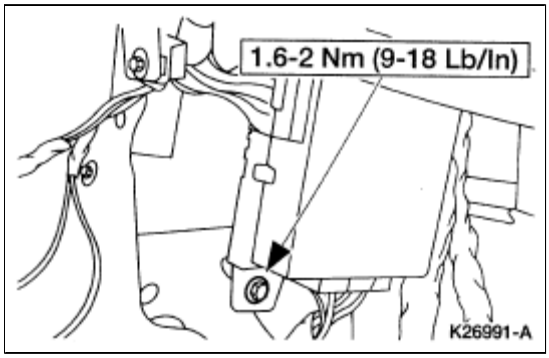
4. Remove the GEM/CTM.
   1. Remove the screw.
   2. Disconnect the four connectors from the GEM/CTM.
   3. Remove the GEM/CTM.



Installation

1. **NOTE:** When the battery (10655) i s disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

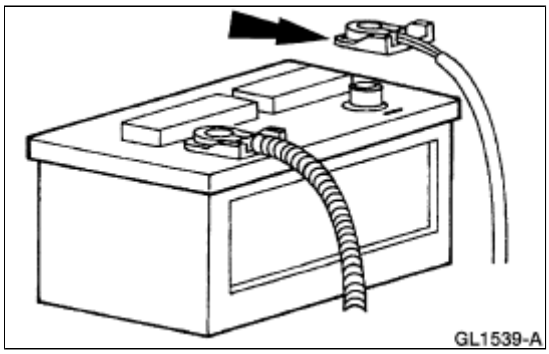


Module —Remote Anti-Theft Personality (RAP)

Removal

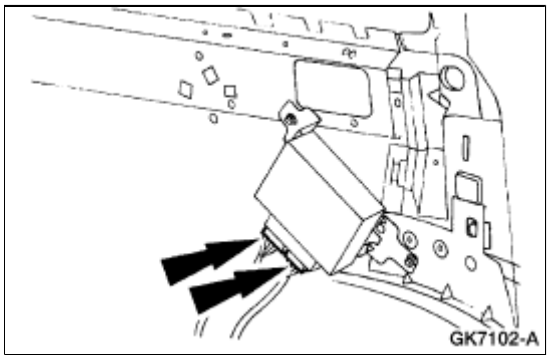
1. **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these static charges, damage may result.**

   Disconnect the battery ground cable.

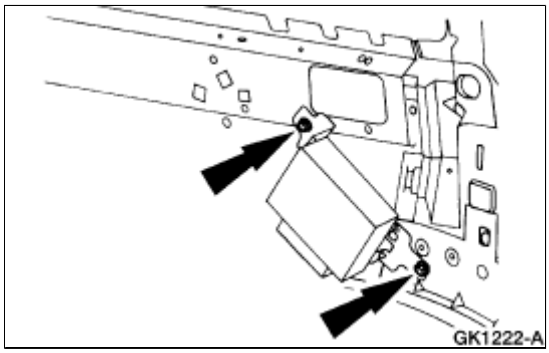


2. Remove the LH rear quarter trim panel; refer to Section 501-05 .

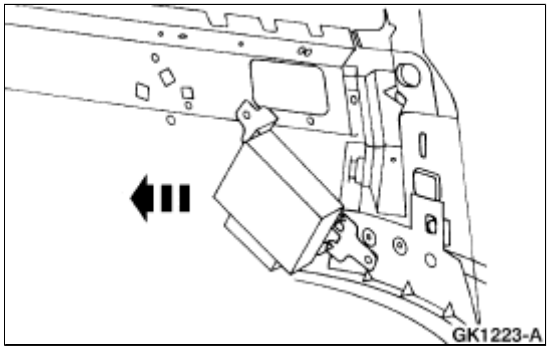
3. Disconnect the two remote anti-theft personality (RAP) module electrical connectors.



4. Remove the two RAP module fasteners.



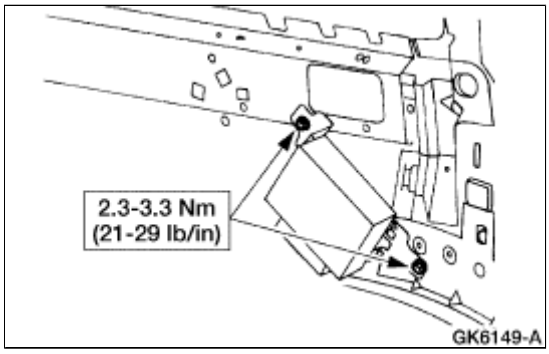
5. Remove the RAP module.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

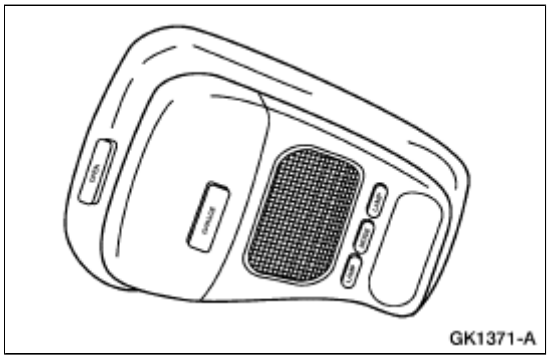


Electronic Compass

A compass and outside temperature display are contained in the overhead console.

The compass and temperature display can be turned off and on by pressing the MODE switch in the overhead console. The vehicle heading is displayed as one of N, NE, E, SE, S, SW, W, and NW.

Overhead Console



Compass Accuracy

Magnetic mounted devices like antennas and luggage racks should not be located on the front third of the vehicle roof. Placing these devices near the compass will cause inaccurate directional readings. If these devices must be used, accuracy may be improved by recalibrating the compass while the devices are installed on the vehicle.

Driving near power lines, or driving in the area of large iron or steel structures can temporarily change the compass' heading. If the compass remains inaccurate after driving near such objects, demagnetize the vehicle and recalibrate the compass.

Most geographic areas (zones) have a magnetic north compass point that varies slightly from the northerly direction on maps. This variation is four degrees between the adjacent zones and will become noticeable as the vehicle crosses multiple zones. A correct zone setting eliminates the error. Refer to Compass Zone Adjustment .

Temperature, Outside Air

The thermometer sensor (15A022) is attached to the radiator frame behind the grille. The temperature can be displayed in centigrade or Fahrenheit by pressing the MODE switch.

If the outside temperature falls below 3.3°C (38°F), the display will alternate from "ICE" to the outside temperature at a two second rate for one minute.

The outside air temperature reading can be affected by engine heat when the vehicle is idling or has been off for less than two hours. The compass and thermometer (19A548) will limit the increase of the displayed temperature to one degree per minute at very low speeds or immediately after the ignition is turned on. After two minutes at a sustained speed of at least 53 km/h (33 mph), effects of engine heat are minimal and the compass will display the current outside temperature reading. Temperature decreases are always updated immediately.

If the outside air temperature sensor is short or open circuited, then the display will show 60°C (140°F) or -40°C (-40°F) respectively in place of temperature.

Electronic Compass

Refer to Wiring Diagrams Cell 102 , Overhead Console for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the compass and thermometer (19A548).
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged compass and thermometer • Damaged thermometer sensor	• Fuse • Damaged wiring harness • Loose or corroded connections

3. If inspection reveals an obvious concern(s) that can be readily identified, repair or replace as required.
4. If the fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Compass Is Inaccurate/Inoperative	• Compass zone setting. • Compass calibration. • Vehicle magnetization. • Compass and thermometer.	• GO to Pinpoint Test A .
• The Display Does Not Light	• Compass and	• GO to

	thermometer. • Circuitry. • Panel dimmer switch.	Pinpoint Test A .
• The Display Is Locked In One Position	• Compass and thermometer. • Vehicle magnetization. • Compass calibration.	• GO to Pinpoint Test A .
• The Display Will Not Dim With the Instrument Panel Dimmer Switch	• Panel dimmer switch. • Circuitry.	• REFER to Section 413-00 .
• The Outside Air Temperature Is Inaccurate/Inoperative	• Compass and thermometer. • Thermometer sensor (15A022). • Circuitry.	• GO to Pinpoint Test B .

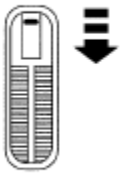
Pinpoint Tests

NOTE: Always set the zone, calibrate, and demagnetize a vehicle before replacing an inaccurate compass.

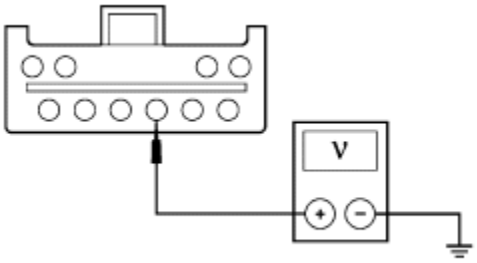
NOTE: After replacing the compass, always set the zone and calibrate.

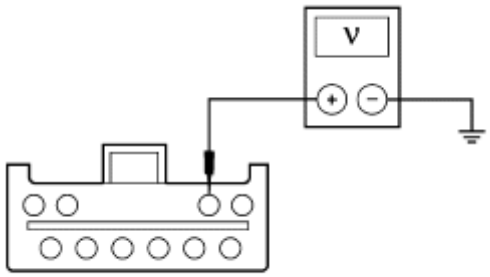
PINPOINT TEST A: THE COMPASS IS INACCURATE/INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK OVERHEAD COMPASS DISPLAY	
1 	• **Does the overhead compass display remain on after prove out?** → **Yes** GO to A3 . → **No** GO to A2 .
A2 CHECK COMPASS MODE	
	1 Press and release the MODE switch on the overhead console. • **Does the overhead compass display turn**

	on? → **Yes** If the compass display turns on properly, GO to A3 . If the compass display turns on but the heading is inoperative/inaccurate or display indicates VAR, GO to A4 . If the compass display turns on but it does not display all directions, GO to A5 . If the compass display turns on but indicates CAL, GO to A5 . → **No** GO to A8 .
A3 CHECK COMPASS DIMMING	
1 GK0182-A	1 Turn the headlamp switch to the parking lamps ON position.
2  GK4256-A	2 Rotate the panel dimmer switch. • **Does the compass display dim with the other instrumentation?** → **Yes** GO to A4 . → **No** GO to A9 .
A4 CHECK COMPASS ZONE SETTING	
	1 Set the compass to the correct zone for your location; refer to Compass Zone Adjustment . • **Could the zone be set?**

	→ **Yes** GO to A5 . → **No** REPLACE the compass and thermometer. SET the zone and CALIBRATE the compass.
A5 CALIBRATE THE COMPASS	
	1 Recalibrate the compass; refer to Calibration Adjustment . • **Could the compass be calibrated?** → **Yes** GO to A7 . → **No** GO to A6 .
A6 DEMAGNETIZE THE VEHICLE	
1 	2 Demagnetize the vehicle; refer to Vehicle Demagnetizing . 3 Recalibrate the compass; refer to Calibration Adjustment . • **Could the compass be calibrated?** → **Yes** GO to A7 . → **No** REPLACE the compass and thermometer. SET the zone and CALIBRATE the compass. TEST the system for normal operation.
A7 CHECK COMPASS ACCURACY	
	1 Position the vehicle at each of the eight directions (N, NE, E, SE, S, SW, W, NW) and verify that the displayed heading is accurate. The vehicle must be stationary for at least 10 seconds at each direction. • **Is the compass display accurate in each direction?** → **Yes** The compass is OK. REVIEW the operation of

	the compass with the customer. → **No** REPLACE the compass and thermometer. SET the zone; refer to Compass Zone Adjustment . CALIBRATE the compass; refer to Calibration Adjustment . TEST the system for normal operation.
A8 CHECK POWER SUPPLY TO COMPASS AND THERMOMETER	
1 2 Compass and Thermometer 3 4  GK6891-A	4 Measure the voltage between compass and thermometer C342-3, circuit 1003 (GY/Y), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A10 . → **No** REPAIR circuit 1003 (GY/Y) and/or BK wire to compass and thermometer. TEST the system for normal operation.
A9 CHECK DIMMING CIRCUIT	
1	1 Measure the voltage between compass and thermometer C342-8, circuit 19 (LB/R), and ground, while rotating the panel dimmer switch.



GK6892-A

- **Does the voltage vary as the switch is rotated?**

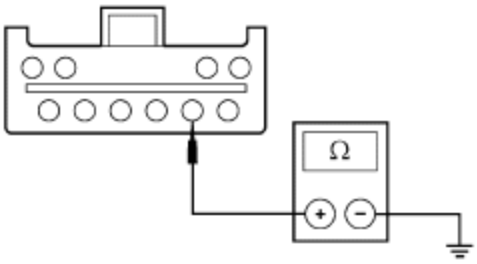
→ **Yes**
GO to A10 .

→ **No**
REFER to Section 413-00 .

A10 CHECK CIRCUIT 57 (BK) FOR OPEN

1

2



GK6893-A

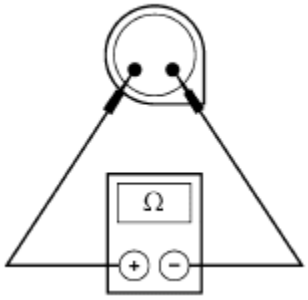
2 Measure the resistance between compass and thermometer C342-2, circuit 57 (BK), and ground.

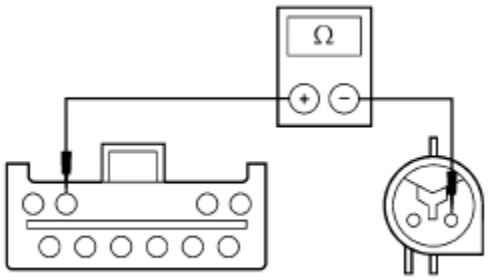
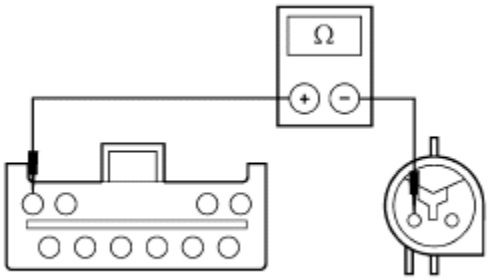
- **Is the resistance less than 5 ohms?**

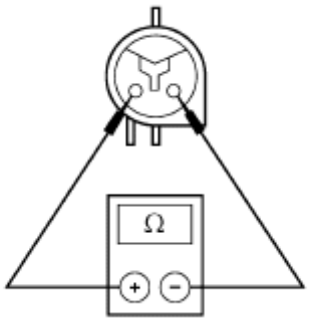
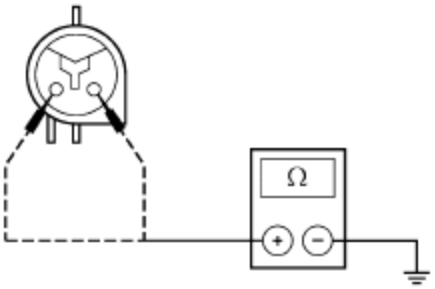
→ **Yes**
REPLACE the compass and thermometer. SET the zone; REFER to Compass Zone Adjustment . CALIBRATE the compass; refer to Calibration Adjustment .

→ **No**
REPAIR circuit 57 (BK) and/or BK wire to compass and thermometer. TEST the system for normal operation.

PINPOINT TEST B: THE OUTSIDE AIR TEMPERATURE IS INACCURATE/INOPERATIVE

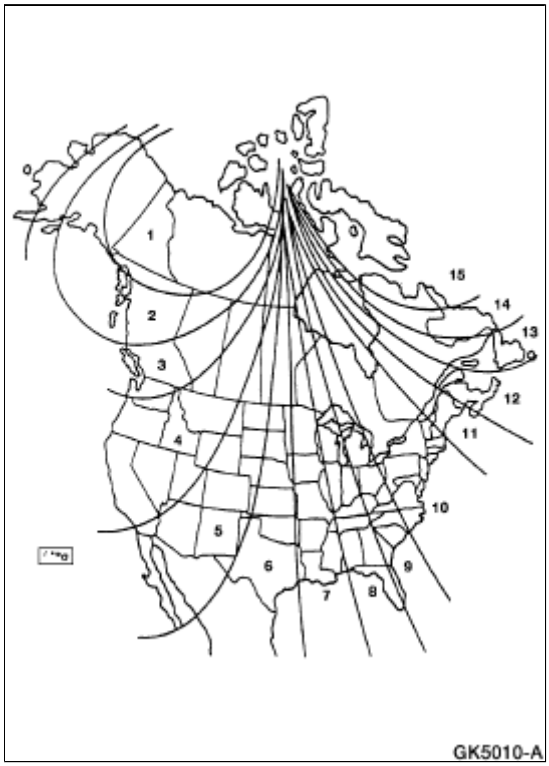
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK FOR PROPERLY INSTALLED SENSOR	
1 	2 Verify the thermometer sensor is properly installed and fully connected. • **Is the thermometer sensor properly installed and fully connected?** → **Yes** GO to B2 . → **No** REINSTALL or RECONNECT the thermometer sensor. TEST the system for normal operation.
B2 CHECK THERMOMETER SENSOR FUNCTION	
2  GK6894-A	1 Remove the thermometer sensor. 2 Measure the resistance between thermometer sensor terminal 1 and terminal 2 at an ambient temperature of 18°-29.5°C (65°-85° F). Check for intermittent readings. • **Is the resistance between 8,000 ohms and 14,000 ohms?** → **Yes** GO to B3 . → **No** REPLACE the thermometer sensor. TEST the system for normal operation.
B3 CHECK SENSOR CIRCUIT FEED FOR OPEN	
1 	

Compass And Thermometer C902 2  GK6895-A	2 Measure the resistance between compass and thermometer C342-9, circuit 233 (DB/Y), and thermometer sensor C194-1, circuit 233 (DB/Y). • **Is the resistance less than 5 ohms?** → **Yes** GO to B4 . → **No** REPAIR circuit 233 (DB/Y) and/or BK wire to compass and thermometer C902-5. TEST the system for normal operation.
B4 CHECK SENSOR CIRCUIT RETURN FOR OPEN	
1  GK6896-A	1 Measure the resistance between compass and thermometer C342-10, circuit 234 (DB/W), and thermometer sensor C194-2, circuit 234 (DB/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to B5 . → **No** REPAIR circuit 234 (DB/W) and/or BK wire to compass and thermometer C902-6. TEST the system for normal operation.
B5 CHECK SENSOR CIRCUITS FOR SHORT	
1	1 Measure the resistance between thermometer sensor C194-1, circuit 233 (DB/Y), and C194-2, circuit 234 (DB/W).

 GK6897-A 2  GK6898-A	2 Measure the resistance between thermometer sensor C194-1, circuit 233 (DB/Y), and ground; and between thermometer sensor C194-2, circuit 234 (DB/W), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** RECONNECT the thermometer sensor. GO to B6 . → **No** REPAIR circuit(s) 233 (DB/Y) and/or 234 (DB/W). TEST the system for normal operation.
B6 CHECK TEMPERATURE ACCURACY	
	1 Drive the vehicle for three minutes above 56 km/h (35 mph) (sustained). • **Does the display show the proper outside air temperature?** → **Yes** Outside air temperature function is OK. → **No** REPLACE the compass and thermometer. SET the zone; REFER to Compass Zone Adjustment . CALIBRATE the compass; REFER to Calibration Adjustment . TEST the system for normal operation.

Compass Zone Adjustment

1. Determine the zone in which the vehicle is located.



2. Press and hold the MODE button until VAR appears on the display. Release the MODE button.
3. **NOTE:** After a few seconds, the compass will exit the VAR mode if the button is no longer pressed.

   Momentarily press the MODE button to increment the zone by one. Set the zone according to the map.

Calibration Adjustment

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures. Switch off all non-essential electrical accessories (rear window defrost, heater A/C, map lamps, wipers, etc.) and make sure all doors are closed.

   Start the vehicle.

2. **NOTE:** To exit CAL mode before performing a compass adjustment, turn the ignition switch to the OFF position.

   Locate the electronic compass/temperature display on the overhead console, press and hold the MODE button until CAL appears in the display, then release the MODE button.

3. **NOTE:** If the CAL indicator does not turn off after the vehicle has been driven in a circle no more than five times, demagnetize the vehicle and repeat the procedure.

   Drive the vehicle slowly (less than 5 km/h [3 mph]) in complete circles until CAL disappears from the display.

Vehicle Demagnetizing

CAUTION: During demagnetizing, the demagnetizer coil will be pulled toward the vehicle. Place a cloth over the vehicle roof to protect the vehicle surface if contact occurs. Make sure the cloth covers the front third and the entire width of the roof.

NOTE: The demagnetizing process requires the use of a demagnetizing coil commonly used by television repair technicians to demagnetize television tubes.

NOTE: To demagnetize, use a constant circular motion over the vehicle roof. Do not turn off the demagnetizer while sweeping the vehicle roof to prevent remagnitizing ferrous materials contained in the vehicle.

NOTE: During the demagnetizing process, make sure the phenolic surface of the tool (the side opposite the handle) is closest to the vehicle surface.

1. Demagnetize the front third of the vehicle roof.
    1. Turn on the demagnetizer at least 1 m (3 ft) away from the vehicle.
    2. Holding the demagnetizer no more than 2.5 cm (1 in) from the vehicle roof and starting on the passenger side, demagnetize the front third of the vehicle roof closest to the windshield using a constant circular motion. Keep the circle radius within 30 cm (12 in) while sweeping across the entire surface of the vehicle roof closest to the windshield. Continue the circular motion four times.
    3. After the fourth pass and without stopping, move the demagnetizer at least 1 m (3 ft) away from the vehicle.
    4. Turn the demagnetizer off.

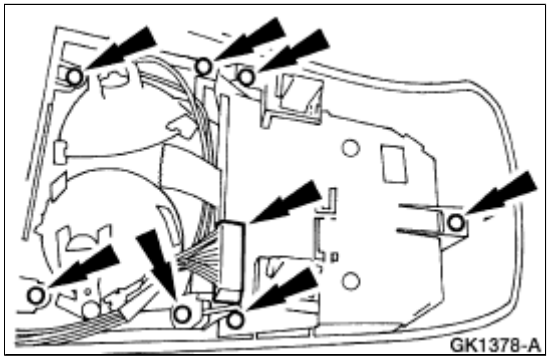
2. Perform the Compass Zone Adjustment procedure; refer to Compass Zone Adjustment .

3. Perform the Compass Calibration Adjustment procedure; refer to Calibration Adjustment .

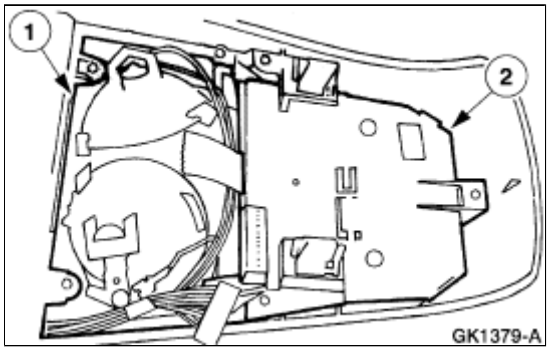
Display

Removal

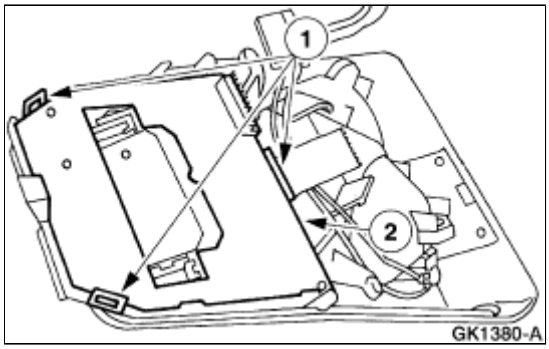
1. Remove the overhead console; refer to Section 501-12 .
2. Remove the screws and disconnect the electrical connector.



3. Remove the compass/lamp bezel from the console housing.
    1. Push the clip.
    2. Remove the compass/lamp bezel from the console housing.



4. Remove the compass and thermometer (19A548).
    1. Push the three locking tabs.
    2. Remove the compass and thermometer.



Installation

1. To install, reverse the removal procedure.

General Specifications

Item	Specification
Sealers	
HB Fuller E709	ESD-M4G162-A
3M Strip-Caulk-Black 051135-08578	ESB-M4G32-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSK-M2G343-A4
Adhesives	
Weather Strip Adhesive E8AZ-19552-A	ESB-M2G14-A
3M Scotch CA Tape F67B-78311A40-AA	
Lubricants	
Silicone Lubricant COAZ-19553-AA	ESR-M13P4-A

Body

The body is constructed of a lightweight all-steel welded material. The body is bolted to a full frame.

Insulation

Insulation is installed:

- Under the hood.
- Above and below the instrument panel.
- At the cowl side panels.
- Over the front and rear tunnel.
- Over the front and rear floor pans.
- Inside the B, C, and D pillars.

Body Sealer Types and Applications

HB Fuller E709

HB Fuller E709:

- Does not run.
- Is fast drying.
- Remains semi-elastic.
- Can be used for seam sealing in such areas as the floorpan, wheelhouse, bulkhead, door openings, and drip rails.
- Can be used to seal outside moulding clip holes.
- Meets Ford Specification ESD-M4G162-A.

3M Strip-Caulk-Black 051135-08578

3M Strip-Caulk-Black 051135-08578:

- Has a plastic base with a filler.
- Is heavy-bodied.
- Is used on spot-weld holes, around mounting clips, and between surfaces not sealed by a gasket.
- Meets Ford Specification ESB-M4G32-A.

Weatherstrip Adhesive

Weatherstrip Adhesive E8AZ-19552-A or equivalent meeting Ford specification ESB-M2G14-A is designed to hold weatherstripping to the body.

Silicone Lubricant

Silicone Lubricant COAZ-19553-AA meeting Ford specification ESR-M13P4-A :

- Is used on the door and window weatherstrips.
- Should be applied at regular lubrication intervals.
- Makes doors easier to close.
- Reduces weatherstrip squeaks.
- Reduces weatherstrip wear.
- Helps retain door-window alignment by reducing friction between the glass and the rubber weatherstrips.

Body System

Inspection and Verification

Leaks

NOTE: Trim will reveal the location of most leaks.

1. Remove any trim or carpet in the general area of the leak.
2. Road test or water test the vehicle.
3. Inspect for a dust pattern around the area in question.
4. Inspect for water paths near and above the area in question.
5. Some leaks can be located by placing bright light under the vehicle, removing any necessary trim or carpet, and inspecting the interior of the body at joints and weld lines.

Noise

Wind noise, rattles, and their sources are detected by driving the vehicle at highway speeds. The vehicle should be driven in four different directions, with all the windows closed, the radio off, the blower motor off, and all the ventilation ducts open.

Most wind noise leaks will occur at the door and window seals or at the sheet metal joints in the door or the door opening.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Dust/Water Leaks	• Body sealer missing. • Opening in weldings or body joints. • Components not fully installed. • Components missing. • Components damaged.	• REMOVE trim. CHECK for leaks and SEAL with appropriate sealer. ROAD TEST or WATER TEST for leaks. RECHECK trim for leaks; USE light under vehicle with trim removed. CHECK interior of body at joints and weld lines.
• Dust Leak at Right Rear Quarter Panel	• Tape under trim panel is loose.	• REPAIR and/or REPLACE tape as necessary. TEST the system for normal operation.
• Dust/Water	• Missing or damaged	• CHECK plugs for proper

Leaks at Floor Pan and Grommets	plugs and/or grommets.	installation. REPLACE if necessary. TEST the system for normal operation.
• Door Drain Holes Collecting Water	• Holes clogged with mud or road tar.	• CLEAN drain holes of dirt and foreign material with a punch or screwdriver. CHECK drain holes regularly. TEST the system for normal operation.
• Wind Noise	• Leaks at door and window seals or sheet metal joints in dorrs or door openings.	• SEAL leaks with Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford Specification WSK-M2G343-A4.
	• Loose/misaligned weatherstrip.	• Reattach weatherstrip. Replace any damaged pin-type retainers. Use weatherstrip adjesive E8AZ-19552-A or equivalent meeting Ford Specification ESB-M2G14-A as necessary.
	• Poor Door Fit.	• Adjust the striker or hinges as necessary. For additional information on the hinge adjustment, refer to Section 501-03 . Check for acceptable door efforts after repair.
• Rattles	• Loose objects in door wells, pillars, and quarter panels.	• CHECK doors by carefully STRIKING underside of door with a rubber mallet. LISTEN for loose objects in door. REPAIR. TIGHTEN body bolts and screws.
	• Misalignment (if tightening bolts does not eliminate rattle).	• REFER to Section 501-03 .
	• Weatherstripping and anti-squeak material.	• APPLY additional sealer; INSTALL in proper location to eliminate rattle. TEST the system for normal operation.

Torque Specifications

Description	Nm	lb-ft	lb-in
Cowl Top Vent Panel to Cowl Screw	2.5-2.9	—	22.3-25.9
Fender to Front Fender Radiator Support Brace Bolt	10-14	8-10	—
Fender to Radiator Grille Opening Panel Nut	6-8	—	54-70
Front Fender to Front Fender Apron Screws	10-14	8-10	—
Fender to Rocker Panel Bolts	10-14	8-10	—
Radiator Grille Opening Panel to Fender Bolt	6-8	—	54-70
Radiator Grille Opening Panel to Hood Latch Support Bolt	6-8	—	54-70
Radiator Grille Opening Panel Support Bracket Bolts	6-8	—	54-70
Speed Control Servo Bracket Bolt	9-12	7-9	—
Top Fender to Inner Fender Bolts	10-14	8-10	—

Front End Body Panels

The front end body panel components consist of:

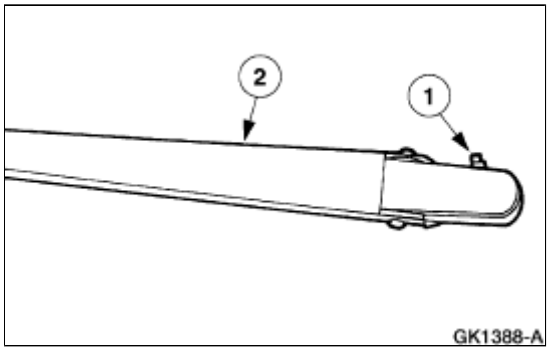
- the hood
- the hood hinges
- the cowl top vent panels
- the front fenders
- the front fender apron (16054)
- the radiator grille opening panel reinforcement
- the radiator opening cover
- the hood latch support
- the radiator air deflector
- the front bumper
- the radiator grille
- the radiator upper sight shield

Panel —Cowl Top Vent

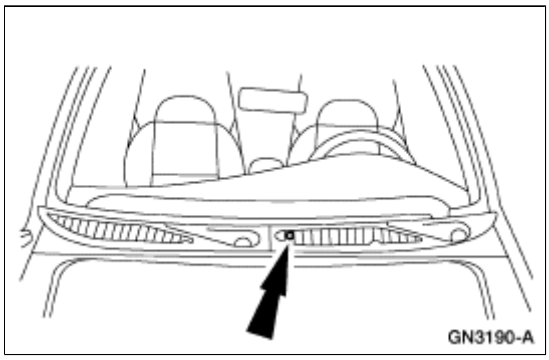
Removal

1. Disconnect the LH windshield washer hose from inside the engine compartment.

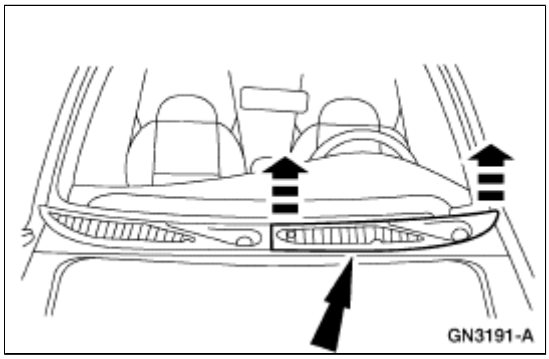
2. Remove the wiper arms.
    1. Slide the clip to clear the wiper arm drive mechanism.
    2. Pull the wiper arm from the wiper arm drive mechanism.



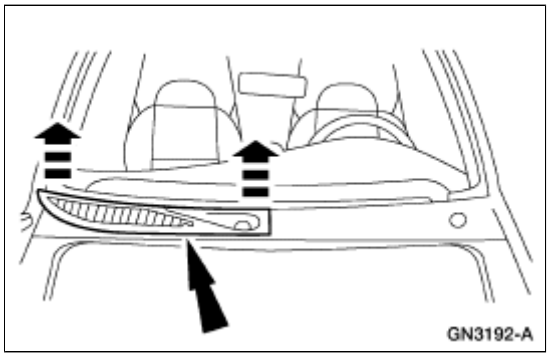
3. Remove the cowl top vent panel-to-cowl screw.



4. Remove the LH cowl top vent panel by pulling up on the LH cowl top vent panel to disengage the clips.

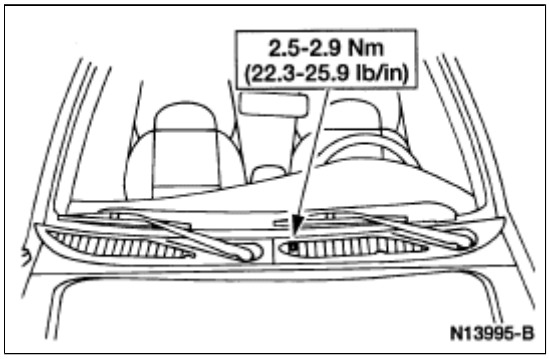


5. Remove the RH cowl top vent panel by pulling up on the RH cowl top vent panel to disengage the clips and disconnect the right washer hose.



Installation

1. To install, reverse the removal procedure.



Fender —Front

Removal

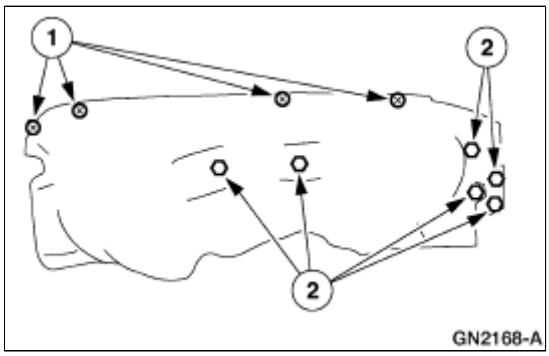
1. Remove the grille opening panel reinforcement. For additional information, refer to Grille Opening Panel Reinforcement .

2. Remove the front bumper (17757). For additional information, refer to Section 501-19 .

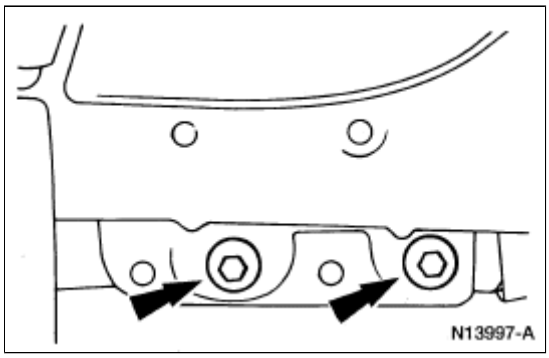
3. Remove the front panel of the rocker panel trim or, if equipped, the running board(s).

4. Remove the front wheel and tire assembly. For additional information, refer to Section 204-04 .

5. Remove the front fender apron (16054).
    1. Remove the screws.
    2. Remove the bolts.

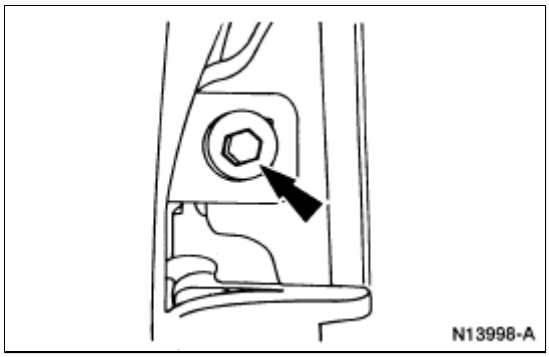


6. Remove the lower fender to rocker panel bolts and spacers.

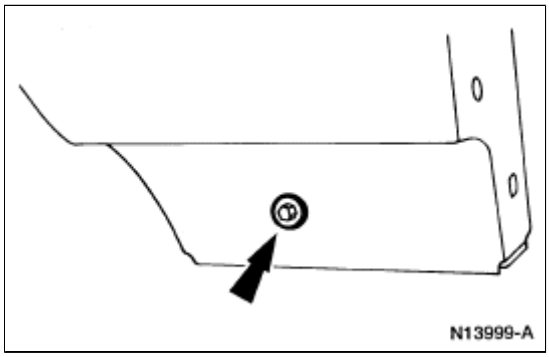


7. **NOTE:** The front door must be open to gain access to the fender bolt.

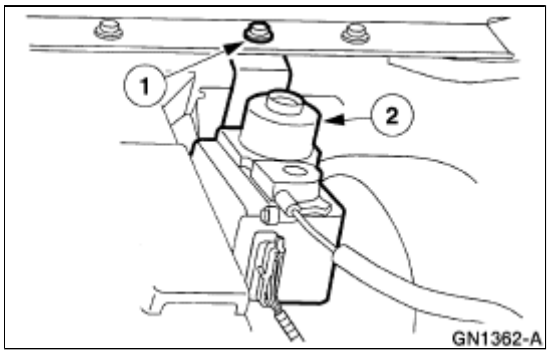
    Remove the fender bolt.



8. Remove the fender to front fender radiator support brace bolt.

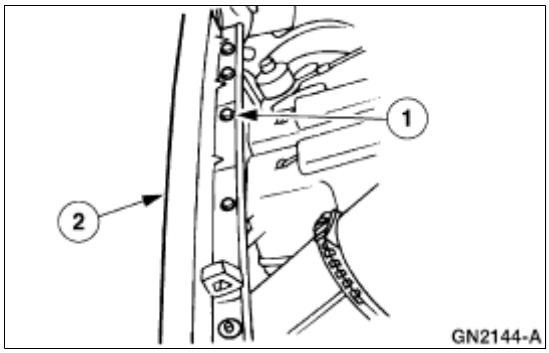


9. If removing the RH front fender, position the speed control servo (9C735) aside.
    1. Remove the bolt.
    2. Position the speed control servo aside.



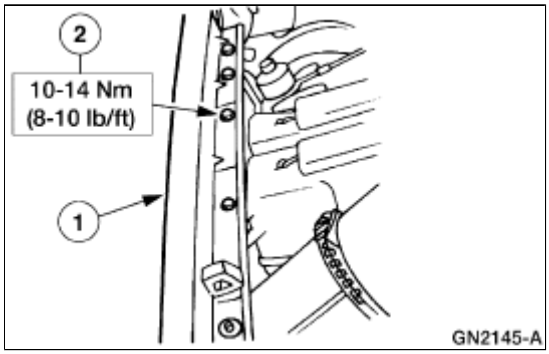
10. If removing the RH front fender, remove the antenna. For additional information, refer to Section 415-02 .

11. Remove the front fender (16005).
    1. Remove the top fender to inner fender bolts.
    2. Remove the front fender.



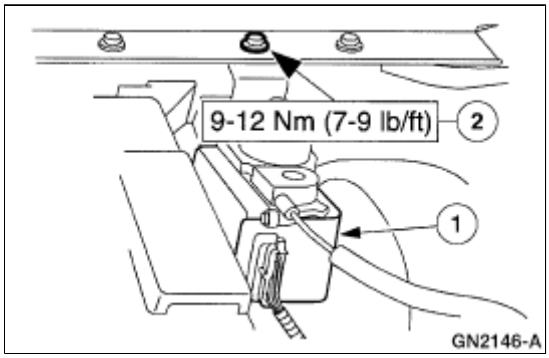
Installation

1. Install the front fender.
    1. Install the front fender.
    2. Install the top fender to inner fender bolts.

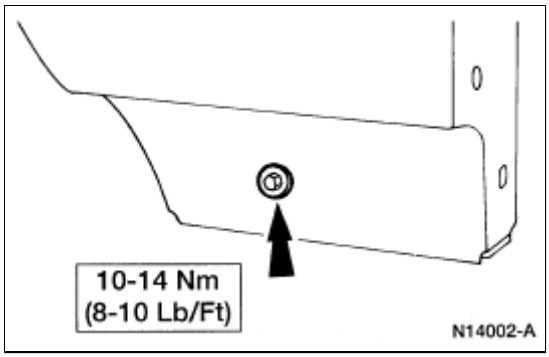


2. If installing the RH front fender, install the antenna. For additional information, refer to Section 415-02 .

3. If installing the RH front fender, install the speed control servo bracket.
    1. Position the servo bracket.
    2. Install the bolt.

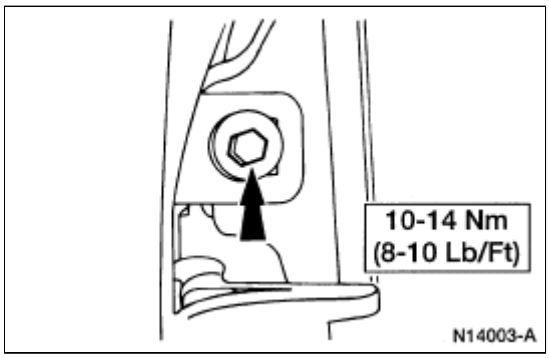


4. Install the fender to front fender radiator support brace bolt.

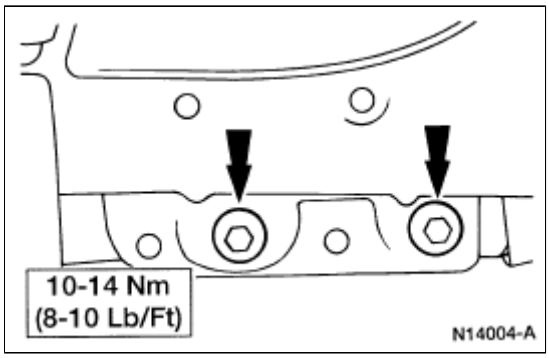


5. **NOTE:** The front door must be open to gain access to the bolt.

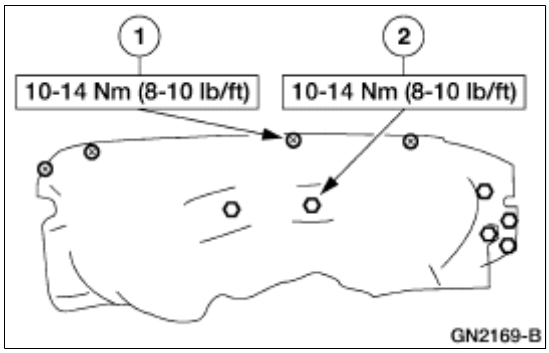
   Install the top fender to inner fender bolt.



6. Install the fender to rocker panel bolts and spacers.



7. Install the front fender apron.
   1. Install the front fender to front fender apron screws.
   2. Install the top fender to inner fender bolts.



8. Install the front wheel and tire assembly. For additional information, refer to Section 204-04 .
9. Install the front panel of the rocker panel trim or, if equipped, the running board(s).
10. Install the front bumper. For additional information, refer to Section 501-19 .
11. Install the grille opening panel reinforcement. For additional information, refer to Grille Opening Panel Reinforcement .

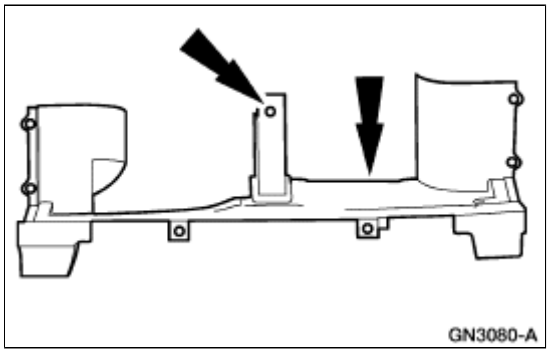
Grille Opening Panel Reinforcement

Removal

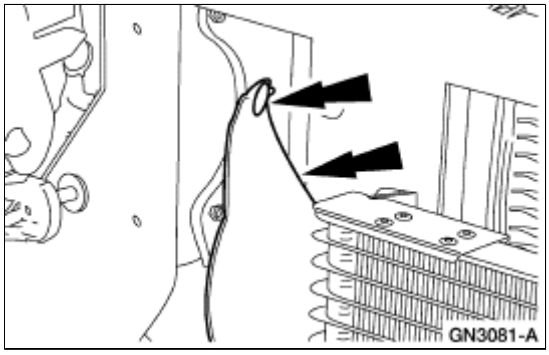
NOTE: Mountaineer shown, Explorer similar.

1. Remove the radiator grille (8200). For additional information, refer to Section 501-08 .

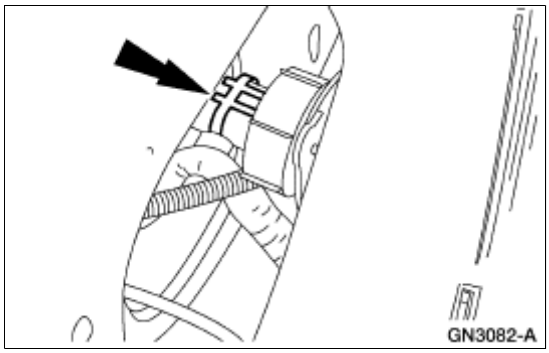
2. Remove the radiator opening cover (8C299).
   - Remove the seven pin-type retainers.



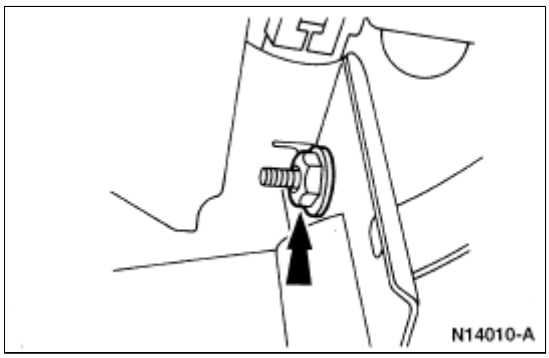
3. Position the two radiator grille splash shields aside.
   - Remove the two pin-type retainers.



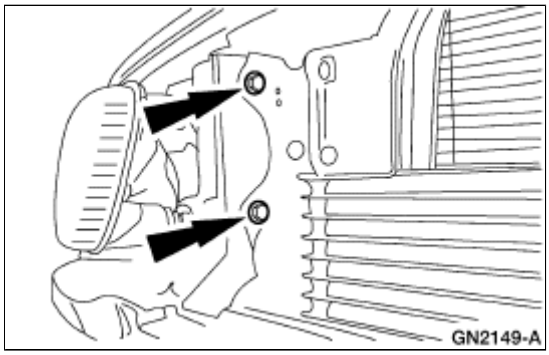
4. Disconnect the two headlamp electrical connectors.



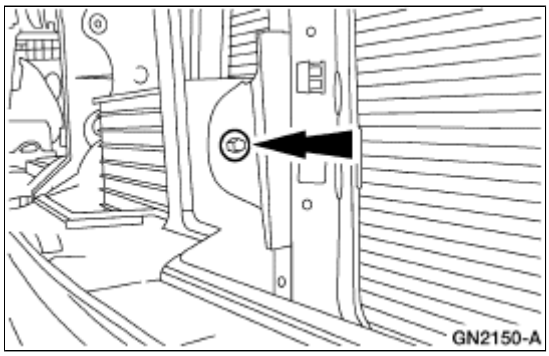
5. Remove the fender to radiator grille opening panel nut.



6. Remove the four radiator grille opening panel support bracket bolts.



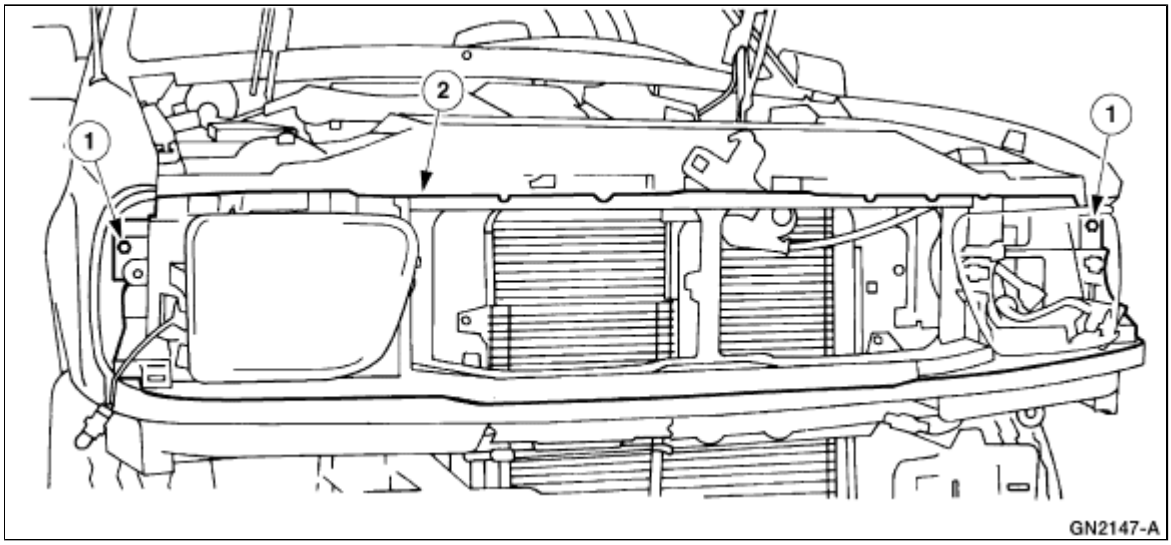
7. Remove the radiator grille opening panel to hood latch support bolt.



8. **NOTE:** If necessary, transfer parts to the new component.

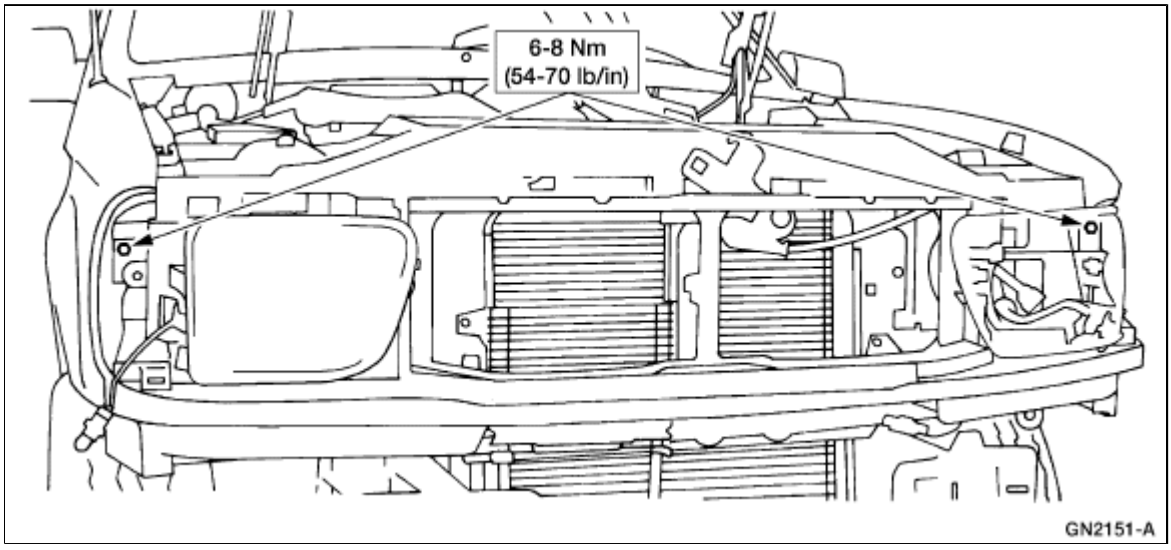
Remove the radiator grille opening panel.

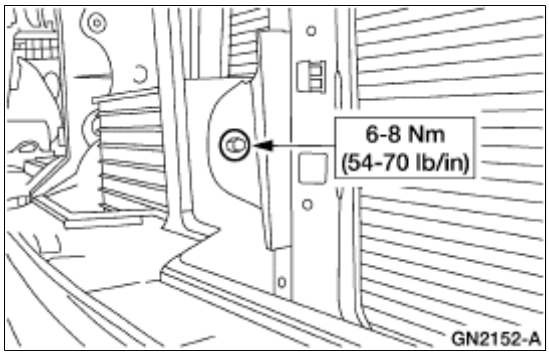
1. Remove the radiator grille opening panel to fender bolts.
2. Remove the grille opening panel.

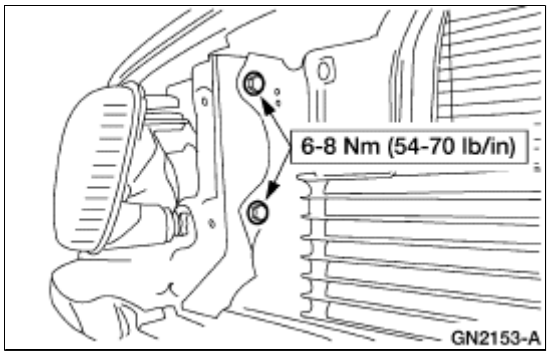


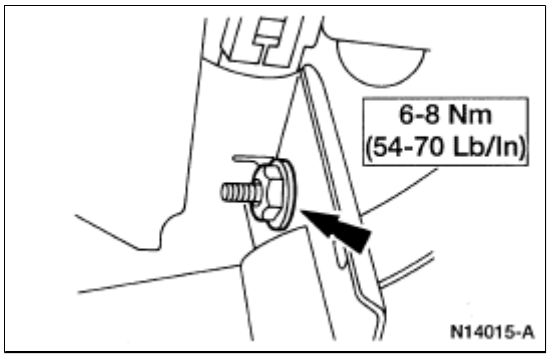
Installation

1. To install, reverse the removal procedure.






6-8 Nm (54-70 lb/in)
GN2153-A


6-8 Nm
(54-70 Lb/In)
N14015-A

General Specifications

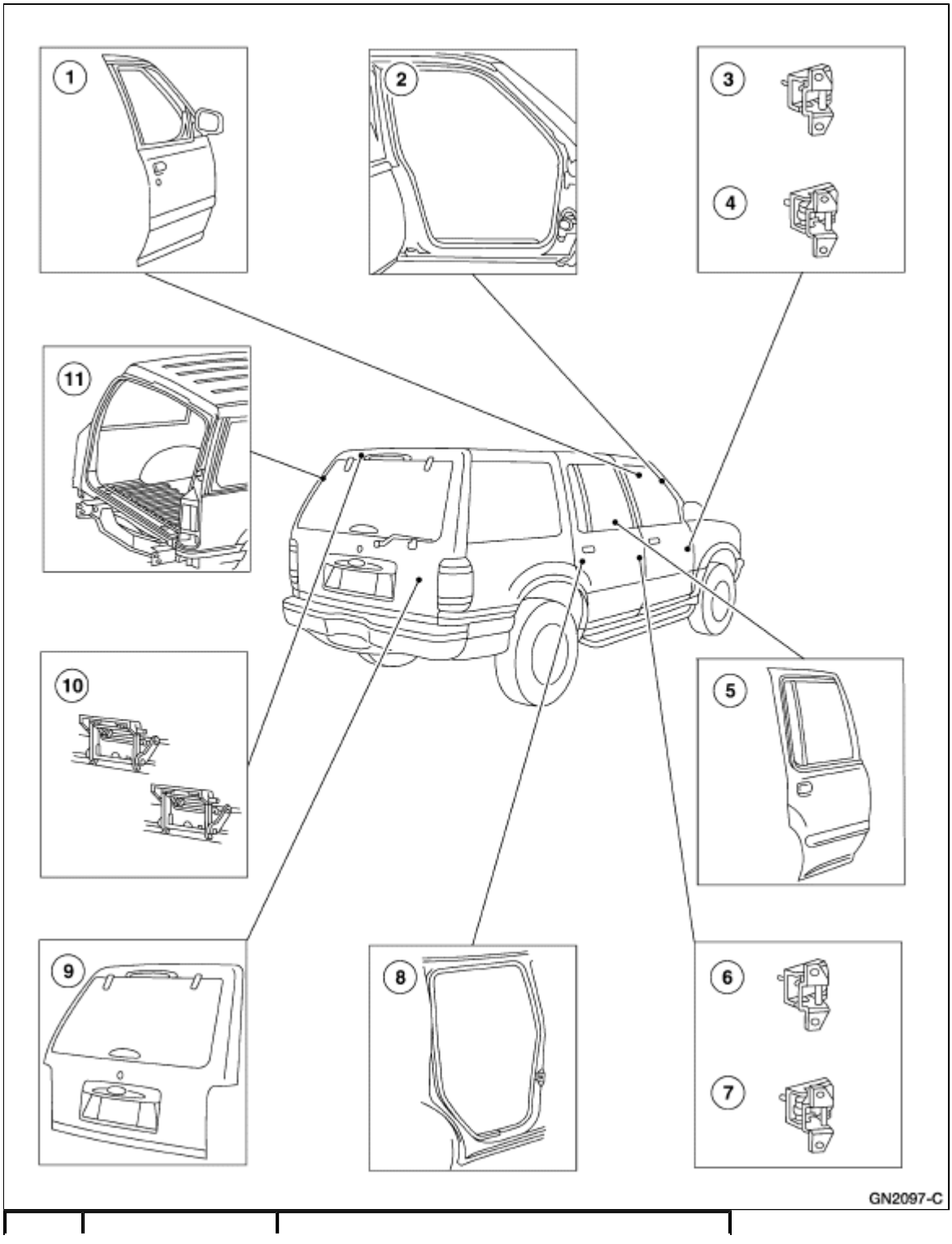
Item	Specification
Door clearance; front and rear edge	3.0-7.0 mm (0.118-0.275in) parallel top to bottom within 1.0 mm (0.04 in)
Door clearance; top of door to roof	3.0-7.0 mm (0.118-0.275in) parallel top to bottom within 2.0 mm (0.08 in)
Door flushness; front door to front fender, rear door to front door	-1.0-0.00mm (-0.04-0.00in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery cable bolts	7-10	—	62-89
Chassis wire harness to front door bolt	2.7-3.7	—	24-33
Door hinge to body bolts/nuts	30	22	—
Hinge to door bolts	30	22	—
Liftgate hinge to liftgate bolts	17-27	13-20	—
Liftgate hinge to body bolt and nut	26-34	19-24	—

Body Closures

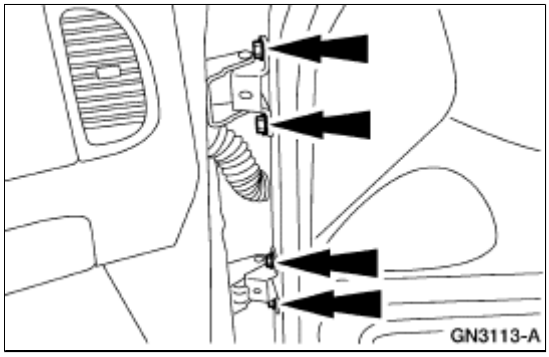
Body Closures



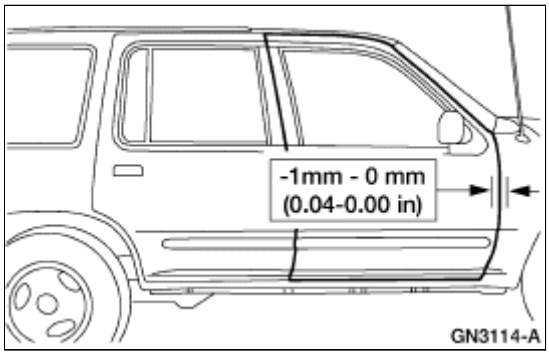
Item	Part Number	Description
1	20124	Front Door
2	20708	Front Door Opening Weatherstrip
3	22800	Front Door Upper Hinge
4	22810	Front Door Lower Hinge
5	24630	Rear Door
6	—	Rear Door Upper Hinge
7	26802	Rear Door Lower Hinge
8	—	Rear Door Opening Weatherstrip
9	40010	Liftgate
10	42900	Liftgate Hinge
11	404A06	Liftgate Weatherstrip

Hinge Adjustment —Front Door, Horizontal and Verticle

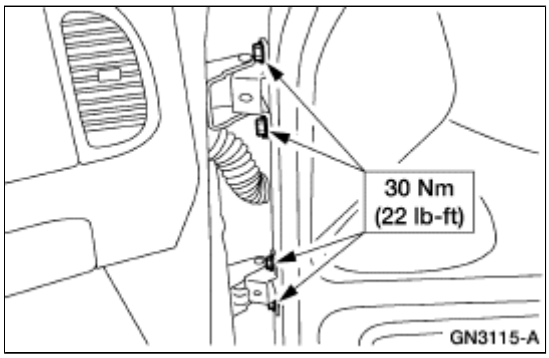
1. Mark the position of the front door hinges to use as a reference point.
2. Loosen the front door hinge to front door bolts just enough to permit movement of the door .



3. Adjust the front door alignment to specification.



4. Tighten the front door hinge to front door bolts.

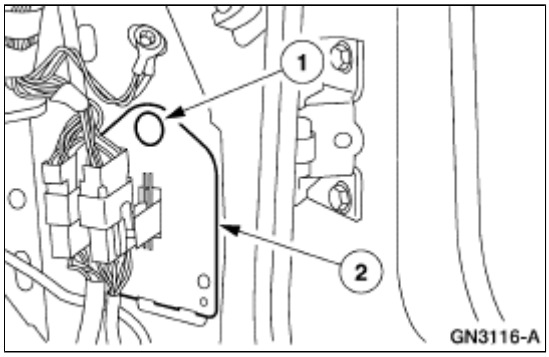


Hinge Adjustment —Front Door, Fore and Aft

NOTE: Check the rear door hinge adjustment before adjusting the front door hinge.

1. Remove the cowl side trim panel. For additional information, refer to Section 501-05 .

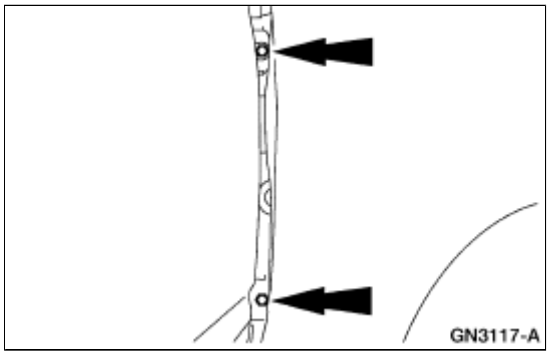
2. Position the electrical connector mounting bracket aside.
    1. Remove the pin-type retainer.
    2. Position the electrical connector mounting bracket aside.



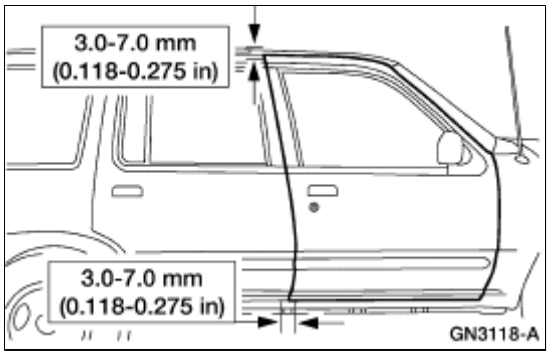
3. Mark the position of the front door hinges to use as a reference point.

4. **NOTE:** Position the front door to gain access to the bolts.

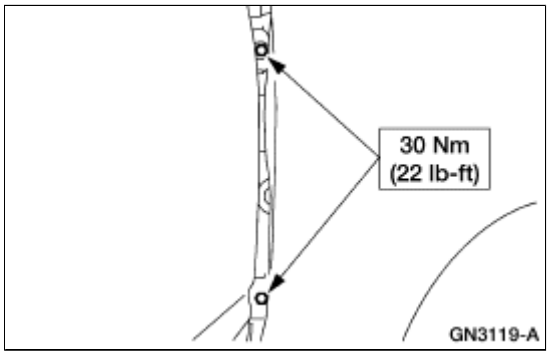
    Loosen the two front door hinge to body bolts and nuts just enough to permit movement of the door.



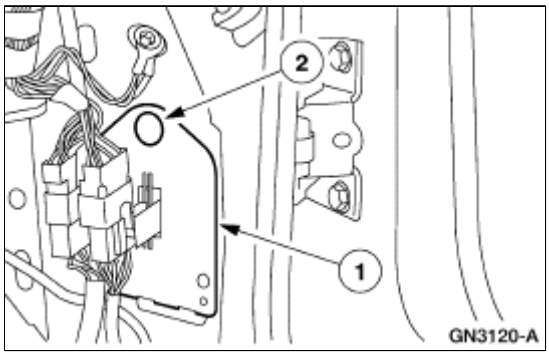
5. Adjust the front door alignment to specification.



6. Tighten the front door hinge to body bolts.



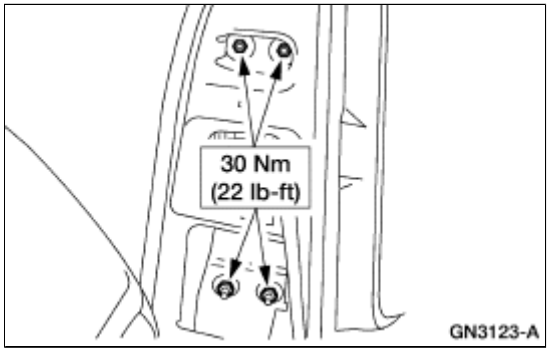
7. Position the electrical connector mounting bracket.
    1. Position the electrical connector mounting bracket.
    2. Install the pin-type retainer.



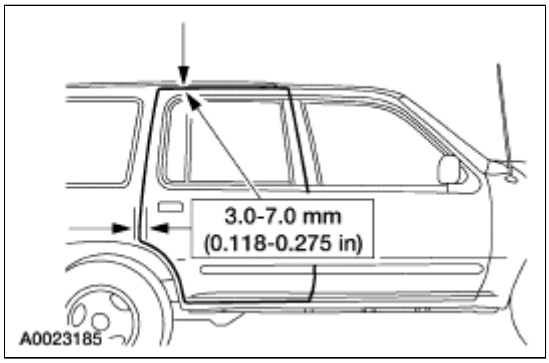
8. Install the cowl side trim panel. For additional information, refer to Section 501-05 .

Hinge Adjustment —Door, Rear

1. Remove the front seat safety belt retractor. For additional information, refer to Section 501-20A .
2. Mark the position of the rear door hinges to use as a reference point.
3. Loosen the rear door hinge to body nuts just enough to permit movement of the door.



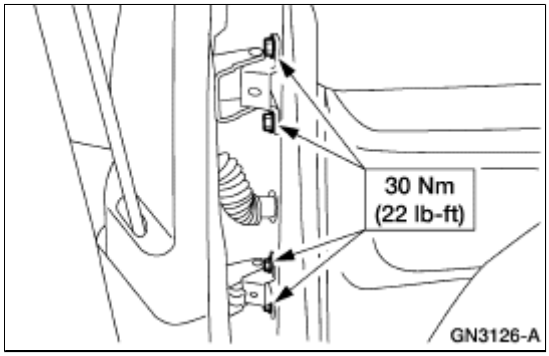
4. Adjust the rear door alignment to specification.



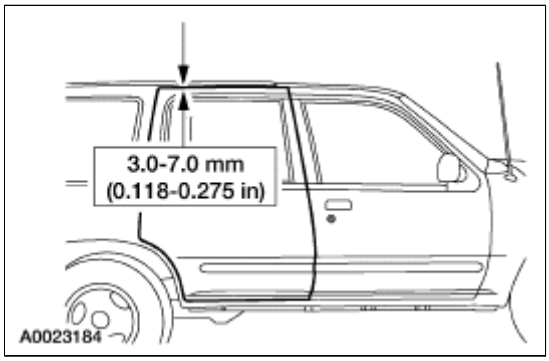
5. Tighten the rear door hinge to body nuts.
6. Check the front door hinge adjustment. For additional information, refer to Hinge Adjustment—Front Door, Fore and Aft or Hinge Adjustment—Front Door, Horizontal and Verticle .
7. Install the front seat safety belt retractor. For additional information, refer to Section 501-20A .

Hinge Adjustment —Rear Door, Horizontal and Vertical

1. Mark the position of the rear door hinge to use as a reference.
2. Loosen the rear door hinge to rear door bolts just enough to permit movement of the door.



3. Adjust the rear door alignment to specification and flush to adjacent panels.



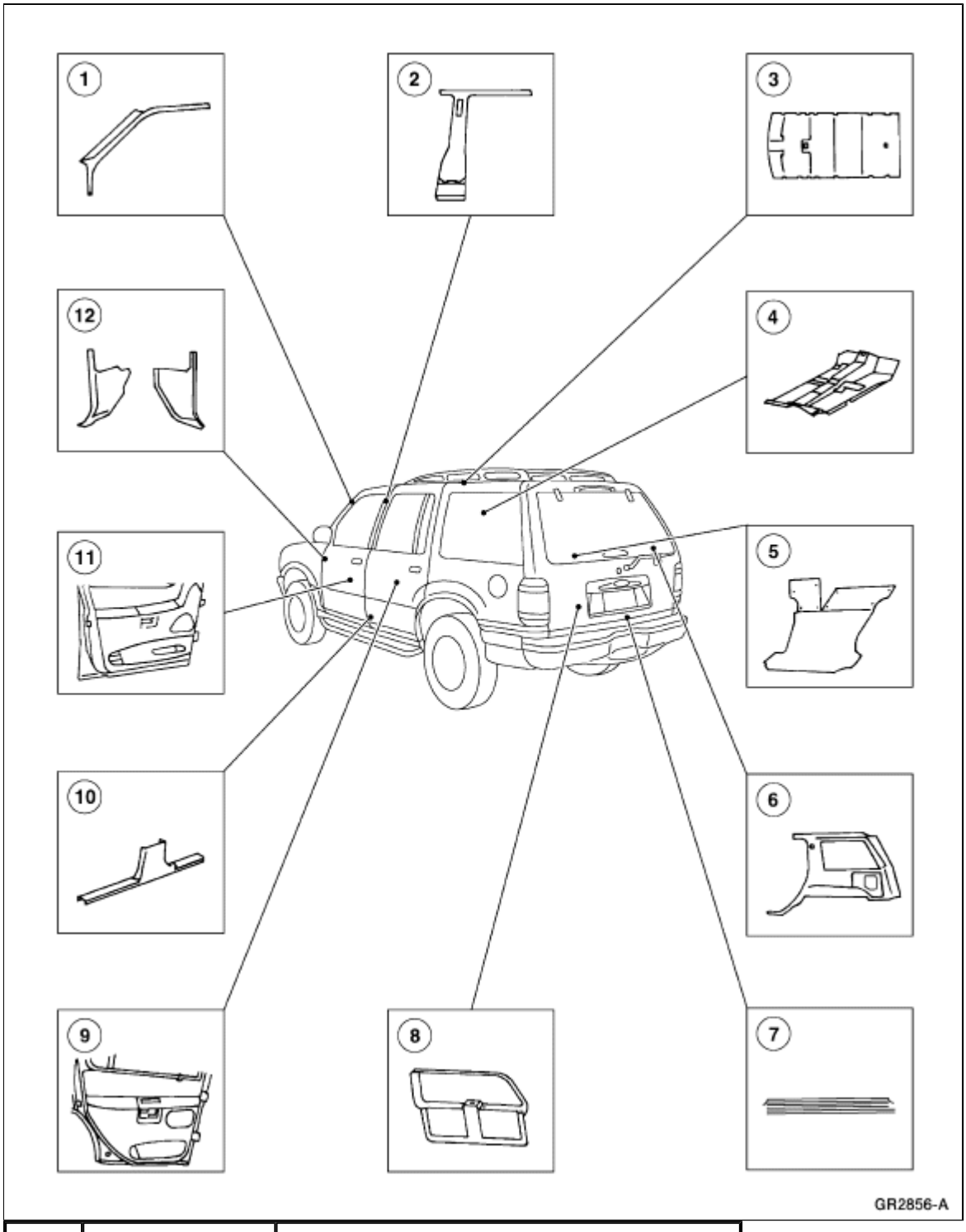
4. Tighten the rear door hinge to rear door bolts.

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable	7-10	5-7	—
Coat hook screw	1.4-2.0	—	12-18
Door trim panel screws	1.4-2.0	—	12-18
Liftgate handle screws	1-1.3	—	9-11
Liftgate trim panel screw	2.3-3.3	—	20-29
Quarter trim panel screws	1.0-1.5	—	9-13
Quarter window latch screws	9	—	80
Safety belt guide bolt	34-46	25.1-33.9	—
Safety belt anchor bolts	30-40	23-29	—
Safety belt anchor nuts	34-46	24.9-33.8	—

Interior Trim

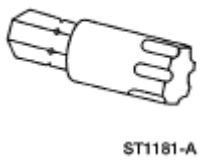
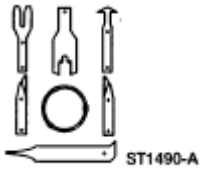
Interior Trim Components



Item	Part Number	Description
1	03598	Windshield Side Garnish Moulding
2	—	B-Pillar Trim Panel
3	51968	Roof Trim Panel
4	13000	Floor Carpet
5	—	Carpet Assembly, Rear Floor
6	31012	Quarter Trim Panel
7	13144	Liftgate Scuff Plate
8	46404	Liftgate Door Trim Panel
9	27406	Rear Door Trim Panel
10	13208	Front Door Scuff Plate
11	23942	Front Door Trim Panel
12	02345	Cowl Side Trim Panel, RH and LH

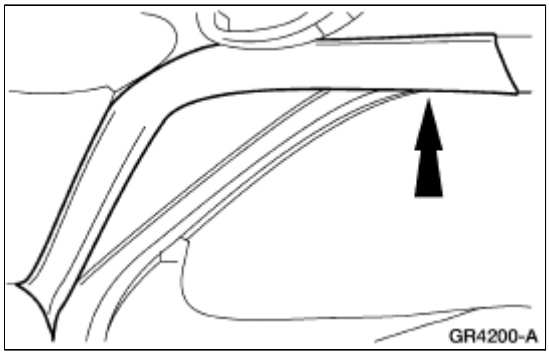
Trim Panel —B-Pillar

Special Tool(s)

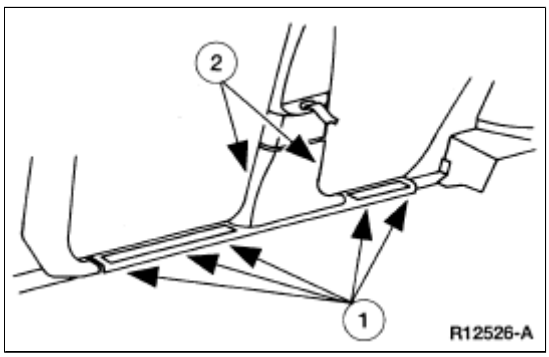
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)
 ST1490-A	Windshield and Molding/Trim Removal Kit or equivalent 107-R0401

Removal

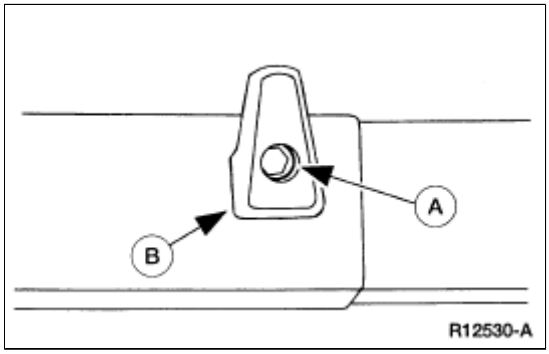
1. Remove the windshield side garnish moulding (03598).



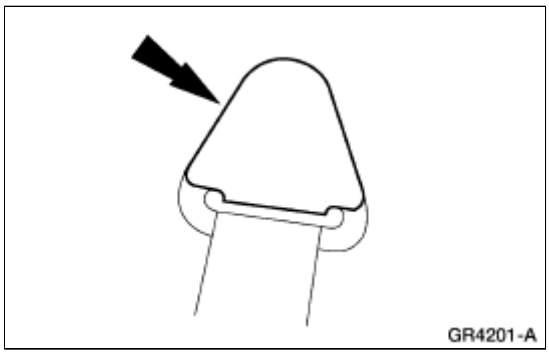
2. Remove the front door scuff plate (13208).
    1. Starting at one end and working along the front door scuff plate, use Windshield and Molding/Trim Removal Kit to remove the front door scuff plate.
    2. Remove the front door scuff plate from the B-pillar.



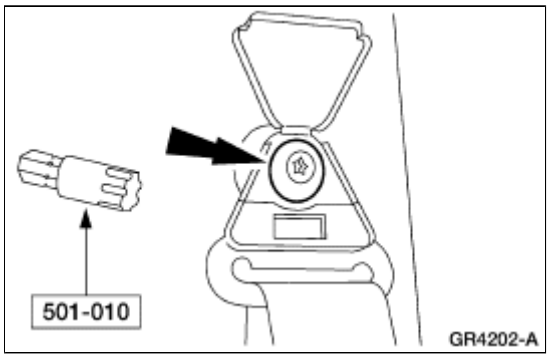
3. Remove the (A) screw and the (B) coat hook.



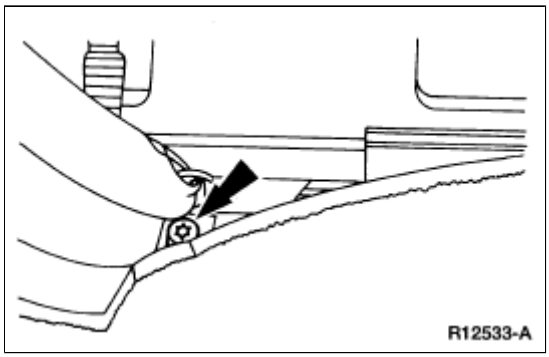
4. Open the front safety belt guide bolt cover.



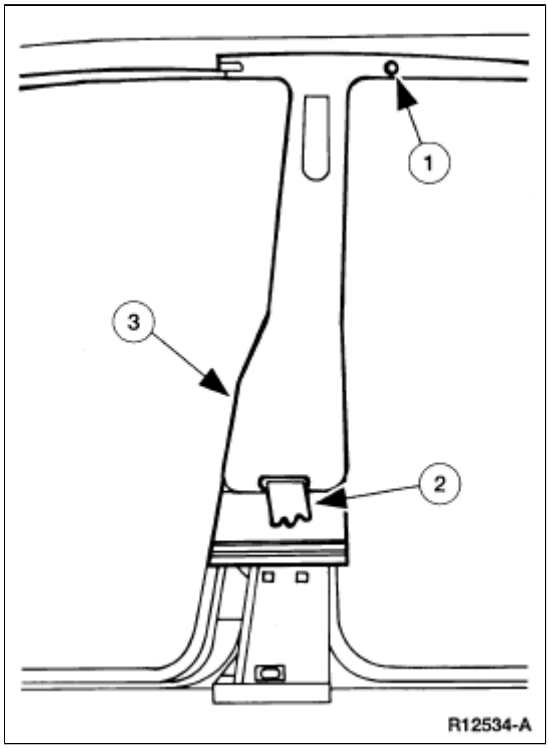
5. Using special tool, remove the front safety belt guide bolt.



6. Use Safety Belt Bolt Bit to remove the front safety belt anchor bolt.

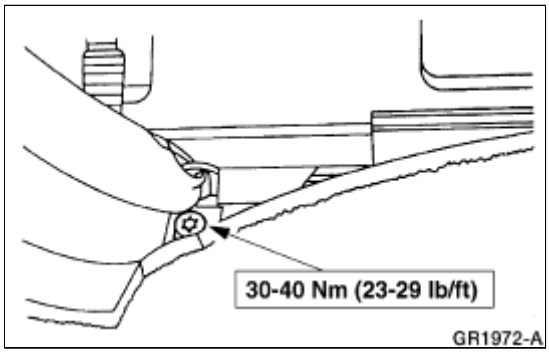


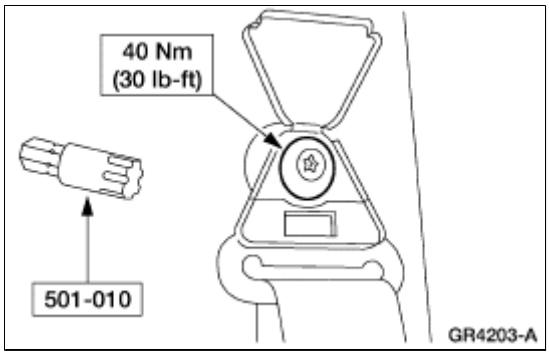
7. Remove the B-pillar trim panel.
    1. Remove the pin-type retainer.
    2. Feed the safety belt webbing through the opening.
    3. Remove the B-pillar trim panel.

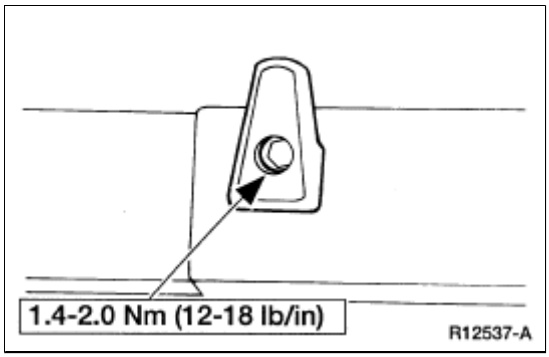


Installation

1. To install, reverse the removal procedure.

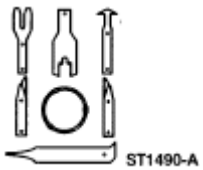



40 Nm
(30 lb-ft)
501-010
GR4203-A


1.4-2.0 Nm (12-18 lb/in)
R12537-A

Trim Panel —Cowl Side

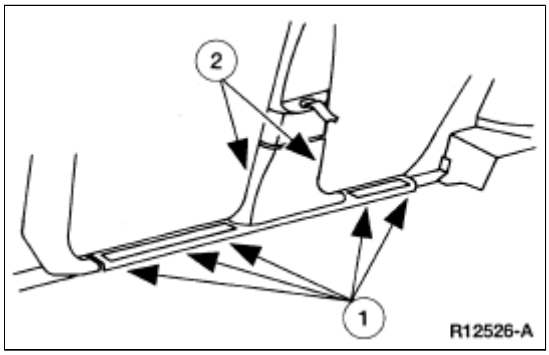
Special Tool(s)

 ST1490-A	Windshield and Molding/Trim Removal Kit or equivalent 107-R0401

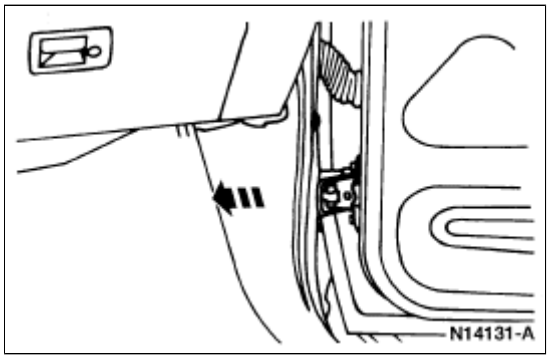
Removal

NOTE: 4-door shown, 2-door similar.

1. Remove the front door scuff plate (13208).
    1. Starting at one end and working along the front door scuff plate, use Windshield and Molding/Trim Removal Kit to remove the front door scuff plate.
    2. Remove the front door scuff plate from the B-pillar.



2. Remove the cowl side trim panel (02345) by pulling outward to disengage the pin-type retainers.



Installation

1. To install, reverse the removal procedure.

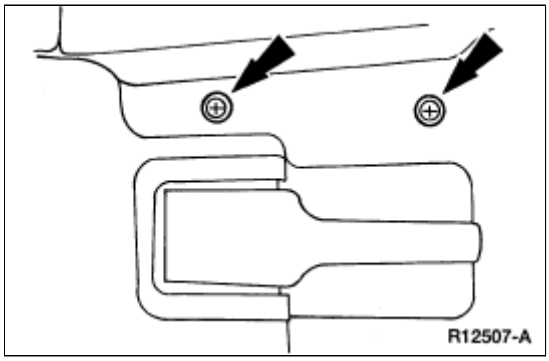
Trim Panel —Front Door

Removal

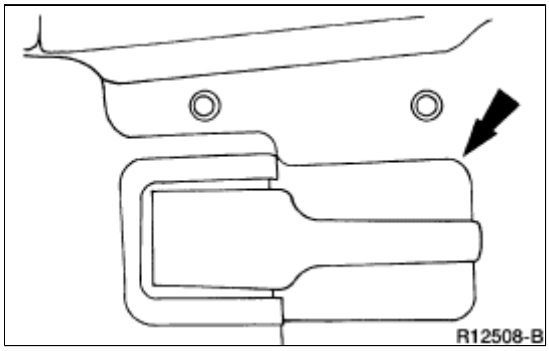
NOTE: High series shown, low series similar.

NOTE: The window must be completely down to remove the front door trim panel.

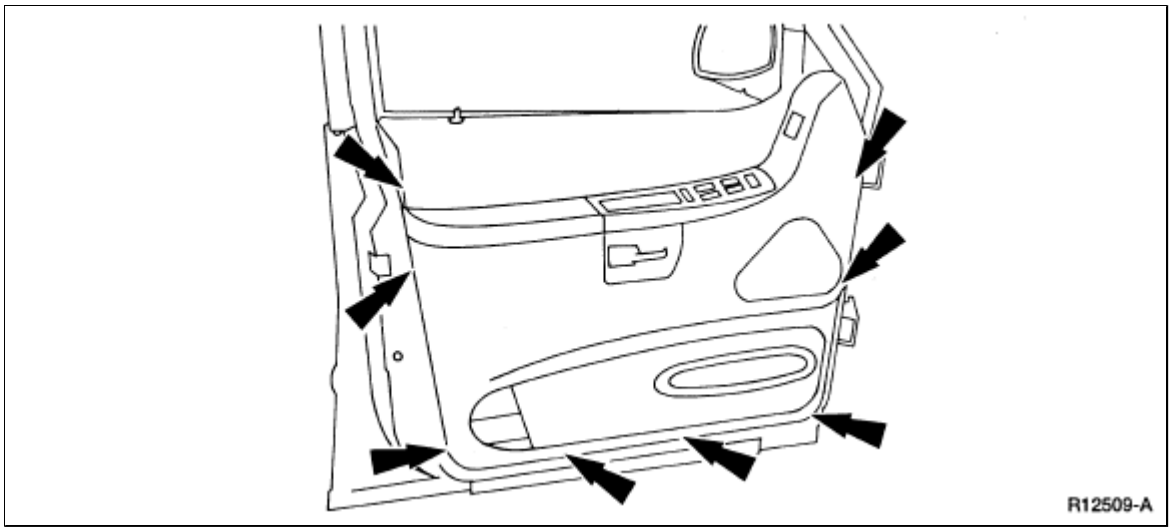
1. On high series front door trim panel, disconnect the battery ground cable (14301).
2. Remove the screws.



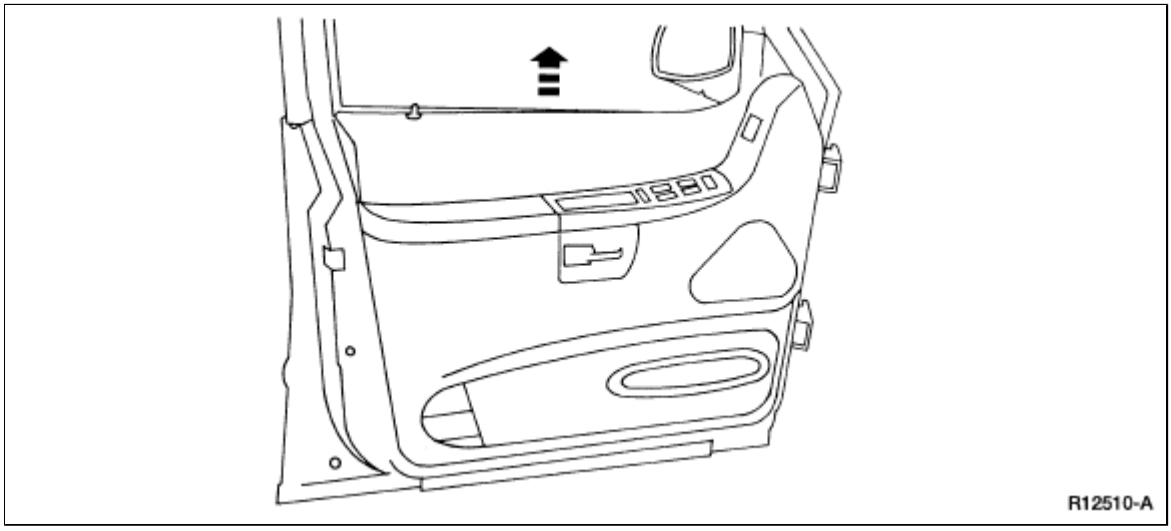
3. Remove the inside door handle cup (22634).



4. On low series front door trim panel, remove the screw and the window regulator handle.
5. Start in a lower corner and work around the panel and separate the front door trim panel (23942) from the front door (20124) to disengage the pin-type retainers.

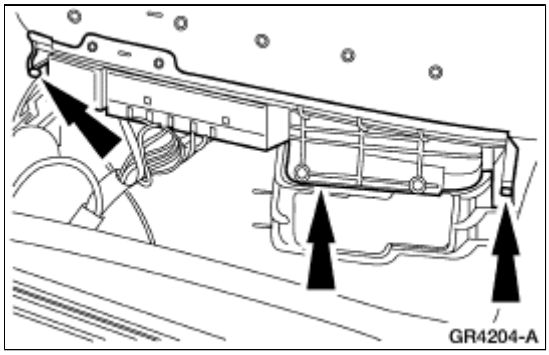


6. Lift the front door trim panel to disengage the top lip from the weatherstrip.

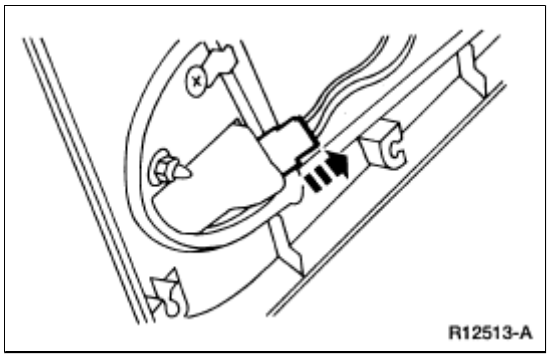


7. Position the front door trim panel aside.

8. Separate the power window switch finish panel from the door trim panel.
   - Release the locking tabs.



9. If equipped, remove the courtesy lamp bulb from the lens and remove the front door trim panel.



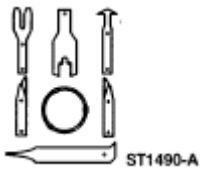
Installation

1. **NOTE:** When the battery (10653) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.

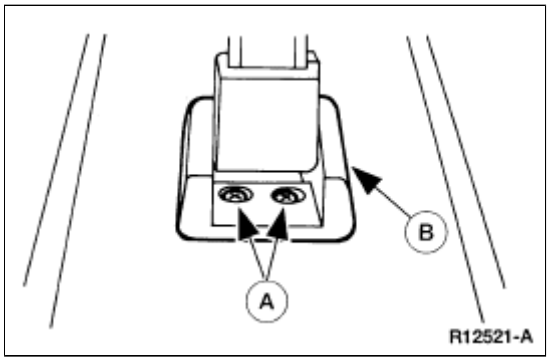
Trim Panel —Liftgate Door

Special Tool(s)

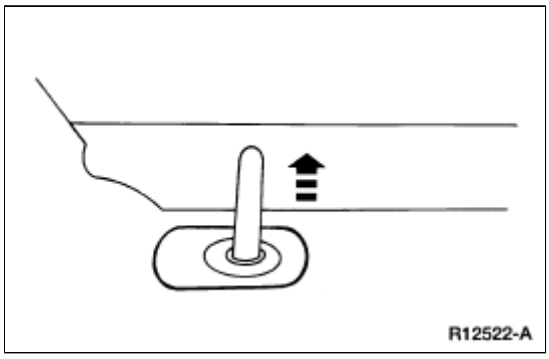
 ST1490-A	Windshield and Molding/Trim Removal Kit or equivalent 107-R0401

Removal

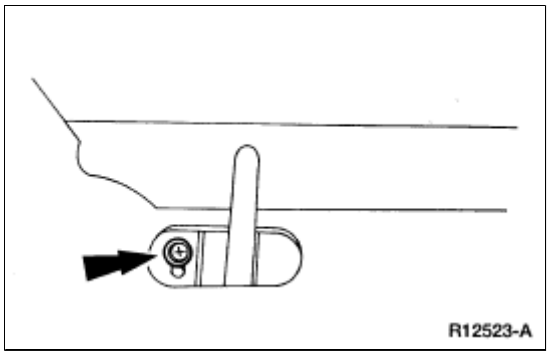
1. Remove the (A) liftgate handle to liftgate screws and the (B) liftgate handle.



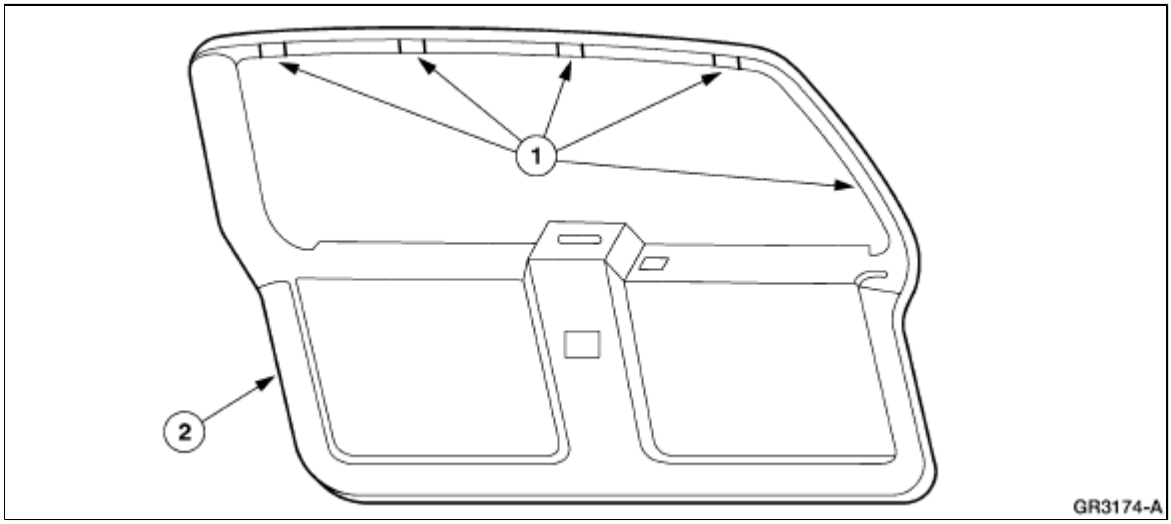
2. Remove the liftgate trim panel screw access plug.



3. Remove the screw.

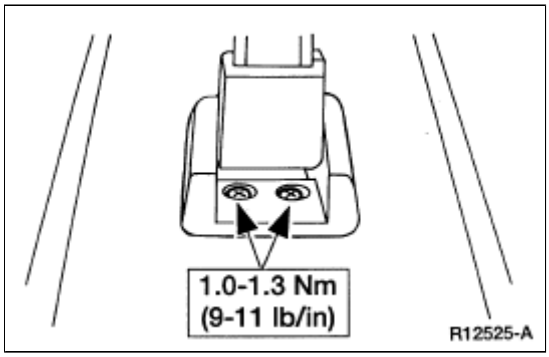


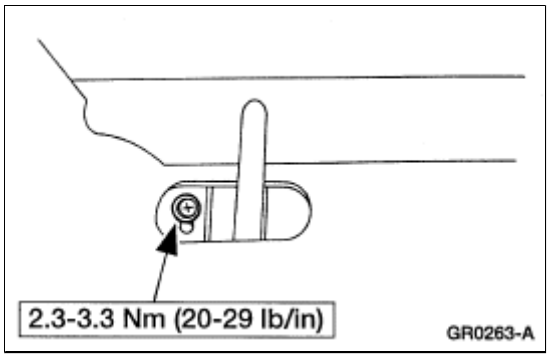
4. Remove the liftgate door trim panel.
    1. Use Windshield and Molding/Trim Removal Kit to remove the liftgate door trim panel from the liftgate window opening.
    2. Push the liftgate door trim panel toward the top of the liftgate and remove the liftgate trim panel.



Installation

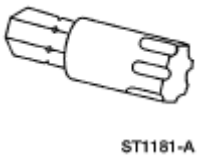
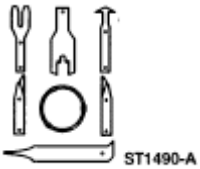
1. To install, reverse the removal procedure.




2.3-3.3 Nm (20-29 lb/in)
GR0263-A

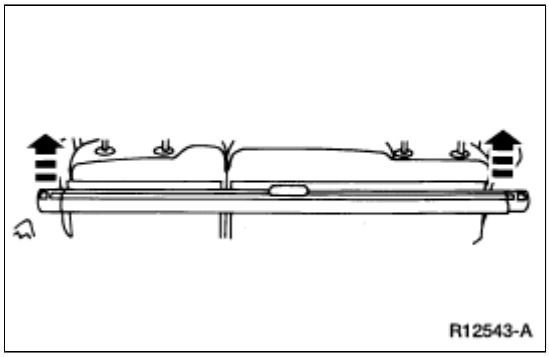
Trim Panel —Quarter, Four Door

Special Tool(s)

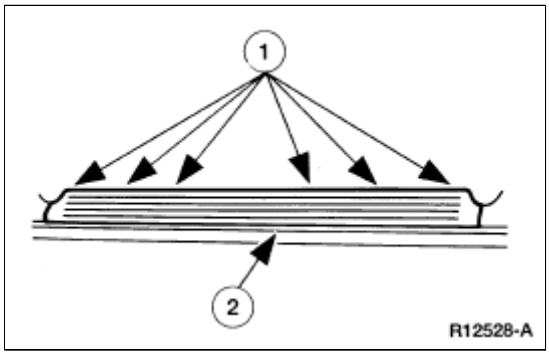
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)
 ST1490-A	Windshield and Molding/Trim Removal Kit or equivalent 107-R0401

Removal

1. If equipped, remove the retractable cargo cover.

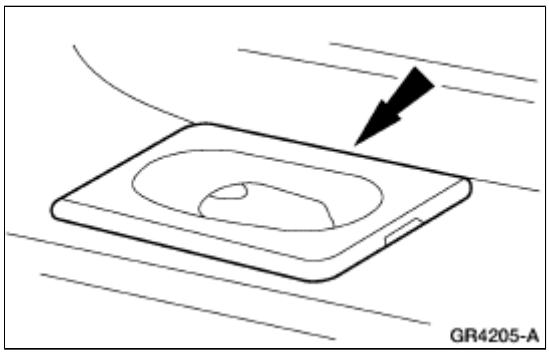

R12543-A

2. Remove the liftgate scuff plate (13144).
    1. Starting at either end and working along the liftgate scuff plate, use Windshield and Molding/Trim Removal Kit to remove the scuff plate.
    2. Remove the liftgate scuff plate.



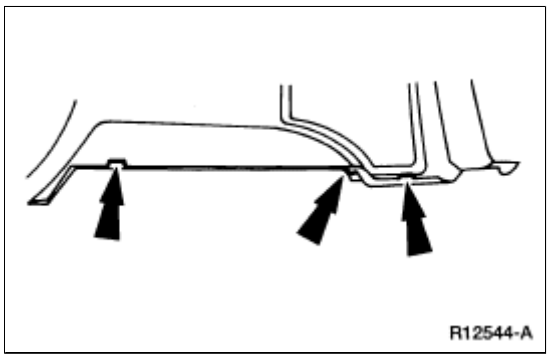
R12528-A

3. If equipped, remove the rear power lock switch assembly.
    - Disconnect the electrical connector.

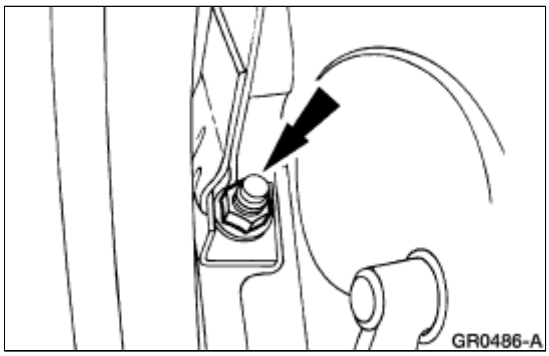


4. Remove the B-pillar trim panel. For additional information, refer to Trim Panel—B-Pillar .

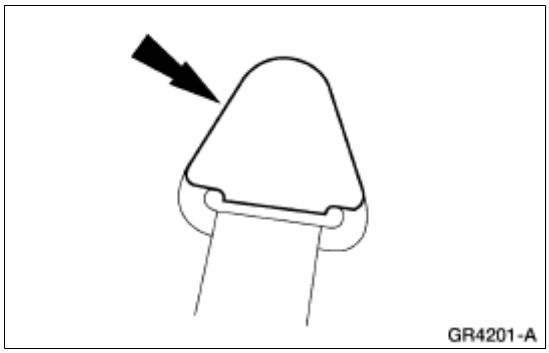
5. Remove the three rear quarter trim panel screws.
    - Position the carpet aside to gain access to the screws.



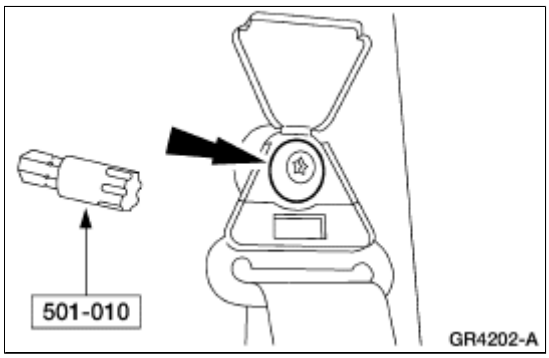
6. Remove the rear safety belt anchor nut.



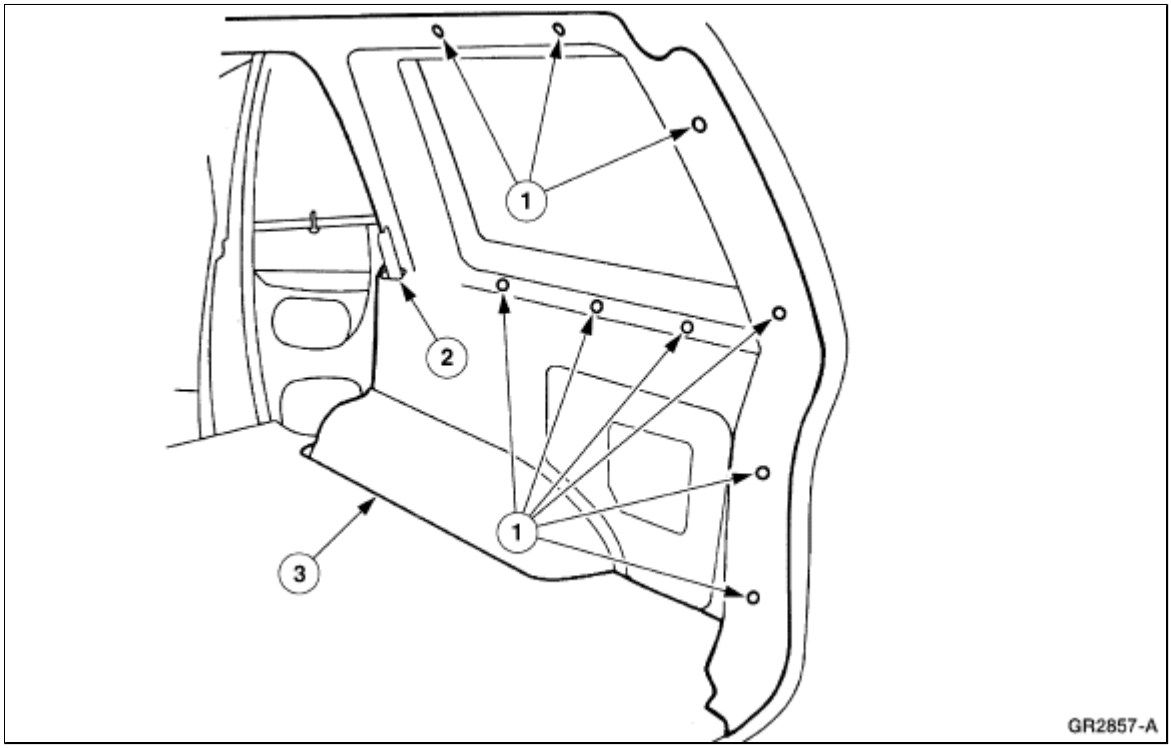
7. Open the rear safety belt guide bolt cover.



8. Using the special tool, remove the rear safety belt guide bolt.

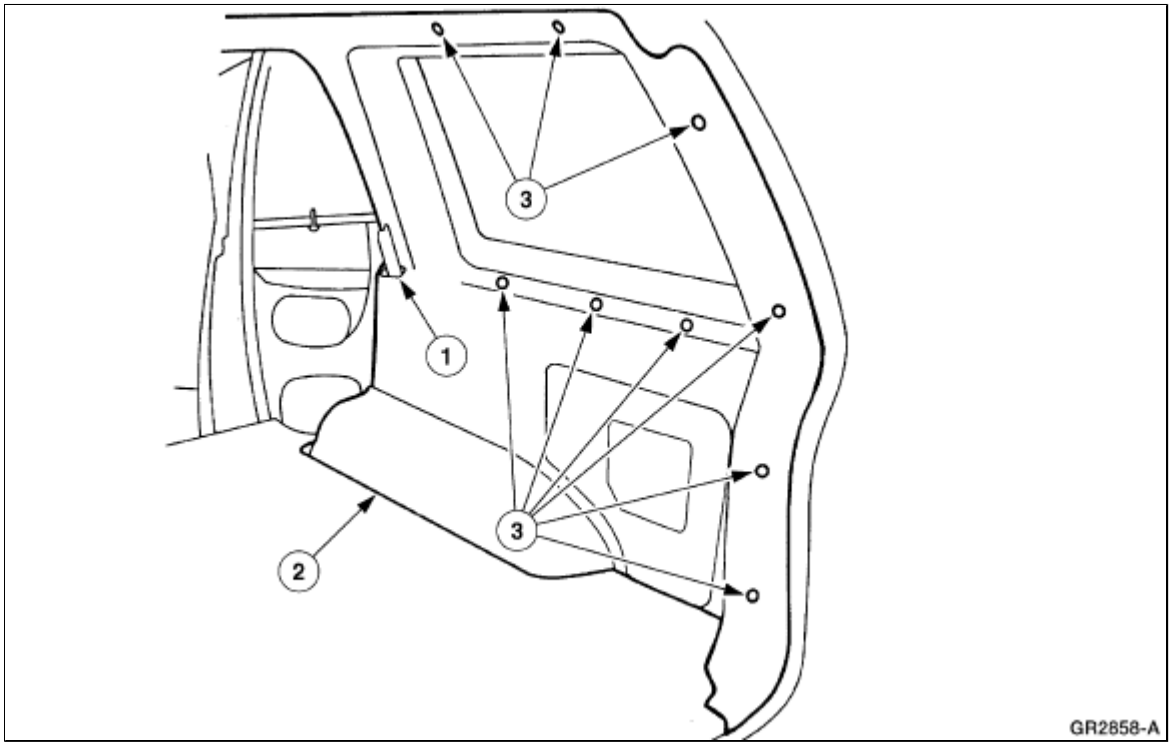


9. Remove the quarter trim panel (31012).
    1. Remove the pin-type retainers.
    2. Feed the safety belt webbing through the opening in the quarter trim panel.
    3. Remove the quarter trim panel.

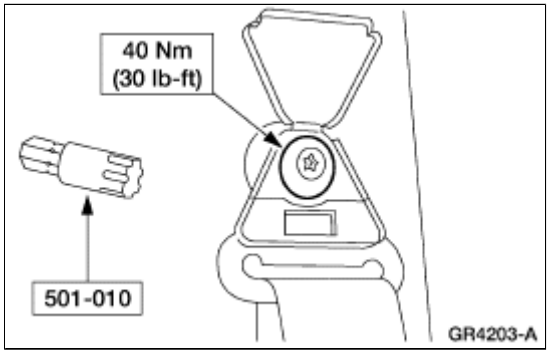


Installation

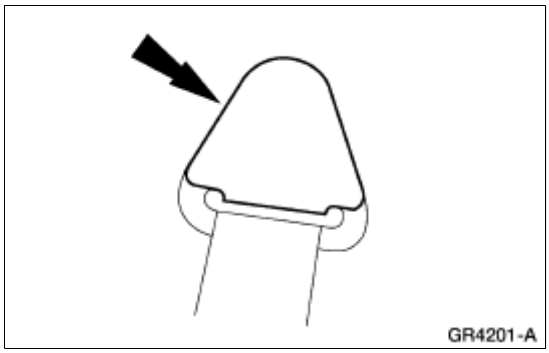
1. Install the quarter trim panel.
    1. Feed the safety belt webbing through the opening in the quarter trim panel.
    2. Position the quarter trim panel.
    3. Install the pin-type retainers.



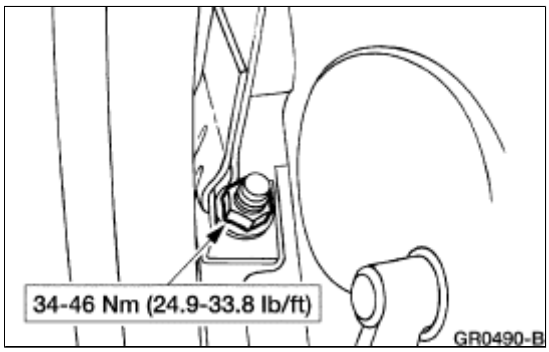
2. Using the special tool, install the rear safety belt guide bolt.



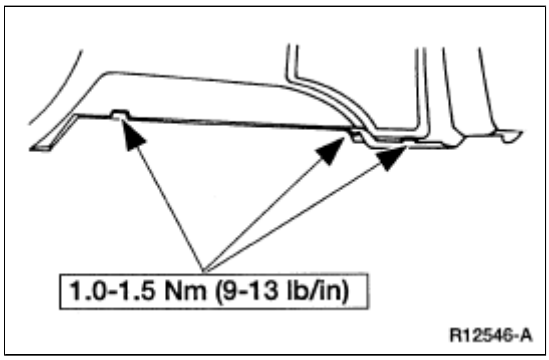
3. Close the rear safety belt guide bolt cover



4. Install the rear safety belt anchor nut.

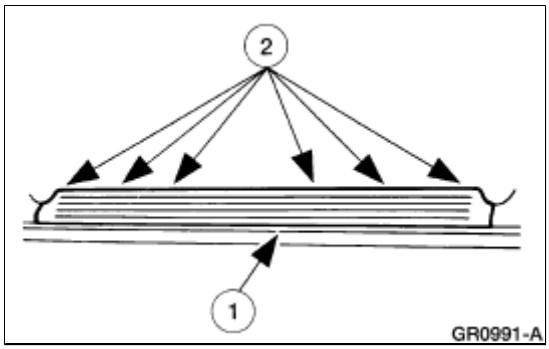


5. Install the three rear quarter trim panel screws.

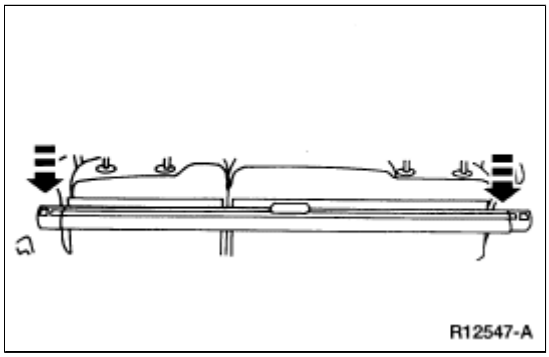


6. Install the B-pillar trim panel. For additional information, refer to Trim Panel—B-Pillar .

7. Install the liftgate scuff plate.
    1. Position the liftgate scuff plate.
    2. Start at either end and work along the liftgate scuff plate, pushing it into the floor panel.



8. If equipped, install the retractable cargo cover.



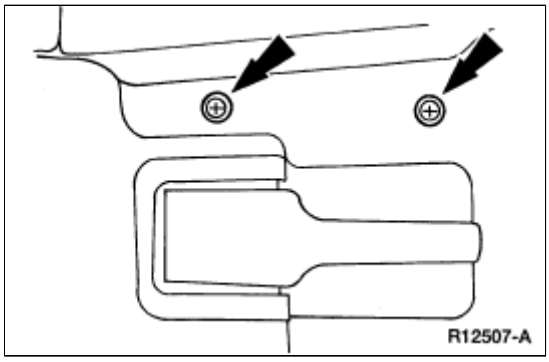
Trim Panel —Rear Door

Removal

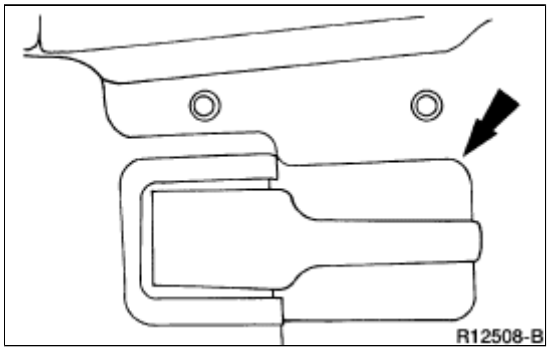
NOTE: High series shown, low series similar.

NOTE: The window glass must be completely down to remove the rear door trim panel.

1. Remove the screws.

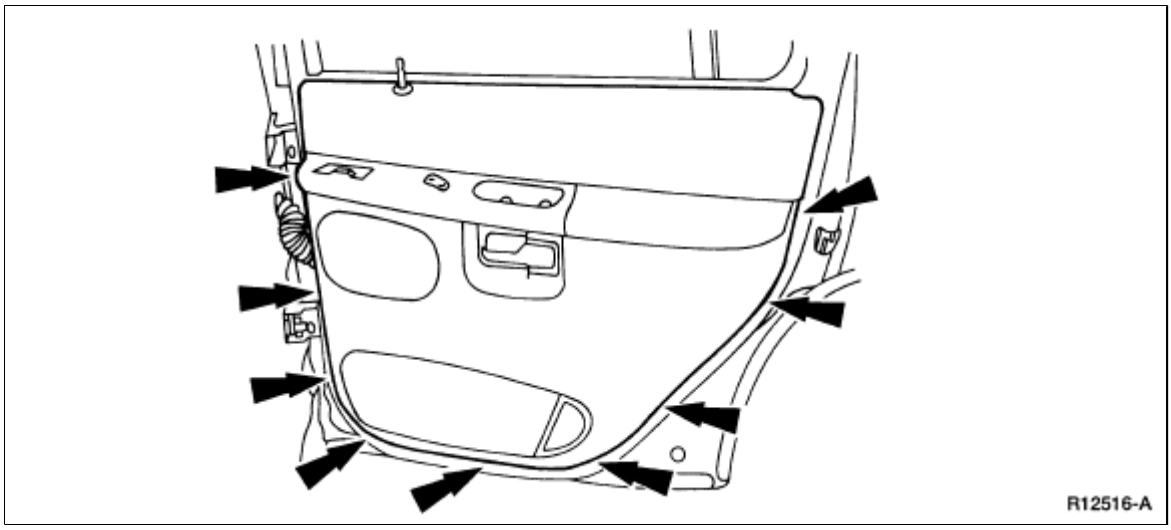


2. Remove the inside door handle cup.

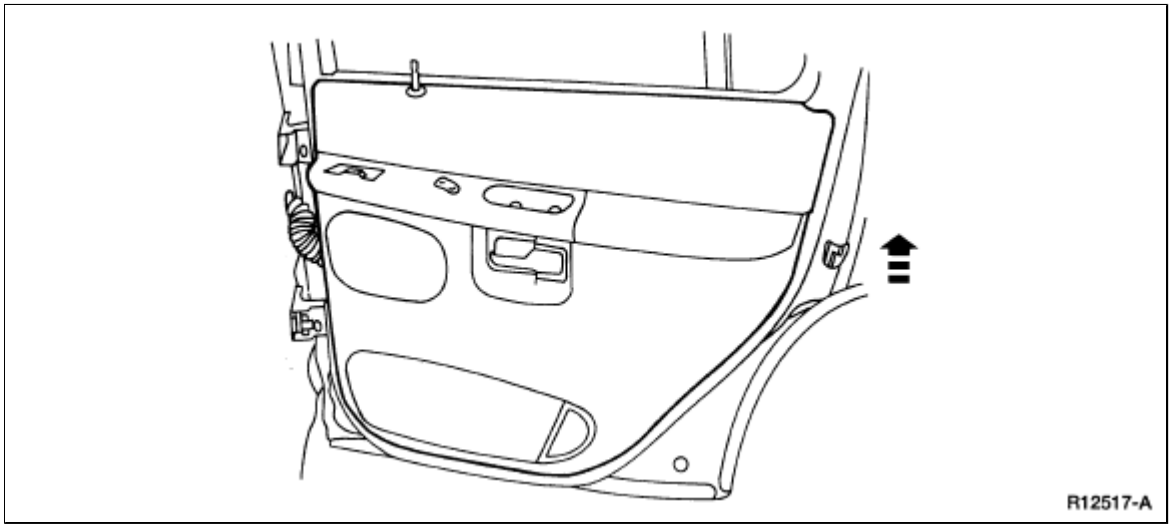


3. On low series rear door trim panel, remove the window regulator handle.
   - Remove the screw.

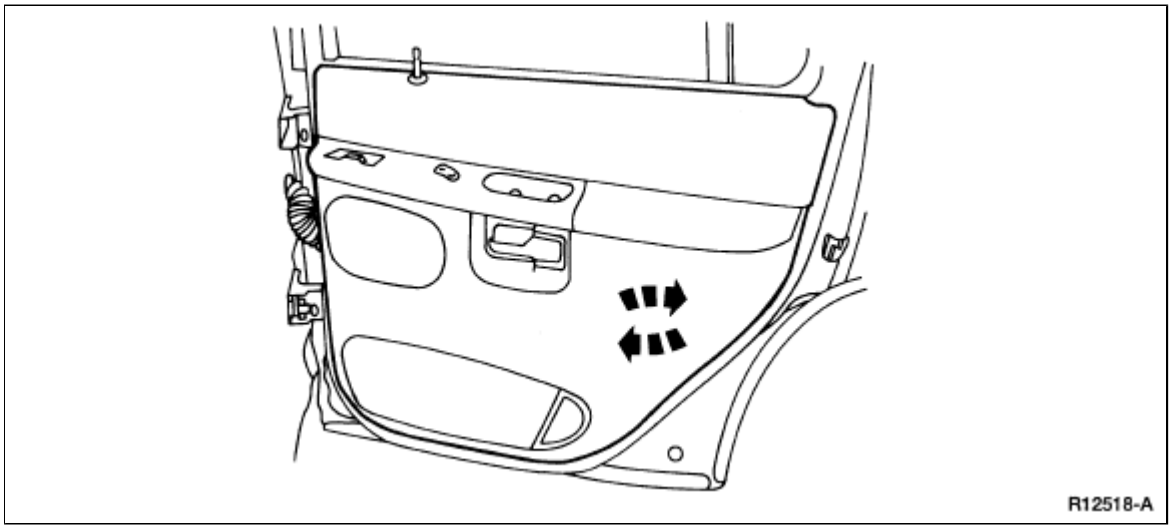
4. Start in a lower corner and work around the panel and separate the rear door trim panel from the rear door to disengage the pin-type retainers.



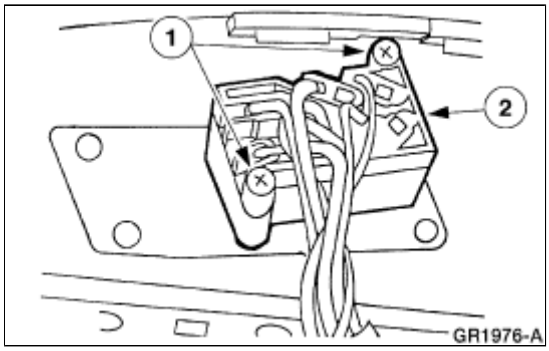
5. Remove the rear door trim panel by lifting to disengage the top lip from the weatherstrip.



6. Turn the rear door trim panel over.



7. Disconnect the power window switch electrical connector.
    1. Remove the screws.
    2. Disconnect the electrical connector.

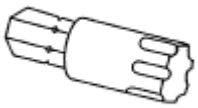
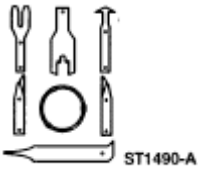


Installation

1. To install, reverse the removal procedure.

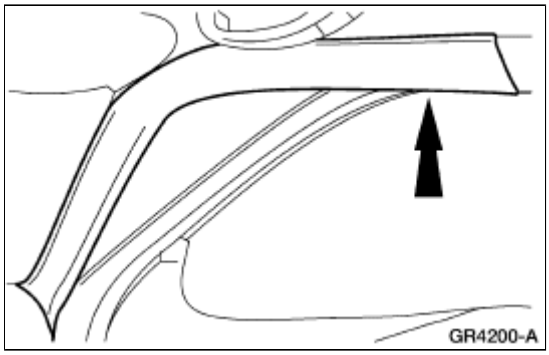
Trim Panel —Quarter, Two Door

Special Tool(s)

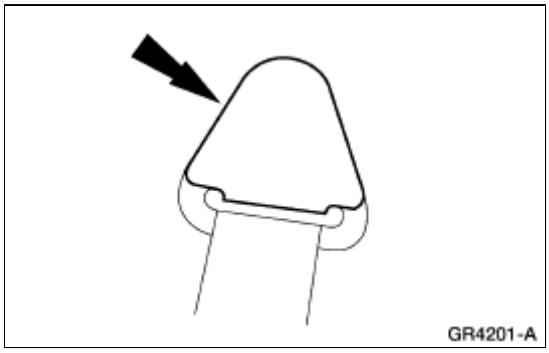
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)
 ST1490-A	Windshield and Molding/Trim Removal Kit or equivalent 107-R0401

Removal

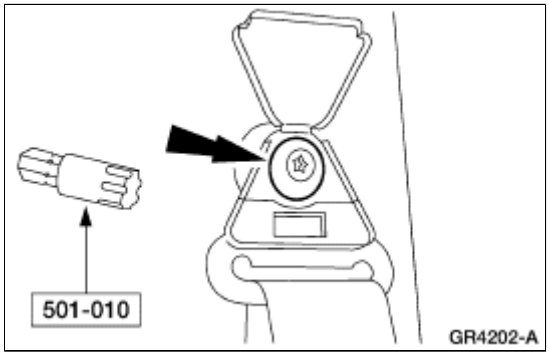
1. Remove the windshield side garnish moulding (03598).


GR4200-A

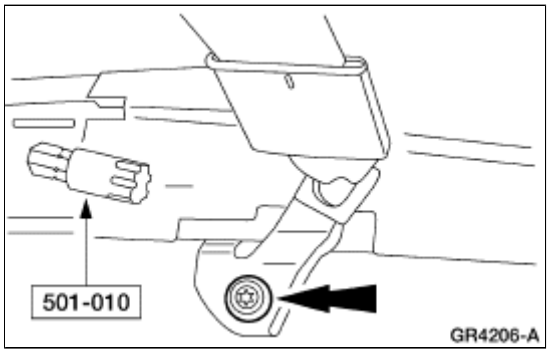
2. Remove the front door scuff plate.
3. Remove the front safety belt guide bolt cover.


GR4201-A

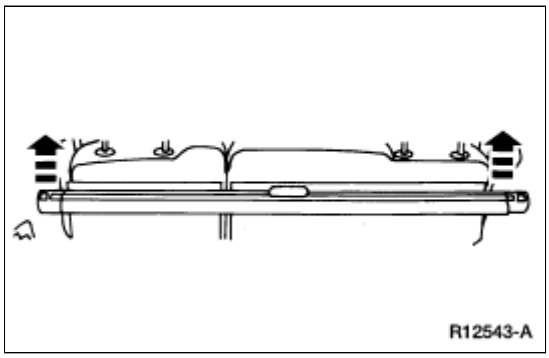
4. Using the special tool, remove the front safety belt guide bolt.



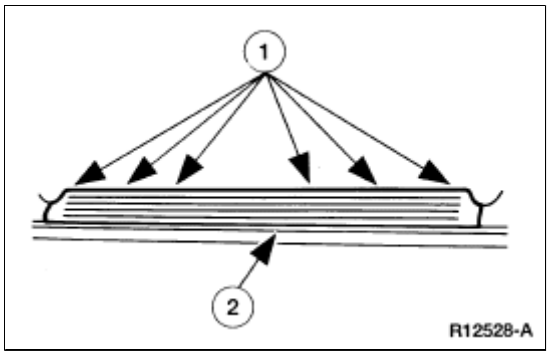
5. Using the special tool, remove the front safety belt anchor bolt.



6. If equipped, remove the retractable cargo cover.

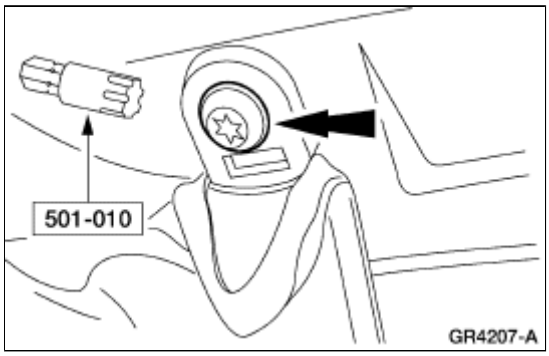


7. Remove the liftgate scuff plate (13144).
    1. Starting at either end and working along the liftgate scuff plate, use Windshield and Molding/Trim Removal Kit to remove the scuff plate.
    2. Remove the liftgate scuff plate.

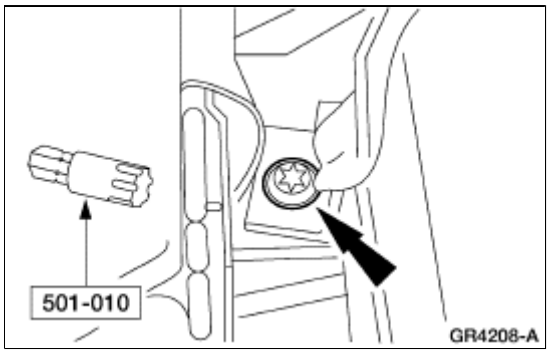


8. Fold the rear seat into the load floor position.

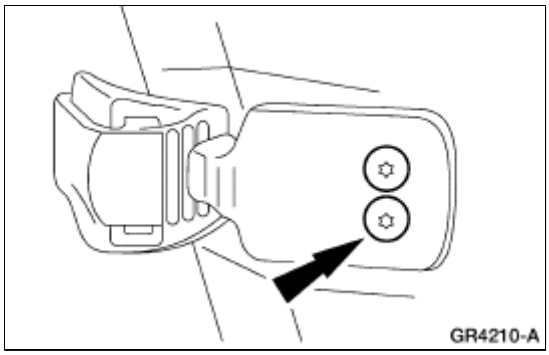
9. Using the special tool, remove the rear safety belt guide bolt.
   - Position the rear safety belt guide cover aside.



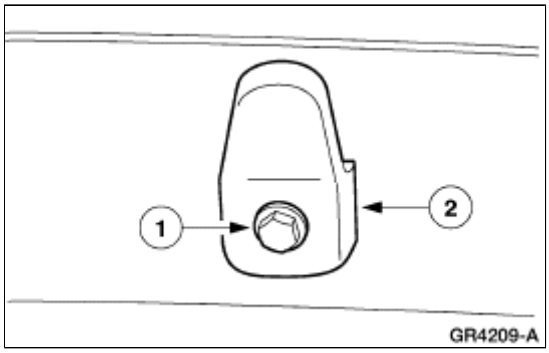
10. Using the special tool, remove the rear safety belt anchor bolt.



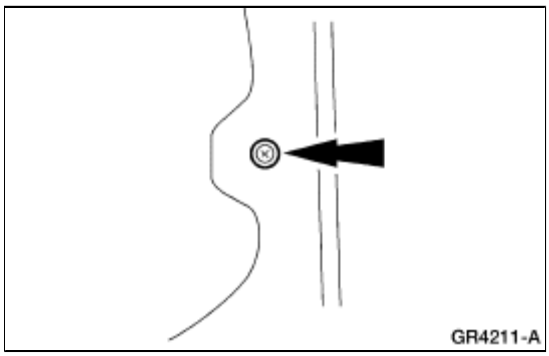
11. Remove the two rear quarter window latch screws.



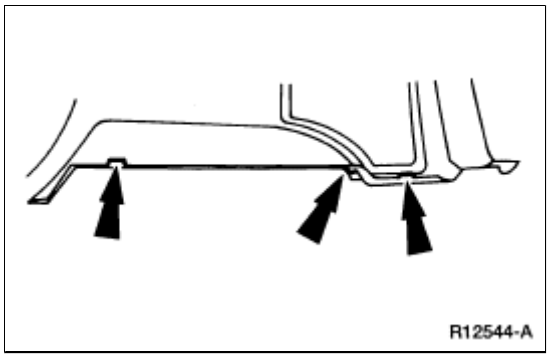
12. Remove the coat hook.
    1. Remove the screw.
    2. Remove the coat hook.



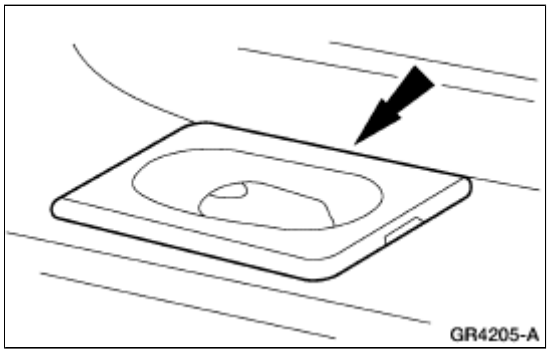
13. Remove the quarter trim panel front screw.
    - Position the carpet aside to gain access to the screw.



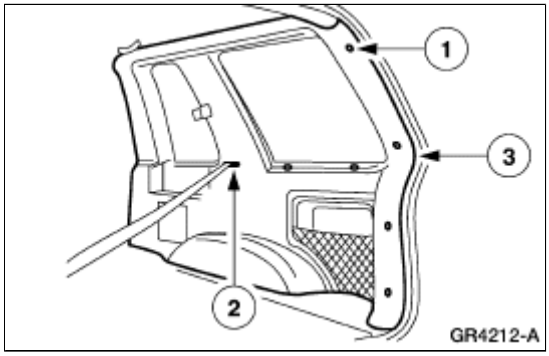
14. Remove the three quarter trim panel rear screws.
    - Position the carpet aside to gain access to the screws.



15. If equipped, remove the rear power lock switch assembly.
    - Disconnect the electrical connector.

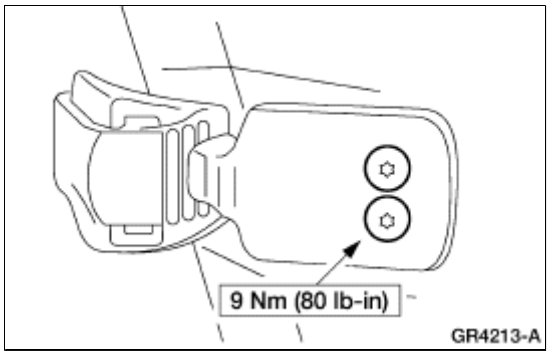


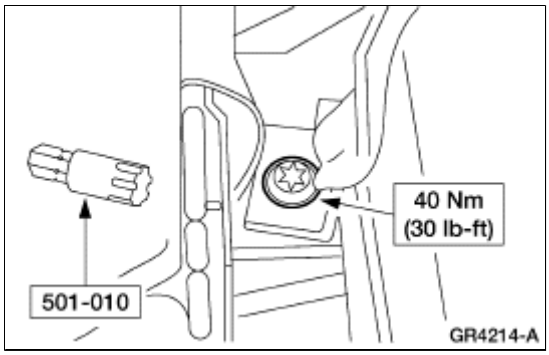
16. Remove the quarter trim panel.
    1. Remove the eight pin-type retainers.
    2. Feed the safety belt webbing through the opening in the quarter trim panel.
    3. Remove the quarter trim panel.

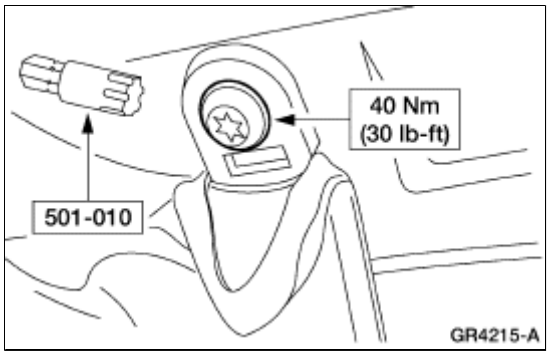


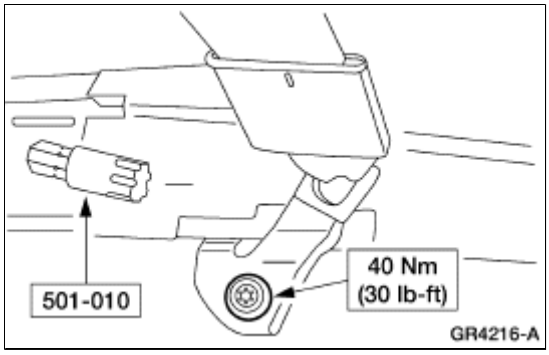
Installation

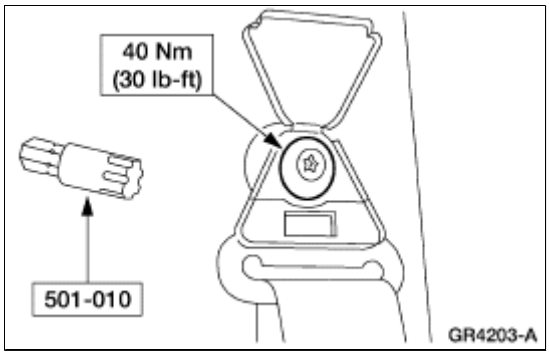
1. To install, reverse the removal procedure.


9 Nm (80 lb-in)
GR4213-A


40 Nm
(30 lb-ft)
501-010
GR4214-A


40 Nm
(30 lb-ft)
501-010
GR4215-A


40 Nm
(30 lb-ft)
501-010
GR4216-A


40 Nm
(30 lb-ft)
501-010
GR4203-A

Headliner

Removal

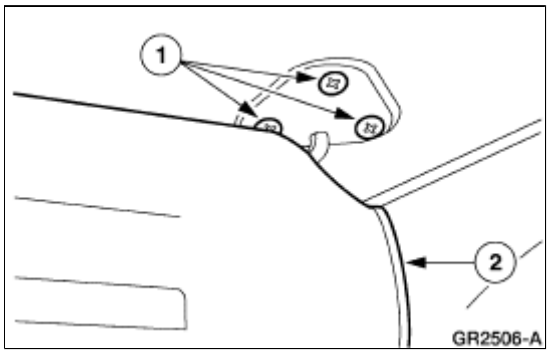
1. Disconnect the battery ground cable (14301).

2. Remove the quarter trim panel (31012) . For additional information, refer to Trim Panel—Quarter, Four Door or Trim Panel—Quarter, Two Door .

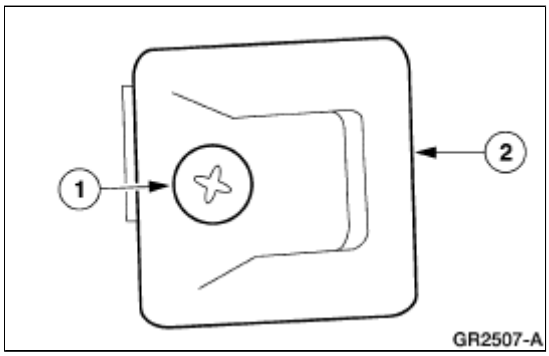
3. If equipped, remove the overhead console. For additional information, refer to Section 501-12 .

4. Remove the interior lamps. For additional information, refer to Section 417-02 .

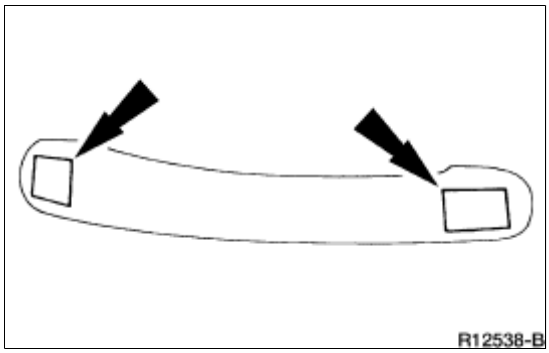
5. Remove the sun visors.
   1. Remove the six screws.
   2. Remove the sun visors.
      - If equipped, disconnect the electrical connectors.



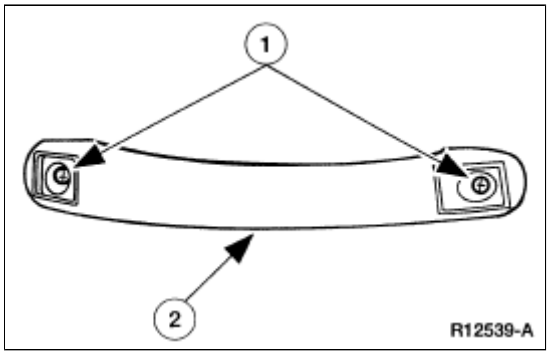
6. Remove the sun visor brackets.
   1. Remove the two screws.
   2. Remove the sun visor brackets.



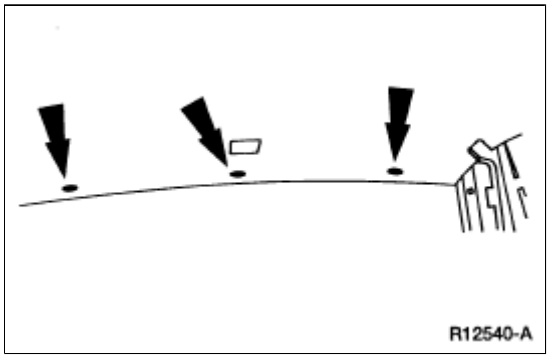
7. Remove the assist handle bolt covers.



8. Remove the assist handles.
    1. Remove the bolts.
    2. Remove the assist handles.



9. Remove the headliner pin-type retainers.



10. Remove the six remaining pin-type retainers.

11. Remove the headliner.

Installation

1. **NOTE:** When the battery (10653) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

    To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Radiator Grille Screws	1.6-2.2	14-20
Front Upper Sight Shield Bolts	6-8	54-70
Running Board Bolts	9-13	81-115
Running Board Nuts	2.5-3.5	23-30
Running Board Screws	0.9-1.3	8-11

Exterior Trim and Ornamentation

The exterior trim components for the Explorer consist of the following:

- luggage rack
- side moulding
- side trim moulding
- running boards
- rear emblem
- rear liftgate trim moulding
- radiator grille
- trim level emblem
- optional step bar

The exterior trim components for the Mountaineer consist of the following:

- luggage rack
- side moulding
- side trim moulding
- trim level emblem
- rear emblem
- radiator grille
- running boards
- rear liftgate trim moulding

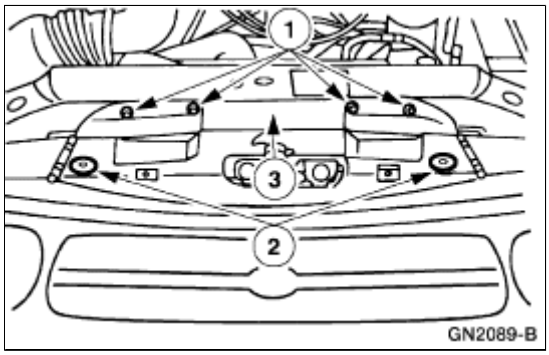
Radiator Grille

Removal

NOTE: Explorer shown; Mountaineer similar.

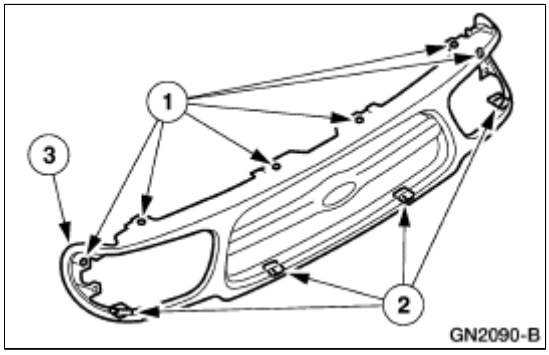
1. Raise and support the hood (16612).

2. Remove the front upper radiator upper sight shield (8C291).
    1. Remove the bolts.
    2. Remove the pin type retainers.
    3. Remove the radiator upper sight shield.



3. Remove the parking lamps; for additional information refer to Section 417-01 .

4. Remove the radiator grille (8200).
    1. Remove the screws.
    2. Release the clips.
    3. Remove the radiator grille.

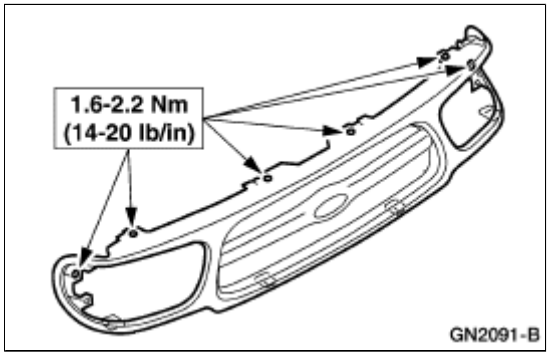


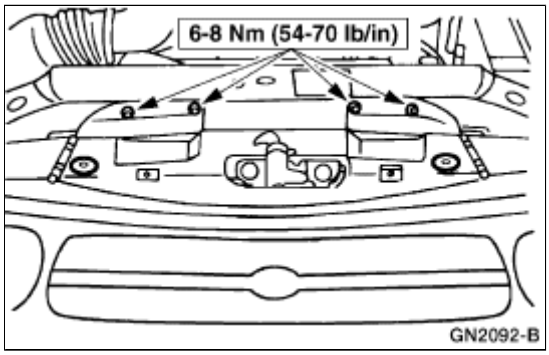
Installation

NOTE: Explorer shown; Mountaineer similar.

1. **NOTE:** Insert the locating tabs before installing the radiator grille screws.

To install, reverse the removal procedure.



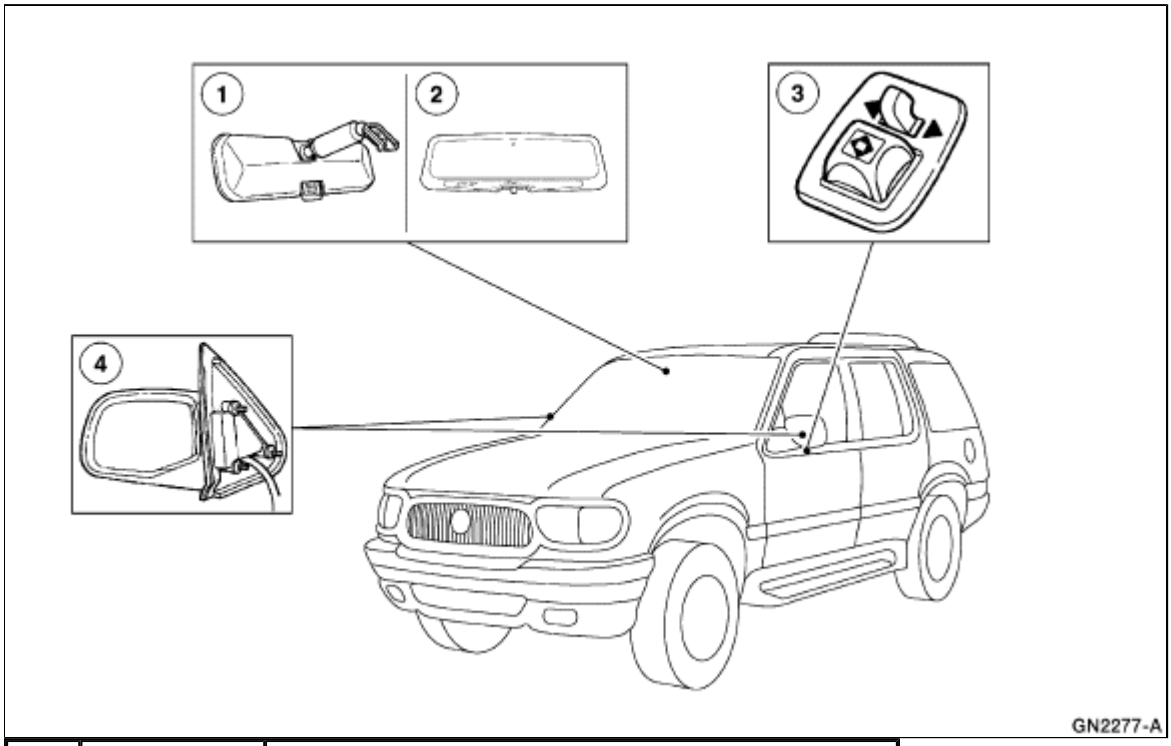


Torque Specifications

Description	Nm	lb-in
Battery Ground Cable Screw	7-10	62-89
Outside Rear View Mirror Nuts	6-8	54-71

Rear View Mirrors

Rear View Mirror Components



Item	Part Number	Description
1	17700	Inside Rear View Mirror
2	17E678	Electrochromic Inside Rear View Mirror (Optional)
3	17B676	Outside Rear View Mirror Control— (LH and RH)
4	17682	Outside Rear View Mirror (LH and RH)

Outside Rear View Mirrors

Both LH and RH outside rear view mirrors are controlled and adjusted from the outside rear view mirror switch. The outside rear view mirrors can also be folded in or manually adjusted. The outside rear view mirrors can also house the optional ground illumination lamps. The mirrors can have the optional heated function when the heated back window glass is actuated.

The heated power mirror contains a grid that is provided power by the rear window defrost relay.

Pressing the rear window defrost switch begins the ten-minute cycle and activates the rear window defrost relay.

Pressing the rear window defrost switch at anytime during the timing cycle will deactivate the function and deactivate the rear window defrost relay. If the switch is NOT pressed during the ten-minute cycle, power remains applied to the rear window defrost relay until the timer interval has expired.

Inside Rear View Mirror — Electrochromic

The electrochromic inside rear view mirror has three features:

- Automatic dimming.
- Autolamp delay; refer to Section 417-01 .
- Automatic lock-in normal view state, when vehicle is placed in REVERSE (R).

The automatic dimming feature darkens the inside rear view mirror whenever the front ambient light sensor detects low outside light and glare reaches the light sensor (photocell), located inside the mirror. The electrochromic inside rear view mirror starts to return to the normal view once glare goes away.

Rear View Mirrors

Refer to Wiring Diagrams Cell 124 , Power Mirrors for schematic and connector information.

Refer to Wiring Diagrams Cell 125 , Automatic Day/Night Mirrors for schematic and connector information.

Refer to Wiring Diagrams Cell 56 , Rear Window Defrost/Mirror Defrost for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the outside/inside rear view mirrors.
2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Mirror • Switch	• Fuse(s) • Wiring harness • Loose or corroded connections

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

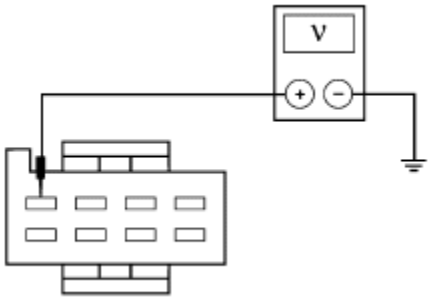
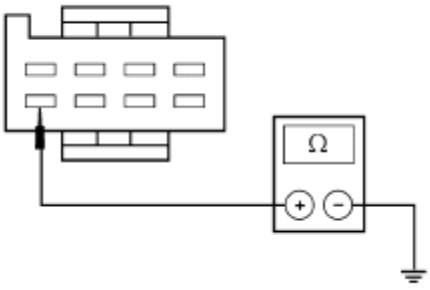
Condition	Possible Sources	Action
• The Mirrors Are Inoperative	• Fuse. • Circuitry. • Outside rear view mirror switch.	• GO to Pinpoint Test A .

• A Single Mirror Is Inoperative	• Circuitry. • Outside rear view mirror motor.	• GO to Pinpoint Test B .
• A Single Mirror Does Not Function With Switch Logic	• Outside rear view mirror control. • Outside rear view mirror motor. • Circuitry.	• GO to Pinpoint Test C .
• The Auto Dimming Mirror Does Not Operate Properly	• Fuse. • Inside rear view mirror. • Circuitry.	• GO to Pinpoint Test D .
• The Heated Outside Mirror Does Not Defrost — Both Power/Heated Mirrors	• Fuse. • Power/heated mirror. • Circuitry.	• GO to Pinpoint Test E .
• The Heated Outside Mirror Does Not Defrost — Left Power/Heated Mirror	• Left power heated mirror. • Circuitry.	• GO to Pinpoint Test F .
• The Heated Outside Mirror Does Not Defrost — Right Power/Heated Mirror	• Right power/heated mirror. • Circuitry.	• GO to Pinpoint Test G .

Pinpoint Tests

PINPOINT TEST A: THE MIRRORS ARE INOPERATIVE

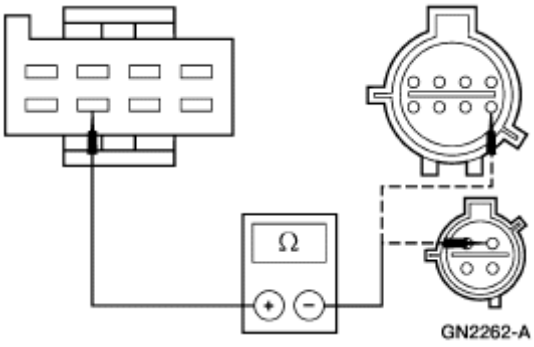
CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FUSE JUNCTION PANEL FUSE 1 (7.5A)	
1 2 Fuse 1 (7.5A)	• **Is the fuse OK?** → **Yes** GO to A2 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again,

	CHECK for a short to ground, REPAIR as necessary.
A2 CHECK THE VOLTAGE TO THE POWER MIRROR SWITCH — CIRCUIT 956 (O/LG)	
1 Outside Rear View Mirror Switch C507 2  GN0910-A	2 Measure the voltage between outside rear view mirror switch C507-1, circuit 956 (O/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A3 . → **No** REPAIR circuit 956 (O/LG). TEST the system for normal operation.
A3 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GN0911-A	1 Measure the resistance between outside rear view mirror switch C507-5, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the outside rear view mirror switch. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for

	normal operation.

PINPOINT TEST B: SINGLE MIRROR INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE OUTSIDE REAR VIEW MIRROR CONTROL	
1 Outside Rear View Mirror Switch C507	2 Use the table to check for continuity between the given terminals of the outside rear view mirror switch for the side that is not operating correctly. **Outside Rear View Mirror** **Direction** / **LH Mirror** / **RH Mirror** Up: 1 and 7; 5 and 6 / 1 and 8; 5 and 6 Down: 1 and 6; 5 and 7 / 1 and 6; 5 and 8 Left: 1 and 4; 5 and 6 / 1 and 3; 5 and 6 Right: 1 and 6; 4 and 5 / 1 and 6; 3 and 5 • **Is the resistance between given terminals less than 5 ohms only for the given sets of terminals in each direction?** → **Yes** GO to B2 . → **No** REPLACE the outside rear view mirror switch. TEST the system for normal operation.
B2 CHECK CIRCUIT 542 (Y) FOR OPEN	
1 Inoperative Outside Rear View Mirror C509 or C606 (C505 or C605 two door) 2	2 Measure the resistance between outside rear



view mirror switch, circuit 542 (Y), and inoperative outside rear view mirror using the chart below:

	LH Mirror	RH Mirror
2 DOOR	C505-1	C605-1
4 DOOR	C509-5	C606-6
OUTSIDE REAR VIEW MIRROR SWITCH	C507-6	C507-6

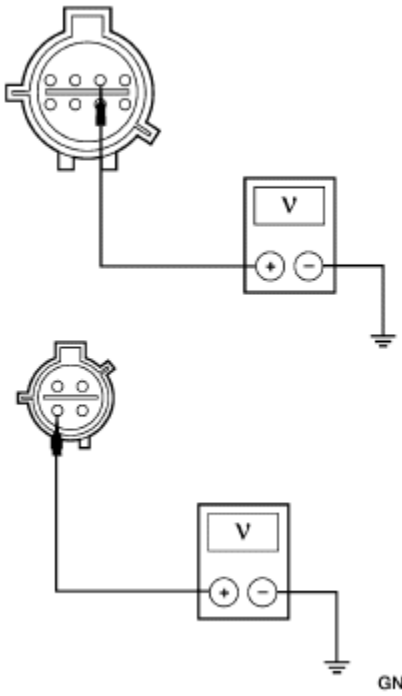
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the inoperative rear view mirror. TEST the system for normal operation.

→ **No**
REPAIR circuit 542 (Y). TEST the system for normal operation.

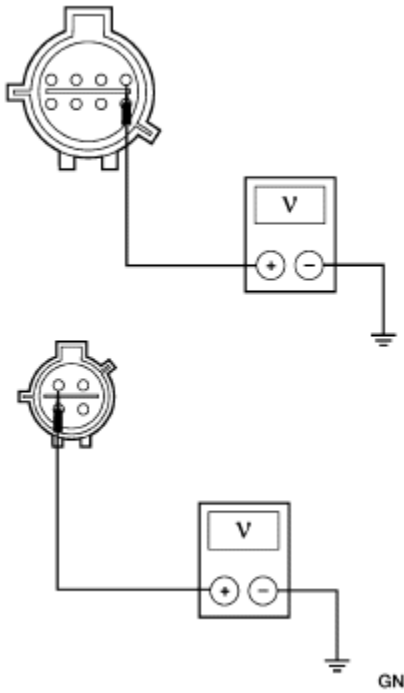
PINPOINT TEST C: A SINGLE MIRROR DOES NOT FUNCTION WITH SWITCH LOGIC

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE MIRROR MOVEMENT (LEFT/RIGHT)	
	1 Operate the LH and RH outside rear view mirrors in the left and right direction. • **Do the outside rear view mirrors move left and right?** → **Yes** GO to C2. → **No** GO to C3.
C2 CHECK MIRROR MOVEMENT (UP/DOWN)	
	1 Operate the LH and RH outside rear view mirrors in the up and down direction. • **Do the outside rear view mirrors move up and down?** → **Yes** System is OK.

	→ **No** GO to C4 .
C3 CHECK THE VOLTAGE TO THE INOPERATIVE MIRROR	
1 2 Inoperative Outside Rear View Mirror C509 or C606 (C505 or C605 two door) 3  GN0915-A	3 While operating the outside rear view mirror switch, measure the voltage between circuit 543 (DG) [RH] or circuit 540 (R) [LH], and ground. Refer to the chart below. | | LH Mirror | RH Mirror | | 2 DOOR | C505-4 | C605-4 | | R DOOR | C509-2 | C606-2 | • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the outside rear view mirror in question. TEST the system for normal operation. → **No** GO to C5 .
C4 CHECK THE VOLTAGE TO THE INOPERATIVE MIRROR	
1	

Inoperative Outside Rear View Mirror C509 or C606 (C505 or C605 two door)

2



2 While operating the outside rear view mirror switch, measure the voltage between circuit 544 (P) [RH] or circuit 541 (DB) [LH], and ground. Refer to the chart below.

	LH Mirror	RH Mirror
2 DOOR	C505-2	C605-2
4 DOOR	C509-1	C606-1

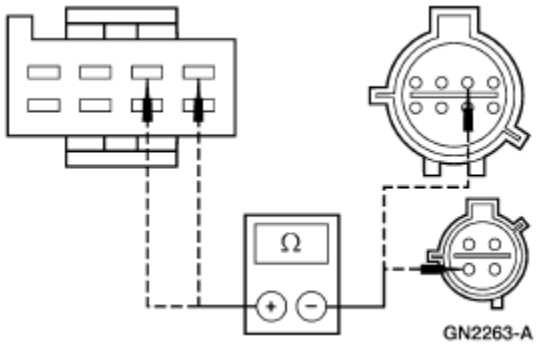
- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the outside rear view mirror in question. TEST the system for normal operation.

→ **No**
GO to C6 .

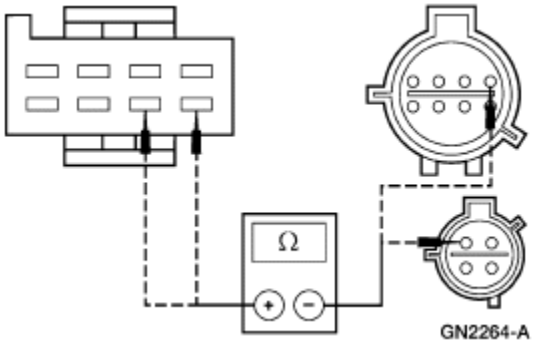
C5 CHECK CIRCUIT 540 (R) AND CIRCUIT 543 (DG) FOR OPEN

1



1 Measure the resistance between outside rear view mirror switch circuit 543 (DG) [RH], or circuit 540 (R) [LH] and inoperative outside rear view mirror. Refer to the charts below.

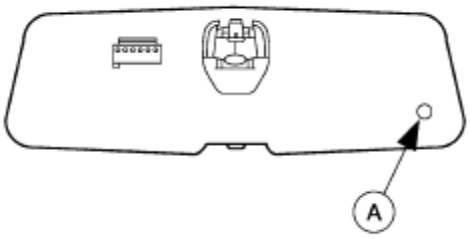
	LH Mirror	RH Mirror
2 DOOR	C505-4	C605-4
4 DOOR	C509-2	C606-2
OUTSIDE REAR VIEW MIRROR	C507-4	C507-3

	SWITCH • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the outside rear view mirror switch. TEST the system for normal operation. → **No** REPAIR circuit 540 (R) or circuit 543 (DG). TEST the system for normal operation.
C6 CHECK CIRCUIT 541 (DB) AND CIRCUIT 544 (P) FOR OPEN	
1  	1 Measure the resistance between outside rear view mirror switch circuit 541 (DB) [LH], or circuit 544 (P) [RH] and inoperative outside rear view mirror. Refer to the charts below. LH Mirror: 2 DOOR C505-2; 4 DOOR C509-1; OUTSIDE REAR VIEW MIRROR SWITCH C507-7 RH Mirror: 2 DOOR C605-2; 4 DOOR C606-1; OUTSIDE REAR VIEW MIRROR SWITCH C507-8 • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the outside rear view mirror switch. TEST the system for normal operation. → **No** REPAIR circuit 541 (DB) or circuit 544 (P). TEST the system for normal operation.

PINPOINT TEST D: THE AUTO DIMMING MIRROR DOES NOT OPERATE PROPERLY

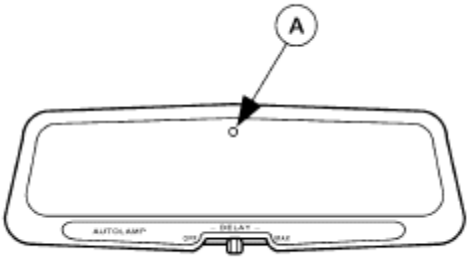
CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: If the transmission range sensor is malfunctioning so that the backup lamps are on, the electrochromic inside rear view mirror will not darken.	
D1 CHECK INSIDE REAR VIEW MIRROR OPERATION	
2	1 Perform the Inside Rear View Mirror — Self Test. Refer to Component Tests.

3



GN0320-A

4



GN0321-A

3 Cover the (A) back sensor with a dark cloth or dark tape.

4 With a flashlight, shine the light on the (A) sensor located in the upper center area of the inside rear view mirror.

- **Does the inside rear view mirror glass darken to the non-reflective state?**

→ **Yes**
The inside rear view mirror is OK. REVIEW the inside rear view mirror operations with the customer.

→ **No**
REMOVE the cloth or tape. GO to D2 .

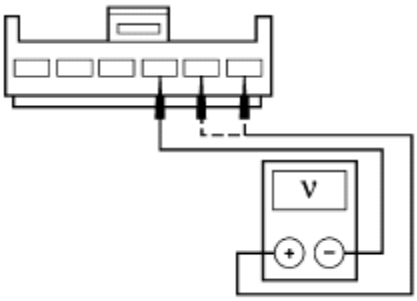
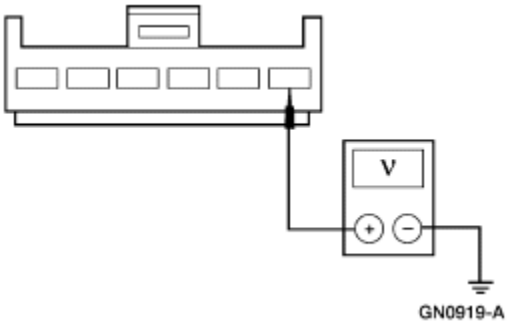
D2 CHECK FOR VOLTAGE TO THE INSIDE REAR VIEW MIRROR

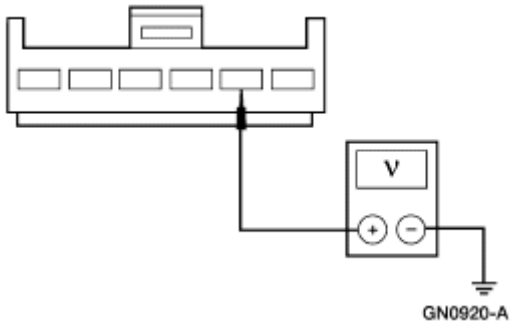
1

2

Inside Rear View Mirror C341

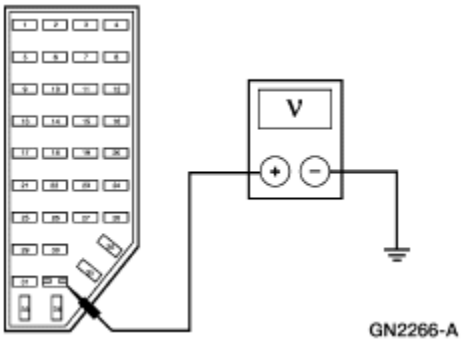
3

 4  GN2265-A	4 Measure the voltage between the inside rear view mirror C341-6, circuit 640 (R/Y), C341-5, circuit 54 (LG/Y), and inside rear view mirror C341-4, circuit 57 (BK). • **Are the voltages greater than 10 volts?** → **Yes** REPLACE the inside rear view mirror. REFER to Mirror — Inside Rear View, Electrochromic. TEST the system for normal operation. → **No** GO to D3.
D3 CHECK CIRCUIT 640 (R/Y) FOR VOLTAGE	
1  GN0919-A	1 Measure the voltage between inside rear view mirror C341-6, circuit 640 (R/Y), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to D4. → **No** REPAIR circuit 640 (R/Y). TEST the system for normal operation.
D4 CHECK CIRCUIT 54 (LG/Y) FOR VOLTAGE	
1	1 Measure the voltage between inside rear view mirror C341-5, circuit 54 (LG/Y), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. → **Yes** REPAIR circuit 54 (LG/Y). TEST the system for normal operation.

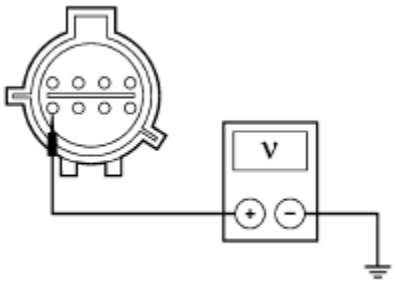
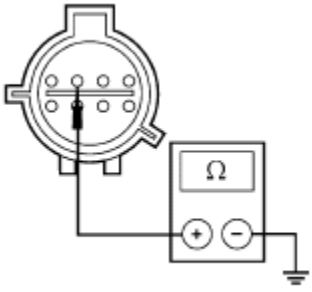
PINPOINT TEST E: THE HEATED OUTSIDE MIRROR DOES NOT DEFROST — BOTH POWER/HEATED MIRRORS

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE HEATED REAR WINDOW SWITCH OPERATION	
1 	2 Place the heated rear window switch in the ON position. • **Does the heated rear window switch illuminate?** → **Yes** REFER to Section 501-11 . → **No** GO to E2 .
E2 CHECK FUSE JUNCTION PANEL FUSE 32 (7.5A)	
1 Fuse 32 (7.5A)	

	• **Is the fuse OK?** → **Yes** GO to E3 . → **No** REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
E3 CHECK FUSE JUNCTION PANEL FUSE 32 (7.5A) FOR VOLTAGE	
1  	1 Verify the heated rear window switch in illuminated. 2 Measure the voltage between fuse junction panel fuse 32 (7.5A), pin 2, and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPAIR circuit 59 (DG/P). TEST the system for normal operation. → **No** REPAIR circuit 186 (BR/LB). TEST the system for normal operation.

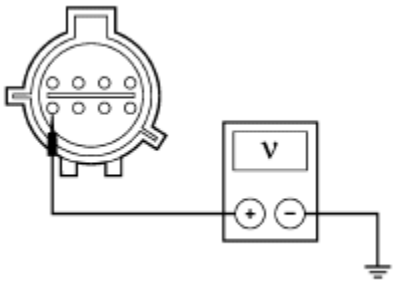
PINPOINT TEST F: THE HEATED OUTSIDE MIRROR DOES NOT DEFROST — LEFT POWER/HEATED MIRROR

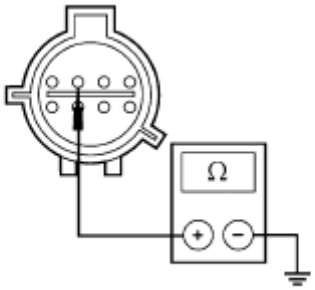
CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK CIRCUIT 59 (DG/P) FOR VOLTAGE	
1 2 	

Left Power/Heated Mirror C509 3 4  GN2267-A	4 Measure the voltage between left power/heated mirror C509-8, circuit 59 (DG/P), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to F2 . → **No** REPAIR circuit 59 (DG/P). TEST the system for normal operation.
F2 CHECK CIRCUIT 57 (BK) FOR OPEN	
1 2  GN2110-B	2 Measure the resistance between left power/heated mirror C509-6, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the left power/heated mirror; REFER to Mirror — Outside Rear View. TEST the system for normal operation.

	→ **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST G: THE HEATED OUTSIDE MIRROR DOES NOT DEFROST — RIGHT POWER/HEATED MIRROR INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK CIRCUIT 59 (DG/P) FOR VOLTAGE	
1 2 Right Power/Heated Mirror C606 3 4  GN2267-A	4 Measure the voltage between right power/heated mirror C606-8, circuit 59 (DG/P), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to G2 . → **No** REPAIR circuit 59 (DG/P). TEST the system for normal operation.
G2 CHECK CIRCUIT 57 (BK) FOR OPEN	
1	1 Measure the resistance between right power/heated mirror C606-6, circuit 57 (BK), and ground.

 GN2110-B	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the right power/heated mirror; REFER to Mirror — Outside Rear View. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

Component Tests

Inside Rear View Mirror — Self Test

NOTE: This diagnostic test is applicable to late build models equipped with electrochromic inside rear view mirrors.

1. Place the ignition switch in the OFF position.

2. Place the autolamp in the OFF (slide control at the far left [detent]) position.

3. Using a ball-point pen or paper clip, press and hold the mode switch located at the bottom of the mirror. After three seconds, the headlamps and parking lights will illuminate. If the headlamps do not illuminate, check inside rear view mirror C341-2, circuit 218 (W/P), for an open or a short, or check for a defective parklamp relay. The autolamp status LED will illuminate.

4. Release the mode switch. If the headlamp or status LED does not illuminate then check inside rear view mirror C341-5, circuit 54 (LG/Y), and inside rear view mirror C341-4, circuit 57 (BK), for a short or an open.

5. Place the ignition switch in the ON position. The headlamps and parking lights will extinguish. The inside rear view mirror will dim. The autolamp status indicator and headlamps will extinguish and the inside rear view mirror will darken. If the autolamps remain ON and/or the inside rear view mirror does not darken, check inside rear view mirror C341-6, circuit 640 (R/Y), for an open; or check inside rear view mirror C341-3, circuit 140 (BK/PK), for battery voltage.

6. **NOTE:** This procedure must be started within ten seconds or the mirror will default to the power-up state.

   The mirror will reset to the power-on state (mirror bright, lamps off). Once the inside rear view mirror is dark, place the gear shift lever in the REVERSE position. If the mirror does not return to full bright,

check inside rear view mirror C341-3, circuit 140 (BK/PK), for an open.

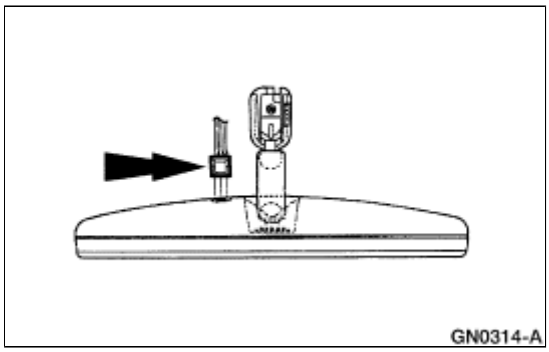
7. Place the gear shift lever in the PARK position.
8. Place the ignition switch in the OFF position.

Mirror —Inside Rear View, Electrochromic

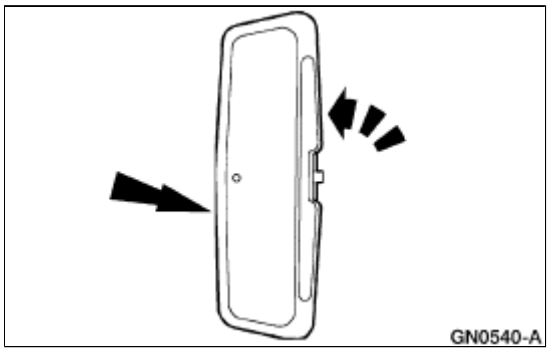
Removal

CAUTION: Do not use tools or other objects to pry the mount or mirror away from the windshield. Use of tools may damage the mirror mount.

1. Disconnect the inside rear view mirror electrical connector.



2. Turn the inside rear view mirror to the vertical position.



3. Remove the inside rear view mirror.
   - Twist the mirror horizontally until the tube assembly bottoms out and the spring releases off the mounting button.

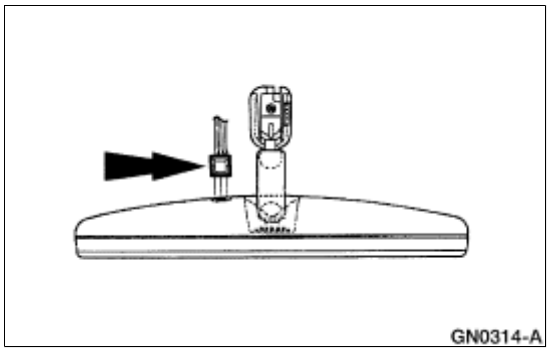
Installation

1. Position the inside rear view mirror onto the mounting button.

2. **NOTE:** Make sure the inside rear view mirror remains parallel to the windshield glass.

   Slide the inside rear view mirror onto the mounting button while applying holding force against the button until a click is heard.

3. Connect the inside rear view mirror electrical connector.



4. **NOTE:** The mirror mount is designed to detach from the button during air bag deployment. Excessive force or adjustment can cause the mirror to detach from the windshield.

   Check the inside rear view mirror for normal operation.

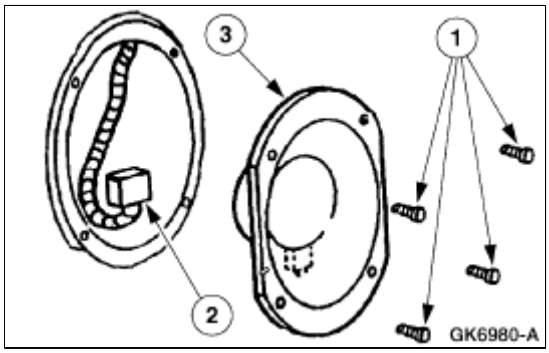
Mirror —Outside Rear View

Removal

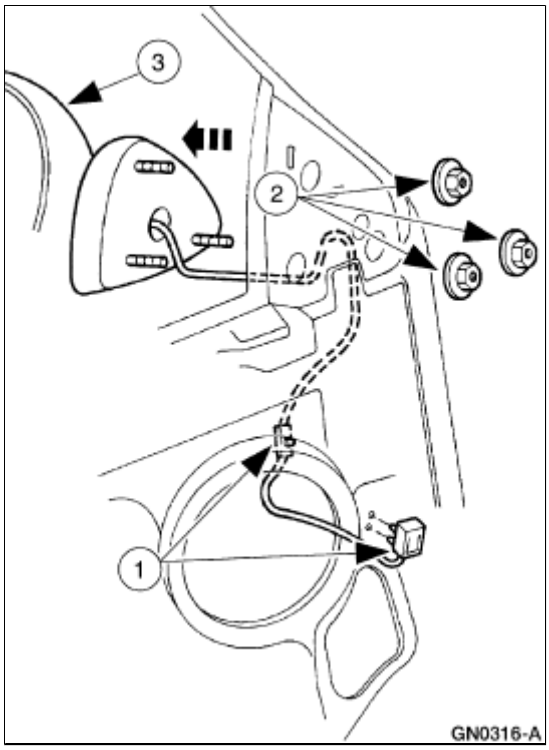
1. Disconnect the battery ground cable (14301).

2. Remove the front door trim panel; refer to Section 501-05 .

3. Remove the speaker.
    1. Remove the screws.
    2. Disconnect the electrical connector.
    3. Remove the speaker.



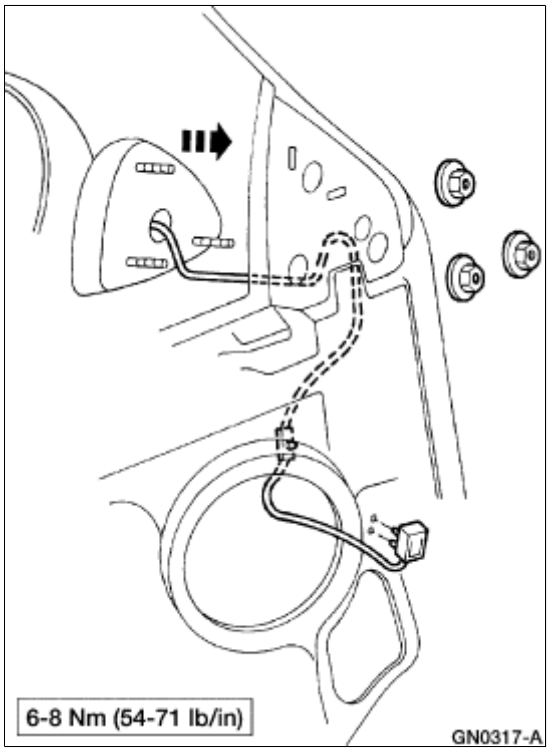
4. Remove the outside rear view mirror (17682).
    1. Disconnect the power mirror wiring clips.
    2. Remove the outside rear view mirror nuts.
    3. Remove the outside rear view mirror.
        - Feed the power mirror wiring through the opening in the front door (20124).



Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.



Torque Specifications

Description	Nm	lb-ft	lb-in
Adjuster latch/pivot cover screw	1.6-2.2	—	15-19
Battery ground cable bolt	7-10	—	62-89
Center occupant safety belt bolt	30-40	22-30	—
Driver seat module screws	12	9	—
Front/rear seat backrest latch bolts	47-63	34-46	—
Front seat back pad adjusting pump bolt	11-14	8-10	—
Front seat cushion side cover screws	1.6-2.2	—	15-19
Front seat inboard pivot bolt	19-26	14-19	—
Front seat track to floor bolts	21-28	15-21	—
Inboard safety belt bracket bolt	38-44	28-32	—
Latch handle screws	1.6-2.2	—	15-19
Link arm nut	30-40	22-30	—
Rear outboard bolt	30-40	22-30	—
Rear outboard nut	30-40	22-30	—
Rear seat back inboard/outboard pivot bolts	38-44	28-32	—
Rear seat riser to floor nuts	30-40	22-30	—
Rear seat riser pivot bolts	38-44	28-32	—
Rear seat link bolt	30-40	22-30	—
Rear seat to floor bolts	30-40	22-30	—
Safety belt buckle bracket to floor nuts	34-46	25-34	—
Seat cushion to adjuster latch bolts, rear seat	38-44	28-32	—
Seat track to seat cushion bolts	17-23	13-17	—
Side air bag nuts	8	—	71
Slide bar to floor bolt	40	30	—
Slide bar to seat track bolt	7.5-10.5	—	66.4-92.9
Slide bar to seat track nut	7.5-10.5	—	66.4-92.9
40% seat inboard pivot bolts	23-32	17-24	—
50% seat cushion to seat hinge bolts	7-11	—	62-97
50/50 seat back latch bolt	30-46	22-33	—
60% front seat armrest bolt	30-35	22-26	—
60% seat cushion outboard side bolster screw	1.6-2.2	—	15-19
60% seat inboard pivot cover bolt	1.6-2.2	—	15-19

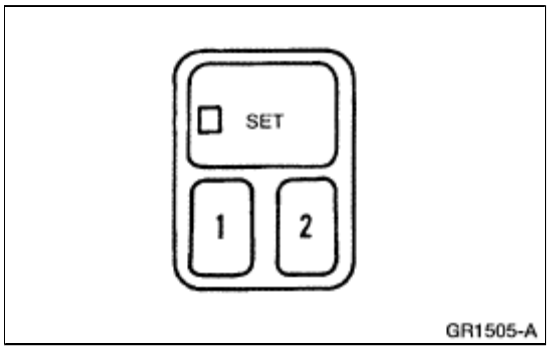
Seats

The seat options consist of:

- Captain's Chair (cloth)
- Eddie Bauer Sport Bucket (leather, standard power driver, optional power passenger, optional heated, optional side air bag)
- Limited Seat (leather, optional heated, optional side air bag)
- Sport Bucket (cloth, optional side air bag)
- Sport Bucket (driver, cloth, optional power, optional side air bag)
- Sport Bucket (leather, optional power, optional side air bag)
- Vinyl Bucket
- 60/40 Front Bench (vinyl, cloth)
- 50/50 Rear Seat (vinyl, cloth, leather)
- 60/40 Rear Seat (vinyl, cloth, leather)

Programmable Seat, Explorer Limited

Programmable Seat Switch



This system allows automatic positioning of the driver seat to three programmable positions.

- To program position one, move the driver seat to the desired position using the seat regulator control switch. Depress the set button. Within five seconds, depress button one.
- To program position two, repeat the previous procedure using button two.
- To program position three, repeat the previous procedure but depress buttons one and two simultaneously
- To recall position one, depress button one. To recall position two, depress button two. To recall position three, depress button one and two simultaneously.

A position can only be recalled when the transmission selector is in PARK or NEUTRAL. A position may be programmed at any time.

Heated Seat

This system allows the electrical heating of the front seats on passenger demand.

The components of the system are:

- The seat heating elements located in the seat cushion and backrest.
- The heated seat module located on the seat cushion frame.
- The heated seat control switch, located on the seat side trim panel.
- Temperature sensors located in the seat heating elements.

Side Air Bag

Driver and passenger side air bags are attached to the seat backrest frame. For diagnostic information or if the side air bag has been deployed, refer to Section 501-20B .

Front seat backrest trim covers installed on seats with side air bags cannot be repaired. The front seat backrest trim covers are to be installed new. Cleaning is permissible.

If a side air bag deployment took place the seat back pad, trim cover and side air bag module must be replaced. Replace the seat back frame if necessary.

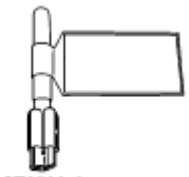
Seats

Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 122 , Power Lumbar Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter or equivalent 105-R0057
ST1253-B	Passenger Car Pressure Tester or equivalent 014-R1052
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST2506-A	Air Bag Simulator (Restraints System Diagnostic Tool) 418-F088 (105-R0012) or equivalent

Restraint System Diagnostic Tool Warning

WARNING: This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Inspection and Verification

1. Verify the customer concern by operating the power seat(s).

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Switch(s) • Seat tracks obstructed or damaged • Hose(s) • Pad adjuster	• Fuse(s) • Wiring harness • Loose or corroded connections • Motor(s) • Adjusting pump

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

3. If the concern remains after the inspection connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for DSM, Go To Pinpoint Test K .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self test diagnostics for the driver seat module (DSM).

6. If the DTCs retrieved are related to the concern, go to DSM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

DSM Diagnostic Trouble Code (DTC) Index

DSM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
B1342	ECU is Defective	DSM	INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation.
B1529	Memory SET Switch Circuit Short to Power	DSM	Go To Pinpoint Test H .
B1533	Memory 1 Switch Circuit Short to Power	DSM	Go To Pinpoint Test H .
B1537	Memory 2 Switch Circuit Short to Power	DSM	Go To Pinpoint Test H .
B1663	Seat Driver Front Up/Down Motor Stalled	DSM	REFER to Symptom Chart for customer concern, then Go To Pinpoint Test G or Go To Pinpoint Test H .
B1664	Seat Driver Rear Up/Down Motor Stalled	DSM	REFER to Symptom Chart for customer concern, then Go To Pinpoint Test G or Go To Pinpoint Test H .
B1665	Seat Driver Forward/Backward Motor Stalled	DSM	REFER to Symptom Chart for customer concern, then Go To Pinpoint Test G or Go To Pinpoint Test H .
B1676	Battery Power Out of Range	DSM	REFER to Section 414-00 .
B1711	Seat Driver Front Up Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1715	Seat Driver Down Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1719	Seat Driver Forward Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1723	Seat Driver Rearward Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1727	Seat Driver Rear Up Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1731	Seat Driver Rear Down Switch Circuit Short to Power	DSM	Go To Pinpoint Test G .
B1950	Seat Rear Up/Down Potentiometer Feedback Circuit Failure (Possible Open or Short to Ground Condition)	DSM	Go To Pinpoint Test H .
B1952	Seat Rear Up/Down Potentiometer Feedback Circuit Short to Power	DSM	Go To Pinpoint Test H .
B1954	Seat Front Up/Down Potentiometer Feedback Circuit Failure (Possible Open or Short to Ground Condition)	DSM	Go To Pinpoint Test H .
B1956	Seat Front Up/Down Potentiometer Feedback Circuit Short to Power	DSM	Go To Pinpoint Test H .

B1962	Seat Horizontal Fwd/Rwd Potentiometer Feedback Circuit Failure (Possible Open or Short to Ground Condition)	DSM	Go To Pinpoint Test H .
B1964	Seat Horizontal Fwd/Rwd Potentiometer Feedback Circuit Short to Power	DSM	Go To Pinpoint Test H .

DSM Parameter Identification (PID) Index

DSM Parameter Identification (PID) Index

PID	Description	Expected Values
CCNT_DS	Number of Continuous DTCs in Module	One Count Per Bit
P/N SW	Park/Neutral Switch	P/N, not P/N
SFWD_MT	Driver Seat Forward/Rearward Motor	SENSED, NOTSEN
SREARMT	Driver Seat Rear Motor	SENSED, NOTSEN
SFNT_MT	Driver Seat Front Motor	SENSED, NOTSEN
MEM2_SW	Memory Recall Switch 2	OFF, ON
MEM1_SW	Memory Recall Switch 1	OFF, ON
MEMS_SW	Memory SET Switch	OFF, ON
SFNT_SW	Power Seat Switch — Front	SHORT, UP, DOWN, OFF
SREARSW	Power Seat Switch — Rear	SHORT, UP, DOWN, OFF
SFWD_SW	Power Seat Switch — Forward/Rearward	SHORT, RWD, FWD, OFF
SFWD_P	Driver Seat Position % Forward	% of Full Forward
SFNT_P	Driver Seat Front Position % Up	% of Full Up
SREAR_P	Driver Seat Rear Position % Up	% of Full Up
VBATVDM	Battery Voltage	Volts
PMIR_H	Passenger Side Mirror Horizontal Motor	SENSED, notSEN
PMIR_V	Passenger Side Mirror Vertical Motor	SENSED, notSEN
DMIR_H	Driver Side Mirror Horizontal Motor	SENSED, notSEN
DMIR_V	Driver Side Mirror Vertical Motor	SENSED, notSEN
MIR_SEL	Power Mirror Select Switch	PSSNGR, DRIVER
MIRV_SW	Power Mirror Position Switch — Vertical	SHORT, DOWN, UP, OFF
MIRH_SW	Power Mirror Position Switch — Horizontal	SHORT, RIGHT, LEFT, OFF
DMIR_R	Driver Mirror Position % Right	% of Full Right
DMIR_UP	Driver Mirror Position % Up	% of Full Up
PMIR_R	Passenger Mirror Position % Right	% of Full Right
PMIR_UP	Passenger Mirror Position % Up	% of Full Up

DSM Active Command Index

DSM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
MEMORY SET LED CONTROL	LED STATE	ON, OFF
SEAT CONTROL	FRONT UP	ON, OFF
	FRONT DWN	ON, OFF
	REAR UP	ON, OFF
	REAR DWN	ON, OFF
	HORZ FWD	ON, OFF
	HORZ RWD	ON, OFF

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The power seat is inoperative	• Fuse. • Circuitry. • Front seat regulator control switch (14A701) .	• Go To Pinpoint Test A . If equipped with memory seat, Go To Pinpoint Test G .
• The power seat moves but is noisy	• Seat track.	• Go To Pinpoint Test B .
• The power seat moves but is loose	• Fastening hardware. • Seat track.	• Go To Pinpoint Test C .
• The power seat does not make full travel	• Track obstructed. • Seat track.	• Go To Pinpoint Test D .
• The power seat does not move horizontally/vertically	• Front seat regulator motors (14547) . • Circuitry. • Front seat regulator control switch .	• Go To Pinpoint Test E . If equipped with memory seat, Go To Pinpoint Test G .
• The power lumbar is inoperative	• Circuitry. • Fuse. • Seat control switch (14C715) . • Front seatback pad adjusting pump (65530) . • Front seatback pad adjusting hose (65528) . • Front seatback pad adjuster (65500) .	• Go To Pinpoint Test F .

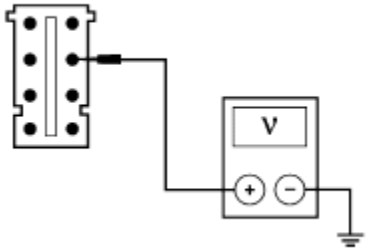
• The memory seat is inoperative	• Seat regulator control switch. • Circuitry. • DSM.	• Go To Pinpoint Test G.
• The memory seat does not operate correctly — does not operate using the memory SET switch	• Memory SET switch. • DSM. • Circuitry.	• Go To Pinpoint Test H.
• The memory seat does not operate correctly — the seat moves in one second intervals	• DSM. • Circuitry.	• Go To Pinpoint Test H.
• The memory seat does not operate correctly — the seat does not move to the correct memory position	• DSM. • Circuitry. • Memory SET switch. • Memory seat.	• Go To Pinpoint Test H.
• The memory seat does not operate correctly — does not operate using the remote transmitter	• Circuitry. • Keyless entry transmitter. • RAP module. • DSM.	• Go To Pinpoint Test J.
• No communication with the module — unable to perform on-demand self-test with the driver seat module	• DSM. • Circuitry.	• Go To Pinpoint Test K.
• The heated seat is inoperative	• Fuse. • Circuitry. • Heated seat switch. • Heated seat module. • Seat heater and temperature sensor.	• Go To Pinpoint Test L.
• The heated seat is inoperative— seat does heat but the heated seat switch illuminates when pressed.	• Circuitry. • Heated seat module. • Seat heater and temperature sensor.	• Go To Pinpoint Test M.
• The heated seat is inoperative— seat does heat but the heated seat switch does not illuminate when pressed.	• Circuitry. • Heated seat module. • Heated seat switch.	• Go To Pinpoint Test N.

Pinpoint Tests

PINPOINT TEST A: THE POWER SEAT IS INOPERATIVE

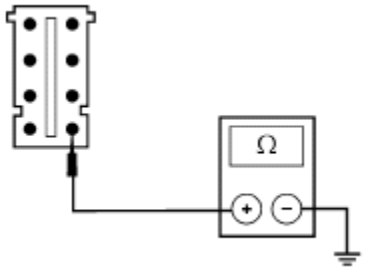
CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FUSE JUNCTION PANEL FUSE 18 (25A)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position.	
2 3 Fuse 18 (25A)	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . • **Is the fuse OK?** → **Yes** GO to A2 . → **No** INSTALL a new Fuse 18 (25A). TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
A2 CHECK THE VOLTAGE TO THE SEAT REGULATOR CONTROL SWITCH — CIRCUIT 171 (BK/W)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible	

violation of vehicle safety standards.

1 Inoperative Power Seat Regulator Control Switch 2  GR2666-B	2 Measure the voltage between seat regulator control switch C349M-2 (driver) or C355M-2 (passenger), Circuit 171 (BK/W), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A3 . → **No** REPAIR Circuit 171 (BK/W). TEST the system for normal operation. REPAIR as necessary. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

A3 CHECK CIRCUIT 57 (BK) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1  GR2667-B	1 Measure the resistance between power seat regulator control switch C349M-4 (driver) or C355M-4 (passenger), Circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new seat regulator control switch . REFER to Switch—6-Way Power Seat.

	Limited or Switch—6-Way Power Seat, Sport Bucket . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR Circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST B: THE POWER SEAT MOVES BUT IS NOISY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE TRACK ALIGNMENT	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position.	
	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . 2 Check the alignment of the track to the floor and the track to the seat. • **Is the track out of alignment?** → **Yes** ALIGN the track to the seat and the floor. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** INSTALL a new seat track assembly. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST C: THE POWER SEAT MOVES BUT IS LOOSE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE FASTENING HARDWARE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.	
	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . 2 Check the hardware fastening the seat. • **Is the fastening hardware loose?** → **Yes** TIGHTEN all the fastening hardware to specifications. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** INSTALL a new seat track assembly. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST D: THE POWER SEAT DOES NOT MAKE FULL TRAVEL

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE SEAT TRACK FOR OBSTRUCTIONS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate	

car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . 2 Remove the driver seat. Refer to Seat—Front Bucket . • **Are there any obstructions in the seat track?** → **Yes** REMOVE the obstruction(s) and grease the track(s). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** INSTALL a new seat track assembly. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST E: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 DETERMINE WHICH DIRECTION HAS FAILED	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

2 	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . 3 Push the driver or passenger seat regulator control switch to the front and rear. • **Does the power seat move to the front and rear?** → **Yes** GO to E2 . → **No** GO to E9 .

E2 DETERMINE POWER SEAT TILTING FAILURE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

	1 Verify the power seat tilting feature. • **Can the power seat be tilted forward and backward?** → **Yes** If only the forward tilting operates, GO to E3 . If only the rearward tilting operates, GO to E6 . → **No** INSTALL a new seat regulator control switch. REFER to Switch—6-Way Power Seat, Limited or Switch—6-Way Power Seat, Sport Bucket . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

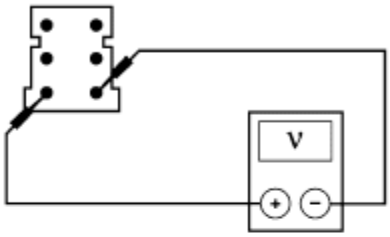
E3 CHECK THE VOLTAGE TO THE REAR HEIGHT MOTOR

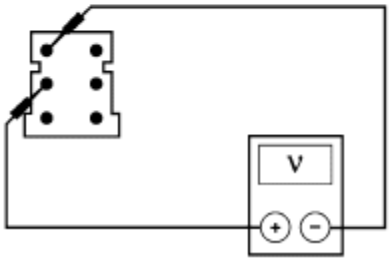
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1	

Front Seat Regulator Motors in Question

2





GR2988-B

2 Measure the voltage between driver front seat regulator motor C353M-1, Circuit 978 (Y/LB), and C353M-4, Circuit 980 (Y/W); or between passenger front seat regulator motor C357M-3, Circuit 987 (R/W), and C357M-2, Circuit 985 (R/LB), while pushing the driver or passenger seat regulator control rear height switch up and down.

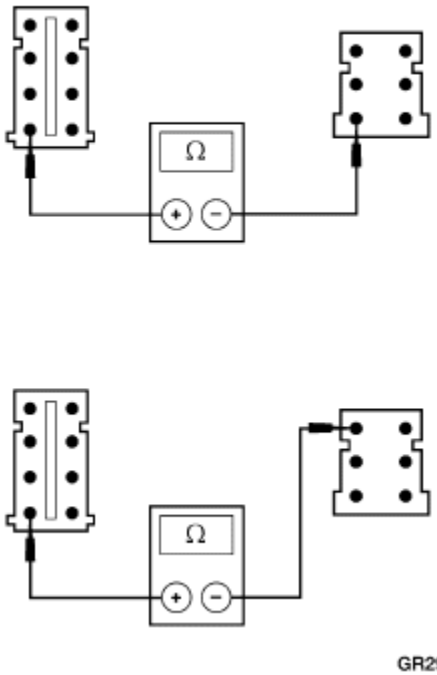
- **Is the voltage greater than 10 volts when the seat regulator control rear height switch is in the up position, greater than negative (-) 10 volts when the seat regulator control rear height switch is in the down position and 0 volts when the seat regulator control rear height switch is in the neutral position?**

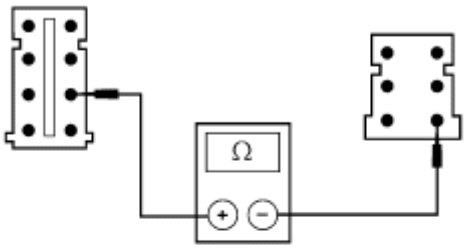
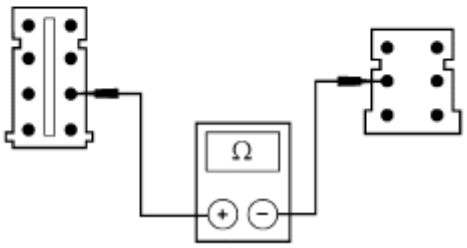
→ **Yes**
INSTALL a new seat track assembly in question. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

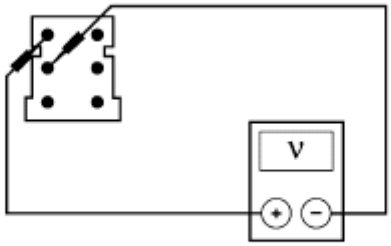
→ **No**
GO to E4 .

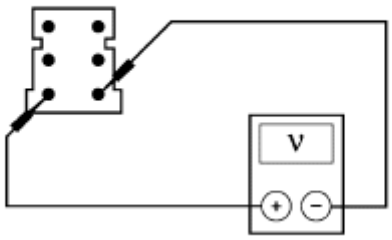
E4 CHECK CIRCUIT 978 (Y/LB) DRIVER OR 987 (R/W) PASSENGER FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 Seat Regulator Control Switch in Question 2  GR2989-B	2 Measure the resistance between the driver seat regulator control switch C349M-1, Circuit 978 (Y/LB), and driver front seat regulator motor C353M-1, Circuit 978 (Y/LB); or between passenger seat regulator control switch C355M-1, Circuit 987 (R/W), and passenger front seat regulator motor C357M-3, Circuit 987 (R/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to E5 . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
E5 CHECK CIRCUIT 980 (Y/W) DRIVER OR 985 (R/LB) PASSENGER FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between driver seat regulator control switch C349M-6, Circuit 980 (Y/W), and driver front seat regulator motor C353M-4, Circuit 980 (Y/W); or between passenger seat regulator control switch C355M-6, Circuit 985 (R/LB), and passenger front seat regulator motor C357M-2, Circuit

  GR2990-B	985 (R/LB). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new seat regulator control switch in question. REFER to Switch—6-Way Power Seat, Limited or Switch—6-Way Power Seat, Sport Bucket . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
E6 CHECK THE VOLTAGE TO THE FRONT HEIGHT MOTOR	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 Front Seat Regulator Motor in Question	
2	2 Measure the voltage between driver front seat regulator motor C353M-2, Circuit 979 (R/LB), and C353M-3, Circuit 981 (R/W); or between





GR2992-B

passenger front seat regulator motor C357M-4, Circuit 986 (Y/W), and C357M-1, Circuit 984 (Y/LB), while pushing the driver or passenger power seat regulator control front height switch up and down.

- **Is the voltage greater than 10 volts when the seat regulator control front height switch is in the up position, greater than negative (-) 10 volts when the seat regulator control front height switch is in the down position and 0 volts when the seat regulator control front height switch is in the neutral position?**

→ **Yes**
INSTALL a new seat track assembly in question. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

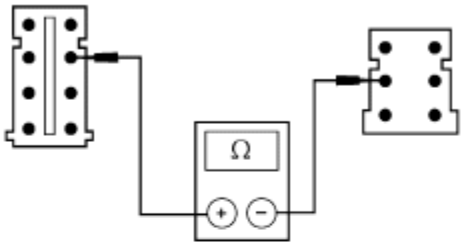
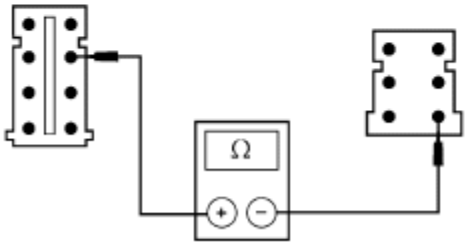
→ **No**
GO to E7 .

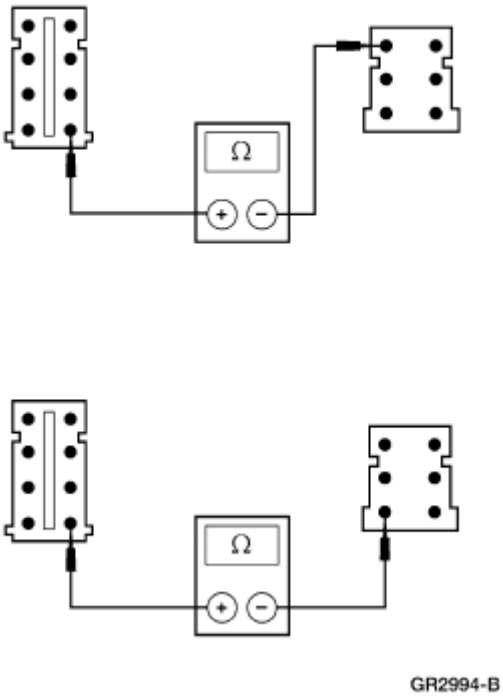
E7 CHECK CIRCUIT 979 (R/LB) DRIVER OR 986 (Y/W) PASSENGER FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Seat Regulator Control Switch in Question

2   GR2993-B	2 Measure the resistance between driver seat regulator control switch C349M-7, Circuit 979 (R/LB), and driver front seat regulator motor C353M-2, Circuit 979 (R/LB); or between passenger seat regulator control switch C355M-7, Circuit 986 (Y/W), and passenger front seat regulator motor C357M-4, Circuit 986 (Y/W). • **Is the resistance less than 5 ohms?** → **Yes** GO to E8 . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
E8 CHECK CIRCUIT 981 (R/W) DRIVER OR 984 (Y/LB) PASSENGER FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between driver seat regulator control switch C349M-5, Circuit 981 (R/W), and front seat regulator motor C353M-3, Circuit 981 (R/W); or between passenger seat regulator control switch C355M-5, Circuit 984 (Y/LB), and passenger front seat regulator motor C357M-1, Circuit 984 (Y/LB).



- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new seat regulator control switch in question. REFER to Switch—6-Way Power Seat, Limited or Switch—6-Way Power Seat, Sport Bucket . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

E9 CHECK THE VOLTAGE TO THE FORWARD/REARWARD MOTOR

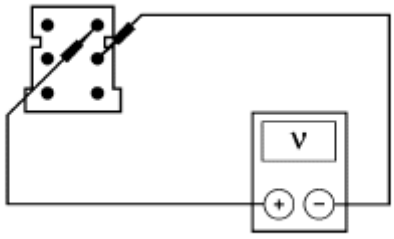
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Front Seat Regulator Motor in Question

2

2 Measure the voltage between driver front seat regulator motor C353M-6, Circuit 982 (Y/LG), and C353M-5, Circuit 983 (R/LG); or between



GR2995-A

passenger front seat regulator motor C357-6, Circuit 988 (Y/LG), and C357-5, Circuit 989 (R/LG), while pushing the driver or passenger seat regulator control switch forward and rearward.

- **Is the voltage greater than 10 volts when the seat regulator control switch is in the forward position, greater than negative (-) 10 volts when the seat regulator control switch is in the rearward position and 0 volts when the seat regulator control switch is in the neutral position?**

→ **Yes**
INSTALL a new seat track assembly in question. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
GO to E10 .

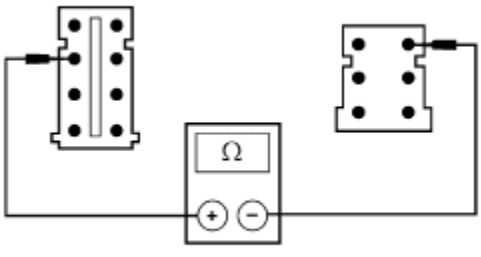
E10 CHECK CIRCUIT 982 (Y/LG) DRIVER OR 988 (Y/LG) PASSENGER FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Seat Regulator Control Switch in Question

2

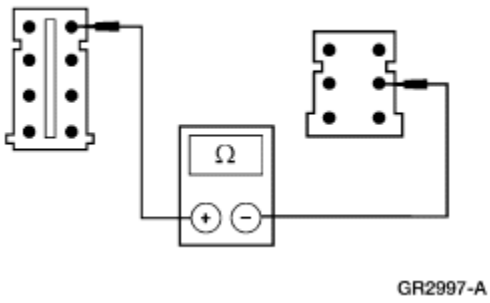


GR2996-A

2 Measure the resistance between seat regulator control switch C349M-3, Circuit 982 (Y/LG), and driver front seat regulator motor C353M-6, Circuit 982 (Y/LG); or between passenger seat regulator control switch C355M-3, Circuit 988 (Y/LG), and passenger front seat regulator motor C357-6, Circuit 988 (Y/LG).

- **Is the resistance less than 5 ohms?**

	→ **Yes** GO to E11 . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

E11 CHECK CIRCUIT 983 (R/LG) DRIVER OR 989 (R/LG) PASSENGER FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  GR2997-A	1 Measure the resistance between driver seat regulator control switch C349M-8, Circuit 983 (R/LG), and driver front seat regulator motor C353M-5, Circuit 983 (R/LG); or between passenger seat regulator control switch C355M-8, Circuit 989 (R/LG), and passenger front seat regulator motor C357M-5, Circuit 989 (R/LG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new seat regulator control switch in question. Refer to Switch—6-Way Power Seat, Limited or Switch—6-Way Power Seat, Sport Bucket . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST F: THE POWER LUMBAR IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK FRONT SEATBACK ADJUSTING PUMP	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system	

must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

2 	1 Deactivate the supplemental restraint system. Refer to Section 501-20B . 3 Press and hold the driver or passenger lumbar seat control switch (+) button. • **Does the driver or passenger front seatback pad adjusting pump run?** → **Yes** GO to F7 . → **No** GO to F2 .

F2 CHECK OPERATION OF POWER SEAT(S)

NOTE: Do not press the front lumbar seat control switch.

	1 Verify the operation of the power seat(s). • **Does the driver or passenger power seat(s) operate?** → **Yes** GO to F3 . → **No** If the power lumbar in question is part of the driver memory seat, GO to Pinpoint Test G . If equipped with power seat(s), GO to Pinpoint Test A .

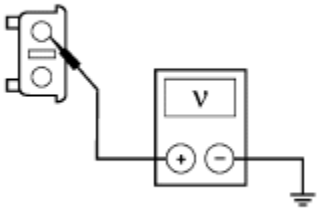
F3 CHECK THE VOLTAGE TO THE LUMBAR SEAT CONTROL SWITCH

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Lumbar Seat Control Switch

2



GR0429-A

2 Measure the voltage between lumbar seat control switch C348M-2 (driver), or C356M-2 (passenger), Circuit 171 (BK/W) [driver and passenger power seats], or Circuit 170 (R/LB) [driver memory seat], and ground.

- **Is the voltage greater than 10 volts?**

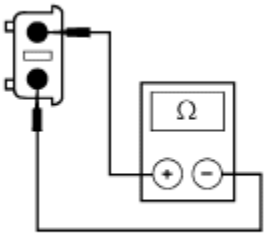
→ **Yes**
GO to F4 .

→ **No**
REPAIR Circuit 171 (BK/W) and/or Circuit 170 (R/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

F4 CHECK THE LUMBAR SEAT CONTROL SWITCH OPERATION

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

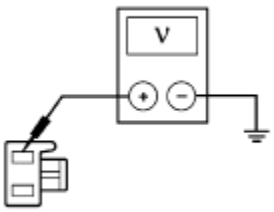
1

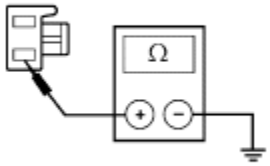


GR3314-A

1 Measure the resistance between the driver or passenger lumbar seat control switch terminals.

2 While holding the driver or passenger lumbar seat control switch (-) button, measure the resistance between the driver or passenger

	front lumbar seat control switch terminals. 3 While holding the driver or passenger lumbar seat control switch (+) button, measure the resistance between the driver or passenger front seat control switch terminals. • **Is the resistance less than 5 ohms while holding the driver or passenger seat control (+) button and greater than 10,000 ohms at all other times?** → **Yes** RECONNECT the driver or passenger lumbar seat control switch. GO to F5 . → **No** INSTALL a new driver or passenger lumbar seat control switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F5 CHECK THE VOLTAGE TO THE FRONT SEATBACK PAD ADJUSTING PUMP — CIRCUIT 490 (R)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 Front Seatback Pad Adjusting Pump 2  GR1393-A	2 While holding the lumbar seat control switch (+) button, measure the voltage between front seatback adjusting pump C347-1 (driver) or C354-1 (passenger), Circuit 490 (R), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to F6 . → **No** REPAIR Circuit 490 (R). TEST the system for

	normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F6 CHECK CIRCUIT 57 (BK) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  GR1394-A	1 Measure the resistance between front seatback pad adjusting pump C347-2 (driver) or C354-2 (passenger), Circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new driver or passenger front seatback pad adjusting pump. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR Circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F7 CHECK FRONT SEATBACK PAD ADJUSTING SYSTEM	
	1 Press and hold the driver or passenger lumbar seat control switch (+) button. 2 Observe the driver or passenger front seatback pad adjuster . • **Does the driver or passenger front seatback pad adjuster inflate?** → **Yes** GO to F13 . → **No** GO to F8 .
F8 CHECK FRONT SEATBACK PAD ADJUSTER	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

	1 Gain access to the driver or passenger front seatback pad adjuster . 2 Inspect the driver or passenger front seatback pad adjuster. • **Is there any visible damage to the driver or passenger front seatback pad adjuster ?** → **Yes** REPAIR or INSTALL a new driver or passenger front seatback pad adjuster. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to F9 .

F9 CHECK AIR FLOW AT FRONT SEATBACK PAD ADJUSTING PUMP

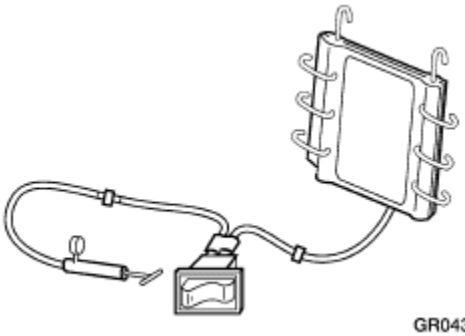
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

	1 Remove the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjusting pump . 2 Press and hold the driver or passenger lumbar seat control switch (+) button. 3 Check the driver or passenger front seatback pad adjusting pump opening for air flow. • **Was air felt coming from the front seatback pad adjusting pump opening?** → **Yes** GO to F10 . → **No** INSTALL a new driver or passenger front seatback pad adjusting pump. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

F10 CHECK AIR FLOW COMING TO THE SEAT CONTROL SWITCH

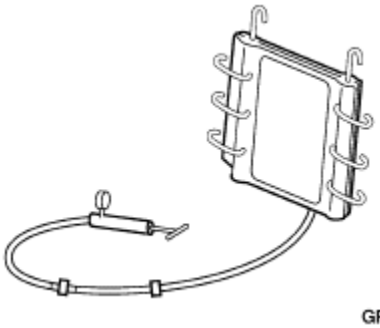
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Reconnect the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjusting pump . 2 Remove the driver or passenger front seatback pad adjusting hose coming from the driver or passenger front seatback pad adjusting pump at the driver or passenger lumbar seat control switch. 3 Press and hold the driver or passenger lumbar seat control switch (+) button. 4 Check the driver or passenger front seatback pad adjusting hose opening for air flow. • **Was air felt coming from the driver or passenger front seatback pad adjusting hose opening?** → **Yes** GO to F11 . → **No** REPAIR or INSTALL a new driver or passenger front seatback pad adjusting hose. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F11 CHECK AIR FLOW COMING FROM THE SEAT CONTROL SWITCH	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Reconnect the driver or passenger front seatback pad adjusting hose coming from the driver or passenger front seatback pad adjusting pump at the driver or passenger lumbar seat control switch. 2 Remove the driver or passenger front seatback pad adjusting hose going to the driver or passenger front seatback pad adjuster at the driver or passenger lumbar seat control switch. 3 Press and hold the driver or passenger lumbar seat control switch (+) button. 4 Check the driver or passenger lumbar seat control switch opening for air flow.

	• **Was air felt coming from the driver or passenger lumbar seat control switch opening?** → **Yes** GO to F12 . → **No** INSTALL a new driver or passenger lumbar seat control switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F12 CHECK AIR FLOW AT FRONT SEATBACK PAD ADJUSTER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Reconnect the driver or passenger front seatback pad adjusting hose at the driver or passenger lumbar seat control switch. 2 Remove the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjuster . 3 Press and hold the driver or passenger lumbar seat control switch (+) button. 4 Check the driver or passenger front seatback pad adjusting hose opening for air flow. • **Was air felt coming from the driver or passenger front seatback pad adjusting hose opening?** → **Yes** GO to F13 . → **No** REPAIR or INSTALL a new driver or passenger front seatback pad adjusting hose. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
F13 CHECK THE SYSTEM FOR LEAKS	
	1 Reconnect the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjuster . 2 Remove the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjusting

3  GR0433-A	pump . 3 Insert a hand pump into the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjusting pump . 4 Press and hold the driver or passenger lumbar seat control switch (+) button while inflating the driver or passenger front seatback pad adjuster to 34.47 kPa (5 psi). 5 Check the system pressure after three hours. • **After three hours, is the reading 32.41 kPa (4.7 psi) or more?** → **Yes** System OK. → **No** GO to F14 .

F14 CHECK FRONT SEATBACK PAD ADJUSTER FOR LEAKS

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

3  GR0434-A	1 Remove the in-line pressure. 2 Remove the driver or passenger front seatback pad adjusting hose at the driver or passenger front seatback pad adjuster . 3 Insert a hand pump into the driver or passenger front seatback pad adjuster. 4 Inflate the driver or passenger front seatback pad adjuster to 34.47 kPa (5 psi).

	5 Check the system pressure after three hours. • **After three hours, is the reading 32.41 kPa (4.7 psi) or more?** → **Yes** INSTALL a new driver or passenger lumbar seat control switch and/or driver or passenger front seatback pad adjusting hose. TEST the system for normal operation. → **No** INSTALL a new driver or passenger front seatback pad adjuster. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST G: THE MEMORY SEAT IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 RETRIEVE THE DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.	
2 	1 Deactivate the supplemental restraint system. Refer to Section 501-20B .

3

4

Scan Tool

5

Retrieve Continuous DTCs

6

7

Clear Continuous DTCs

8

DSM On-Demand Self-Test

6 Document any continuous DTCs.

- **Are any DTCs retrieved?**

→ **Yes**
If DTC B1663, B1664, and B1665 are all set, GO to G10 .

If DTC B1529, GO to Pinpoint Test H .

If DTC B1533, GO to Pinpoint Test H .

If DTC B1537, GO to Pinpoint Test H .

If DTC B1663, GO to G22 .

If DTC B1664, GO to G25 .

If DTC B1665, GO to G28 .

If DTC B1711, GO to G3 .

If DTC B1715, GO to G3 .

	If DTC B1719, GO to G3. If DTC B1723, GO to G3. If DTC B1727, GO to G3. If DTC B1731, GO to G3. If DTC B1952, GO to Pinpoint Test J. If DTC B1954, GO to Pinpoint Test J. If DTC B1956, GO to Pinpoint Test J. If DTC B1962, GO to Pinpoint Test J. If DTC B1964, GO to Pinpoint Test J. If DTC B1342, REPLACE the DSM. REFER to Seat Module—Driver, 6-Way Power. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B. → **No** GO to G2.
G2 CHECK THE DSM FOR CORRECT SEAT REGULATOR CONTROL SWITCH INPUTS — MONITOR THE DSM PIDS SFNT_SW, SREARSW AND SFWS_SW	
1 	1 Monitor the DSM PIDs SFNT_SW, SREARSW and SFWS_SW while activating the seat switch. • **Do the PID values agree with the switch positions?** → **Yes** GO to G9. → **No** If fuse junction panel Fuse 18 (25A) fails while toggling the seat regulator control switch, GO to G7. If fuse junction panel Fuse 18 (25A) is OK, GO to G7.
G3 CHECK THE SEAT REGULATOR CONTROL SWITCH	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	

2

Seat Regulator Control Switch C349

3 Check the seat regulator control switch.

- **Is the seat regulator control switch OK?**

→ **Yes**
GO to G4 .

→ **No**
INSTALL a new seat regulator control switch. REFER to Switch—6-Way Power Seat, Limited . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G4 CHECK FOR VOLTAGE TO THE SEAT REGULATOR CONTROL SWITCH — CIRCUIT 54 (LG/Y)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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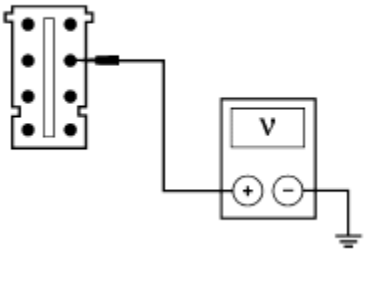


1 Measure the voltage between seat regulator control switch C349-2, Circuit 54 (LG/Y), and ground.

- **Is the voltage greater than 10 volts?**

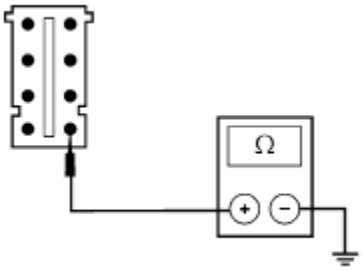
→ **Yes**
GO to G5 .

→ **No**
REPAIR Circuit 54 (LG/Y). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G5 CHECK CIRCUIT 57 (BK) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1



GR2667-B

1 Measure the resistance between seat regulator control switch C349-4, Circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to G6 .

→ **No**
REPAIR Circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G6 CHECK CIRCUITS 979 (R/LB), 980 (Y/W), 981 (R/W), 982 (Y/LG), 983 (R/LG), AND 990 (Y/LB) FOR SHORT TO POWER

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

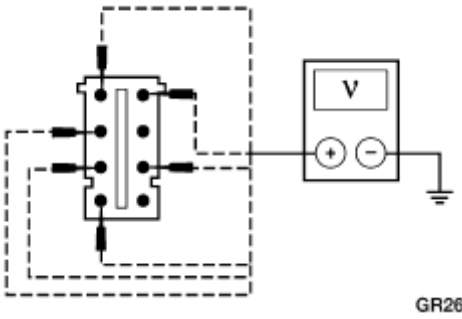
DSM C335

2

3

3 Measure the voltage between the following seat regulator control switch C349 pins, and ground.

Connector	Circuit
C349-5	990 (Y/LB)
C349-1	983 (R/LG)
C349-6	982 (Y/LG)



C349-7	979 (R/LB)
C349-3	981 (R/W)
C349-8	980 (Y/W)

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
GO to G7 .

G7 CHECK CIRCUITS 979 (R/LB), 980 (Y/W), 981 (R/W), 982 (Y/LG), 983 (R/LG), AND 990 (Y/LB) FOR SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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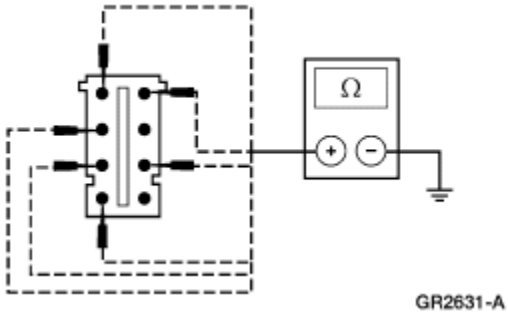

2 Measure the resistance between the following seat regulator control switch C349 pins, and ground.

Connector	Circuit
C349-5	990 (Y/LB)
C349-1	983 (R/LG)
C349-6	982 (Y/LG)
C349-7	979 (R/LB)
C349-3	981 (R/W)
C349-8	980 (Y/W)

- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
REPAIR the circuit in question. TEST the

	system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to G8 .

G8 CHECK CIRCUITS 979 (R/LB), 980 (Y/W), 981 (R/W), 982 (Y/LG), 983 (R/LG), AND 990 (Y/LB) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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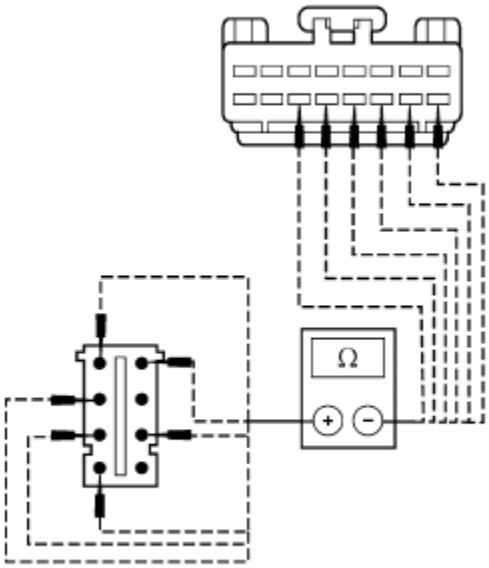


GR2632-A

1 Measure the resistance between the following seat regulator control switch C349 pins, and DSM C335 pins.

Seat Regulator Control Switch	Circuit	DSM
C349-5	990 (Y/LB)	C335-11
C349-1	983 (R/LG)	C335-15
C349-6	982 (Y/LG)	C335-16
C349-7	979 (R/LB)	C335-10
C349-3	981 (R/W)	C335-13
C349-8	980 (Y/W)	C335-14

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G9 CHECK THE DSM FOR CORRECT OUTPUTS USING NGS TESTER ACTIVE COMMANDS

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Trigger DSM Active Command FRONT UP, ON and OFF

2

Trigger DSM Active Command FRONT DWN, ON and OFF

3

Trigger DSM Active Command REAR UP, ON and OFF

4

Trigger DSM Active Command REAR DWN, ON and OFF

5

Trigger DSM Active Command HORZ FWD, ON and OFF

6

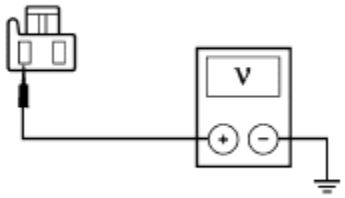
Trigger DSM Active Command HORZ RWD, ON and OFF

- **Does the driver seat operate correctly**

→ **Yes**
INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
If no seat movement, GO to G10 .

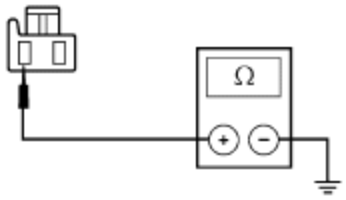
If no front vertical seat movement, GO to G22 .

	If no rear vertical seat movement, GO to G25 . If no horizontal seat movement, GO to G28 .
G10 CHECK THE DSM FOR VOLTAGE — CIRCUIT 170 (R/LB)	
1 2 DSM C350 3  GR2633-A	3 Measure the voltage between DSM C350, Circuit 170 (R/LB), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to G14 . → **No** GO to G11 .
G11 CHECK FUSE JUNCTION PANEL FUSE 18 (25A)	
1 Fuse 18 (25A)	• **Is the fuse OK?** → **Yes** GO to G13 . → **No** GO to G12 .

G12 CHECK CIRCUIT 170 (R/LB) FOR SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1



GR2634-A

1 Measure the resistance between DSM C350, Circuit 170 (R/LB), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPAIR the power distribution box. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
REPAIR Circuit 170 (R/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G13 CHECK CIRCUIT 170 (R/LB) FOR OPEN

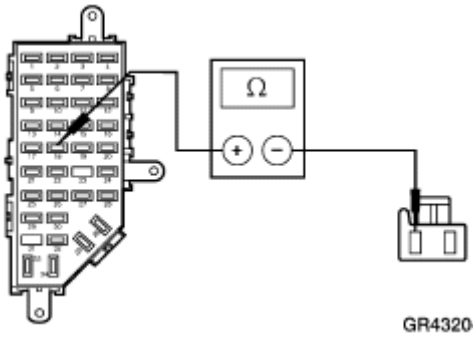
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

Fuse 4 (30A)

2

2 Measure the resistance between DSM C350, Circuit 170 (R/LB), and fuse junction panel Fuse 18 (25A), pin 1.



- **Is the resistance less than 5 ohms?**

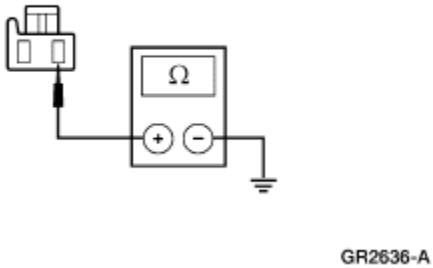
→ **Yes**
GO to G14 .

→ **No**
REPAIR Circuit 170 (R/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G14 CHECK CIRCUIT 57 (BK) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1



1 Measure the resistance between DSM C350, Circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

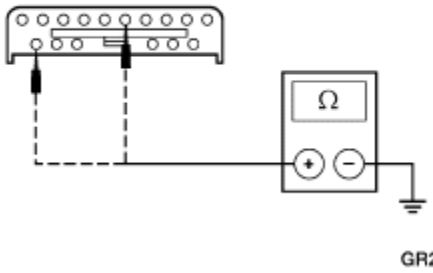
→ **Yes**
GO to G15 .

→ **No**
REPAIR Circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

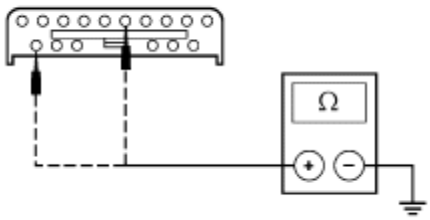
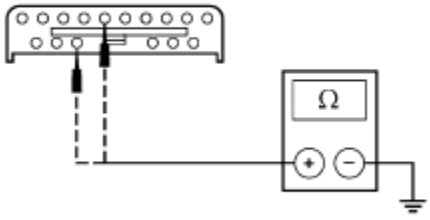
G15 CHECK THE DSM INTERNAL FUSE (30A)

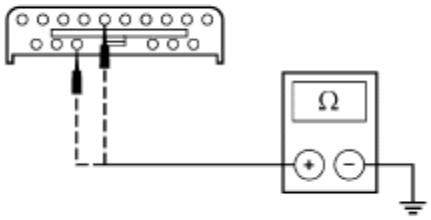
WARNING: The restraint system diagnostic tool is for restraint system service only.

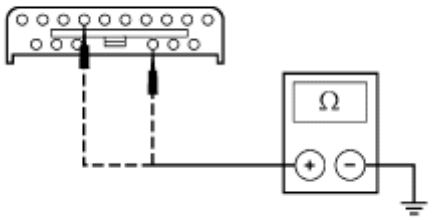
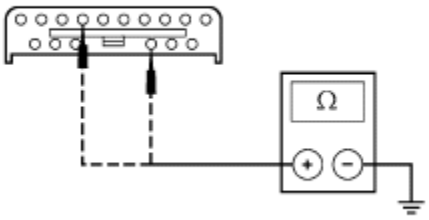
Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

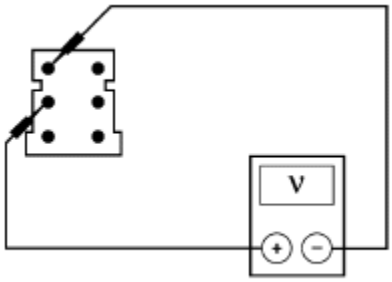
1 DSM Internal Fuse (30A)	• **Is the fuse OK?** → **Yes** GO to G16 . → **No** INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
G16 CHECK CIRCUITS 979 (R/LB) AND 990 (Y/LB) FOR SHORT TO GROUND - MOTOR SIDE	
1 DSM C351 2  GR2637-A	2 Measure the resistance between DSM C351-11, Circuit 979 (R/LB), and ground; and between DSM C351-6, Circuit 990 (Y/LB), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** GO to G18 . → **No** GO to G17 .
G17 CHECK FRONT HEIGHT MOTOR FOR SHORT TO GROUND — CIRCUITS 979 (R/LB) AND 990 (Y/LB)	
WARNING: The restraint system diagnostic tool is for restraint system service only.	

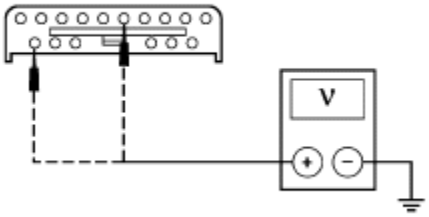
Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

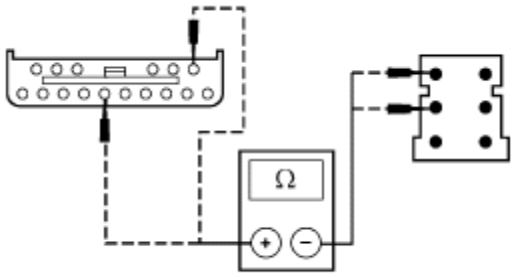
1 Front Height Motor C353 2  GR2637-A	2 Measure the resistance between DSM C351-11, Circuit 979 (R/LB), and ground; and between DSM C351-6, Circuit 990 (Y/LB), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
G18 CHECK CIRCUITS 983 (R/LG) AND 982 (Y/LG) FOR SHORT TO GROUND — MOTOR SIDE	
1  GR2638-A	1 Measure the resistance between DSM C351-5, Circuit 983 (R/LG), and ground; and between DSM C351-13, Circuit 982 (Y/LG), and ground. • **Are the resistances greater than 10,000 ohms?**

	→ **Yes** GO to G20 . → **No** GO to G19 .
G19 CHECK THE REAR HEIGHT MOTOR FOR SHORT TO GROUND — CIRCUITS 982 (Y/LG) AND 983 (R/LG)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 Rear Height Motor C353 2  GR2638-A	2 Measure the resistance between DSM C351-13, Circuit 983 (R/LG), and ground; and between DSM C351-5, Circuit 982 (Y/LG), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
G20 CHECK CIRCUITS 980 (Y/W) AND 981 (R/W) FOR SHORT TO GROUND — MOTOR SIDE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between DSM C351-14, Circuit 980 (Y/W), and ground; and between DSM C351-4, Circuit 981 (R/W),

 GR2639-A	and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to G21 .
G21 CHECK THE HORIZONTAL MOTOR FOR SHORT TO GROUND — CIRCUITS 980 (Y/W) AND 981 (R/W)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  GR2639-A	1 Measure the resistance between DSM C351-14, Circuit 980 (Y/W), and ground; and between DSM C351-4, Circuit 981 (R/W), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No**

	REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
G22 CHECK THE FRONT HEIGHT MOTOR FOR CORRECT OPERATION	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 3 Front Height Motor C353 4 5  GR2998-A	5 Measure the voltage between front height motor C353-2, Circuit 979 (R/LB), and C353-3, Circuit 990 (Y/LB) while triggering DSM active commands FRONT UP and FRONT DOWN ON and OFF. • **Does the voltage change from zero volts?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No**

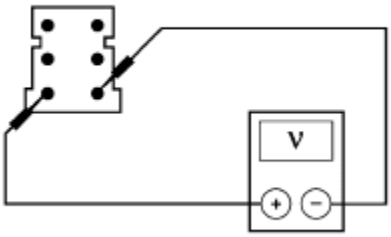
	GO to G23 .
G23 CHECK CIRCUITS 979 (R/LB) AND 990 (Y/LB) FOR SHORT TO POWER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 DSM Motor C351 3 4  GR2640-A	4 Measure the voltage between DSM C351-11, Circuit 979 (R/LB), and ground; and between DSM C351-6, Circuit 990 (Y/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to G24 .
G24 CHECK CIRCUITS 979 (R/LB) AND 990 (Y/LB) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	

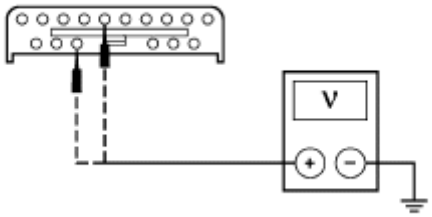
 2  GR2999-A	2 Measure the resistance between DSM C351-11, Circuit 979 (R/LB), and front height motor C353-2, Circuit 979 (R/LB); and between DSM C351-6, Circuit 990 (Y/LB), and front height motor C353-3, Circuit 990 (Y/LB). • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

G25 CHECK THE REAR HEIGHT MOTOR FOR PROPER OPERATION

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 2 3 Rear Height Motor C353 4	

 5  GR3000-A	5 Measure the voltage between rear height motor C353-1, Circuit 983 (R/LG), and C353-4, Circuit 982 (Y/LG), while triggering DSM active commands REAR UP and REAR DOWN ON and OFF. • **Does the voltage change from zero volts?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to G26 .
G26 CHECK CIRCUITS 983 (R/LG) AND 982 (Y/LG) FOR SHORT TO POWER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 DSM C351 3 4	4 Measure the voltage between DSM C351-5, Circuit 983 (R/LG), and ground; and between DSM C351-13, Circuit 982 (Y/LG), and ground.



GR2642-A

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

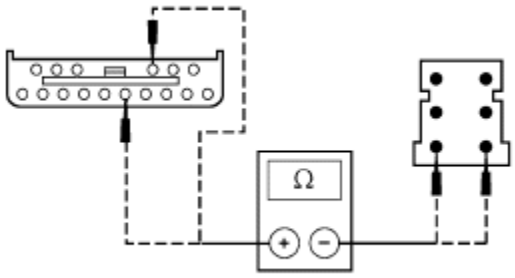
→ **No**
GO to G27 .

G27 CHECK CIRCUITS 983 (R/LG) AND 982 (Y/LG) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

2

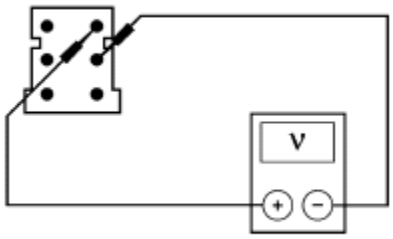


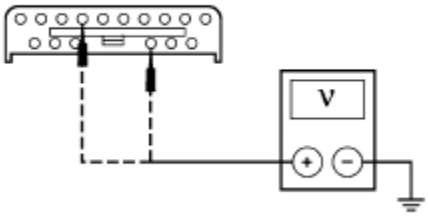
GR3001-A

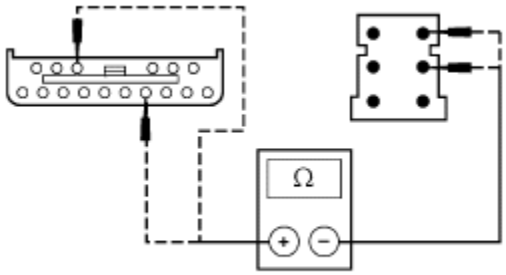
2 Measure the resistance between DSM C351-5, Circuit 983 (R/LG), and rear height motor C353-1, Circuit 983 (R/LG); and between DSM C351-13, Circuit 982 (Y/LG), and rear height motor C353-4, Circuit 982 (Y/LG).

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

	→ **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
G28 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 3 Forward/Rearward Motor C353 4 5  GR2995-A	5 Measure the voltage between forward/rearward motor C353-5, Circuit 980 (Y/W), and C353-6, Circuit 981 (R/W), while triggering DSM active commands HORZ FWD and HORZ RWD ON and OFF. • **Does the voltage change from zero volts?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

	→ **No** GO to G29 .
G29 CHECK CIRCUITS 980 (Y/W) AND 981 (R/W) FOR SHORT TO POWER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 DSM C351 3 4  GR2644-A	4 Measure the voltage between DSM C351-14, Circuit 980 (Y/W), and ground; and between DSM C351-4, Circuit 981 (R/W), and ground. • **Is any voltage indicated?** → **Yes** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to G30 .
G30 CHECK CIRCUITS 980 (Y/W) AND 981 (R/W) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	

 2  GR3002-A	2 Measure the resistance between DSM C351-14, Circuit 980 (Y/W), and forward/rearward motor C353-5, Circuit 980 (Y/W); and between DSM C351-4, Circuit 981 (R/W), and forward/rearward motor C353-6, Circuit 981 (R/W). • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST H: THE MEMORY SEAT DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE MEMORY SET SWITCH

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 RETRIEVE THE DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the	

restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

1 Deactivate the supplemental restraint system. Refer to Section 501-20B .

2

3

4

Scan Tool

5

Retrieve Continuous DTCs

6 Document any continuous DTCs.

7

Clear Continuous DTCs

8

DSM On Demand Self-Test

8 **NOTE:** During the On-Demand Self-Test, document when the memory set LED illuminates and turns off.

- **Are any DTCs retrieved or does the memory set LED fail to illuminate during the On-Demand Self-Test?**

→ **Yes**
If the memory set LED fails to illuminate during the On-Demand Self-Test, GO to H5 .

If DTCs B1950, B1954, and B1962 are all retrieved, GO to H9 .

	If DTC B1529, GO to H3. If DTC B1533, GO to H3. If DTC B1537, GO to H3. If DTC B1663, GO to H10. If DTC B1664, GO to H13. If DTC B1665, GO to H16. If DTC B1950, GO to H13. If DTC B1952, GO to H13. If DTC B1954, GO to H10. If DTC B1956, GO to H10. If DTC B1962, GO to H16. If DTC B1964, GO to H16. If DTC B1342, INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B. → **No** GO to H2.
H2 CHECK THE DSM FOR CORRECT MEMORY SET SWITCH INPUTS — MONITOR THE DSM PIDS MEM1_SW, MEM2_SW AND MEMS_SW	
1 	1 Monitor the DSM PIDs MEM1_SW, MEM2_SW and MEMS_SW while pressing 1, 2, and SET on the memory set switch. • **Do the PID values agree with the switch positions?** → **Yes** GO to H9. → **No** If fuse junction panel Fuse 1 (7.5A) fails while toggling the memory set switch, GO to H7. If the fuse does not fail while toggling the memory seat switch, GO to H3.
H3 CHECK THE MEMORY SET SWITCH	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

2

Memory Set Switch C511

3 Check the memory set switch. Refer to Switch - Memory Set.

- **Is the memory set switch OK?**

→ **Yes**
GO to H4 .

→ **No**
INSTALL a new memory set switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

H4 CHECK FOR VOLTAGE TO THE MEMORY SET SWITCH — CIRCUIT 956 (O/LG)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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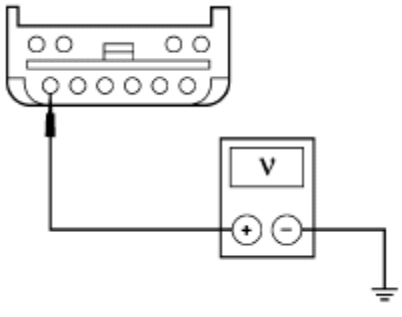


GR2677-A

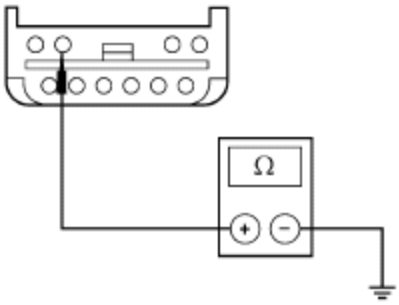
2 Measure the voltage between memory set switch C511-6, Circuit 956 (O/LG), and ground.

- **Is the voltage greater than 10 volts?**

	→ **Yes** GO to H5 . → **No** REPAIR Circuit 956 (O/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

H5 CHECK CIRCUIT 57 (BK) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 2  GR2658-A	2 Measure the resistance between memory set switch C511-9, Circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to H6 . → **No** REPAIR Circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

H6 CHECK CIRCUITS 267 (BR/LG), 268 (BK/O), 270 (BR/O), AND 272 (W/O) FOR SHORT TO POWER

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 DSM C337	

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RAP Module C338

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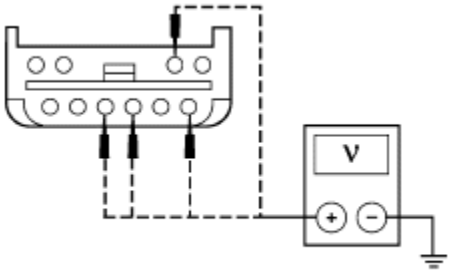

GR3526-A

4 Measure the voltage between the following memory set switch C511 pins and ground.

Connector	Circuit
C511-4	267 (BR/LG)
C511-3	268 (BK/O)
C511-1	270 (BR/O)
C511-8	272 (W/O)

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
GO to H7 .

H7 CHECK CIRCUITS 267 (BR/LG), 268 (BK/O), 270 (BR/O), AND 272 (W/O) FOR SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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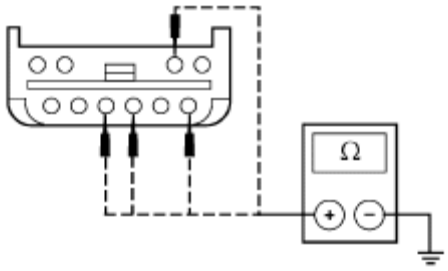
2 Measure the resistance between the following memory set switch C511 pins and ground.

Connector	Circuit
C511-4	267 (BR/LG)
C511-3	268 (BK/O)



C511-1	270 (BR/O)
C511-8	272 (W/O)

- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
GO to H8 .

→ **No**
REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

H8 CHECK CIRCUITS 267 (BR/LG), 268 (BK/O), 270 (BR/O), AND 272 (W/O) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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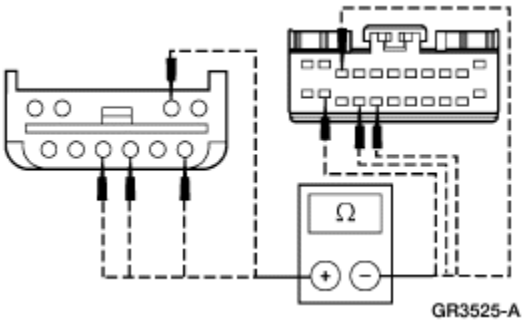

1 Measure the resistance between the following memory set switch C511 pins and DSM C337 pins.

Memory Set Switch	Circuit	DSM
C511-4	267 (BR/LG)	C337-16
C511-3	268 (BK/O)	C337-15
C511-1	270 (BR/O)	C337-3
C511-8	272 (W/O)	C337-13

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

	→ **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
H9 CHECK THE DSM FOR CORRECT OUTPUTS — MONITOR THE DSM PIDS SFWD_P, SFNT_P, AND SREAR_P	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
2 3 4 	1 Place the seat in a central position using the seat regulator control switch. 2 Monitor the DSM PID SFWD_P while operating the seat regulator control switch forward/rearward switch. 3 Monitor the DSM PID SFNT_P while operating the seat regulator control switch front up/down switch. 4 Monitor the DSM PID SREAR_P while operating the seat regulator control switch rear up/down switch. • **Does the PID (position % of travel) values increase with forward/down movement and decrease with rearward/up movement throughout entire travel?** → **Yes** INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** If the DSM PID SFWD_P values do not increase or decrease, GO to H16 . If the DSM PID SFNT_P values do not increase or decrease, GO to H10 . If the DSM PID SREAR_P values do not increase or decrease, GO to H13 .
H10 CHECK CIRCUITS 443 (LG/R), 447 (O/R) AND 446 (O/W) FOR SHORT TO POWER	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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DSM C351

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Front Height Position Sensor C359

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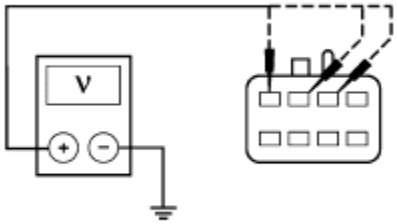

GR3003-A

5 Measure the voltage between front height position sensor C359-2, Circuit 443 (LG/R), and ground; and between front height position sensor C359-3, Circuit 447 (O/R), and ground; and between front height position sensor C359-1, Circuit 446 (O/W), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
GO to H11 .

H11 CHECK CIRCUITS 443 (LG/R), 447 (O/R) AND 446 (O/W) FOR SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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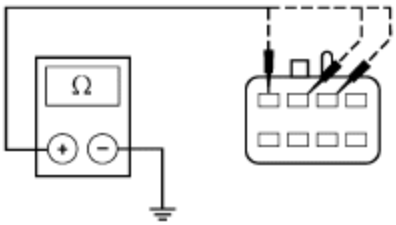

GR3004-A

2 Measure the resistance between front height position sensor C359-2, Circuit 443 (LG/R), and ground; and between front height position sensor C359-3, Circuit 447 (O/R), and ground; and between front height position sensor C359-1, Circuit 446 (O/W), and ground.

- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
GO to H12 .

→ **No**
REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

H12 CHECK CIRCUITS 443 (LG/R), 447 (O/R) AND 446 (O/W) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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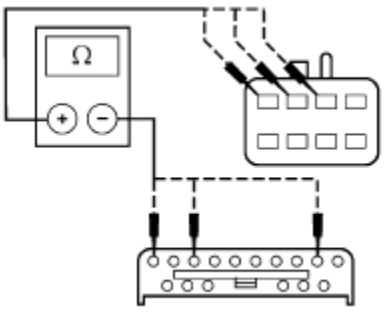
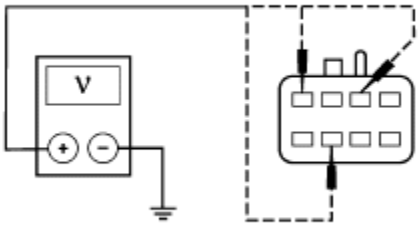


GR3005-A

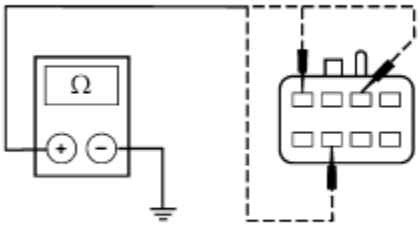
1 Measure the resistance between front height position sensor C359-2, Circuit 443 (LG/R), and DSM C351-9, Circuit 443 (LG/R); and between front height position sensor C359-3, Circuit 447 (O/R), and DSM C351-3, Circuit 447 (O/R); and between front height position sensor C359-1, Circuit 446 (O/W), and DSM C351-1, Circuit 446 (O/W).

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new seat track. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to

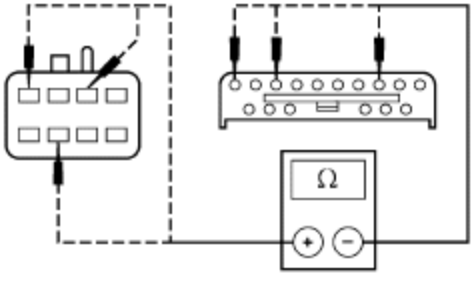
	Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
H13 CHECK CIRCUITS 444 (LG/BK), 447 (O/R) AND 446 (O/W) FOR SHORT TO POWER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 DSM C351 3 Rear Height Position Sensor C359 4  GR3006-A	4 Measure the voltage between rear height position sensor C359-6, Circuit 444 (LG/BK), and ground; and between rear height position sensor C359-3, Circuit 447 (O/R), and ground; and between rear height position sensor C359-1, Circuit 446 (O/W), and ground. • **Is any voltage indicated?** → **Yes** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** GO to H14 .
H14 CHECK CIRCUITS 444 (LG/BK), 447 (O/R) AND 446 (O/W) FOR SHORT TO GROUND	

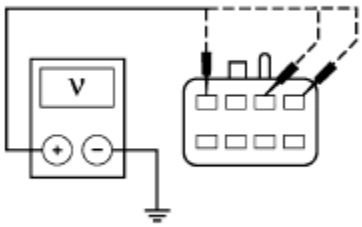
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

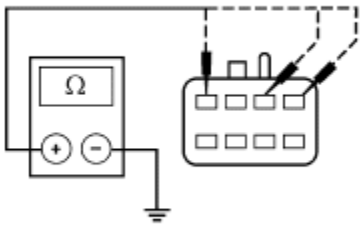
1 2  GR3007-A	2 Measure the resistance between rear height position sensor C359-6, Circuit 444 (LG/BK), and ground; and between rear height position sensor C359-3, Circuit 447 (O/R), and ground; and between rear height position sensor C359-1, Circuit 446 (O/W), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** GO to H15 . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

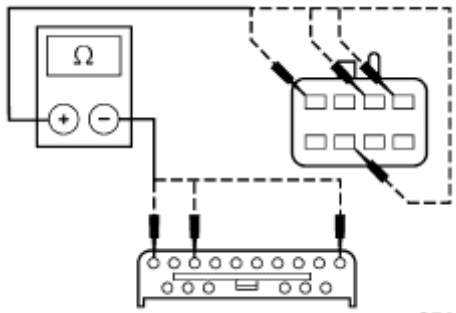
H15 CHECK CIRCUITS 444 (LG/BK), 447 (O/R) AND 446 (O/W) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1  GR3008-A	1 Measure the resistance between rear height position sensor C359-6, Circuit 444 (LG/BK), and DSM C351-8, Circuit 444 (LG/BK); and between rear height position sensor C359-3, Circuit 447 (O/R), and DSM C351-3, Circuit 447 (O/R); and between rear height position sensor C359-1, Circuit 446 (O/W), and DSM C351-1, Circuit 446 (O/W). • **Are the resistances less than 5 ohms?**

	→ **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
H16 CHECK CIRCUITS 442 (LG/O), 447 (O/R) AND 446 (O/W) FOR SHORT TO POWER	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 DSM C351 3 Forward/Rearward Position Sensor C359 4  GR3009-A	4 Measure the voltage between forward/rearward position sensor C359-4, Circuit 442 (LG/O), and ground; and between forward/rearward position sensor C359-3, Circuit 447 (O/R), and ground; and between forward/rearward position sensor C359-1, Circuit 446 (O/W), and ground. • **Is any voltage indicated?** → **Yes** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

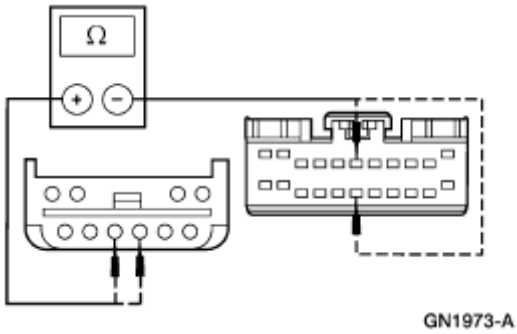
	→ **No** GO to H17 .
H17 CHECK CIRCUITS 442 (LG/O), 447 (O/R) AND 446 (O/W) FOR SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2  GR3010-A	2 Measure the resistance between forward/rearward position sensor C359-4, Circuit 442 (LG/O), and ground; and between forward/rearward position sensor C359-3, Circuit 447 (O/R), and ground; and between forward/rearward position sensor C359-1, Circuit 446 (O/W), and ground. • **Are the resistances greater than 10,000 ohms?** → **Yes** GO to H18 . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
H18 CHECK CIRCUITS 442 (LG/O), 447 (O/R) AND 446 (O/W) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between forward/rearward position sensor C359-4, Circuit 442 (LG/O), and DSM C351-10, Circuit 442 (LG/O); and between forward/rearward position sensor C359-3, Circuit 447 (O/R), and DSM C351-3, Circuit 447 (O/R); and between forward/rearward position sensor C359-1, Circuit 446 (O/W), and DSM C351-1, Circuit 446 (O/W).

	• **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new seat track. REFER to Seat—Track, Limited and 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR the circuit in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST J: THE MEMORY SEAT DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE REMOTE TRANSMITTER

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.	

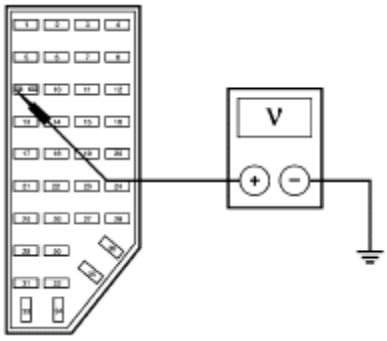
	1 Deactivate the supplemental restraint system. Refer to Section 501-20B .
2 3 4 Scan Tool 5 Retrieve Continuous DTCs	6 Document any continuous DTCs.
7 Clear Continuous DTCs 8 DSM On-Demand Self-Test	• **Are any DTCs retrieved?** → **Yes** REFER to DSM Diagnostic Trouble Code (DTC) Index. → **No** GO to J2 .
J2 CHECK CIRCUITS 267 (BR/LG) AND 268 (BK/O) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between memory set

	switch C511-4, Circuit 267 (BR/LG), and RAP module C338-6, Circuit 267 (BR/LG); and between memory set switch C511-3, Circuit 268 (BK/O), and RAP module C338-18, Circuit 268 (BK/O). • **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 501-14B . → **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

PINPOINT TEST K: NO COMMUNICATION WITH THE MODULE — UNABLE TO PERFORM ON-DEMAND SELF-TEST WITH THE DRIVER SEAT MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK VEHICLE FOR MEMORY SEAT/MIRROR OPTION	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle. **NOTE:** Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.	
	1 Deactivate the supplemental restraint system. Refer to Section 501-20B .

	2 **NOTE:** Driver seat modules are only used on vehicles with memory seat/mirror option. Check vehicle for memory seat/mirror option. • **Is the vehicle equipped with memory seat/mirror option?** → **Yes** GO to K2 . → **No** System is OK. TEST the system for normal operation.
K2 VERIFY THE ABILITY TO MONITOR DSM PID P/N_SW	
1 2 3 	3 Monitor the DSM PID P/N_SW. • **Does the NGS display:** **— UNABLE TO PERFORM TEST/FUNCTION** **— MODULE NOT RESPONDING: DSM** **— CHECK IGNITION STATUS** **— VERIFY CABLE REQUIREMENTS** **— CHECK CABLE CONNECTIONS?** → **Yes** GO to K3 . → **No** GO to K8 .
K3 CHECK FUSE JUNCTION PANEL FUSE 18 (25A)	
1	

 2 Fuse 18 (25A)	• **Is Fuse 18 (25A) OK?** → **Yes** GO to K4 . → **No** GO to K5 .
K4 CHECK FOR VOLTAGE AT FUSE JUNCTION PANEL FUSE 9 (7.5A)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2  GR3221-A	2 Measure the voltage between fuse junction panel Fuse 9 (7.5A) pin 1 and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to K6 . → **No** REPAIR or INSTALL a new fuse junction panel. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .
K5 CHECK CIRCUIT 54 (LG/Y) FOR SHORT TO GROUND	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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Fuse 9 (7.5A)

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DSM C337

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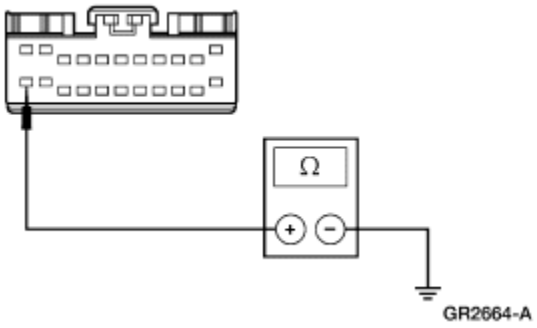

4 Measure the resistance between DSM C337-12, Circuit 54 (LG/Y), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
RECONNECT DSM C337. REPLACE Fuse 9 (7.5A) in fuse junction box. TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

→ **No**
REPAIR Circuit 54 (LG/Y). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

K6 CHECK CIRCUIT 54 (LG/Y) FOR VOLTAGE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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DSM C337

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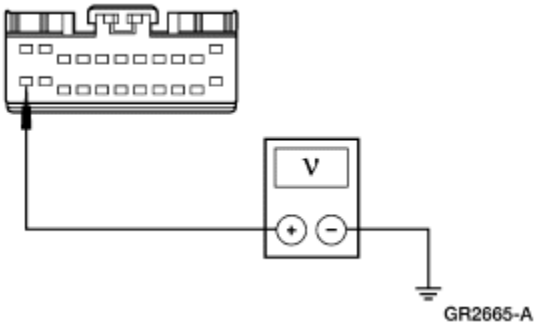

4 Measure the voltage between DSM C337-12, Circuit 54 (LG/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to K7 .

→ **No**
REPAIR Circuit 54 (LG/Y). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

K7 CHECK CIRCUIT 570 (BK/W) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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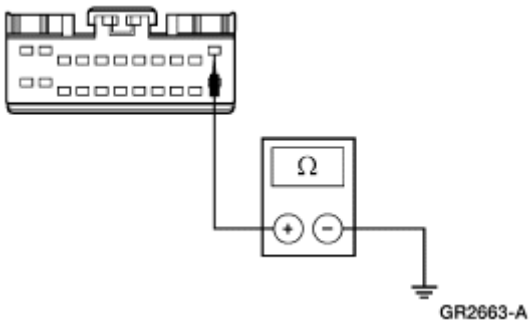
2

2 Measure the resistance between DSM C337-11, Circuit 570 (BK/W), and ground.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REFER to Section 418-00 .

→ **No**
REPAIR Circuit 570 (BK/W). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

K8 CHECK DSM FOR TRANSMISSION RANGE SENSOR INPUT — MONITOR THE DSM PID P/N_SW

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

1 Monitor the DSM PID P/N_SW while moving the transmission gear shift lever through entire range.

- **Does the PID value agree with the gear shift lever positions?**

→ **Yes**
INSTALL a new DSM. REFER to Seat Module—Driver, 6-Way Power . TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

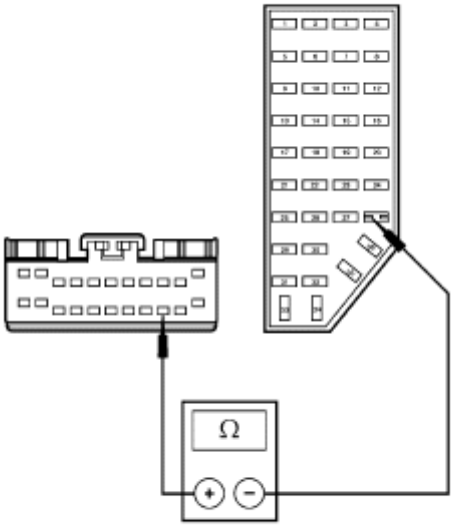
→ **No**
GO to K9 .

K9 CHECK CIRCUIT 1000 (R/BK) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

1 Measure the resistance between DSM C337-20, Circuit 1000 (R/BK), and fuse

 GR3012-A	junction panel Fuse 28 (7.5A) pin 1. • **Is the resistance less than 5 ohms?** → **Yes** CHECK the T/R sensor. REFER to Section 307-01A or Section 307-01B . REACTIVATE the supplemental restraint system. REFER to Section 501-20B . → **No** REPAIR Circuit 1000 (R/BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system. REFER to Section 501-20B .

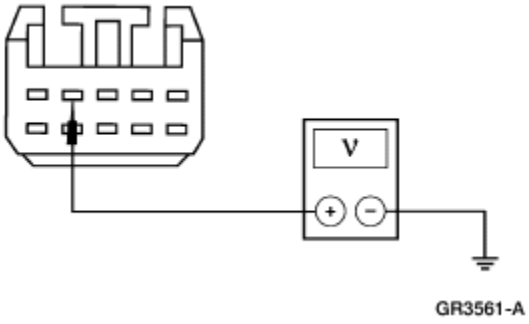
PINPOINT TEST L: THE HEATED SEAT IS INOPERATIVE

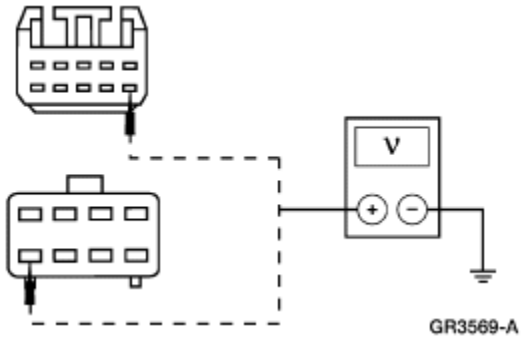
CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULES — CIRCUIT 1048 (LB/WH)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) MUST be installed under the seats in the side airbag to floor connector.	

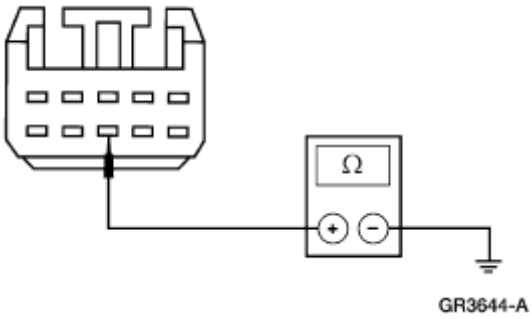
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

	1 **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position. Vehicles equipped with side air bags, prepare the vehicle for seating diagnostics. ■ Deactivate the air bag system. For additional information, refer to Section 501-20B . ■ With the air bag system deactivated, position the seats in the vehicle. Connect the seat system electrical connectors.
2 	2 Disconnect inoperative heated seat module C370 (driver) or C340 (passenger).
3  GR3561-A	3 Measure the voltage between driver heated seat module C370-4 (driver) or C340-4 (passenger), circuit 1048 (LB/WH), and ground.
	• **Is the voltage greater than 10 volts?** → **Yes** GO to L2 . → **No** REPAIR circuit 1048 (LB/WH). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L2 CHECK FOR VOLTAGE TO THE HEATED SEAT SWITCHES AND MODULES — CIRCUIT 1003 (GY/YE)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 3 4 	2 Disconnect inoperative heated seat switch C371 (driver) or C343 (passenger). 4 Measure the voltage between heated seat switch C371 (driver) or C343 (passenger), circuit 1003 (GY/YE), and ground; and between heated seat module C370-6 (driver) or C340-6 (passenger), circuit 1003 (GY/YE), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to L3 . → **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
L3 CHECK PASSENGER HEATED SEAT MODULE(S) GROUND — CIRCUIT 57 (BK)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1	1 Measure the resistance between heated seat module C370 (driver) or C340 (passenger),



circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to L4 .

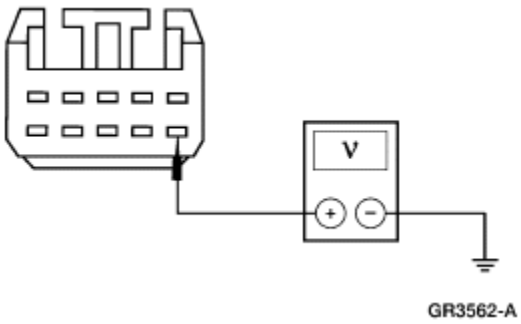
→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L4 CHECK THE HEATED SEAT SWITCH FOR VOLTAGE — CIRCUIT 1003 (GY/YE)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

2

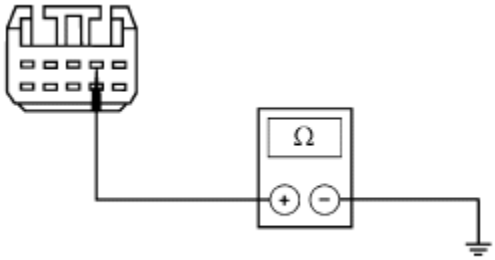


2 Measure the voltage between driver heated seat module C370-6 (driver) or C340-6 (passenger), circuit 1003 (GY/YE), and ground.

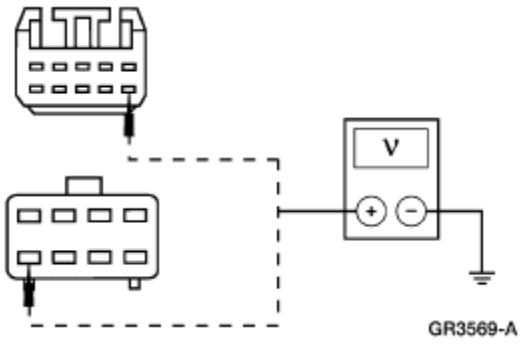
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to L5 .

→ **No**
REPAIR circuit 1003 (GY/YE). TEST the

	system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
L5 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE	
1 2 3  GR3568-A	2 Disconnect inoperative heated seat module C370 (driver) or C340 (passenger). 3 Measure the resistance between heated seat module C370-2 (driver) or C340-2 (passenger) , circuit 1020 (DG/VT), and ground while pressing and holding the heated seat switch. • **Is the resistance less than 500 ohms?** → **Yes** GO to L8 . → **No** GO to L6 .
L6 CHECK FOR VOLTAGE TO THE HEATED SEAT SWITCH AND HEATED SEAT MODULE — CIRCUIT 1003 (GY/YE)	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 3	2 Disconnect inoperative heated seat switch C371 (driver) or C343 (passenger).

4



4 Measure the voltage between heated seat switch C371-1 (driver) or C343-1 (passenger), circuit 1003 (GY/YE), and ground; and between heated seat module C370-6 (driver) or C340-6 (passenger), circuit 1003 (GY/YE), and ground.

- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to L7 .

→ **No**
REPAIR circuit 1003 (GY/YE). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L7 CHECK CIRCUIT 1020 (DG/P) (DRIVER) OR 1020 (DG/VT) (PASSENGER) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

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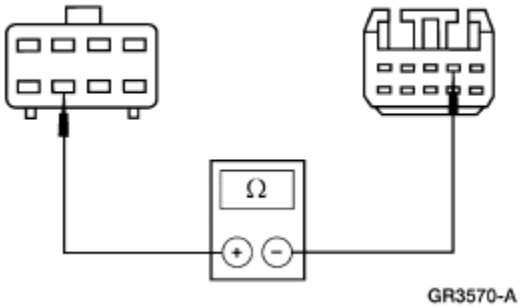
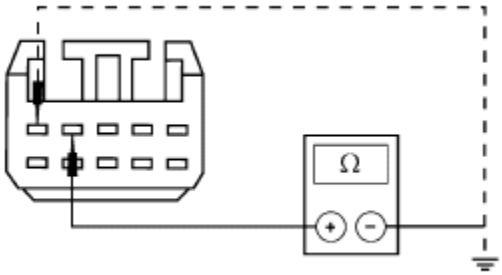
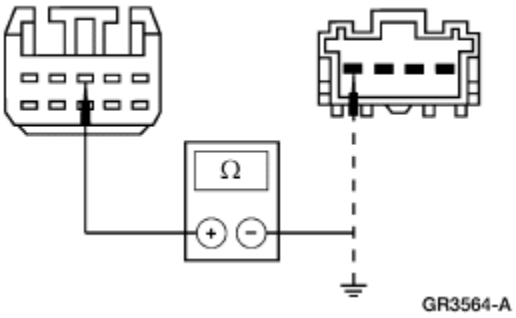
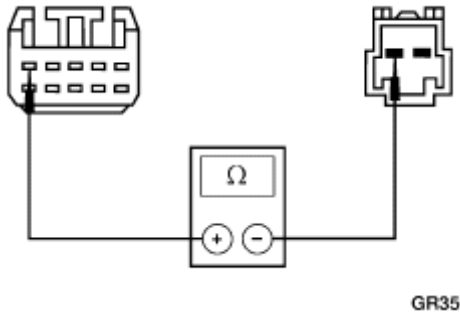


2 Measure the resistance between driver heated seat module C370-2, circuit 1020 (DG/P), and driver heated seat switch C371-2, circuit 1020 (DG/VT); or between passenger heated seat module C340-2, circuit 581 (R), and passenger heated seat switch C343-2, circuit 1020 (DG/VT).

- **Is the resistance less than 5 ohms?**

	→ **Yes** INSTALL a new heated seat switch. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B . → **No** REPAIR circuit 1020 (DG/P). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
L8 CHECK THE HEATED SEAT CIRCUITRY FOR OPEN AND SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 	
2 	2 Disconnect inoperative heated seat module C370 (driver) or C340 (passenger).
3  GR3563-A	3 Measure the resistance between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and heated seat module C370-5 (driver) or C340-5 (passenger), circuit 1067 (P/LB); and between heated seat module C367-3 (driver) or C375-3 (passenger), circuit 1064 (Y/LB), and ground. • **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the heated seat module connector and ground?** → **Yes** INSTALL a new heated seat module. REFER to Seat Module—Heated Seat in this section. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

	→ **No** GO to L9 .
L9 CHECK CIRCUIT 1064 (Y/LB) FOR OPEN AND SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2 	1 Disconnect inoperative seat heater and temperature sensor C373 (driver) or C345 (passenger). 2 Measure the resistance between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and seat heater and temperature sensor C344-1 (driver) or C345-1 (passenger), circuit 1064 (Y/LB); and between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and ground. • **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the seat module connector and ground?** → **Yes** GO to L10 . → **No** REPAIR circuit 1064 (Y/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
L10 CHECK CIRCUIT 1067 (VT/LB) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2	1 Disconnect inoperative seat back heater C372 (driver) or C344 (passenger). 2 Measure the resistance between heated seat module C370-5 (driver) or C340-5 (passenger), circuit 1067 (VT/LB), and seat



back heater C372-2 (driver) or C344-2 (passenger), circuit 1067 (P/LB).

- **Is the resistance less than 5 ohms?**

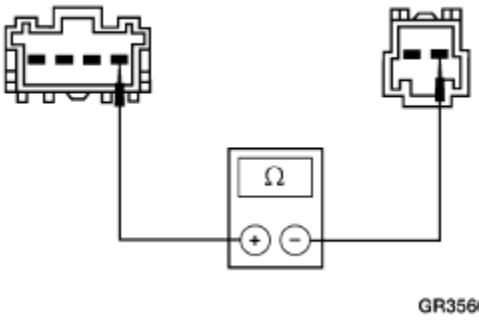
→ **Yes**
GO to L11 .

→ **No**
REPAIR circuit 1067 (VT/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L11 CHECK CIRCUIT 1066 (GY/LB) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1



1 Measure the resistance between seat back heater C372-1 (driver) or C344-1 (passenger), circuit 1066 (GY/LB), and seat heater and temperature sensor C373-1 (driver) or C345-1 (passenger), circuit 1066 (GY/LB).

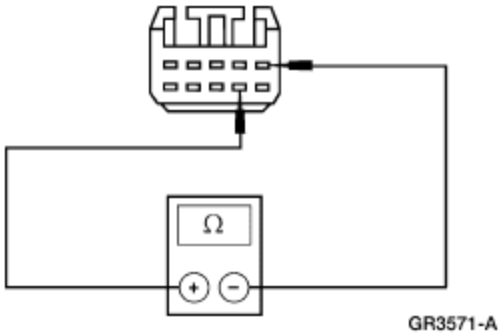
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to L12 .

→ **No**
REPAIR circuit 1066 (GY/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L12 CHECK THE HEATED SEAT TEMPERATURE SENSOR CIRCUITRY FOR CONTINUITY

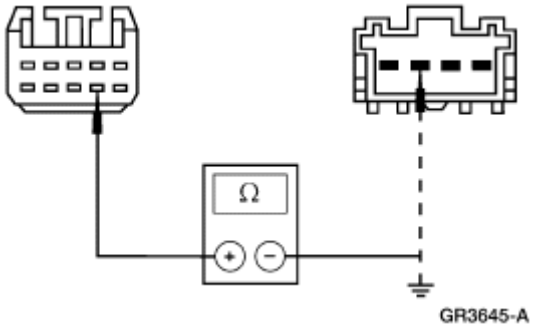
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 2  GR3571-A	2 Measure the resistance between heated seat module C370-7 (driver) or C340-7 (passenger), circuit 1060 (BK/LB), and heated seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB). • **Is the resistance less than 300,000 ohms and greater than 50 ohms?** → **Yes** INSTALL a new heated seat module. REFER to Seat Module—Heated Seat in this section. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B . → **No** GO to L13 .

L13 CHECK CIRCUIT 1060 (BK/LB) FOR OPEN AND SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 2	1 Disconnect inoperative seat heater and temperature sensor C373 (driver) or C345 (passenger). 2 Measure the resistance between heated seat module C370-7 (driver) or C340-7 (passenger), circuit 1060 (BK/LB), and seat heater and temperature sensor C373-2 (driver) or C345-2 (passenger), circuit 1060 (BK/LB); and between heated seat module C370-7 (driver) or C340-7 (passenger), circuit



1060 (BK/LB), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the heated seat module connector and ground?**

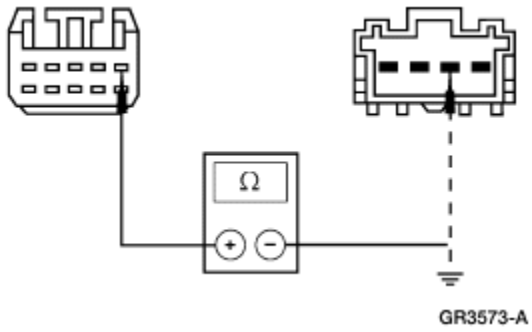
→ **Yes**
GO to L14 .

→ **No**
REPAIR circuit 1060 (BK/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

L14 CHECK CIRCUIT 1061 (BR/LB) FOR OPEN AND SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1



1 Measure the resistance between heated seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB), and seat heater and temperature sensor C373-3 (driver) or C345-3 (passenger), circuit 1061 (BR/LB); and between heated seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the heated seat module connector and ground?**

→ **Yes**
INSTALL a new seat heater and temperature sensor. TEST the system for normal operation. Vehicles equipped with side air bags,

	REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B . → **No** REPAIR circuit 1061 (BR/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

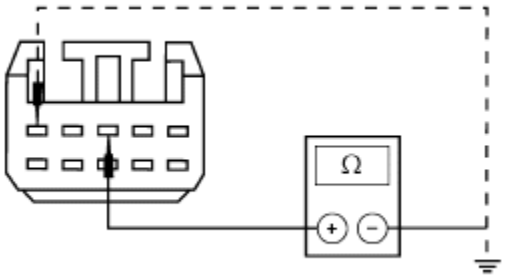
PINPOINT TEST M: THE HEATED SEAT IS INOPERATIVE — SEAT DOES NOT HEAT BUT THE HEATED SEAT SWITCH ILLUMINATES WHEN PRESSED

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK THE HEATED SEAT CIRCUITRY FOR OPEN AND SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) MUST be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
2	1 **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position. Vehicles equipped with side air bags, prepare the vehicle for seating diagnostics. ■ Deactivate the air bag system. For additional information, refer to Section 501-20B . ■ With the air bag system deactivated, position the seats in the vehicle. Connect the seat system electrical connectors.

3

3 Disconnect inoperative heated seat module C370 (driver) or C340 (passenger).

4



GR3642-A

4 Measure the resistance between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and heated seat module C370-5 (driver) or C340-5 (passenger), circuit 1067 (VT/LB); and between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and ground.

- **Is the resistance greater than 1.5 and less than 4 ohms between the two connectors, and greater than 10,000 ohms between the heated seat module connector and ground?**

→ **Yes**
INSTALL a new heated seat module. REFER to Seat Module—Heated Seat . TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

→ **No**
GO to M2 .

M2 CHECK CIRCUIT 1064 (Y/LB) FOR OPEN AND SHORT TO GROUND

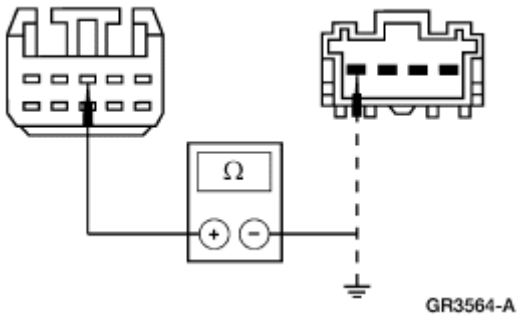
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

1 Disconnect inoperative seat heater and temperature sensor C373 (driver) or C345 (passenger).

2

2 Measure the resistance between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and seat heater and temperature sensor C373-1 (driver) or C345-1 (passenger), circuit 1064



(Y/LB); and between heated seat module C370-3 (driver) or C340-3 (passenger), circuit 1064 (Y/LB), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the seat module connector and ground?**

→ **Yes**
GO to M3 .

→ **No**
REPAIR circuit 1064 (Y/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

M3 CHECK CIRCUIT 1067 (VT/LB) FOR OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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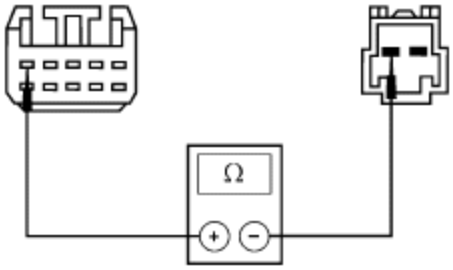
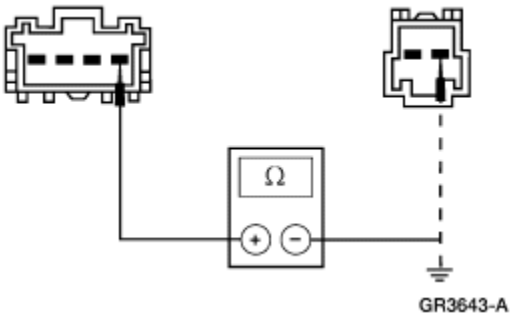


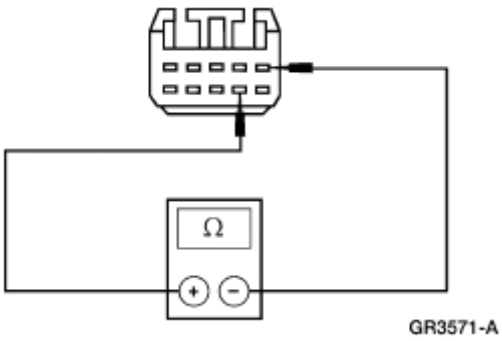
1 Disconnect inoperative seat back heater C372 (driver) or C344 (passenger).

2 Measure the resistance between heated seat module C370-5 (driver) or C340-5 (passenger), circuit 1067 (P/LB), and seat back heater C372-2 (driver) or C344-2 (passenger), circuit 1067 (VT/LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M4 .

	→ **No** REPAIR circuit 1067 (VT/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
M4 CHECK CIRCUIT 1066 (GY/LB) FOR OPEN AND SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  	1 Measure the resistance between seat back heater C372-1 (driver) or C344-1 (passenger), circuit 1066 (GY/LB), and seat heater and temperature sensor C373-4 (driver) or C345-4 (passenger), circuit 1066 (GY/LB); and between seat back heater C372-1 (driver) or C344-1 (passenger), circuit 1066 (GY/LB), and ground. • **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the seat back heater connector and ground?** → **Yes** GO to M5 . → **No** REPAIR circuit 1066 (GY/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
M5 CHECK THE HEATED SEAT TEMPERATURE SENSOR CIRCUITRY FOR CONTINUITY	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2	2 Measure the resistance between heated seat module C370-7 (driver) or C340-7 (passenger), circuit 1060 (BK/LB), and heated



seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB).

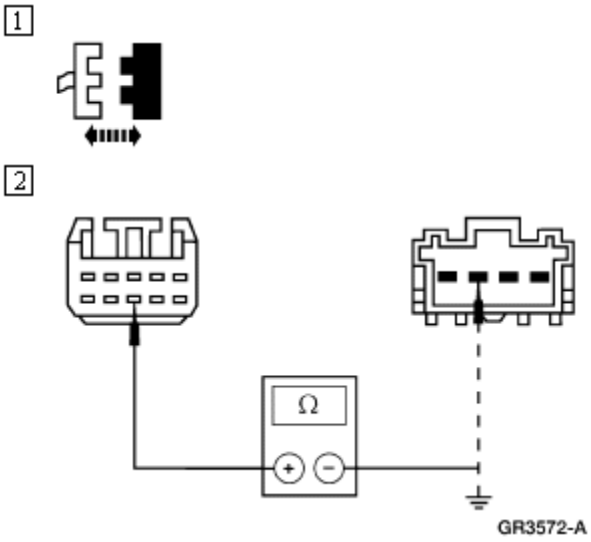
- **Is the resistance less than 10 ohms?**

→ **Yes**
INSTALL a new heated seat module. REFER to Seat Module—Heated Seat in this section. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

→ **No**
GO to M6 .

M6 CHECK CIRCUIT 1060 (BK/LB) FOR OPEN AND SHORT TO GROUND

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

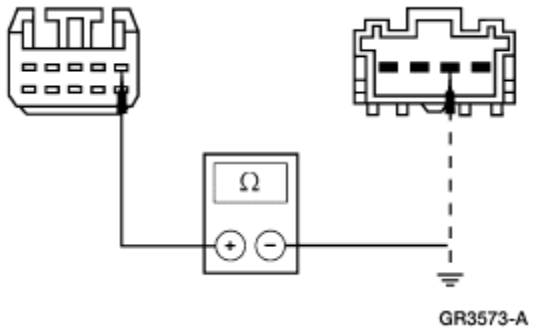


1 Disconnect inoperative seat heater and temperature sensor C373 (driver) or C345 (passenger).

2 Measure the resistance between heated seat module C370-7 (driver) or C340-7 (passenger), circuit 1060 (BK/LB), and seat heater and temperature sensor C373-2 (driver) or C345-2 (passenger), circuit 1060 (BK/LB); and between heated seat module C370-7 (driver) or C340-7 (passenger), circuit 1060 (BK/LB), and ground.

- **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the heated seat module connector and ground?**

→ **Yes**

	GO to M7 . → **No** REPAIR circuit 1060 (BK/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
M7 CHECK CIRCUIT 1061 (BR/LB) FOR OPEN AND SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  GR3573-A	1 Measure the resistance between heated seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB), and seat heater and temperature sensor C373-3 (driver) or C345-3 (passenger), circuit 1061 (BR/LB); and between heated seat module C370-1 (driver) or C340-1 (passenger), circuit 1061 (BR/LB), and ground. • **Is the resistance less than 5 ohms between the two connectors and greater than 10,000 ohms between the heated seat module connector and ground?** → **Yes** INSTALL a new heated seat and temperature sensor. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B . → **No** REPAIR circuit 1061 (BR/LB). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

PINPOINT TEST N: THE HEATED SEAT IS INOPERATIVE — SEAT DOES HEAT BUT THE HEATED SEAT SWITCH DOES NOT ILLUMINATE WHEN PRESSED

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE — CIRCUIT 461 (OG)	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

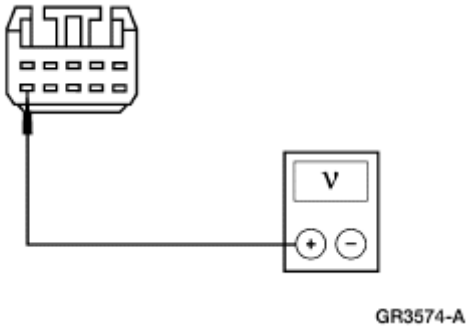
NOTE: Airbag simulators (restraint system diagnostic tools) MUST be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

	1 **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position. Vehicles equipped with side air bags, prepare the vehicle for seating diagnostics. ■ Deactivate the air bag system. For additional information, refer to Section 501-20B . ■ With the air bag system deactivated, position the seats in the vehicle. Connect the seat system electrical connectors.
2	
3	3 Disconnect inoperative heated seat module C370 (driver) or C340 (passenger).
4	
5	5 Measure the voltage between heated seat module C370-10 (driver) or C340-10 (passenger), circuit 461 (OG), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
INSTALL a new heated seat module. REFER to Seat Module—Heated Seat in this section. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

→ **No**
GO to N2 .

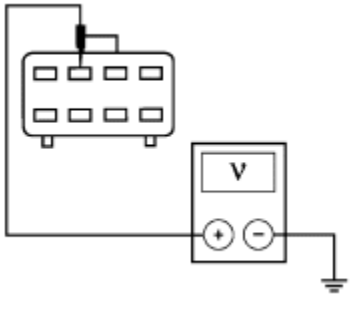
N2 CHECK FOR VOLTAGE TO THE HEATED SEAT SWITCH — CIRCUIT 1003 (GY/YE)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1

2

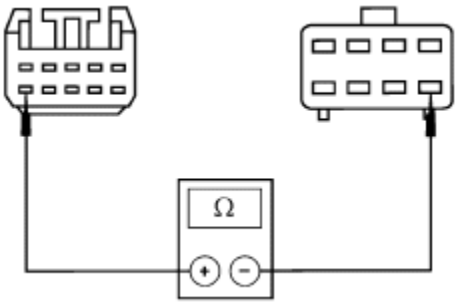
3



1 Disconnect inoperative heated seat switch C371 (driver) or C343 (passenger).

3 Measure the voltage between heated seat switch C371-6 (driver) or C343-6 (passenger), circuit 1003 (GY/YE), and ground.

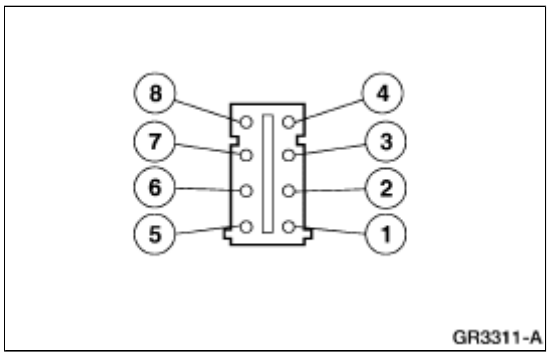
- **Is the voltage greater than 10 volts?**

	→ **Yes** GO to N3 . → **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .
N3 CHECK CIRCUIT 461 (OG) FOR OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1 2  GR3575-A	2 Measure the resistance between heated seat module C370-10 (driver) or C340-10 (passenger), circuit 461 (OG), and heated seat switch C371-4 (driver) or C343-4 (passenger), circuit 461 (OG). • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new heated seat switch. TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B . → **No** REPAIR circuit 461 (OG). TEST the system for normal operation. Vehicles equipped with side air bags, REACTIVATE the seat supplemental restraint system. For additional information, refer to Section 501-20B .

Component Test

Switch — Seat Regulator Control

Seat Regulator Control Switch



Remove the seat regulator control switch. Measure the resistance between the following indicated terminals while pressing the requested switches.

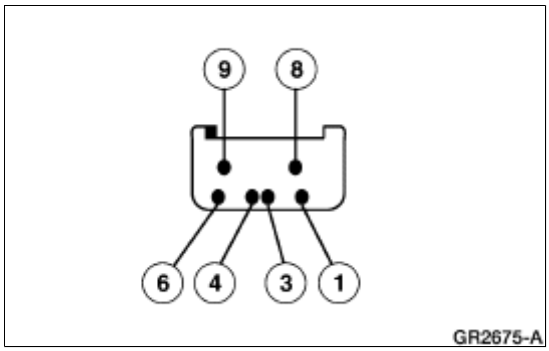
Switch	Terminals	
Front Tilt Up	5 and 4	7 and 2
Front Tilt Down	7 and 4	5 and 2
Rear Tilt Up	6 and 4	1 and 2
Rear Tilt Down	1 and 4	6 and 2
Seat Up	5, 6 and 4	1, 7 and 2
Seat Down	1, 7 and 4	5, 6 and 2
Seat Forward	3 and 4	8 and 2
Seat Rearward	8 and 4	3 and 2

The resistance should be less than 5 ohms for each direction.

If the resistance is not less than 5 ohms for each switch, replace the switch; otherwise, return to the calling pinpoint test.

Switch — Memory Set

Memory Set Switch



Remove the memory set switch.

Measure the resistance between the following indicated terminals while pressing the requested switches.

Switch	Terminals
Memory Switch 1	6 and 4
Memory Switch 2	6 and 3
Memory Set Switch	6 and 1

The resistance should be less than 5 ohms for each switch position.

If the resistance is not less than 5 ohms for each switch, replace the switch; otherwise, return to the calling Pinpoint Test.

Switch	Terminals
Memory Switch LED	8 and 9

NOTE: Refer to Multimeter User's Manual for testing diodes.

To check the memory set switch LED, connect the positive meter lead to terminal 8 and the negative lead to terminal 9. The meter should indicate greater than 0.3 volts. Reversing the leads, the meter should read OL.

If the meter readings are not as indicated above, replace the switch; otherwise, return to the calling Pinpoint Test.

Switch —6-Way Power Seat, Sport Bucket

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

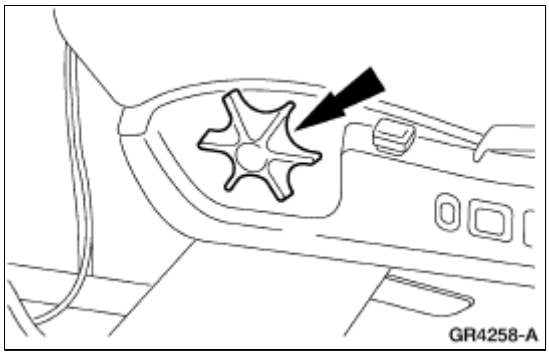
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

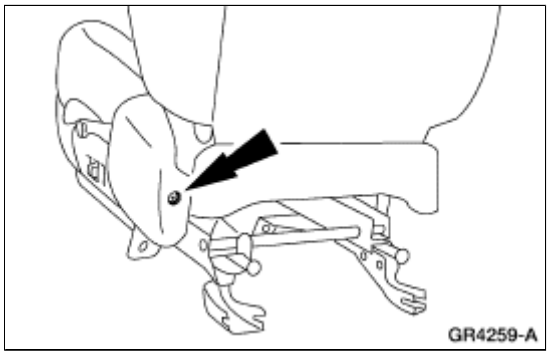
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

   Remove the front seat. For additional information, refer to Seat—Front Bucket .

3. Remove the lumbar support knob.

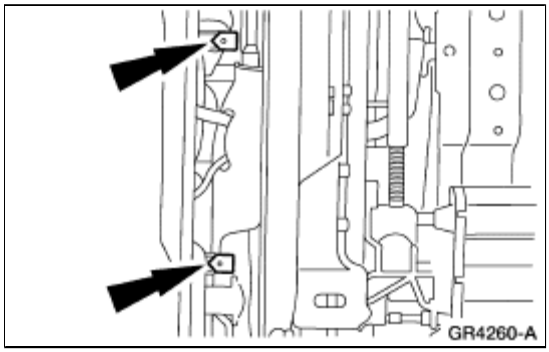


4. Remove the rear side shield screw.

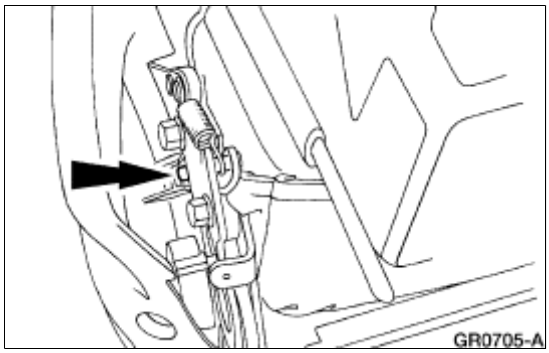


5. **CAUTION: To prevent damage to the side shield, the clips must be depressed in order to release the side shield from the cushion pan.**

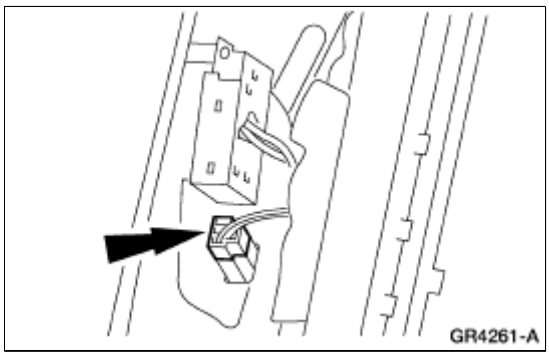
   Release the side shield clips.



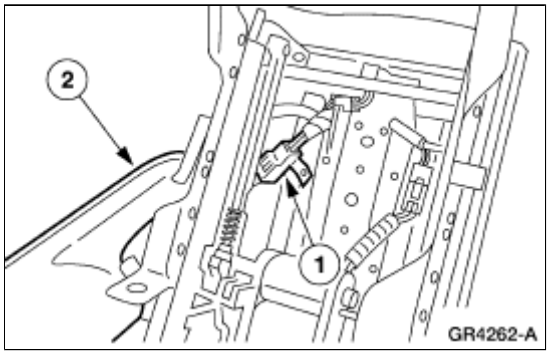
6. Unhook the side shield from the seat latch.



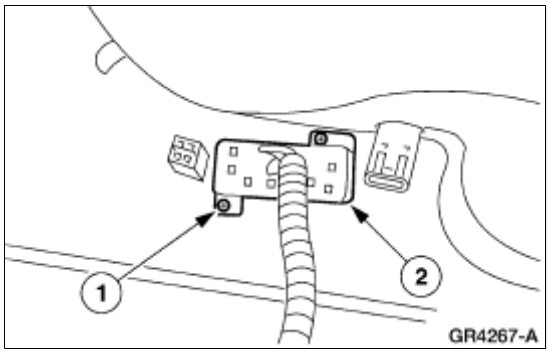
7. If equipped, disconnect the heated seat switch electrical connector.



8. Remove the side shield.
    1. Disconnect the electrical connector.
    2. Remove the side shield.



9. Remove the 6-way power seat switch.
    1. Remove the screws.
    2. Remove the 6-way power seat switch.



Installation

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1. To install, reverse the removal procedure.
2. Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .
3. Prove out the air bag system. For additional information, refer to Section 501-20B .
4. Check the restraint system for proper operation.

Switch —6-Way Power Seat, Limited

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

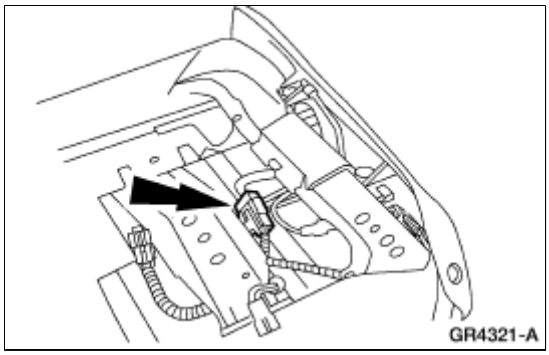
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

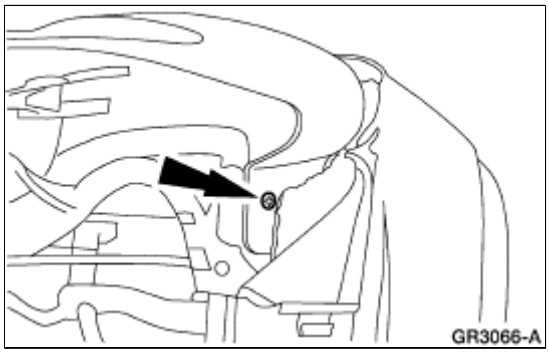
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

   Remove the front seat. For additional information, refer to Seat—Front Bucket .

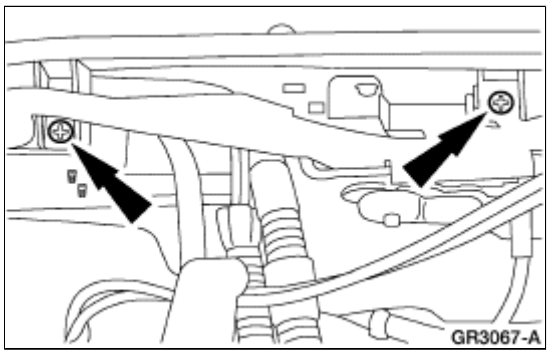
3. Disconnect the power seat switch electrical connector.



4. Remove the front seat cushion side shield rear screw.

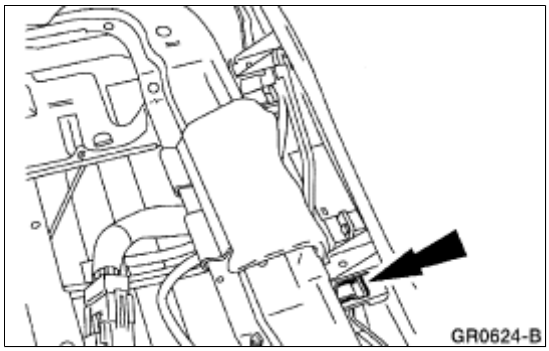


5. Remove the front seat cushion side shield screws.

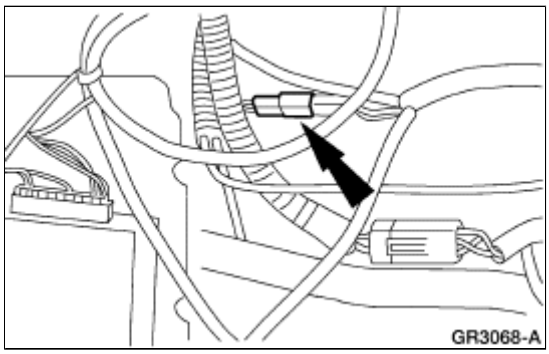


6. **CAUTION: Use care when disconnecting the seat cushion side shield from the seat cushion frame so the tabs on the seat cushion side shield are not damaged.**

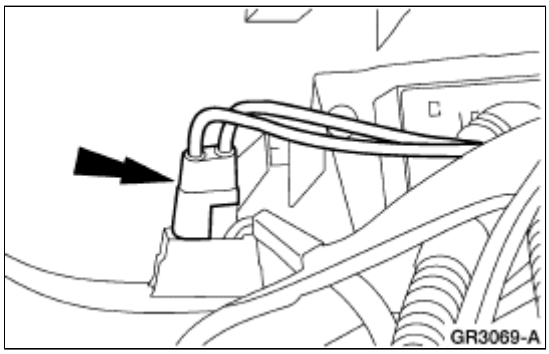
   Disconnect the front seat cushion side shield.



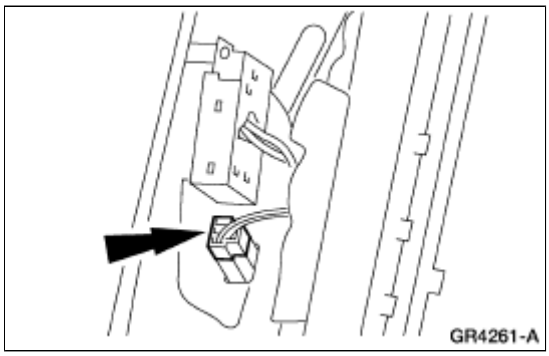
7. Disconnect the lumbar support control switch electrical connector.



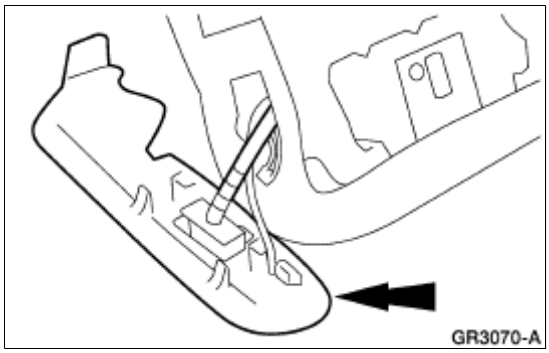
8. Disconnect the lumbar support adjusting hoses (65528) from the adjusting switch.



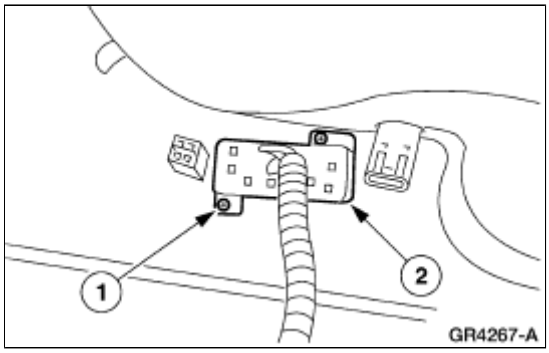
9. If equipped, disconnect the heated seat switch electrical connector.



10. Remove the front seat cushion side shield.



11. Remove the 6-way power seat switch.
    1. Remove the screws.
    2. Remove the 6-way power seat switch.



Installation

1. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   To install, reverse the removal procedure.

2. Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

4. Check the restraint system for proper operation.

Switch —Heated Seat, Sport Bucket

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

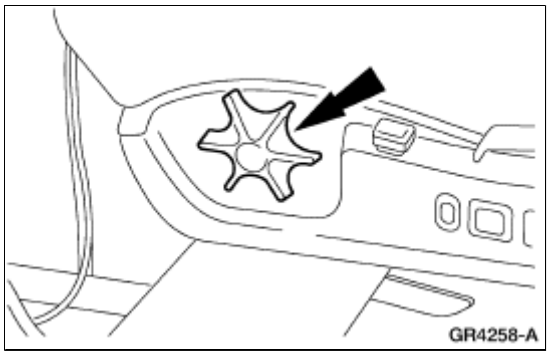
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

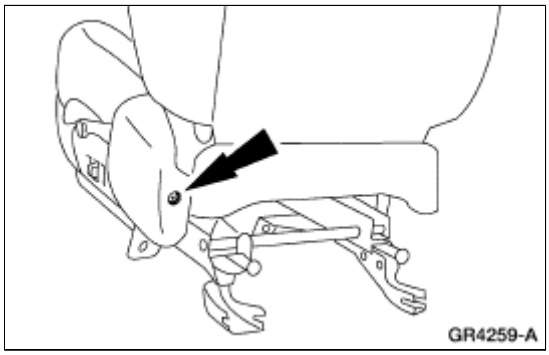
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

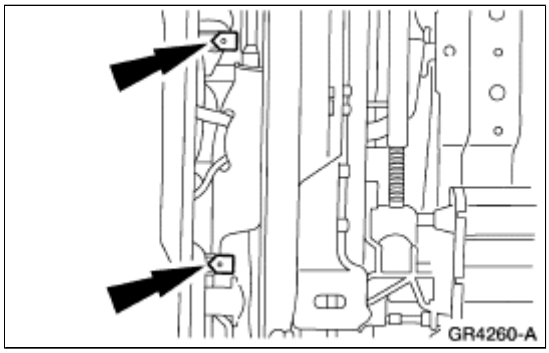
   Remove the front seat. For additional information, refer to Seat—Front Bucket .
3. Remove the lumbar support knob.



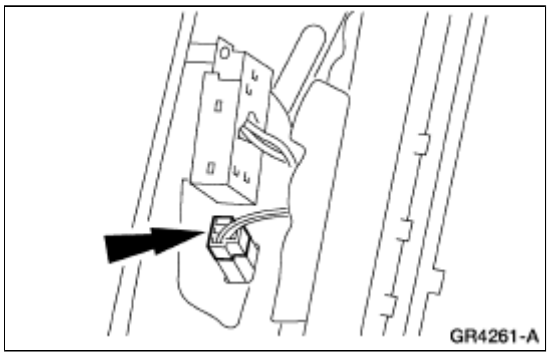
4. Remove the rear side shield screw.



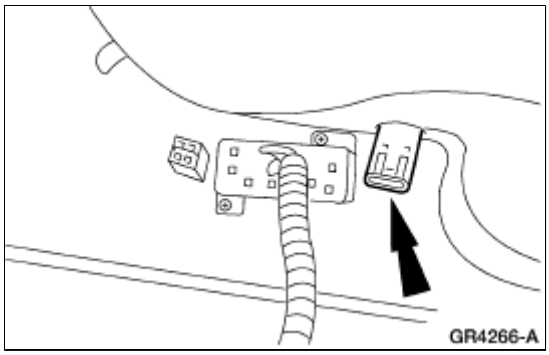
5. Release the side shield clips.



6. Disconnect the heated seat switch electrical connector.



7. Remove the heated seat switch.



Installation

1. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   To install, reverse the removal procedure.

2. Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

4. Check the restraint system for proper operation.

Switch —Heated Seat, Limited

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

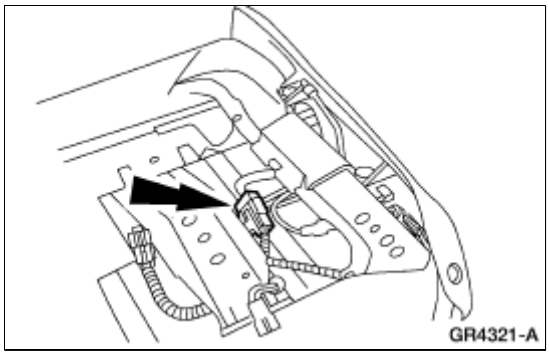
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

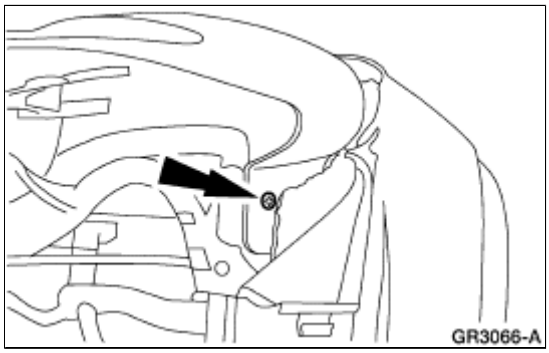
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

   Remove the front seat. For additional information, refer to Seat—Front Bucket .

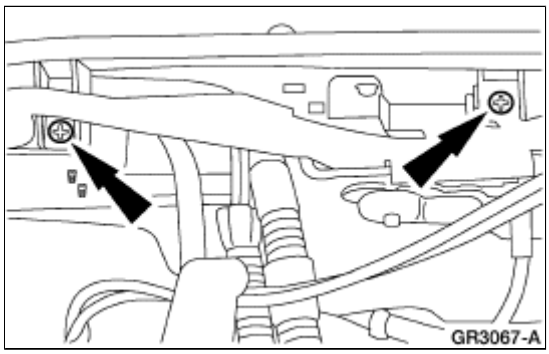
3. Disconnect the power seat switch electrical connector.



4. Remove the front seat cushion side shield rear screw.

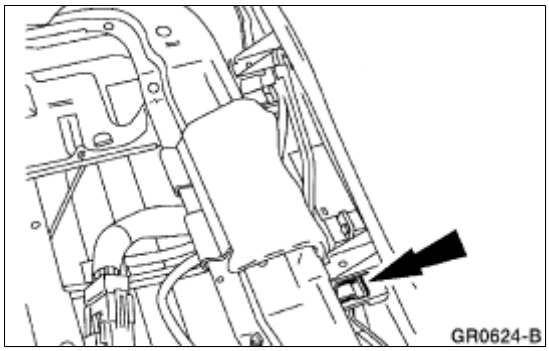


5. Remove the front seat cushion side shield screws.

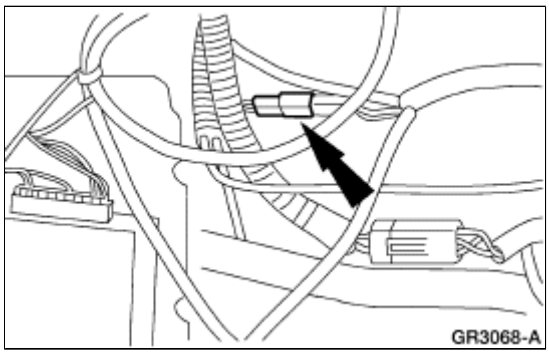


6. **CAUTION: Use care when disconnecting the seat cushion side shield from the seat cushion frame so the tabs on the seat cushion side shield are not damaged.**

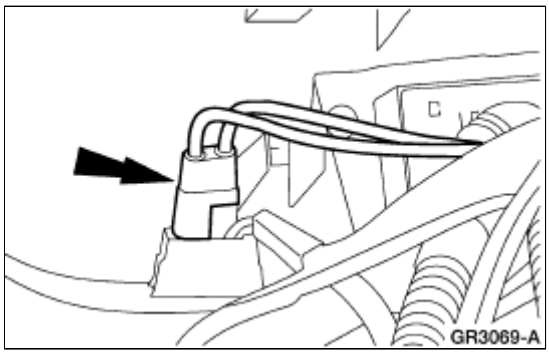
   Disconnect the front seat cushion side shield.



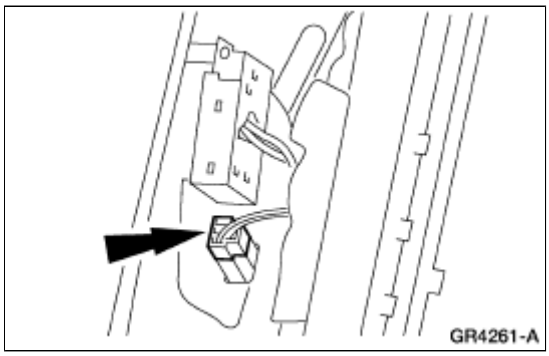
7. Disconnect the lumbar support control switch electrical connector.



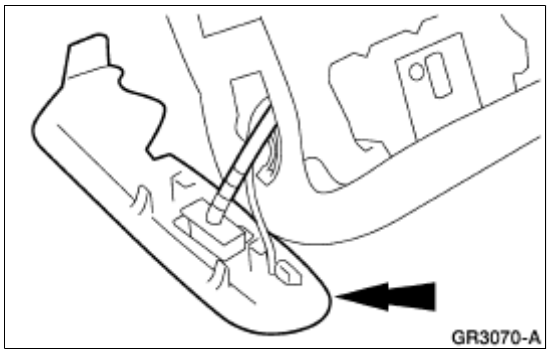
8. Disconnect the lumbar support adjusting hoses (65528) from the adjusting switch.



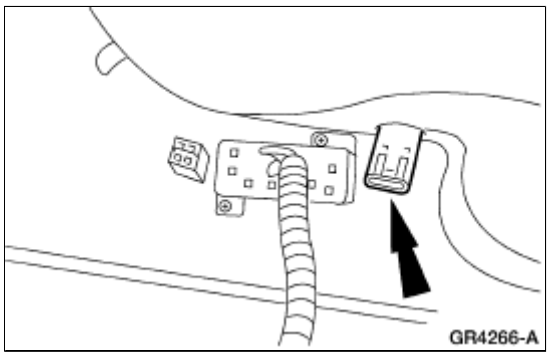
9. Disconnect the heated seat switch electrical connector.



10. Remove the front seat cushion side shield.



11. Remove the heated seat switch.



Installation

1. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   To install, reverse the removal procedure.

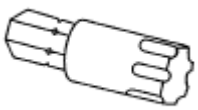
2. Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

4. Check the restraint system for proper operation.

Seat —Front Bucket

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T50 Head Bolt) 501-010 (T77L-2100-A)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live side air bag module down on the cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking

components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

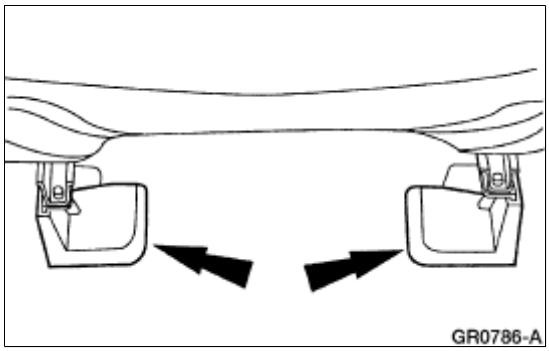
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

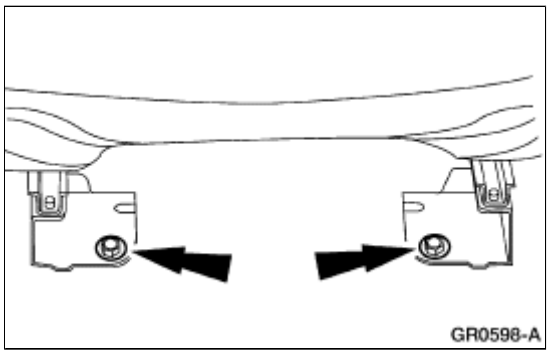
NOTE: A repair is made by replacement only. If a part is replaced and the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

NOTE: If a side air bag deployment took place the seatback pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

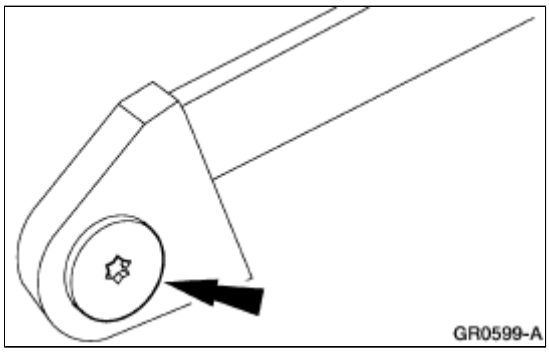
1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .
2. On 6-way power seat equipped vehicles, position the seat in the full up position.
3. Disconnect the battery ground cable (14301) and wait at least one minute.
4. Remove the front seat track rear bolt covers.



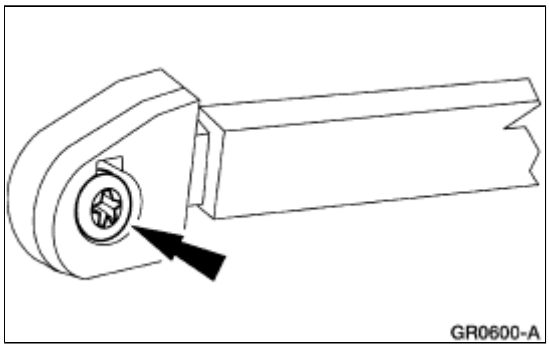
5. Remove the bolts.



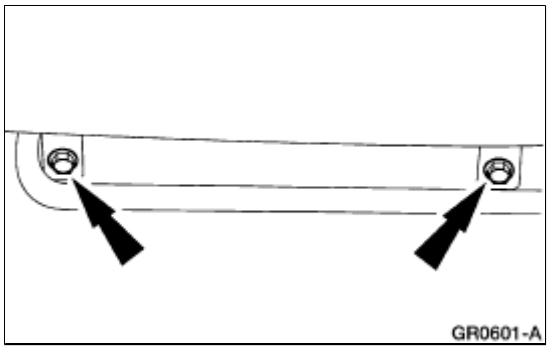
6. Remove the slide bar bolt cover plug.



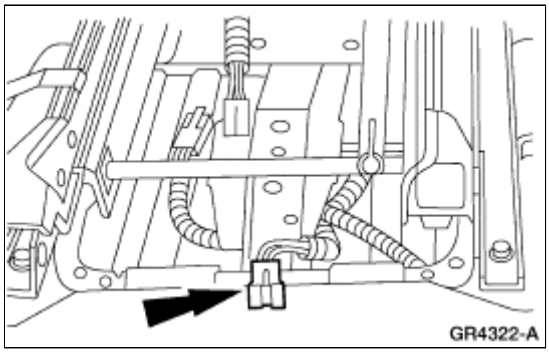
7. Using the Safety Belt Bolt Bit, remove the bolt.



8. Remove the front seat track to floor front bolts.



9. Disconnect the safety belt warning indicator electrical connector.
10. If equipped, disconnect the side air bag electrical connector.
11. On 6-way power seat equipped vehicles, lean the seat back and disconnect the electrical connectors.

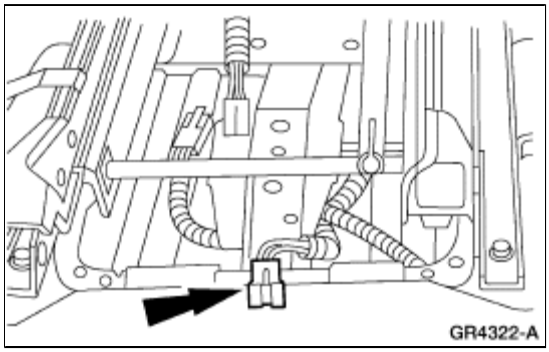


12. **CAUTION: Use care when handling the seat and track assembly. Dropping the assembly or sitting on a seat not secured in the vehicle may result in damaged components.**

    Remove the front seat.

Installation

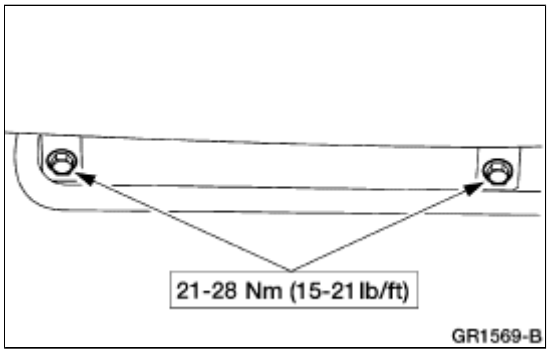
1. Position the front seat.
   - On 6-way power seat equipped vehicles, connect the electrical connectors.



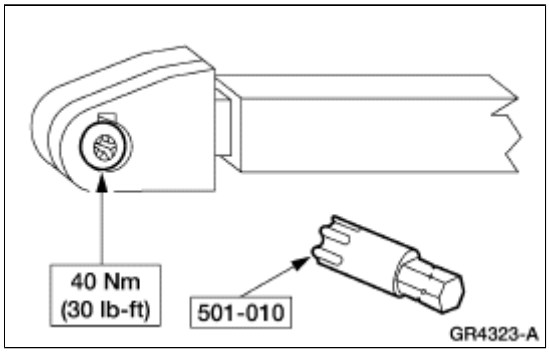
2. If equipped, connect the side air bag electrical connector.

3. Connect the safety belt warning indicator electrical connector.

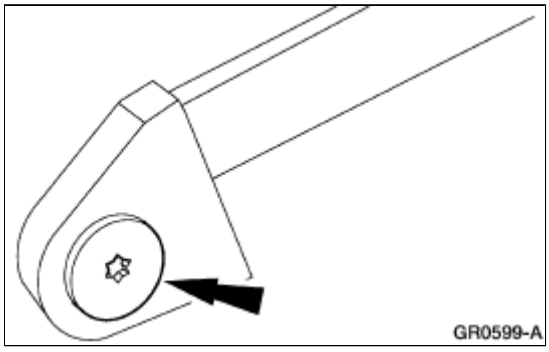
4. Install the front seat track to floor bolts.



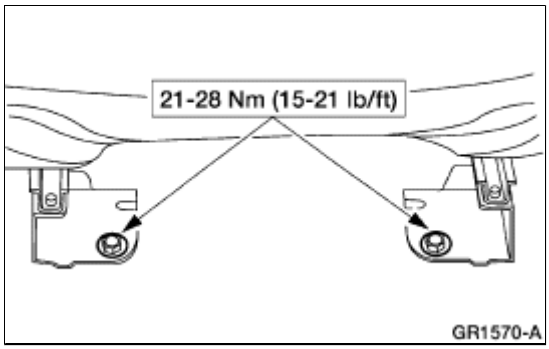
5. Using the special tool, install the slide bar bolt.



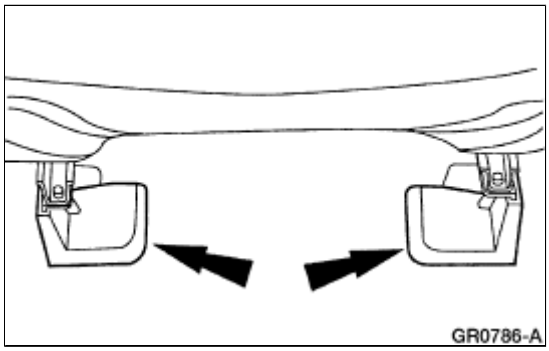
6. Install the slide bar bolt cover plug.



7. Install the rear front seat track bolts.



8. Install the rear front seat track bolt covers.



9. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   On 6-way power seat equipped vehicles, connect the battery ground cable.

10. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

11. Prove out the air bag system. For additional information, refer to Section 501-20B .

12. Check the restraint system for proper operation.

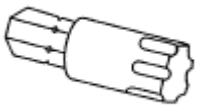
Seat —Rear, 40% Portion of 60/40 Split Bench

Removal and Installation

For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench in this section.

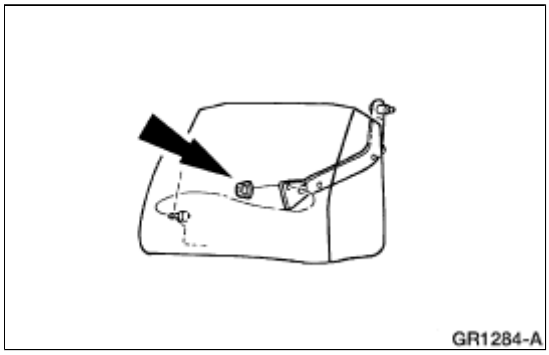
Seat —Rear, 50/50 Split Bench

Special Tool(s)

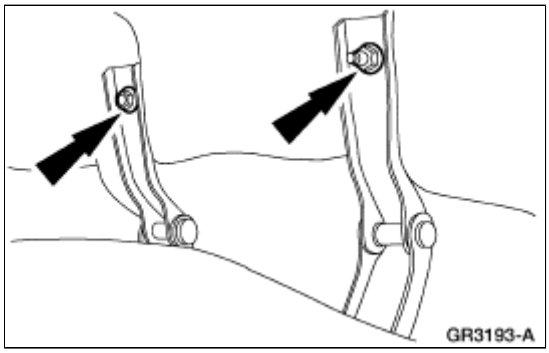
 ST1181-A	Safety Belt Bolt Bit (Used for T50 Head Bolt) 501-010 (T77L-2100-A)

Removal

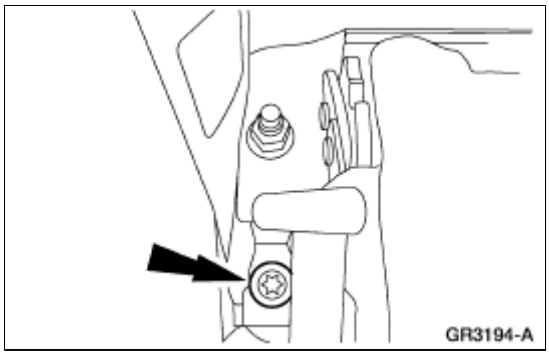
1. Fold the rear seat cushion assembly forward.
2. Remove the retaining nut from the end of the link arm and slide the link arm off the stud on the seat cushion frame.


GR1284-A

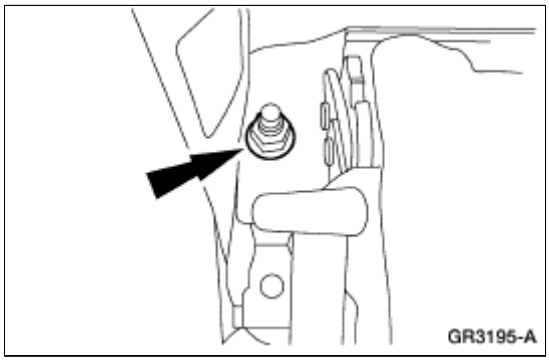
3. Return the seat back assembly to the upright position.
4. Remove the retaining nuts from the front floor attachment.


GR3193-A

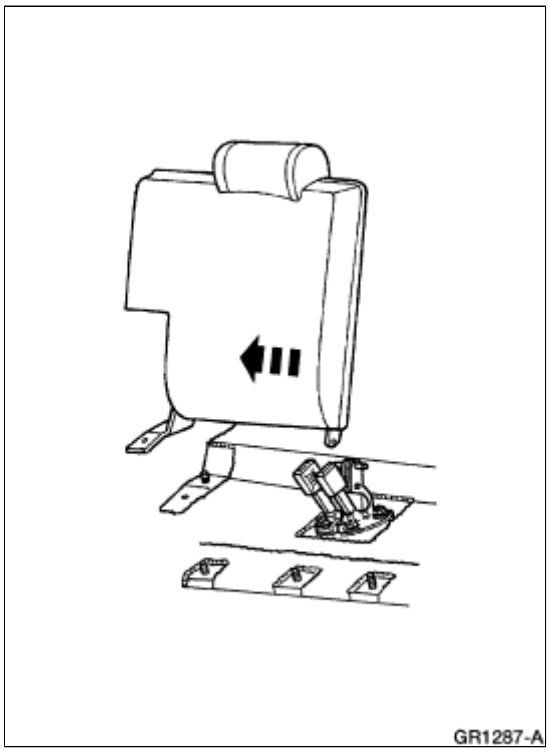
5. Remove the seat cushion assembly from the vehicle.
6. Use Safety Belt Bolt Bit to remove the safety belt bolt.



7. Remove the rear outboard nut.



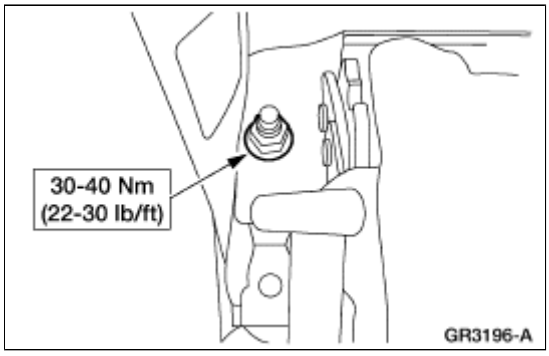
8. Slide the seat back assembly off the center pivot bracket and remove the seat back assembly from the vehicle.



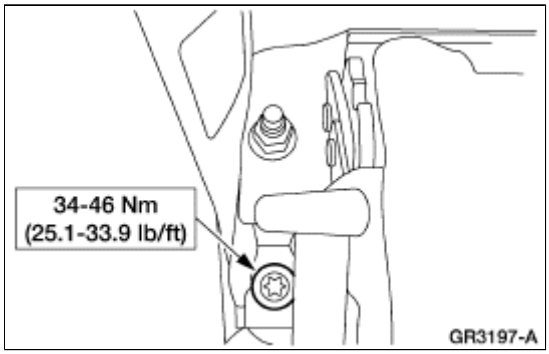
Installation

1. Install the seat back (with link arm) onto the pin on the center pivot bracket and position the seat onto the floor pan.

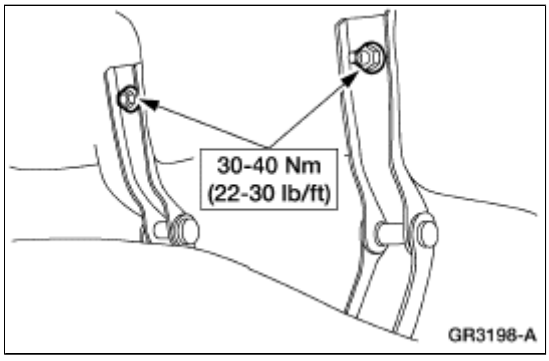
2. Install the rear outboard nut.



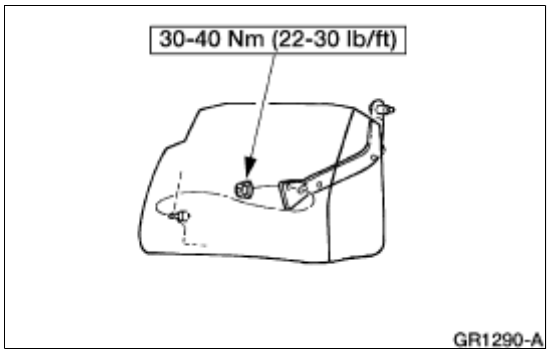
3. Use Safety Belt Bolt Bit to install the rear outboard bolt.



4. Install the seat cushion.
   - Install the nuts.



5. Install the link arm nut.

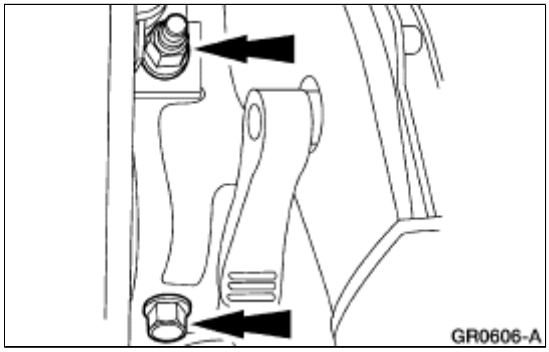

30-40 Nm (22-30 lb/ft)
GR1290-A

Seat —Rear, 60% Portion of 60/40 Split Bench

Removal

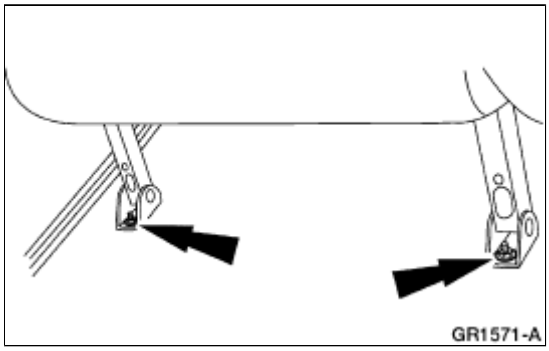
NOTE: 60 percent rear seat shown; 40 percent rear seat similar.

1. Remove the rear outboard nut and bolt.



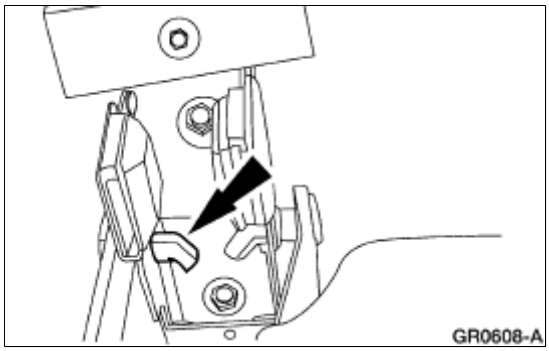
2. **NOTE:** Remove the plastic caps from the studs.

   Remove the rear seat riser to floor nuts.



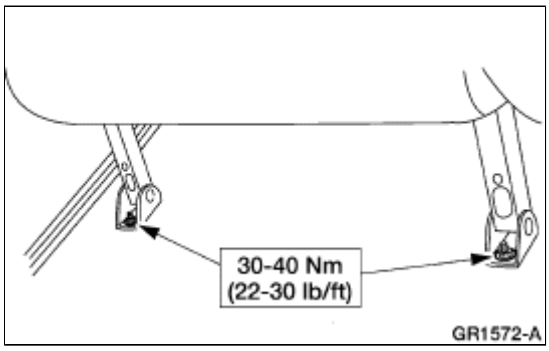
3. Fold the rear seat down.

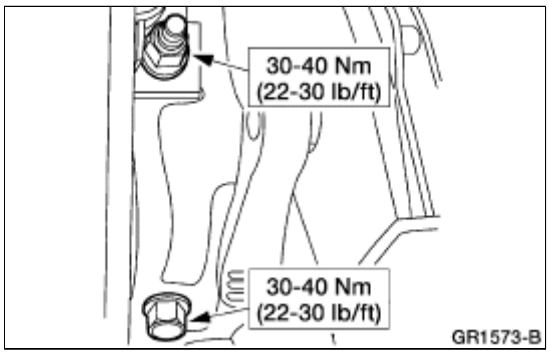
4. Remove the rear seat.
   - Pivot the seat to unhook the tab from the safety belt buckle bracket.



Installation

1. To install, reverse the removal procedure.





Seat —Track, Front Manual

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

CAUTION: Use care when handling the seat and track assembly. Dropping the assembly or sitting on a seat not secured in the vehicle may result in damaged components.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

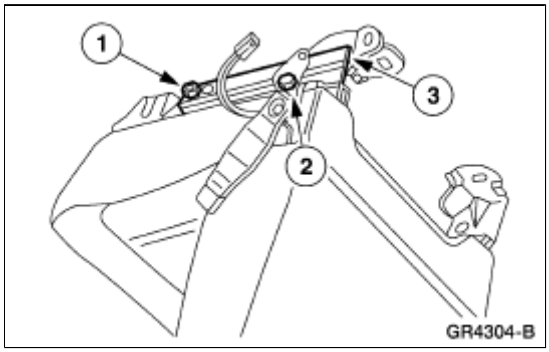
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

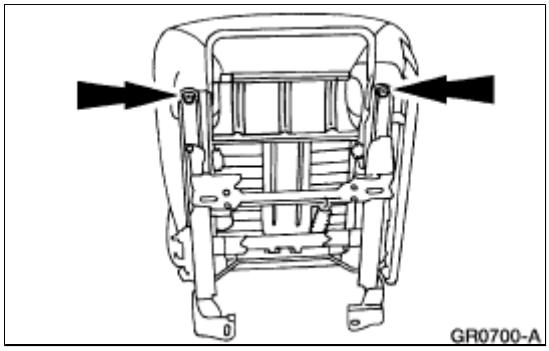
1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

   Remove the front seat. For additional information, refer to Seat—Front Bucket .
3. Place the front seat (60012) upside-down on a clean workbench.

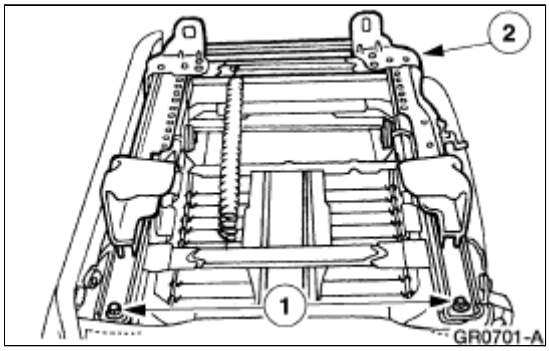
4. Remove the safety belt buckle slide bar.
    1. Remove the nut.
    2. Remove the bolt.
    3. Remove the safety belt buckle slide bar.



5. Remove the seat track to seat cushion front bolts.

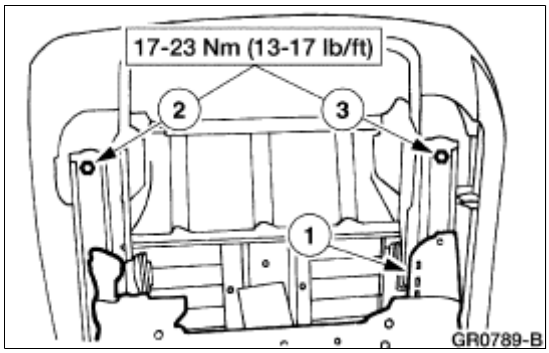


6. Remove the front seat track (61705).
    1. Remove the seat track to seat cushion rear bolts.
    2. Remove the front seat track.

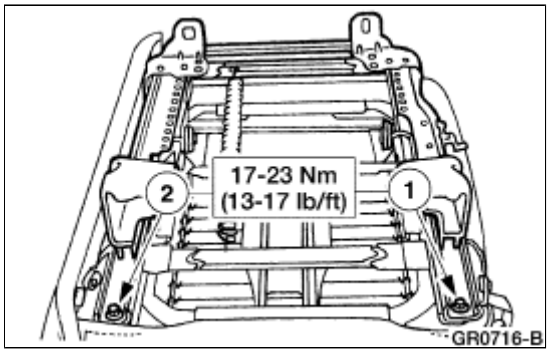


Installation

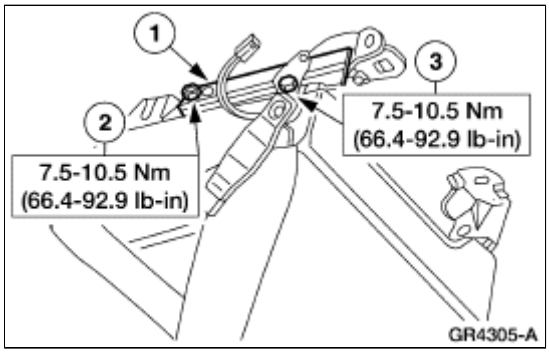
1. Install the front seat track front bolts.
    1. Position the front seat track.
    2. Install the inboard bolt.
    3. Install the outboard bolt.



2. Install the front seat track rear bolts.
    1. Install the inboard bolt.
    2. Install the outboard bolt.



3. Install the safety belt buckle slide bar.
    1. Position the safety belt buckle slide bar.
    2. Install the nut.
    3. Install the bolt.



4. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

    Install the front seat. For additional information, refer to Seat—Front Bucket .

5. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

6. Prove out the air bag system. For additional information, refer to Section 501-20B .
7. Check the restraint system for proper operation.

Seat —Track, Limited and 6-Way Power

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

CAUTION: Use care when handling the seat and track assembly. Dropping the assembly or sitting on a seat not secured in the vehicle may result in damaged components.

NOTE: LHD seats shown, RHD seat similar.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

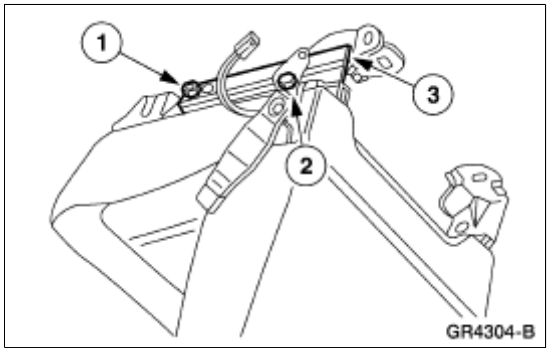
1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Front Bucket , Removal and Installation.

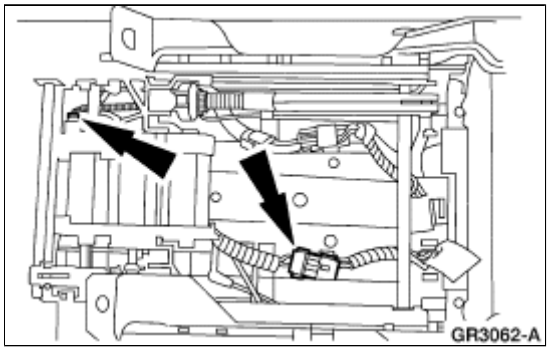
   Remove the front seat. For additional information, refer to Seat—Front Bucket .

3. Place the seat on a clean workbench.

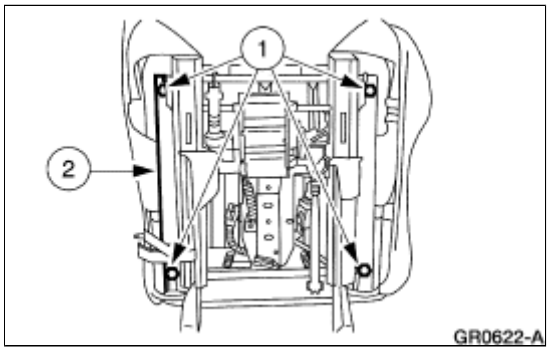
4. Remove the safety belt buckle slide bar.
    1. Remove the nut.
    2. Remove the bolt.
    3. Remove the safety belt buckle slide bar.



5. Disconnect the seat track wiring harness electrical connectors.
    - If equipped, disconnect the memory seat module electrical connectors.
    - Disconnect the seat track motor electrical connectors.



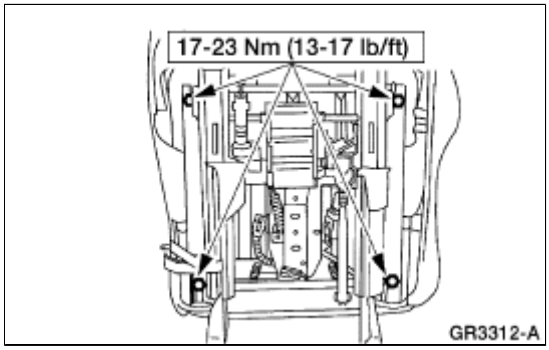
6. Remove the seat track.
    1. Remove the bolts.
    2. Remove the seat track.



Installation

1. **NOTE:** When installing the power seat track, start at the corner with the round hole and work around the seat base in a horseshoe pattern.

To install, reverse the removal procedure.

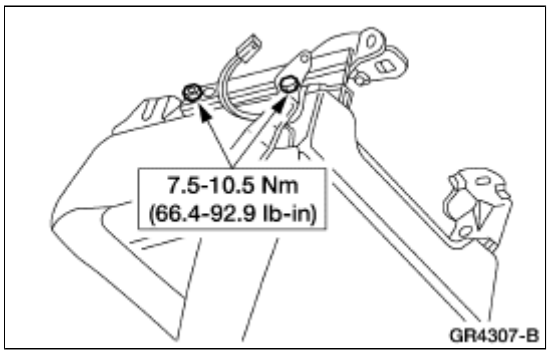


2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

4. Check the restraint system for proper operation.



Seat Module —Heated Seat

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

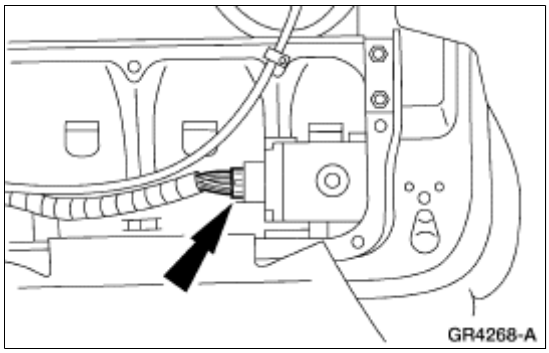
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

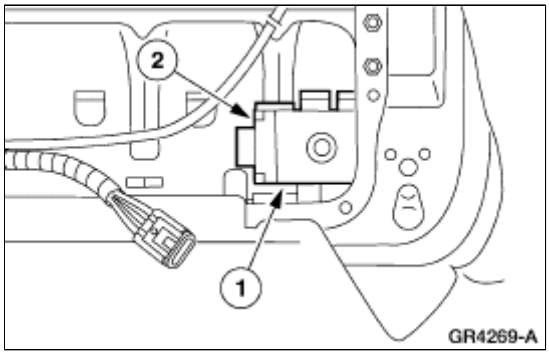
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .
2. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Track, Limited and 6-Way Power , Removal and Installation.

   Remove the power front seat track. For additional information refer to Seat—Track, Limited and 6-Way Power .
3. Disconnect the heated seat module electrical connector.



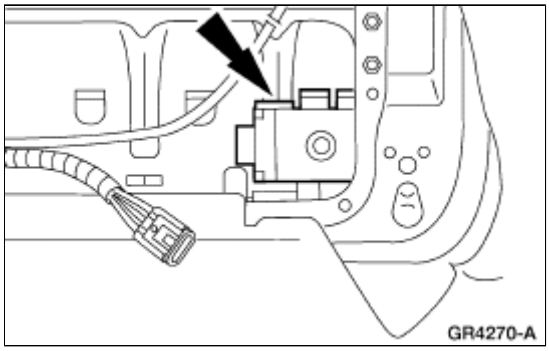
4. Remove the heated seat module.
    1. Release the clip.
    2. Remove the heated seat module.



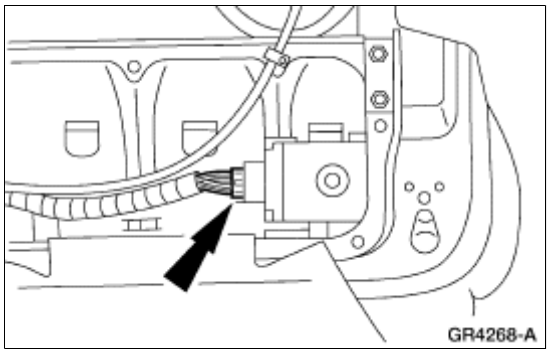
Installation

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

1. Install the heated seat module.



2. Connect the heated seat module electrical connector.



3. **NOTE:** Be sure to read and follow all air bag warnings contained in Seat—Track, Limited and 6-Way Power , Removal and Installation.

   Install the power front seat track. For additional information, refer to Seat—Track, Limited and 6-Way Power .

4. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

5. Prove out the air bag system. For additional information, refer to Section 501-20B .

6. Check the restraint system for proper operation.

Side Air Bag Wiring Harness

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live side air bag module down on the cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: A side air bag repair is made by installing a new component only. If a part is replaced and the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

All Seats

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

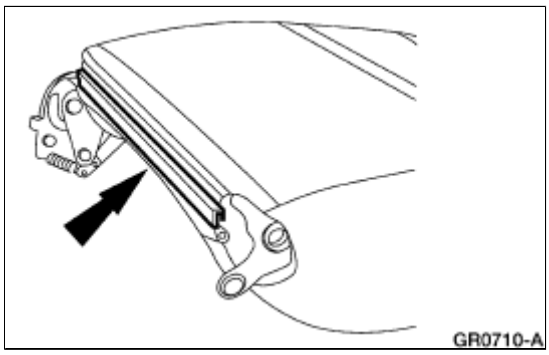
1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

2. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited , Seat—Front Bucket, Limited , or Seat—Front Bucket, Manual , Disassembly and Assembly.

   Disassemble the seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited , Seat—Front Bucket, Limited or Seat—Front Bucket, Manual .

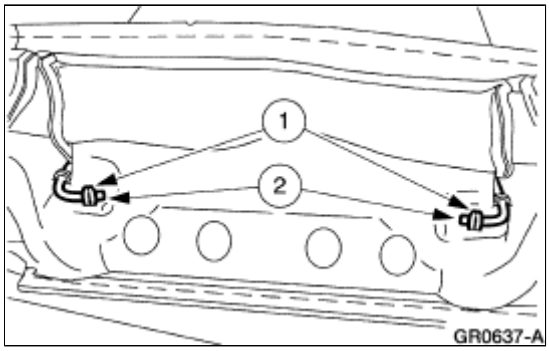
3. **WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired. They are to be replaced (cleaning is permissible).**

   Unhook the trim cover J-clip.



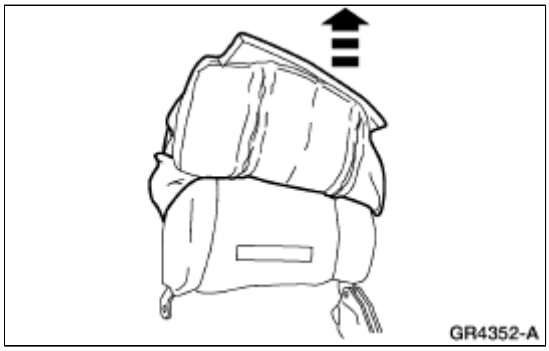
Sport Bucket Seat

4. Remove the seat backrest trim cover swing rods.
    1. Remove and discard the hog rings.
    2. Remove the seat backrest trim cover cushion swing rods.



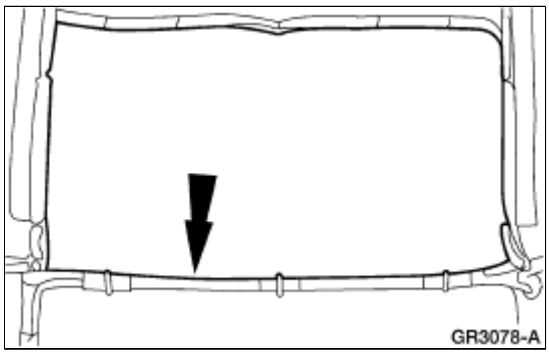
5. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip, or the hook and loop strip can be torn from the seat cushion foam.**

    Roll the seatback trim cover in an inside out fashion to the side air bag deployment chute.

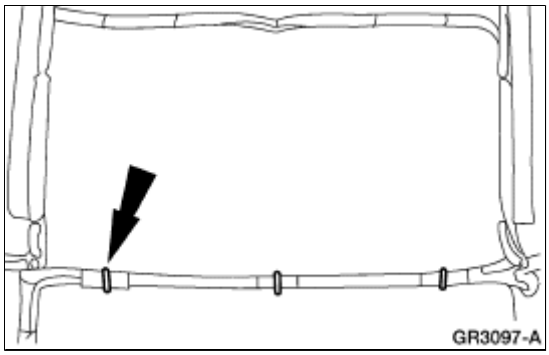


Limited Seat

6. Roll the seat backrest trim cover to the first row of hog rings.
7. Remove and discard the hog rings.
8. Roll the seat backrest trim cover to the second row of hog rings.



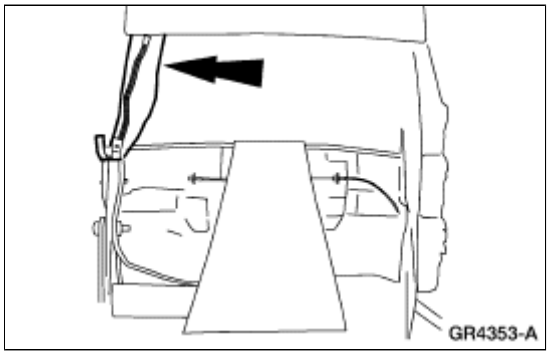
9. Remove and discard the hog rings.



10. Roll the seat backrest trim cover to the side air bag deployment chute.

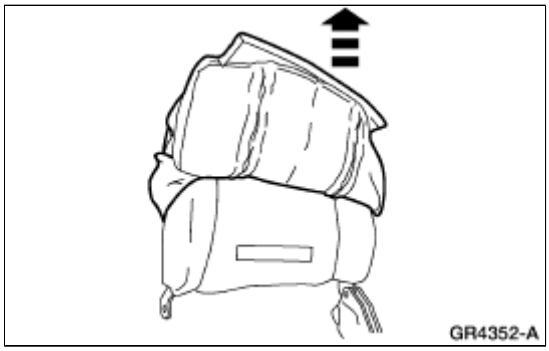
All Seats

11. Unzip the side air bag deployment chute.



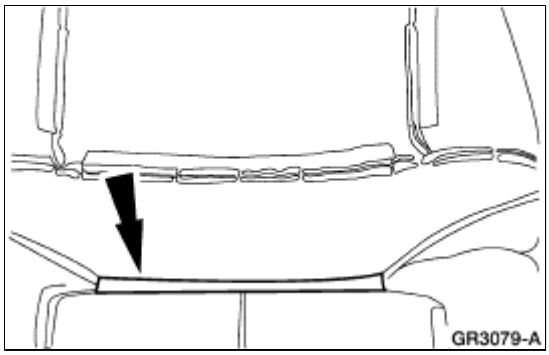
Sport Bucket

12. Roll the seat backrest cover and side air bag deployment chute to completely expose the side air bag bracket and side air bag module.

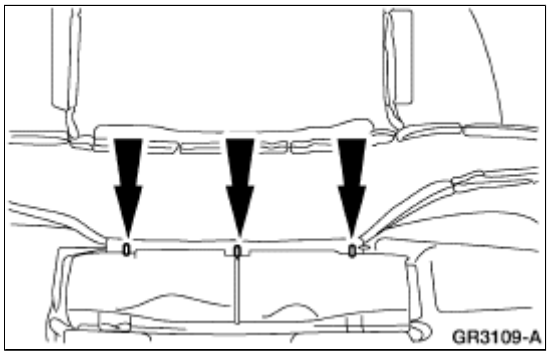


Limited Seat

13. Roll the seat backrest trim cover to the third row of hog rings.

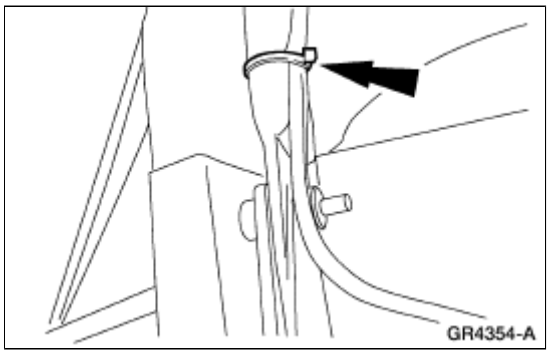


14. Remove and discard the hog rings.



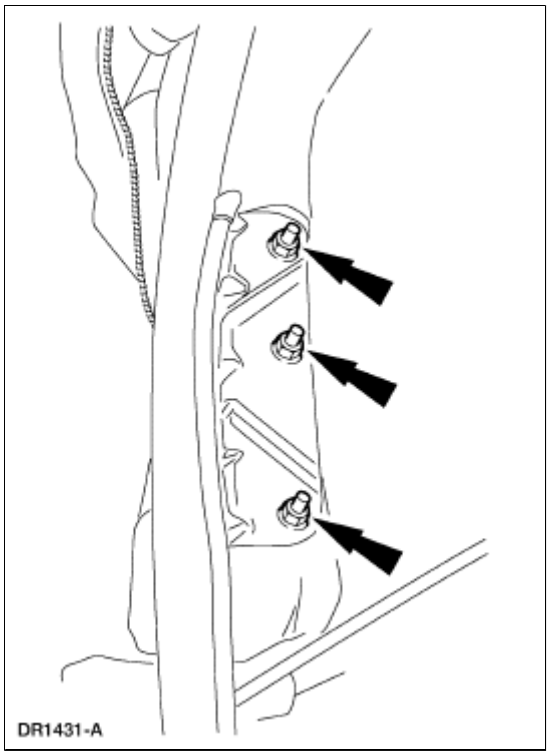
All Seats

15. Remove the side air bag wiring harness wire tie.

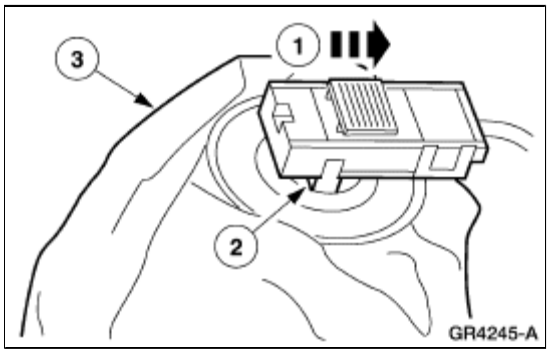


16. **NOTE:** If installing a new side air bag module, use new retaining nuts. If the same side air bag module is to be reused, then reuse the side air bag module retaining nuts.

    Through the seat backrest cushion opening, position the side air bag module aside.
    - Remove the retaining nuts.



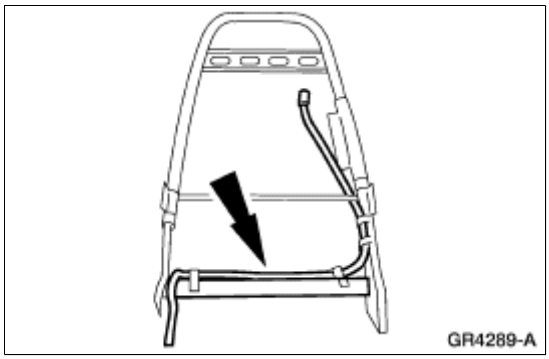
17. Remove the side air bag module.
    1. Release the side air bag module electrical connector clip.
    2. Release the connector tabs by pushing in on them, then disconnect the side air bag module electrical connector.
    3. Remove the side air bag module.



18. **NOTE:** Sport bucket seat shown; Limited seat similar.

    NOTE: The seat backrest components other than the seat backrest frame and side air bag wiring harness have been omitted for clarity.

    Remove the side air bag wiring harness.
    - Disconnect the pin-type retainers from the seat backrest frame.



Installation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper, the seat back trim cover and deployment chute must be installed new as a unit. Failure to do so may result in personal injury.

WARNING: The deployment seam cannot be repaired or resewn. A trim cover requiring replacement of the bolster or side facing must be replaced as a unit.

WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly. Failure to follow these instructions may result in personal injury.

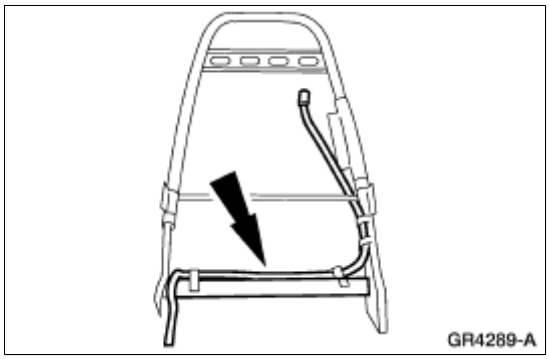
NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

All Seats

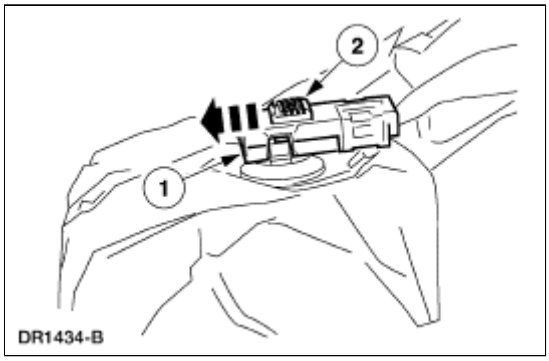
1. **NOTE:** The seat backrest components other than the seat backrest frame and side air bag wiring harness have been omitted for clarity.

   NOTE: Sport bucket seat shown; Limited seat similar.

   Install the side air bag wiring harness.
   - Connect the pin-type retainer to the seat backrest frame.



2. Connect the side air bag module electrical connector.
    1. Install the connector to the side air bag module.
    2. Slide the side air bag module electrical connector locking clip to secure the connector to the side air bag module.



3. Make sure the electrical connector is securely fastened to the side air bag module.

4. **WARNING: Inspect the mounting surfaces of the side air bag module and the seat back frame mounting bracket for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.**

   WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

   WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

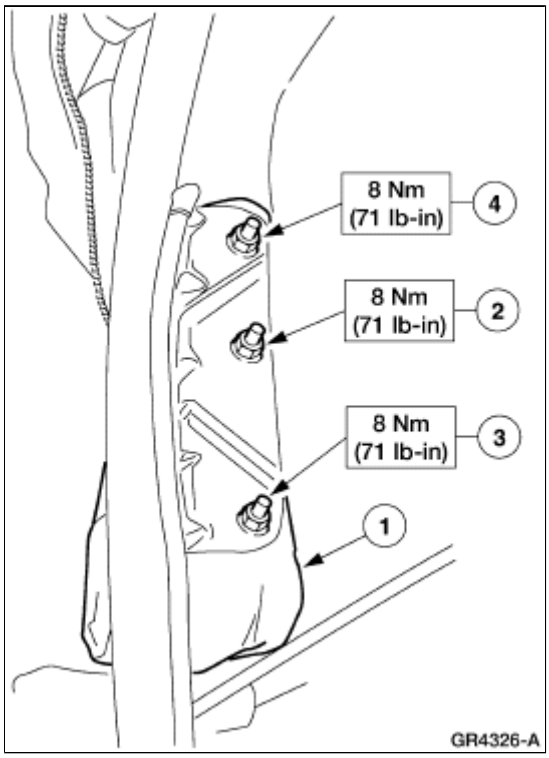
   WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury in the event of an air bag deployment.

   CAUTION: The retaining nuts of the side air bag module must be tightened in the sequence described.

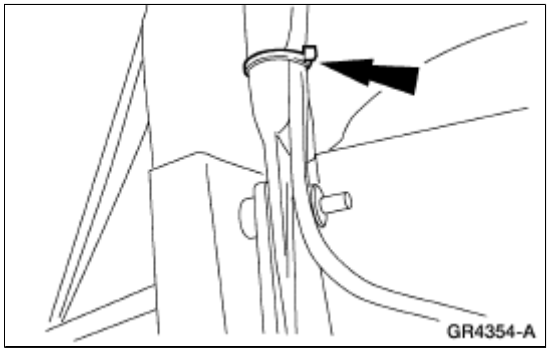
CAUTION: Be sure the side air bag wiring harness is not pinched between the side air bag module and mounting bracket.

Install the side air bag module onto the front seat back frame mounting bracket.

1. Position the side air bag module onto the front seat back mounting bracket being sure the side air bag wiring harness is located behind the seat backrest frame.
2. Install the side air bag module retaining nut.
3. Install the side air bag module retaining nut.
4. Install the side air bag module retaining nut.

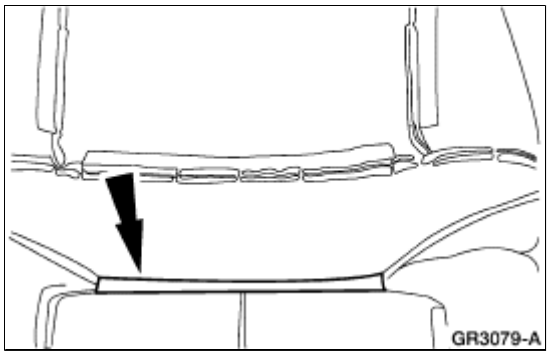


5. Tie-strap the side air bag module wire harness to the seat back frame.

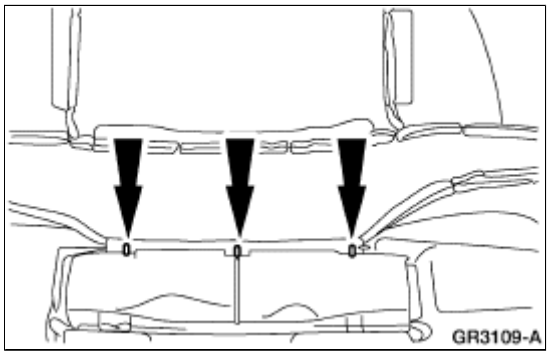


Limited Seats

6. Unroll the seat backrest trim cover to the third row of hog rings.

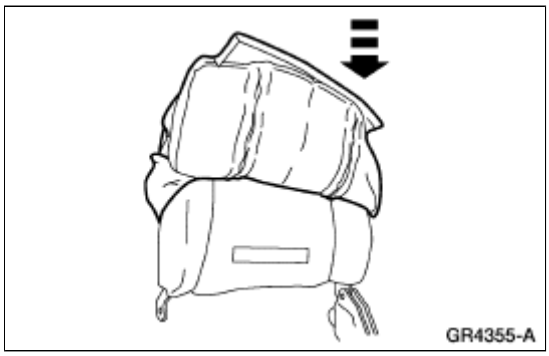


7. Install the hog rings.



All Seats

8. Roll the seat back trim cover to position the deployment chute around the side air bag module.

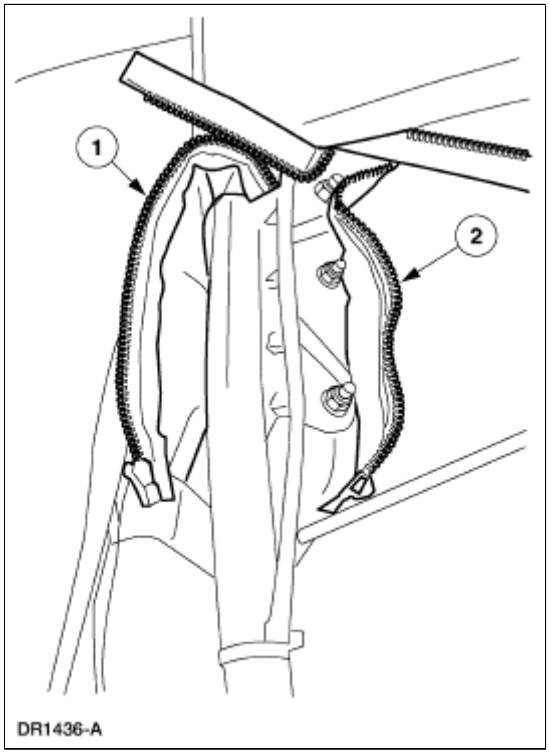


9. **WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper the seat back trim cover and deployment chute must be installed new as a unit.**

   WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly.

   Position the air bag deployment chute.
   1. Insert the outboard side of the air bag deployment chute between the seat back pad and the side air bag module, pulling it around the outboard side of the seat back frame.
   2. Insert the inboard side of the air bag deployment chute between the seat back pad and the

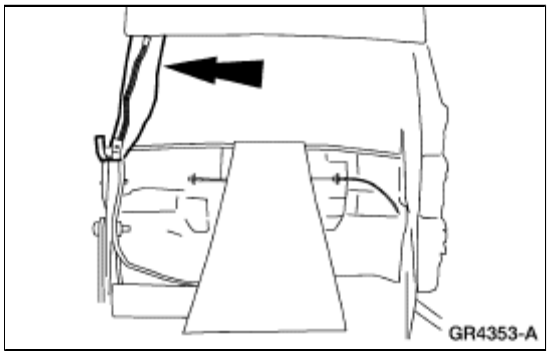
side air bag module from the inboard side of the seat back.



10. **NOTE:** Sport bucket seat shown; Limited seat similar.

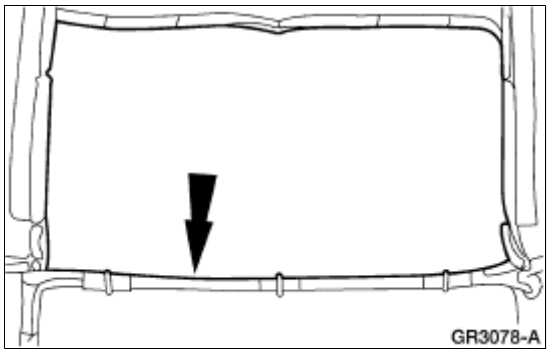
    NOTE: Be sure the side air bag deployment chute is properly positioned, before proceeding to the next step.

    Zip the air bag deployment chute completely closed, then position the zipper tails at the top and bottom of the deployment chute, into the seat back opening.
    - The side air bag deployment chute must encircle the side air bag module, going completely around the side air bag module and the side of the seat back frame.
    - Align the side air bag deployment chute to the side air bag module, making sure it covers the length of the side air bag module.

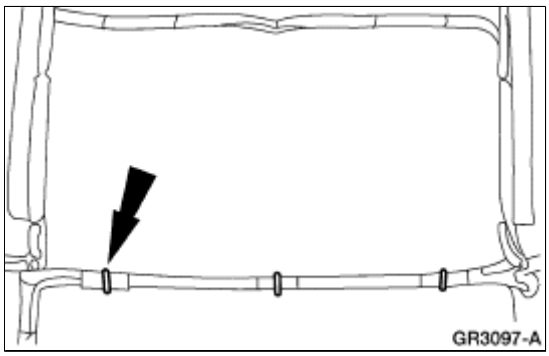


Limited Seat

11. Unroll the seat backrest trim cover to the second row of hog rings.



12. Install the hog rings.



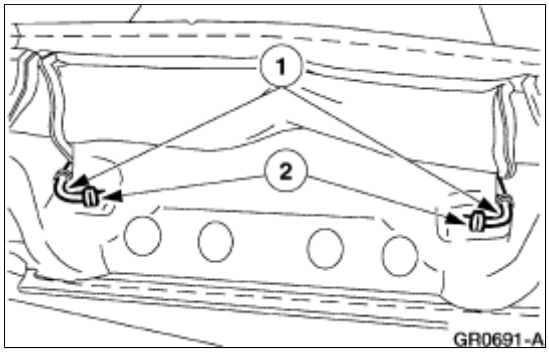
13. Unroll the seat backrest trim cover to the bottom row of hog rings.

14. Install the hog rings.

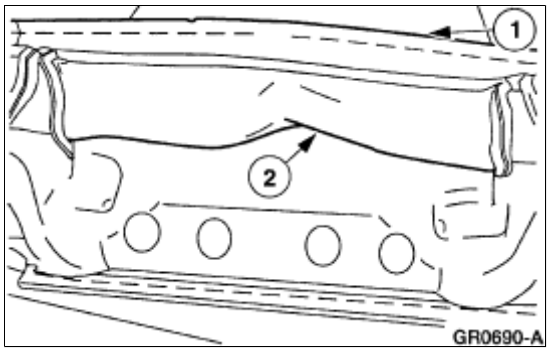
Sport Bucket Seat

15. **NOTE:** Make sure that the top of the swing rod is positioned beneath the listing wire near the middle row of hog rings.

    If equipped, install the seat backrest trim cover swing rods.
    1. Position the seat backrest trim cover and install the swing rods through the sleeves.
    2. Install the hog rings.



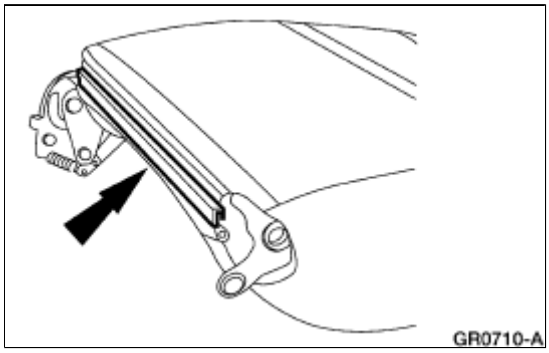
16. Connect the hook and loop fastener to the seat backrest trim cover.
    1. Pull the seat backrest trim cover completely down.
    2. Reach up inside the seat backrest and grab the plastic above the hook and loop. Remove enough plastic to expose the hook and loop.



All Seats

17. **NOTE:** If equipped, make sure that the seat backrest heating element wire is aligned with and off-set from the lower seat backrest trim cover J-clip.

    Hook the trim cover clip.



18. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited and Seat—Front Bucket, Limited , Disassembly and Assembly.

    Assemble the seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited and Seat—Front Bucket, Limited .

19. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

20. Prove out the air bag system. For additional information, refer to Section 501-20B .

21. Check the restraint system for proper operation.

Seat —40% Portion of Front 60/40 Split Bench

Disassembly

1. The disassembly of the 40% portion of the front 60/40 split bench is similar to the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Limited .

Assembly

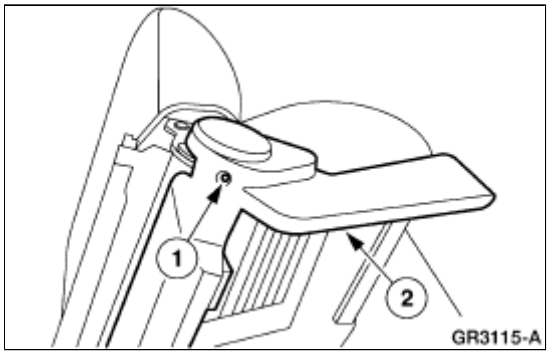
1. The assembly of the 40% portion of the front 60/40 split bench is similar to the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Manual .

Seat —60% Portion of Front 60/40 Split Bench

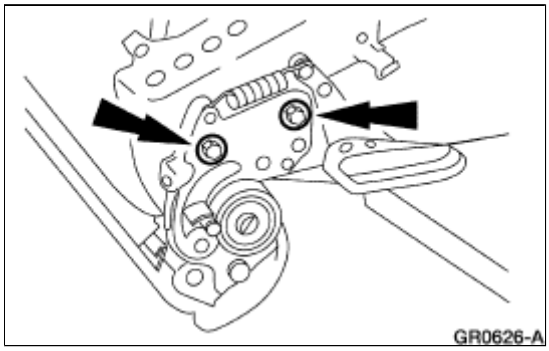
Disassembly

1. Remove the seat track. For additional information, refer to Seat—Track, Front Manual .

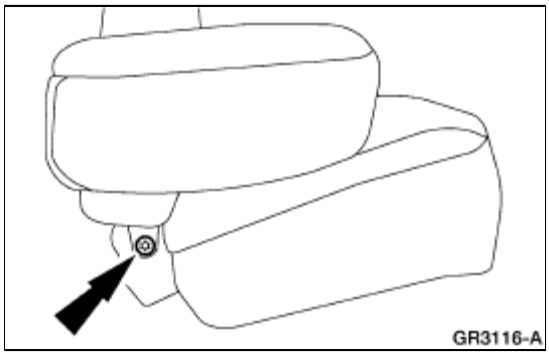
2. Remove the seat backrest latch cover.
    1. Remove the screw.
    2. Remove the seat backrest latch cover.



3. Remove the front seat backrest latch to seat cushion bolts.

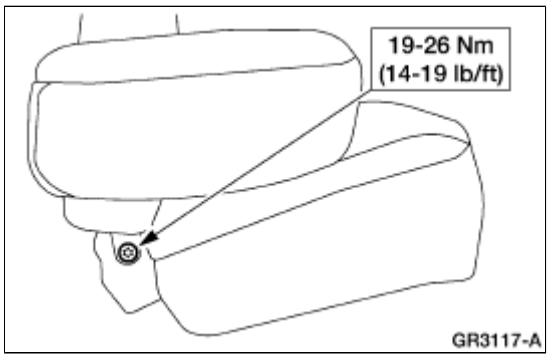


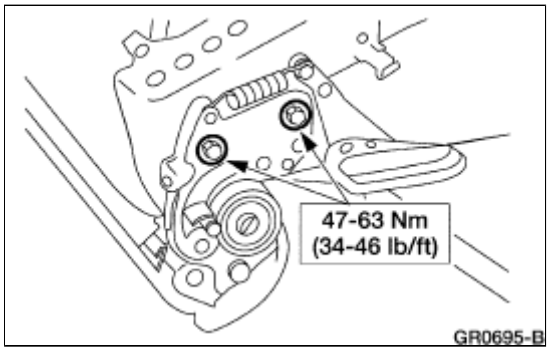
4. Remove the inboard pivot bolt and separate the seat cushion from the seat backrest.



Assembly

1. To assemble, reverse the disassembly procedure.
    - Check the restraint system for proper operation.





Seat —Back, 40% Portion of Front 60/40 Split Bench

Disassembly

1. For the disassembly of the 40 percent front seat backrest, refer to Seat—Back, Front Bucket, Manual .

Assembly

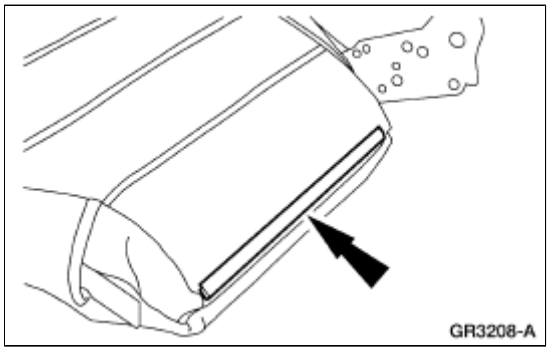
1. For the assembly of the 40 percent front seat backrest, refer to Seat—Back, Front Bucket, Manual .

Seat —Back, 40% Portion of Rear 60/40 Split Bench

Disassembly

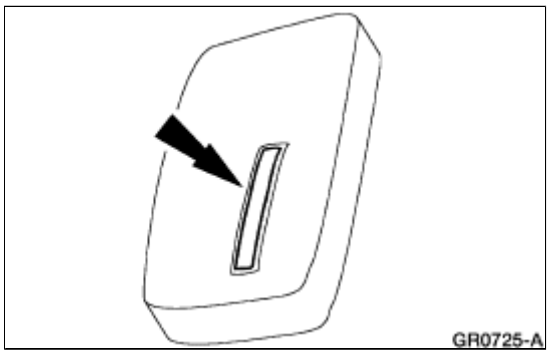
1. Disassemble the rear 40 percent seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

2. Unhook the seat backrest trim cover J-clip.

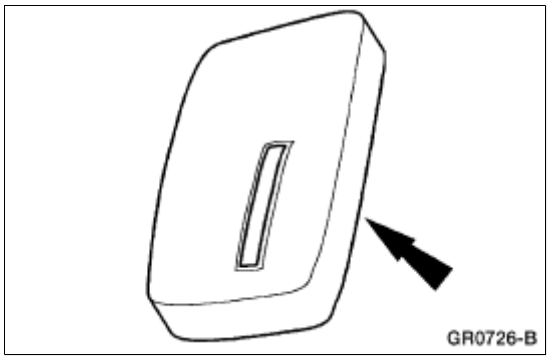


3. **CAUTION: Use care when separating the seat backrest trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat backrest foam.**

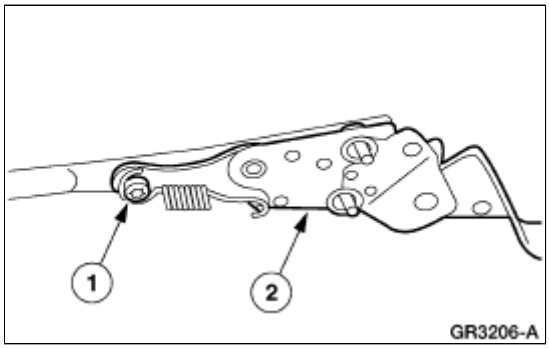
   Disengage the hook and loop strip and remove the seat backrest trim cover.



4. Remove the seat backrest frame from the seat backrest foam.

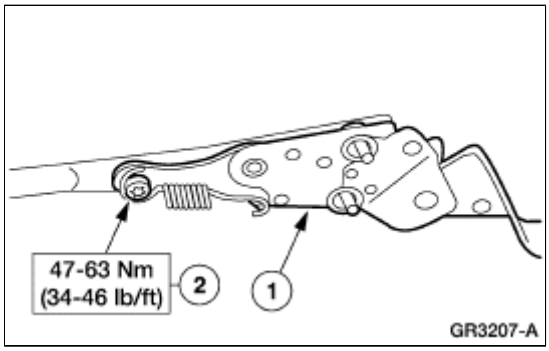


5. Remove the rear seat backrest latch.
    1. Remove the bolt.
    2. Remove the rear seat backrest latch.

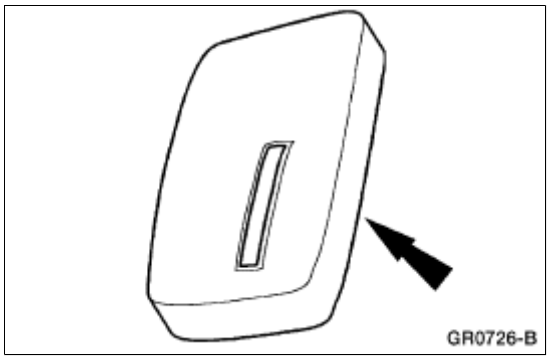


Assembly

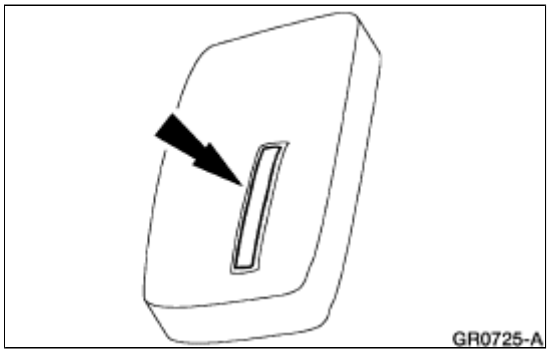
1. Install the rear seat backrest latch.
    1. Position the rear seat backrest latch.
    2. Install the bolt.



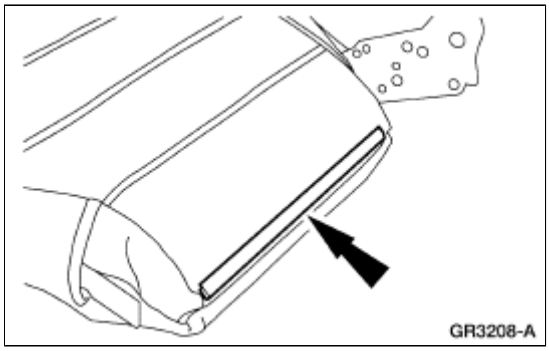
2. Install the seat backrest frame into the seat backrest foam.



3. Install the seat backrest trim cover.
    - Connect the hook and loop strip to the seat backrest trim cover.



4. Hook the seat backrest trim cover J-clip.



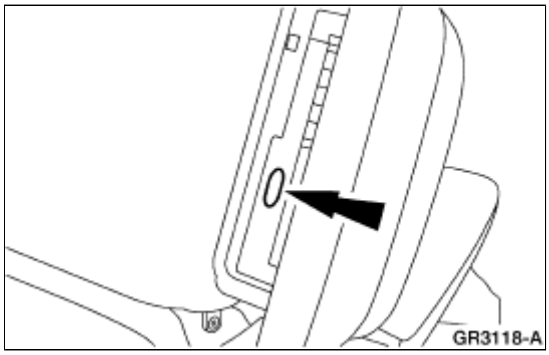
5. Assemble the rear 40 percent seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

Seat —Back, 60% Portion of Front 60/40 Split Bench

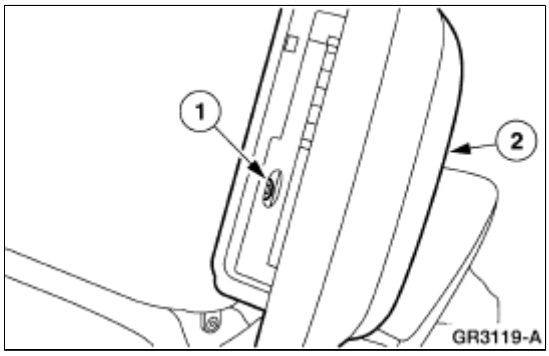
Disassembly

1. Disassemble the seat. For additional information, refer to Seat—60% Portion of Front 60/40 Split Bench .

2. Remove the armrest bolt cover.



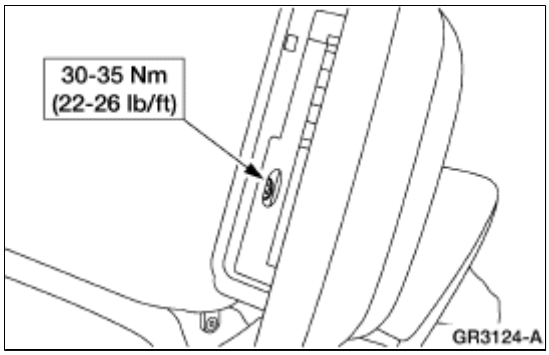
3. Remove the armrest.
    1. Remove the bolt.
    2. Remove the armrest.



4. Disassemble the seat backrest. For additional information, refer to Seat—Back, Front Bucket, Manual .

Assembly

1. To assemble, reverse the disassembly procedure.


30-35 Nm
(22-26 lb/ft)
GR3124-A

Seat —Back, 60% Portion of Rear 60/40 Split Bench

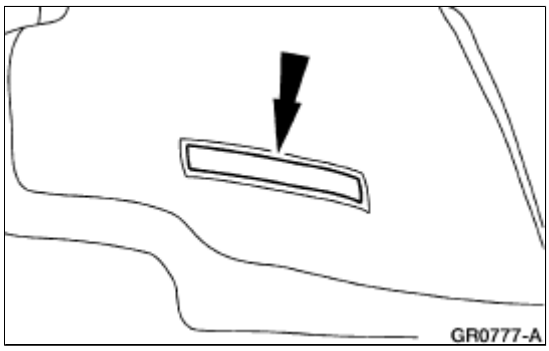
Disassembly

1. Disassemble the rear 60 percent seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

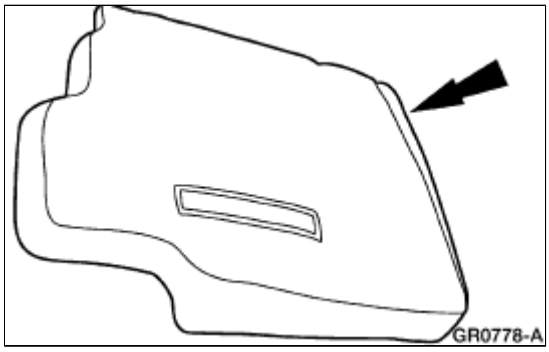
2. Unhook the J-clips.

3. **CAUTION: Use care when separating the seat backrest trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat backrest foam.**

   Disengage the hook and loop strips and remove the seat backrest trim cover.

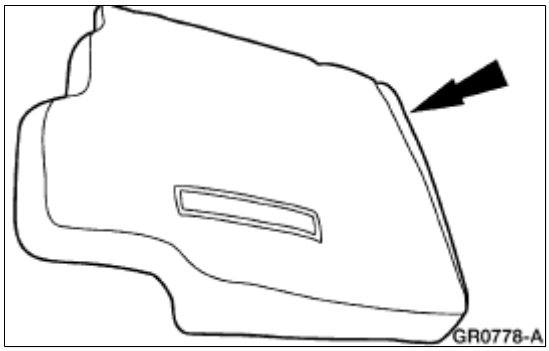


4. Remove the seat backrest padding.

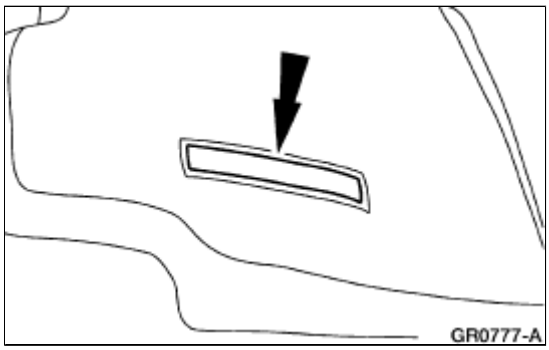


Assembly

1. Install the seat backrest foam.



2. Install the seat backrest trim cover and connect the hook and loop strips.



3. Connect the seat backrest trim cover J-clip.

4. Assemble the rear 60 percent seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

Seat —Back, Front Bucket, 6-Way Power, Except Limited

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live side air bag module down on the cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: A side air bag repair is made by installing a new component only. If a part is replaced and the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

NOTE: If a side air bag deployment took place the seat back pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

NOTE: Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited , Disassembly and Assembly.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

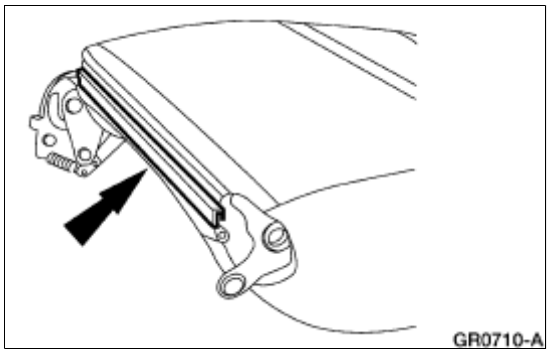
1. **NOTE:** Before disconnecting the battery, raise the seat to its hightest position, then move and tilt the seat to its most forward position.

   Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

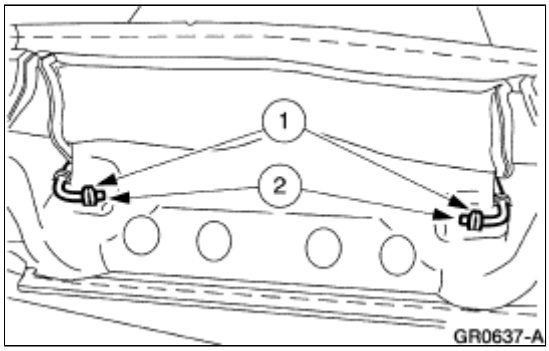
2. Disassemble the 6-way power front bucket seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited .

3. **WARNING: Front seat back trim covers installed on seats equipped with side air bag cannot be repaired. They are to be replaced (cleaning is permissible).**

   Unhook the trim cover J-clip.

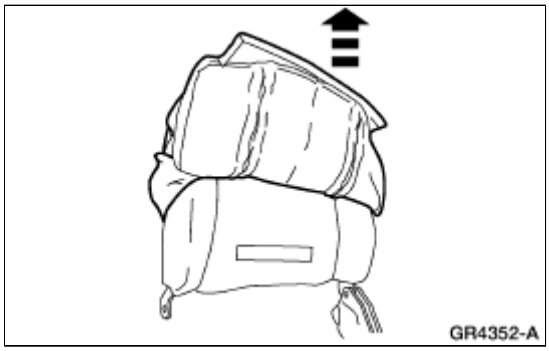


4. Remove the seat backrest trim cover swing rods.
    1. Remove and discard the hog rings.
    2. Remove the seat backrest trim cover cushion swing rods.

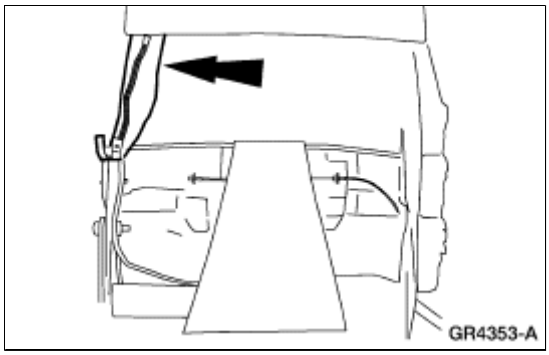


5. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip, or the hook and loop can be torn from the seat cushion foam.**

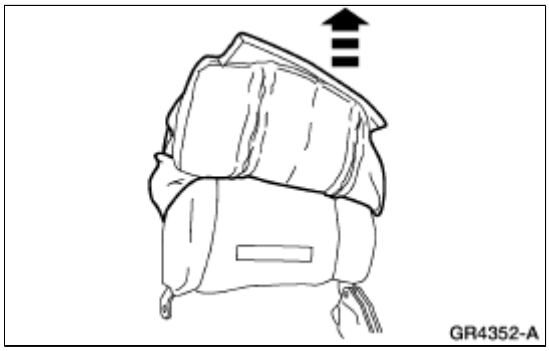
    If equipped, roll the seatback trim cover in an inside out fashion to the side air bag deployment chute.



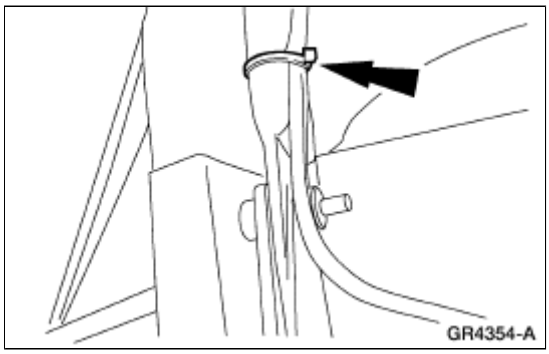
6. If equipped, unzip the side air bag deployment chute.



7. Roll the seat backrest trim cover up to expose the lower row of hog rings.

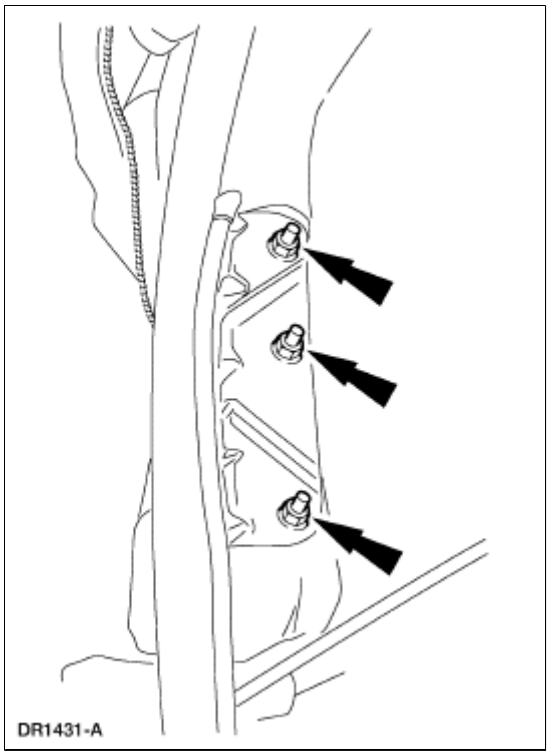


8. If equipped, remove the side air bag wiring harness wire tie.

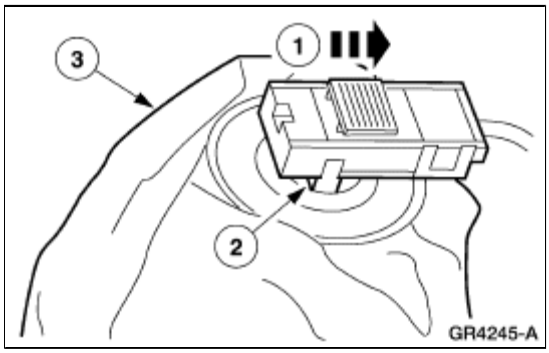


9. **NOTE:** If installing a new side air bag module use new retaining nuts. If the same side air bag module is to be used, then reuse the side air bag module retaining nuts.

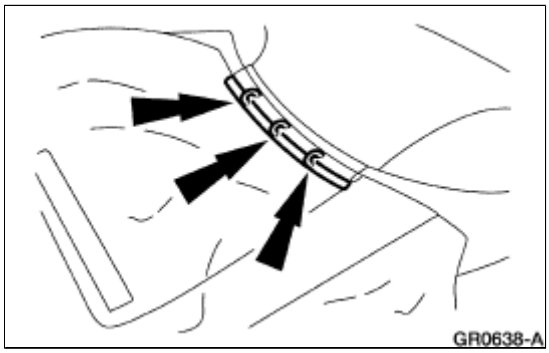
   If equipped, through the seat backrest cushion opening, position the side air bag module aside.
   - Remove the retaining nuts.



10. If equipped, remove the side air bag module.
    1. Slide the side air bag module electrical connector clip.
    2. Release the connector tabs by pushing in on them, then disconnect the side air bag module electrical connector.
    3. Remove the side air bag module.

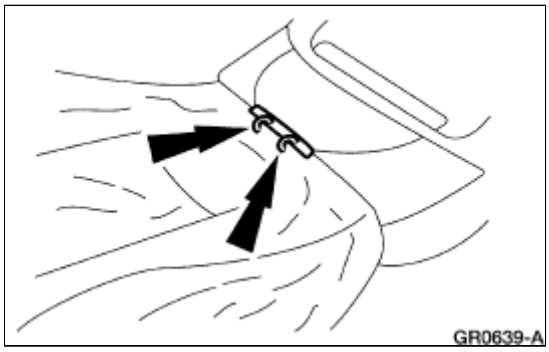


11. Remove and discard the lower row hog rings.



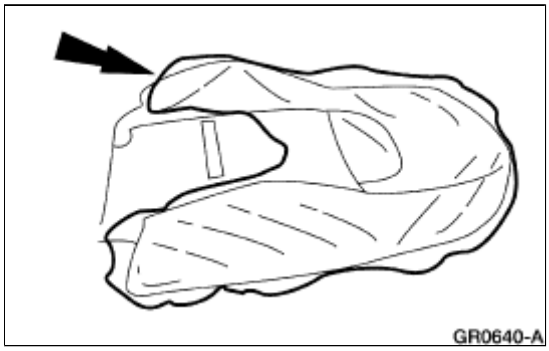
12. On leather seats, pull the seat backrest trim cover up to expose the upper row of hog rings.

13. On leather seats, remove and discard the upper row hog rings.



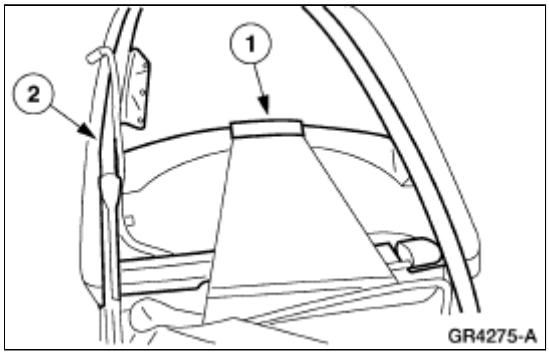
14. Remove the seat backrest trim cover.

15. Remove the plastic bag.

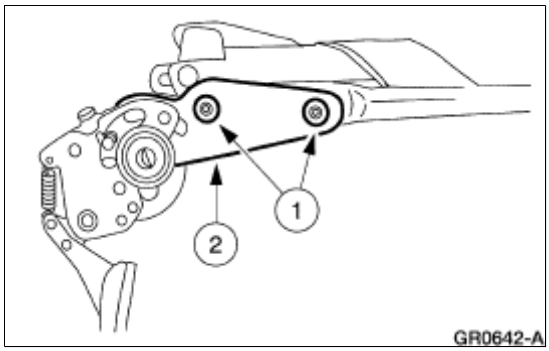


16. Remove the seat backrest frame from the seat backrest foam.
    1. Remove the J-clip.
    2. **NOTE:** The seat backrest foam may be glued to the seat backrest frame.

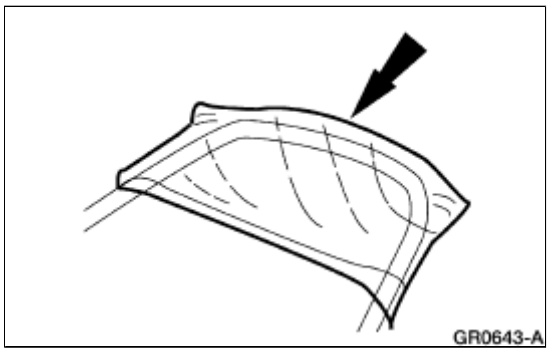
       Remove the seat backrest frame from the seat backrest foam.



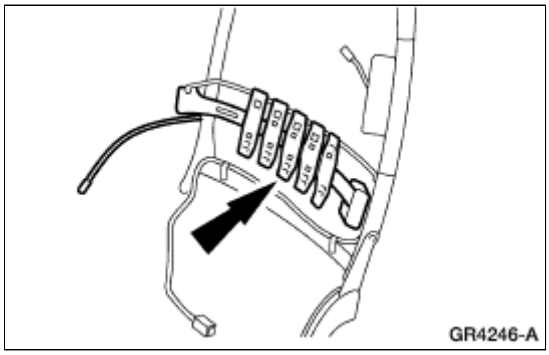
17. Remove the front seat backrest latch.
    1. Remove the bolts.
    2. Remove the front seat backrest latch.



18. Remove the plastic bag from the top of the seat backrest frame.

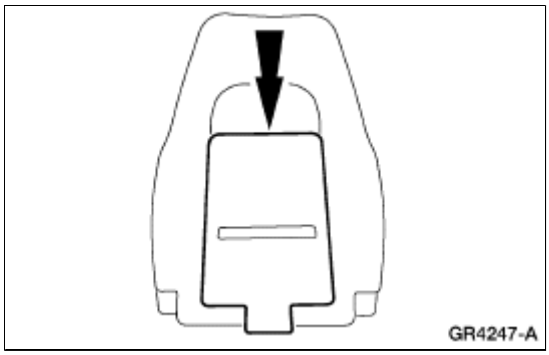


19. Remove the lumbar support adjuster.
    - Release the clips.

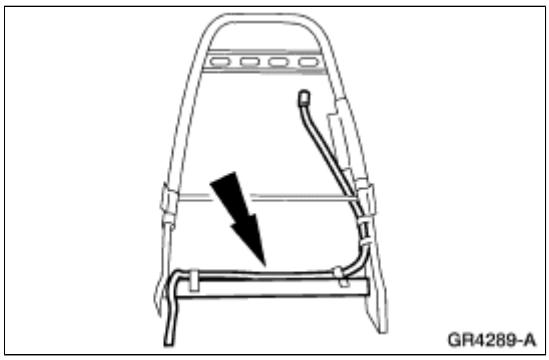


20. **CAUTION: Any time the seat backrest heating element is removed from the seat backrest foam, the foam must be replaced.**

    If equipped, remove the seat backrest heating element from the seat backrest foam.



21. If equipped, remove the side air bag wiring harness.
    - Disconnect the pin-type retainers from the seat backrest frame.



Assembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

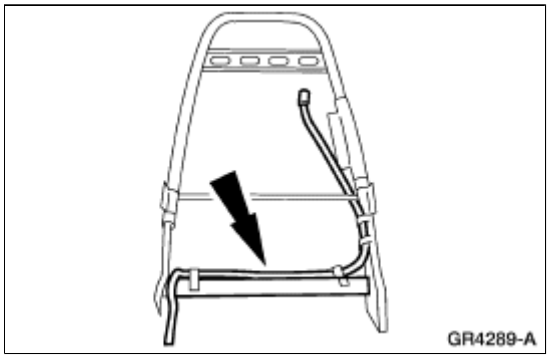
WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper, the seat back trim cover and deployment chute must be installed new as a unit. Failure to do so may result in personal injury.

WARNING: The deployment seam cannot be repaired or resewn. A trim cover requiring replacement of the bolster or side facing must be replaced as a unit.

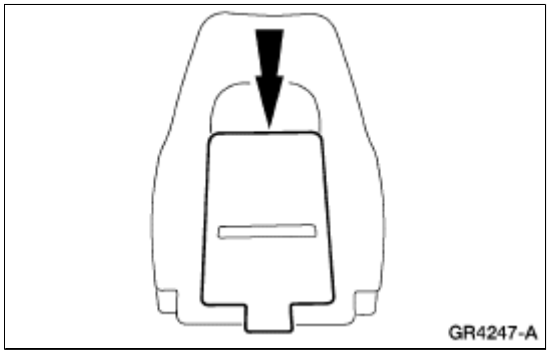
WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly. Failure to follow these instructions may result in personal injury.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

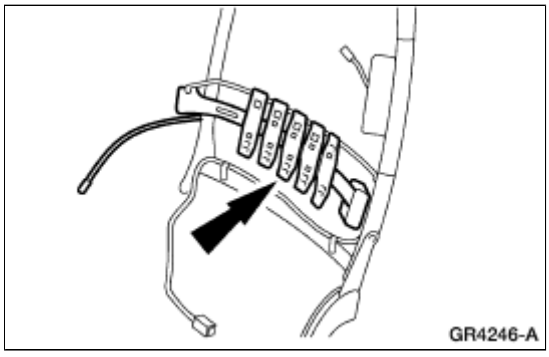
1. If equipped, install the side air bag wiring harness.
    - Connect the pin-type retainer to the seat backrest frame.



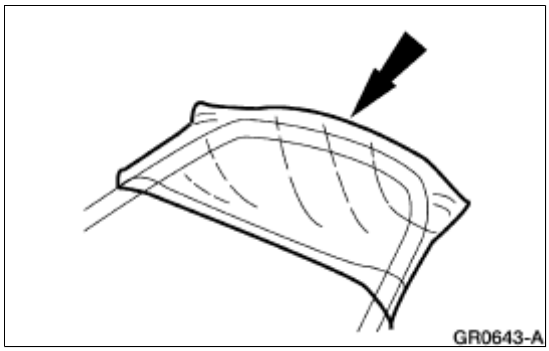
2. If equipped, install the seat backrest heating element.



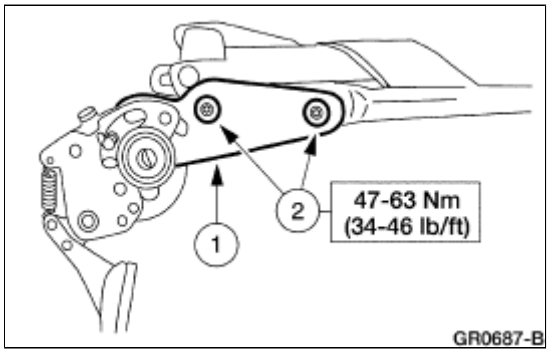
3. Install the lumbar support adjuster.
    - Clip the ends to the seat backrest frame.



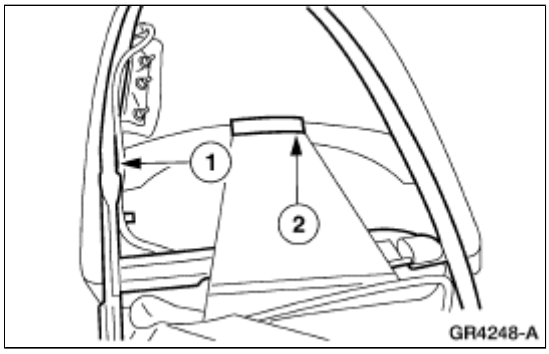
4. Install the plastic bag on the top of the seat backrest frame.



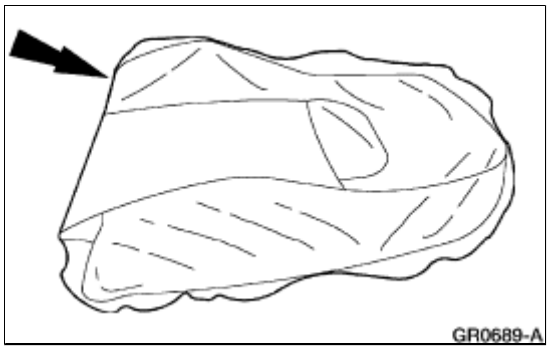
5. Install the front seat backrest latch (62648).
    1. Position the front seat backrest latch.
    2. Install the bolts.



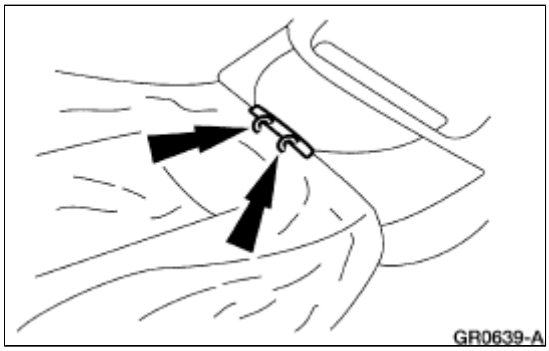
6. Install the seat backrest frame into the seat backrest foam.
    1. Install the seat backrest frame into the seat backrest foam.
    2. Install the J-clip.



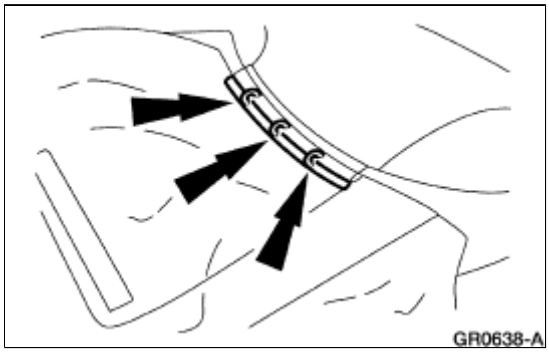
7. Install the plastic bag over the seat backrest.



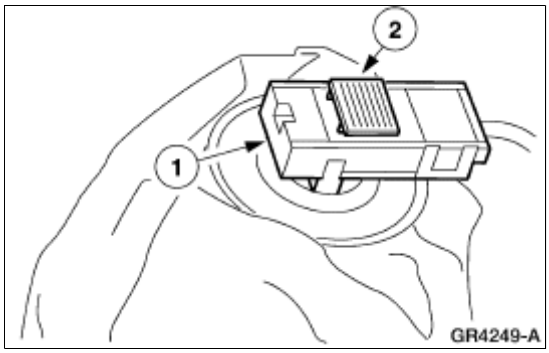
8. Pull the seat backrest trim cover to the upper cutout in the seat backrest.
9. On leather seat, install the upper row of hog rings.



10. Pull the seat backrest trim cover to the lower cutout in the seat backrest.
11. Install the lower row of hog rings.



12. If equipped, connect the side air bag module electrical connector.
    1. Plug the electrical connector into the side air bag module.
    2. Slide the locking clip into position.



13. If equipped, make sure the side air bag module electrical connector is securely fastened to the side air bag module.

14. **WARNING: Inspect the mounting surfaces of the side air bag module and the seat back frame mounting bracket for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.**

WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

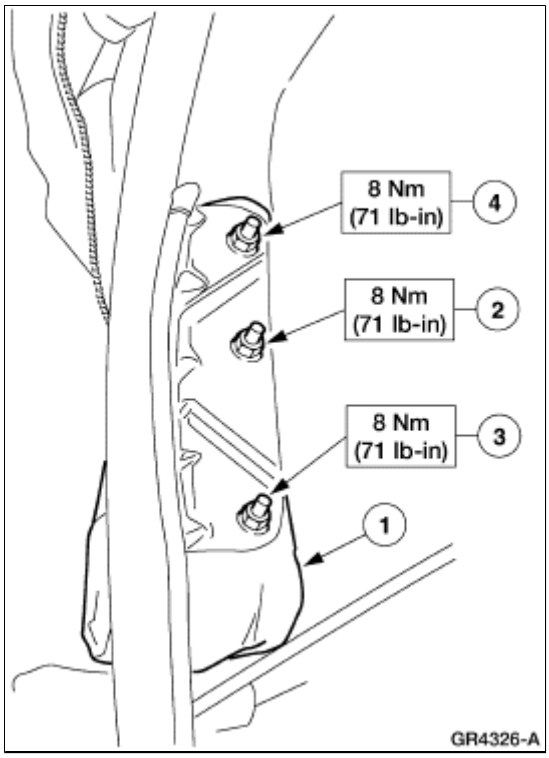
WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury in the event of an air bag deployment.

CAUTION: The retaining nuts of the side air bag module must be tightened in the sequence described.

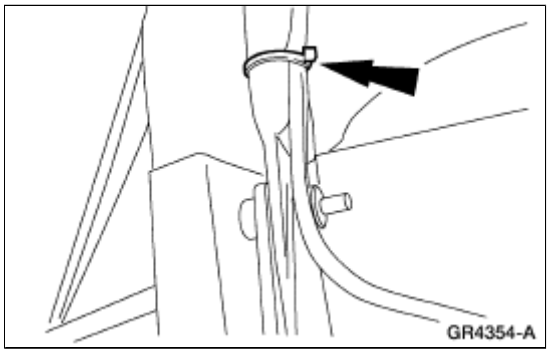
CAUTION: Be sure the side air bag wiring harness is not pinched between the side air bag module and the mounting bracket.

If equipped, install the side air bag module onto the front seat back frame mounting bracket.

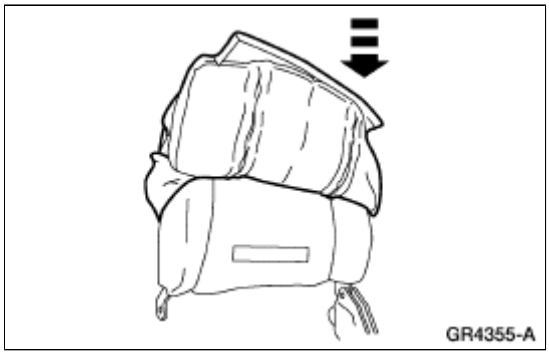
1. Position the side air bag module onto the front seat back mounting bracket being sure the side air bag wiring harness is located behind the seat backrest frame.
2. Install the side air bag module retaining nut.
3. Install the side air bag module retaining nut.
4. Install the side air bag module retaining nut.



15. If equipped, install the side air bag wiring harness wire tie.



16. If equipped, roll the seat backrest trim cover to position the deployment chute around the side air bag module.



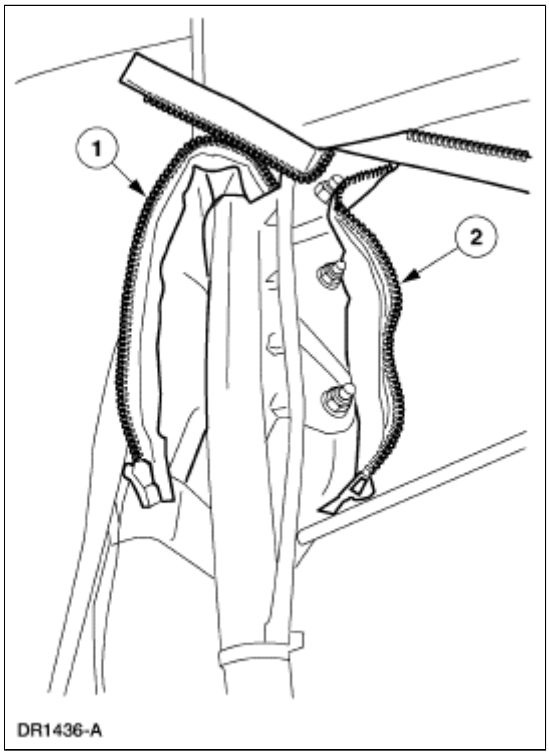
17. **WARNING: Check the side air bag deployment chute and zipper for damage. The**

deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper the seat back trim cover and deployment chute must be installed new as a unit.

WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly.

If equipped, position the side air bag deployment chute.

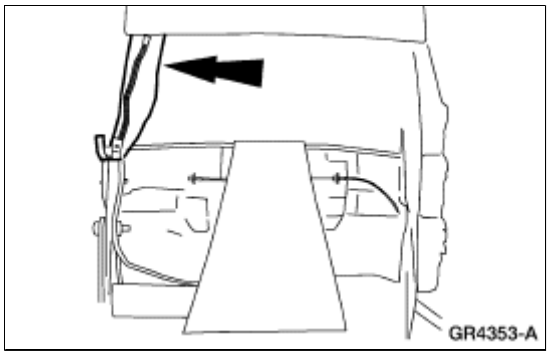
1. Insert the outboard side of the air bag deployment chute between the seat back pad and the side air bag module, pulling it around the outboard side of the seat back frame.
2. Insert the inboard side of the air bag deployment chute between the seat back pad and the side air bag module from the inboard side of the seat back.



18. **NOTE:** Be sure the side air bag deployment chute is properly positioned, before proceeding to Step 19.

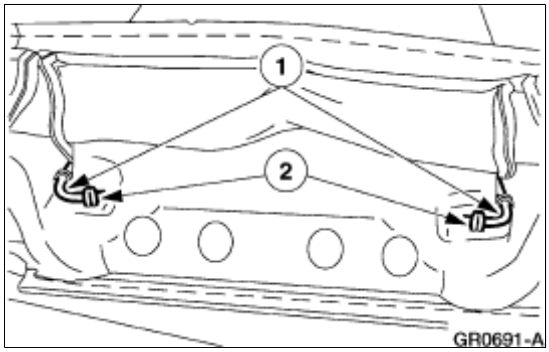
If equipped, zip the air bag deployment chute completely closed, then position the zipper tails at the top and bottom of the deployment chute, into the seat back opening.

- The side air bag deployment chute must encircle the side air bag module, going completely around the side air bag module and the side of the seat back frame.
- Align the side air bag deployment chute to the side air bag module, making sure it covers the length of the side air bag module.

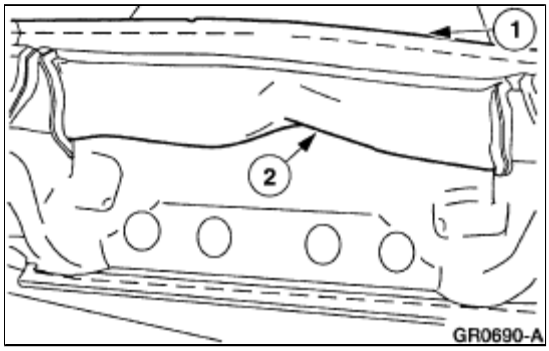


19. **NOTE:** Make sure that the top of the swing rod is positioned beneath the listing wire near the lower row of hog rings.

    Install the seat backrest trim cover swing rods.
    1. Position the seat backrest trim cover and install the swing rods through the sleeves.
    2. Install the hog rings.



20. Connect the hook and loop fastener to the seat backrest trim cover.
    1. Pull the seat backrest trim cover completely down.
    2. Reach up inside the seat backrest and grab the plastic above the hook and loop. Remove enough plastic to expose the hook and loop.

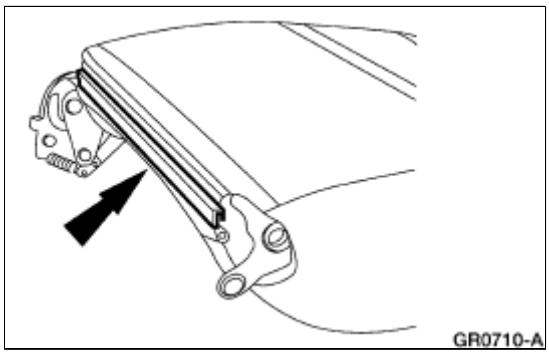


21. **NOTE:** If equipped, make sure that the seat backrest heating element wire is aligned with and off-set from the lower seat backrest trim cover J-clip.

    NOTE: Check that the lumbar strap is secure to the wire paddle before closing the trim cover.

    NOTE: If equipped with a side air bag module, check the positioning of the air bag deployment chute before closing the trim cover.

Hook the trim cover clips.



22. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited , Disassembly and Assembly.

    Assemble the 6-way power front bucket seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited .

23. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

24. Prove out the air bag system. For additional information, refer to Section 501-20B .

25. Check the restraint system for proper operation.

Seat —Back, Front Bucket, Limited

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live side air bag module down on the cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: A side air bag repair is made by installing a new component only. If a part is replaced and the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

NOTE: If a side air bag deployment took place the seat back pad, trim cover, and side air bag module must be replaced. The seat back frame should be replaced as necessary.

NOTE: Be sure to read and follow all air bag warnings in Seat—Front Bucket, Limited , Disassembly and Assembly.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

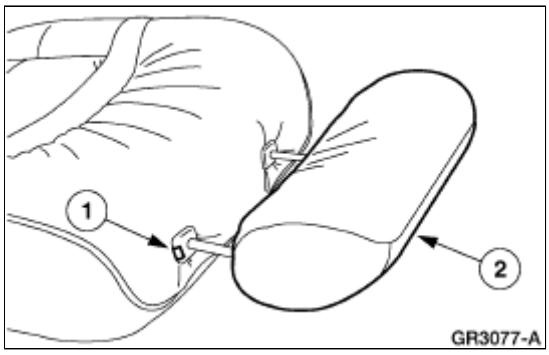
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1. **NOTE:** Before disconnecting the battery, raise the seat to its highest position, then move and tilt the seat to its most forward position.

   Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

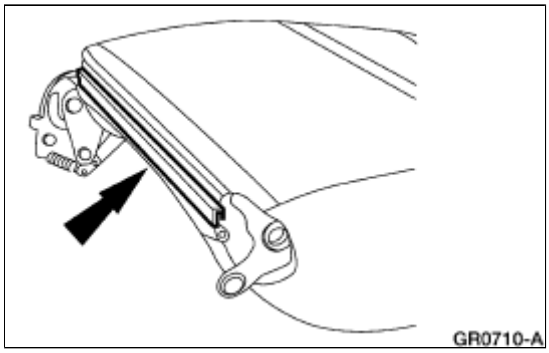
2. Disassemble the seat. For additional information, refer to Seat—Front Bucket, Limited .

3. Remove the head restraint.
   1. Press the head restraint release button.
   2. Remove the head restraint.



4. **WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired. They are to be replaced (cleaning is permissible).**

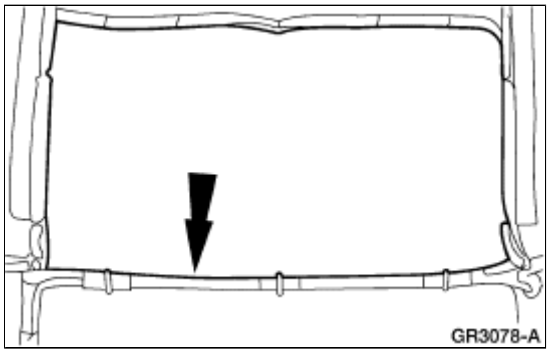
   Unhook the seat backrest trim cover J-clip.



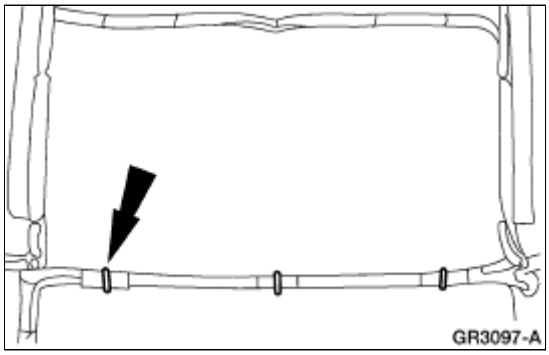
5. Roll the seat backrest trim cover to the first row of hog rings.

6. Remove and discard the hog rings.

7. Roll the seat backrest trim cover to the second row of hog rings.



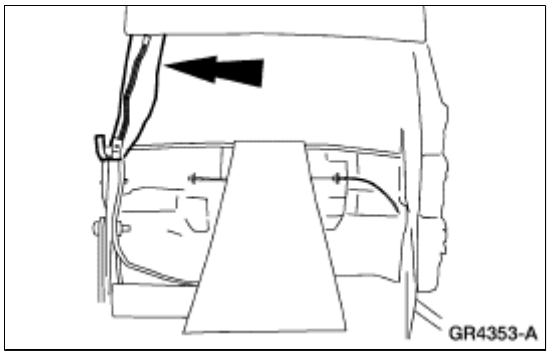
8. Remove and discard the hog rings.



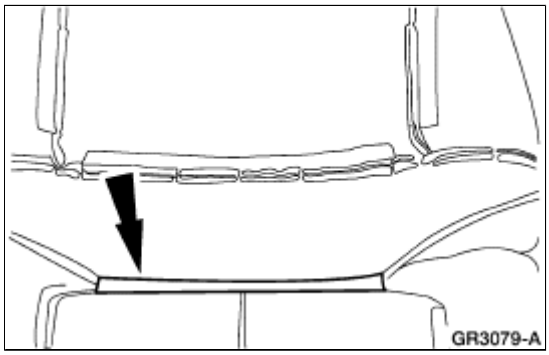
9. If equipped, roll the seat backrest trim cover to the side air bag deployment chute.

10. **NOTE:** Sport bucket seat shown; Limited seat similar.

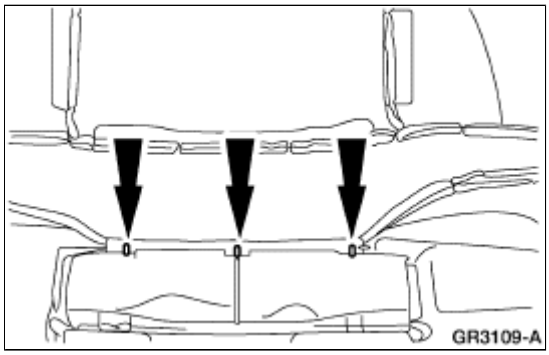
    If equipped, unzip the side air bag deployment chute.



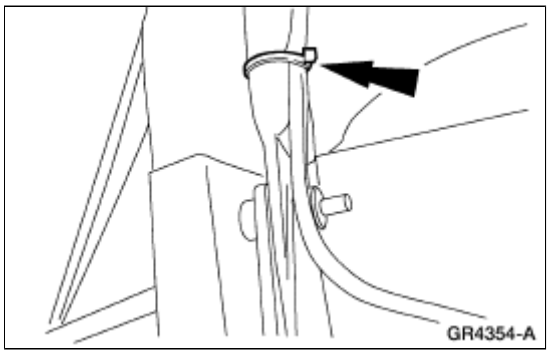
11. Roll the seat backrest trim cover to the top row of hog rings.



12. Remove and discard the hog rings.



13. If equipped, remove the side air bag wiring harness wire tie.

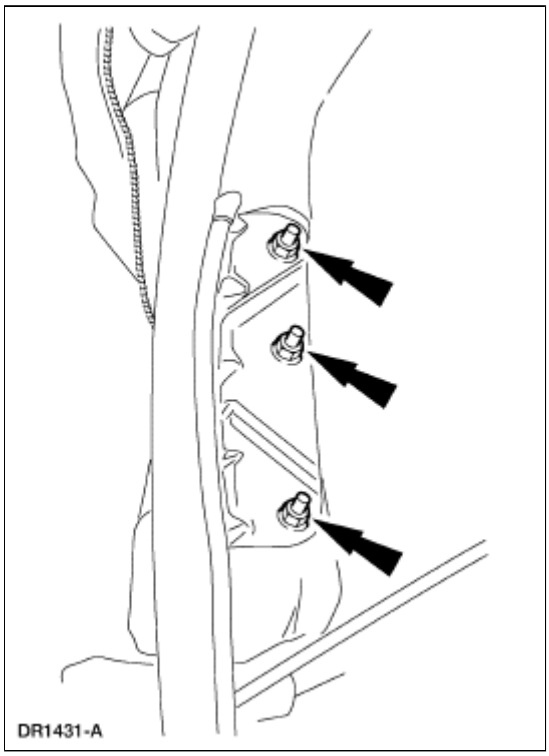


14. **NOTE:** If installing a new side air bag module use new retaining nuts. If the same side air bag module

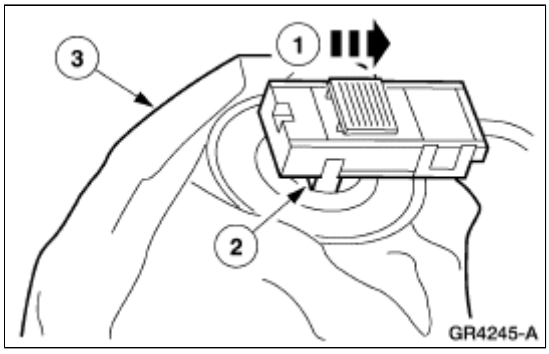
is to be used, then reuse the side air bag module retaining nuts.

If equipped, through the seat backrest cushion opening, position the side air bag module aside.

- Remove the retaining nuts.

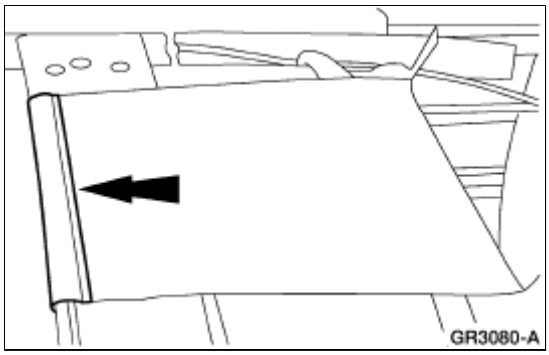


15. If equipped, remove the side air bag module.
    1. Slide the side air bag module electrical connector clip.
    2. Release the connector tabs by pushing in on them, then disconnect the side air bag module electrical connector.
    3. Remove the side air bag module.



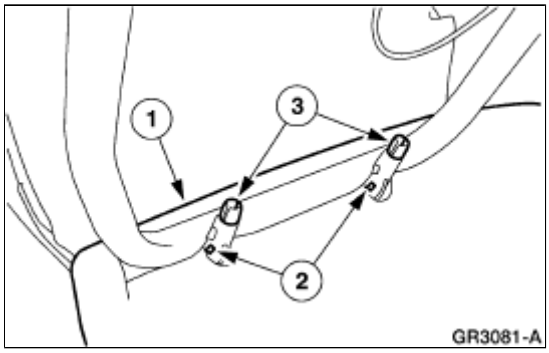
16. Finish inverting the seat backrest trim cover.

17. Unhook the seat backrest foam J-clip.

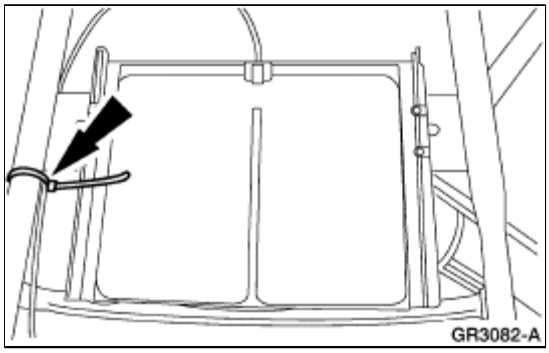


18. **NOTE:** Removing the head restraint guide sleeves will also remove the seat backrest trim cover and the seat backrest foam.

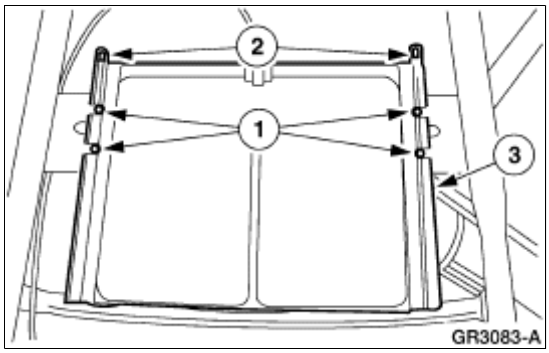
    Remove the head restraint guide sleeves.
    1. Position the seat backrest cushion to gain access to the head restraint guide sleeves.
    2. Press the head restraint guide sleeve tabs.
    3. Remove the head restraint guide sleeve.
    - Remove the head restraint guide sleeves from the seat backrest trim cover and inspect them for damage.



19. Remove the wire tie.



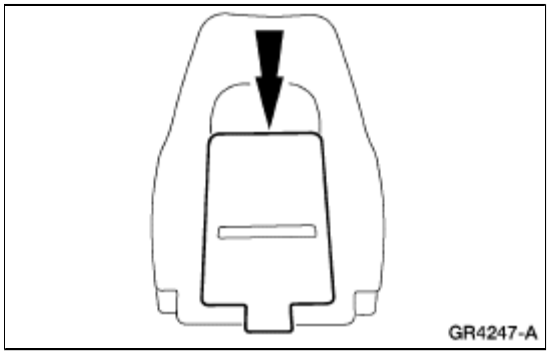
20. Remove the lumbar support adjuster.
    1. Open the tabs enough to remove the tension on the listing wires.
    2. Remove the listing wires.
    3. Remove the lumbar support adjuster.



21. **CAUTION: Any time the seat backrest heating element is removed from the seat backrest foam, the foam must be replaced.**

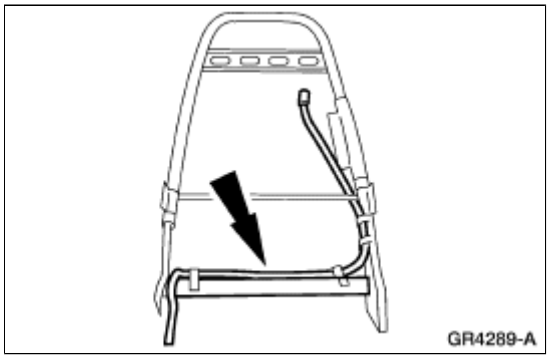
    NOTE: Sport bucket seat shown; Limited seat similar.

    If equipped, and if necessary, remove the seat backrest heating element from the seat backrest foam.



22. **NOTE:** Sport bucket seat shown; Limited seat similar.

    If equipped, remove the side air bag wiring harness.
    - Disconnect the pin-type retainers from the seat backrest frame.



Assembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper, the seat back trim cover and deployment chute must be installed new as a unit. Failure to do so may result in personal injury.

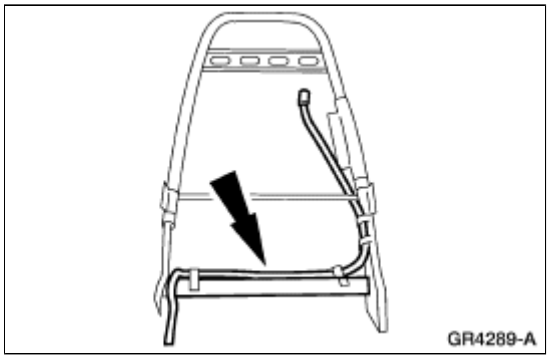
WARNING: The deployment seam cannot be repaired or resewn. A trim cover requiring replacement of the bolster or side facing must be replaced as a unit.

WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly. Failure to follow these instructions may result in personal injury.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

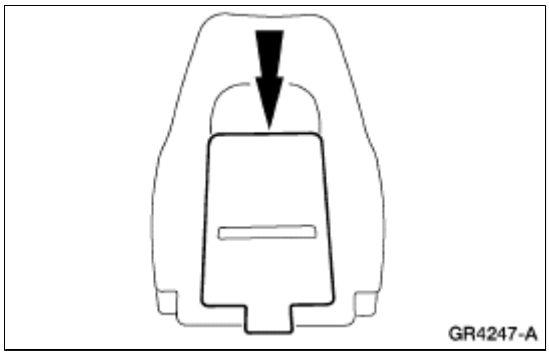
1. **NOTE:** Sport bucket seat shown; Limited seat similar.

   If equipped, install the side air bag wiring harness.
   - Connect the pin-type retainers to the seat backrest frame.

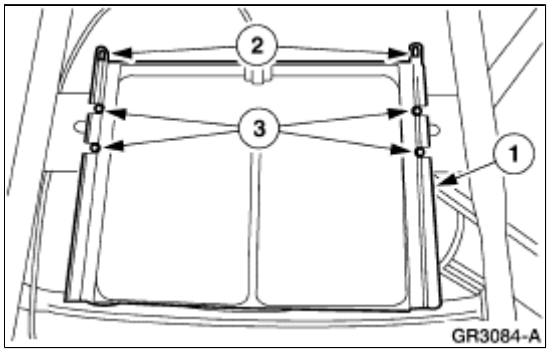


2. **NOTE:** Sport bucket seat shown; Limited seat similar.

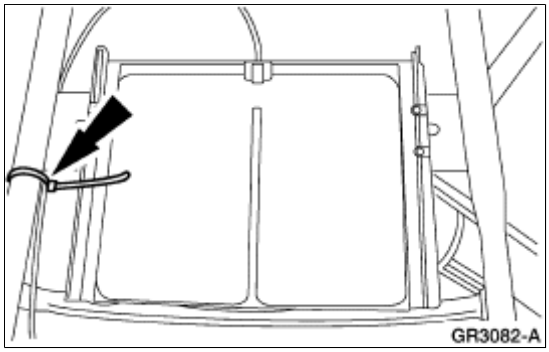
   If equipped, and if necessary, install the seat backrest heating element.



3. Install the lumbar support adjuster.
    1. Position the lumbar support adjuster.
    2. Install the listing wires.
    3. Close the tabs enough to place tension on the listing wires without bending them.



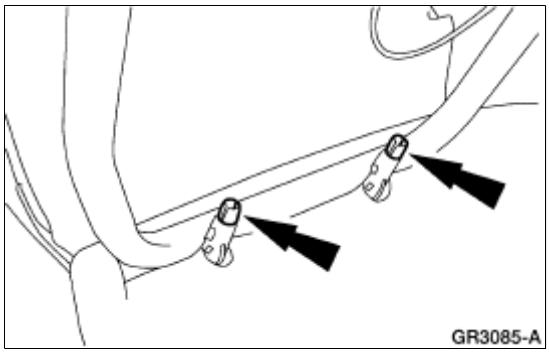
4. Install the wire tie.



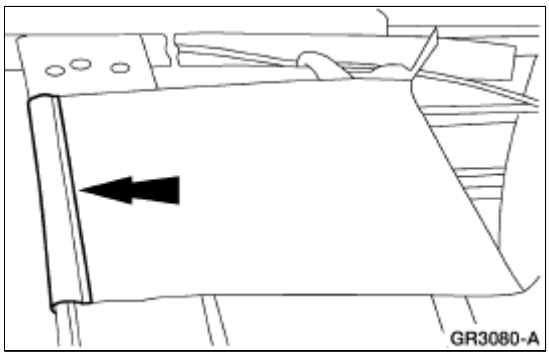
5. Position the seat backrest foam on the seat backrest frame.

6. **NOTE:** The head restraint guide sleeves are keyed; make sure they are aligned with the seat backrest frame and the head restraint guide bars before installing them in the seat backrest trim cover.

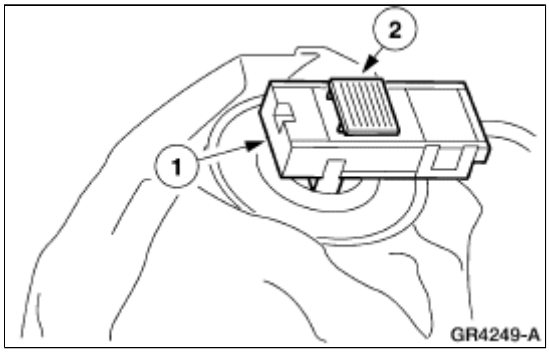
    Install the head restraint guide sleeves.



7. Hook the seat backrest foam J-clip.



8. If equipped, connect the side air bag module electrical connector.
    1. Plug the electrical connector into the side air bag module.
    2. Slide the locking clip into position.



9. If equipped, make sure the side air bag module electrical connector is securely fastened to the side air bag module.

10. **WARNING: Inspect the mounting surfaces of the side air bag module and the seat back frame mounting bracket for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.**

    WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

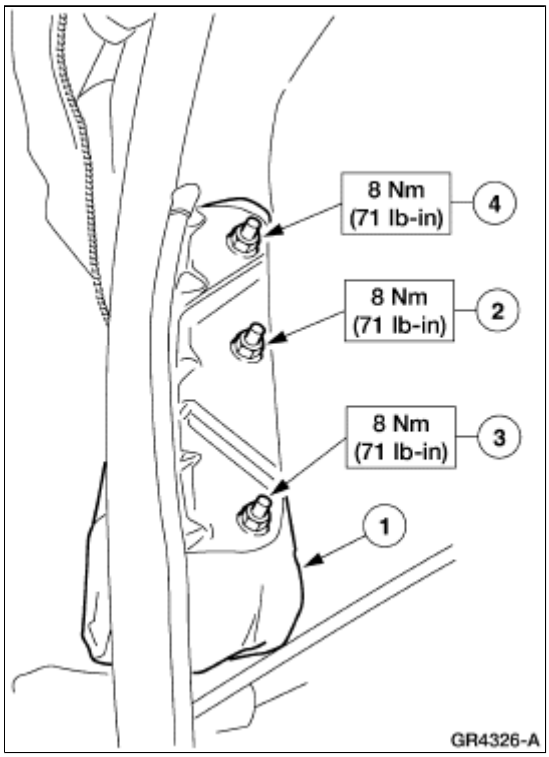
WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury in the event of an air bag deployment.

CAUTION: The retaining nuts of the side air bag module must be tightened in the sequence described.

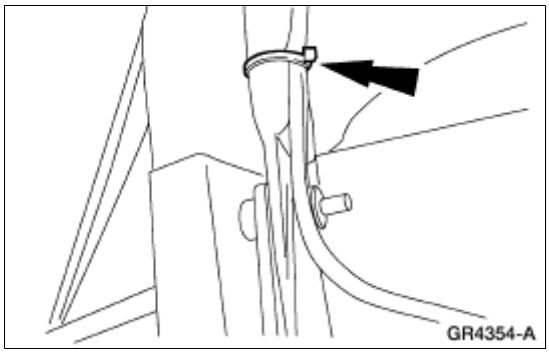
CAUTION: Be sure the side air bag wiring harness is not pinched between the side air bag module and the mounting bracket.

If equipped, install the side air bag module onto the front seat back frame mounting bracket, being sure the side air bag wiring harness is located behind the seat backrest frame.

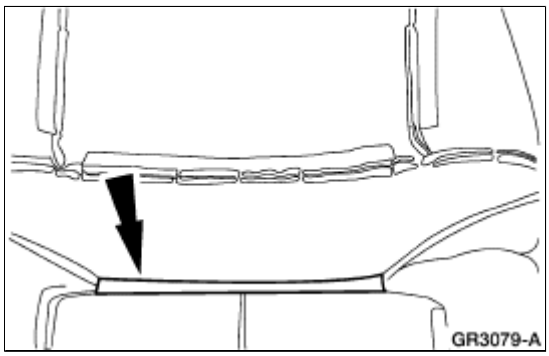
1. Position the side air bag module onto the front seat back mounting bracket.
2. Install the side air bag module retaining nut.
3. Install the side air bag module retaining nut.
4. Install the side air bag module retaining nut.



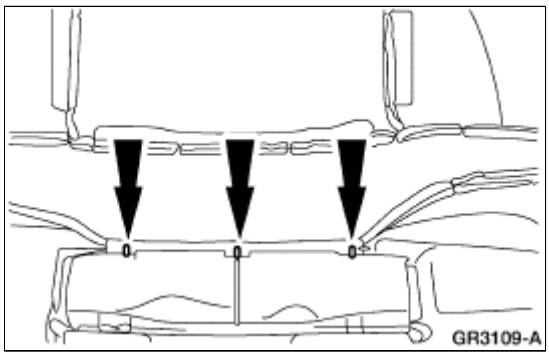
11. If equipped, install the side air bag wiring harness wire tie.



12. Unroll the seat backrest trim cover to the top row of hog rings.



13. Install the hog rings.



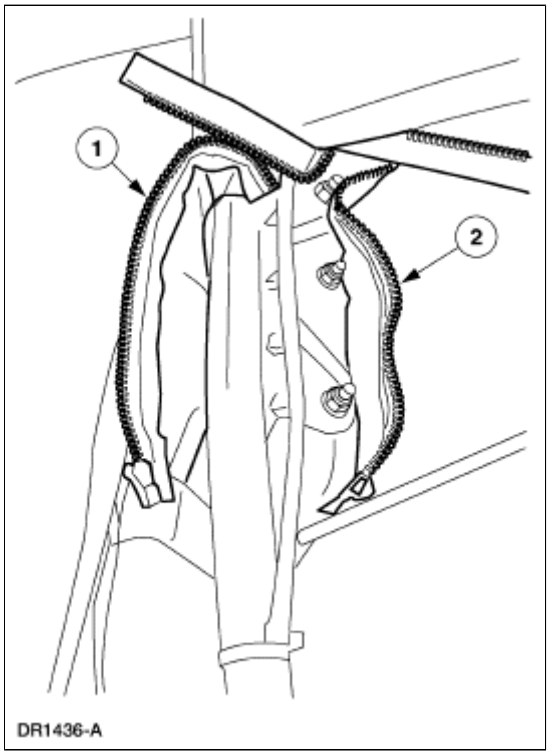
14. If equipped, roll the seat back trim cover to position the deployment chute around the side air bag module.

15. **WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper the seat back trim cover and deployment chute must be installed new as a unit.**

    WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly.

    If equipped, position the air bag deployment chute.
    1. Insert the outboard side of the air bag deployment chute between the seat back pad and the side air bag module, pulling it around the outboard side of the seat back frame.

2. Insert the inboard side of the air bag deployment chute between the seat back pad and the side air bag module from the inboard side of the seat back.

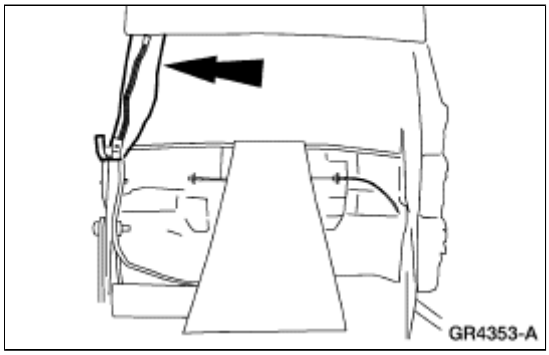


16. **NOTE:** Sport bucket seat shown; Limited seat similar.

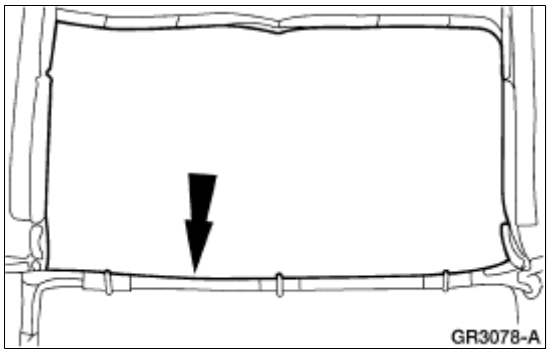
NOTE: Be sure the side air bag deployment chute is properly positioned, before proceeding to Step 17.

Zip the air bag deployment chute completely closed, then position the zipper tails at the top and bottom of the deployment chute, into the seat back opening.

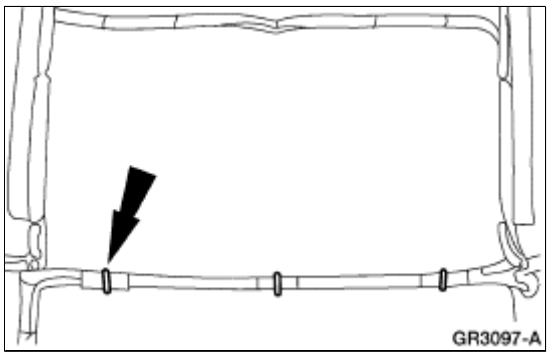
- The side air bag deployment chute must encircle the side air bag module, going completely around the side air bag module and the side of the seat back frame.
- Align the side air bag deployment chute to the side air bag module, making sure it covers the length of the side air bag module.



17. Unroll the seat backrest trim cover to the second row of hog rings.



18. Install the hog rings.

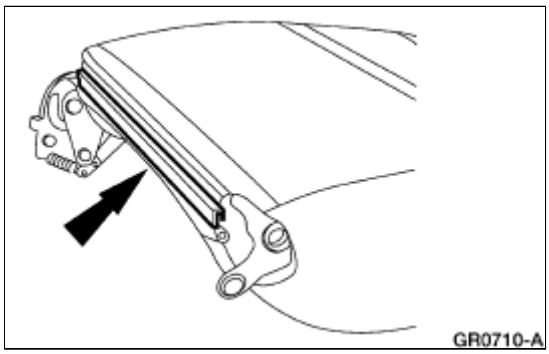


19. Unroll the seat backrest trim cover to the bottom row of hog rings.

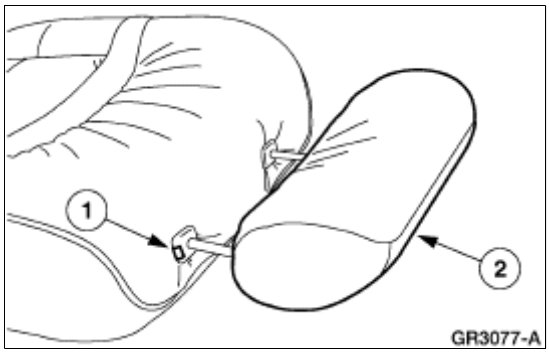
20. Install the hog rings.

21. **NOTE:** If equipped, make sure that the seat backrest heating element wire is aligned with and off-set from the lower seat backrest trim cover J-clip.

    Hook the seat backrest trim cover J-clip.



22. Install the head restraint.
    1. Press the head restraint release button.
    2. Install the head restraint.



23. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, Limited , Disassembly and Assembly.

    Assemble the seat. For additional information, refer to Seat—Front Bucket, Limited .

24. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

25. Prove out the air bag system. For additional information, refer to Section 501-20B .

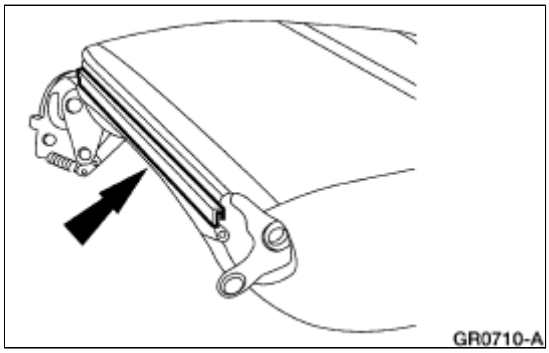
26. Check the restraint system for proper operation.

Seat —Back, Front Bucket, Manual

Disassembly

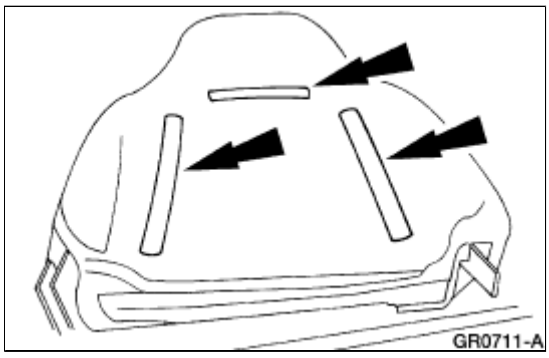
1. Disassemble the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Manual .

2. Unhook the seat backrest trim cover J-clip.

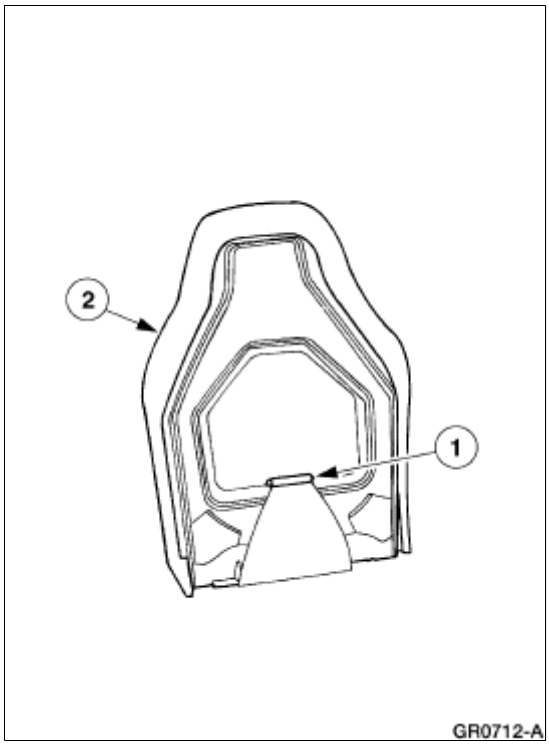


3. **CAUTION: Use care when separating the seat backrest trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat backrest foam.**

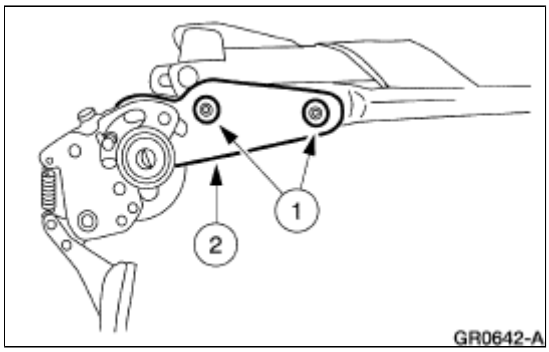
   Disengage the hook and loop strips and remove the seat backrest trim cover.



4. Remove the seat back padding from the seat back frame.
   1. Remove the J-hook.
   2. Remove the seat back padding from the seat back frame.

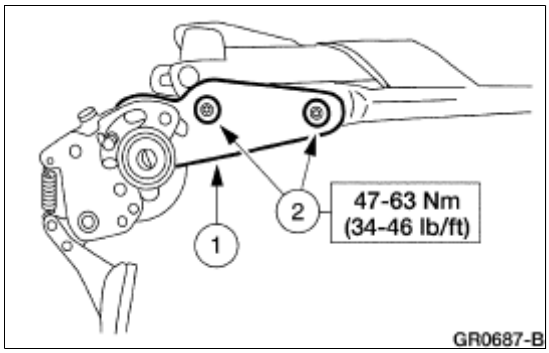


5. Remove the front seat backrest latch (62648).
    1. Remove the bolts.
    2. Remove the front seat backrest latch.

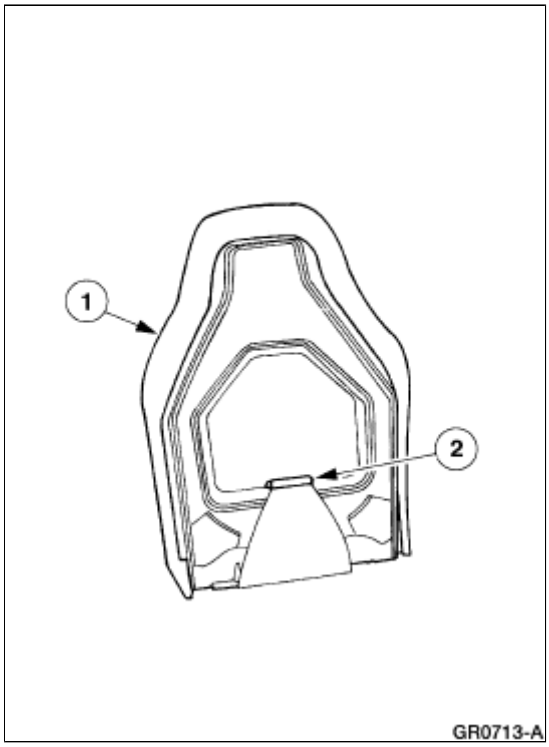


Assembly

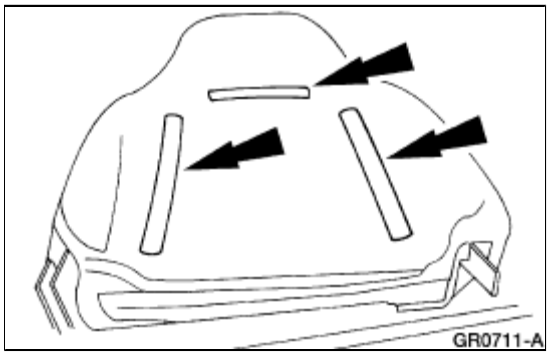
1. Install the front seat backrest latch.
    1. Position the front seat backrest latch.
    2. Install the bolts.



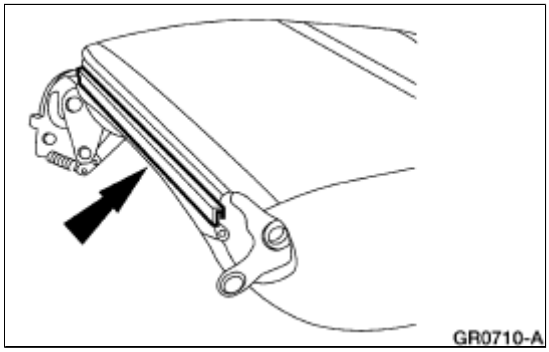
2. Install the seat back padding into the seat back frame.
    1. Install the seat back frame into the seat back padding.
    2. Install the J-hook.



3. Install the seat backrest trim cover.
    - Connect the hook and loop strips to the seat backrest trim cover.



4. Hook the seat backrest trim cover J-clips.

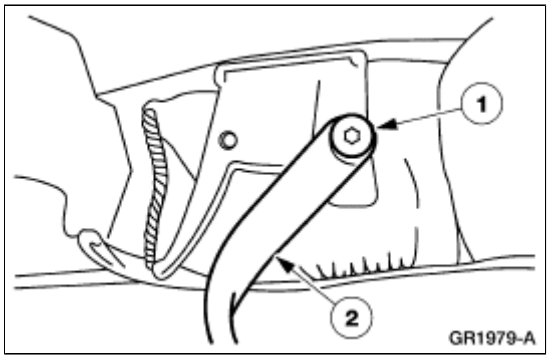


5. Assemble the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Manual .

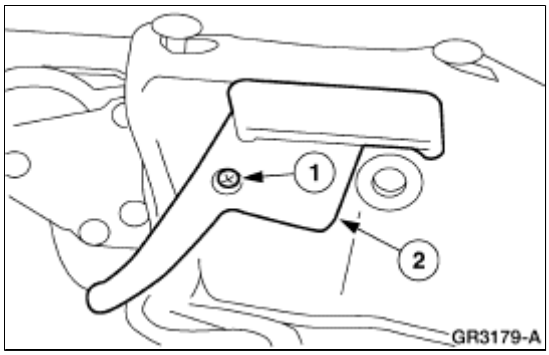
Seat —Back, Rear 50/50 Split Bench

Disassembly

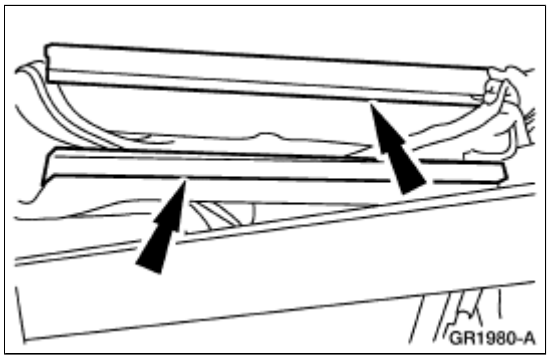
1. Remove the rear seat link from the seat backrest.
    1. Remove the bolt.
    2. Remove the rear seat link.



2. Remove the seat backrest adjuster handle.
    1. Remove the screw.
    2. Remove the seat backrest adjuster handle.

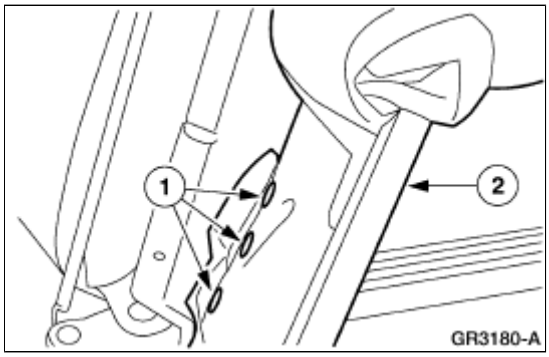


3. Disconnect the seat backrest trim cover.



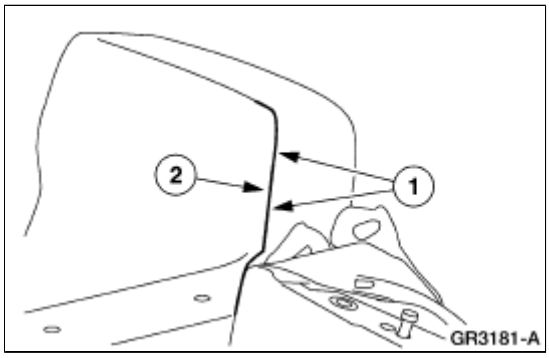
4. Roll back the seat backrest trim cover.

1. Disconnect the pin-type retainers.
2. Roll back the seat backrest trim cover.



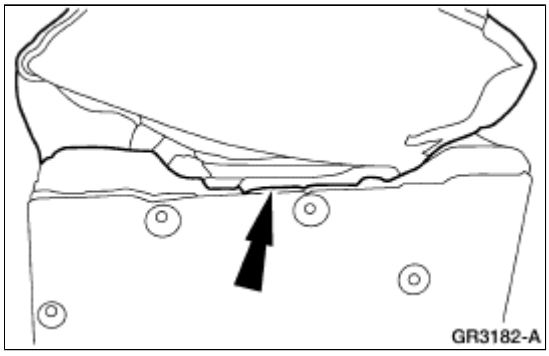
5. Remove the staples.

6. Roll back the seat backrest trim cover.
   1. Disconnect the pin-type retainers.
   2. Roll back the seat backrest trim cover.

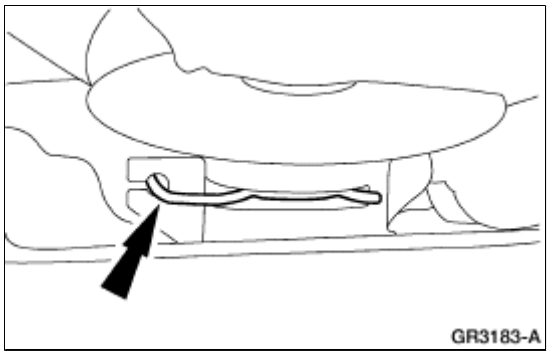


7. Remove the staples.

8. Roll the seat backrest trim cover up completely.



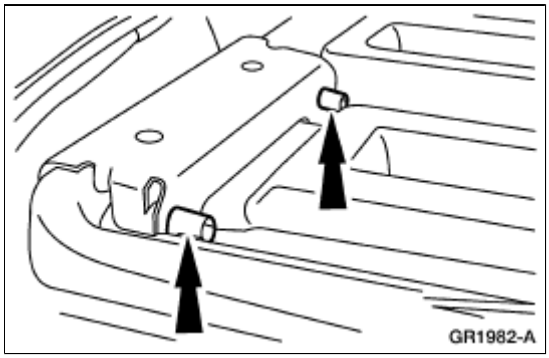
9. Remove the two head restraint lock springs.



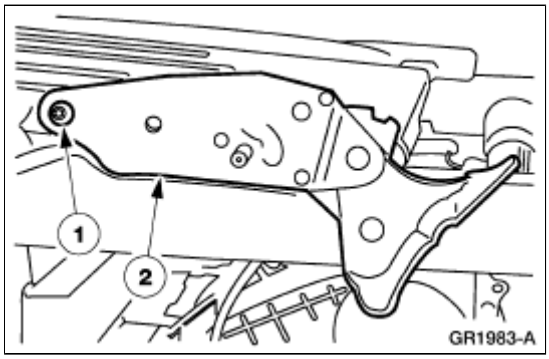
10. Remove the head restraint.

11. Remove the seat backrest foam.

12. Remove the head restraint guide sleeves.
    - Depress the tangs to release.

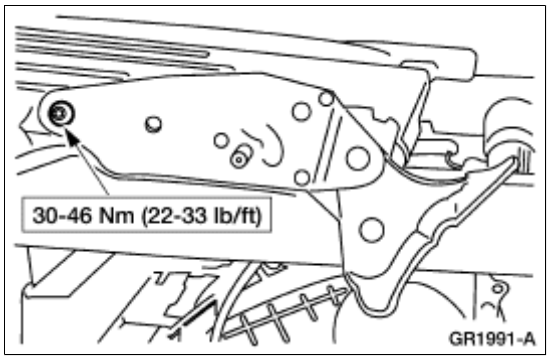


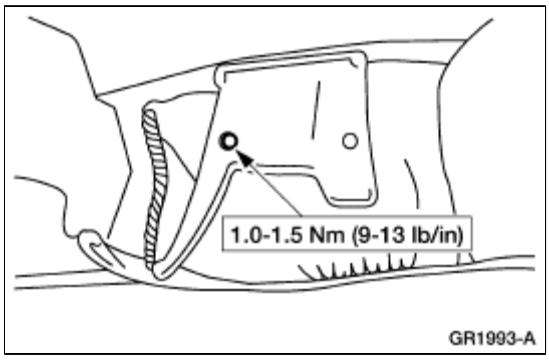
13. Remove the rear seat backrest latch assembly from the seat backrest.
    1. Remove the bolt.
    2. Remove the rear seat backrest latch assembly.

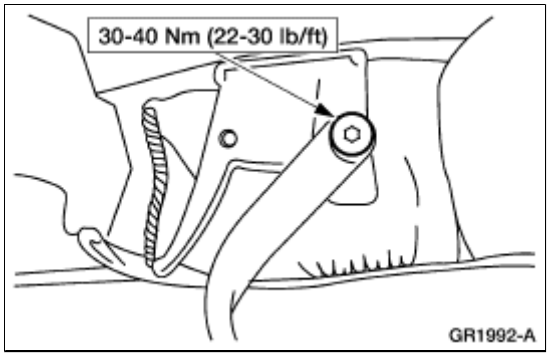


Assembly

1. To assemble, reverse the disassembly procedure.


30-46 Nm (22-33 lb/ft)
GR1991-A


1.0-1.5 Nm (9-13 lb/in)
GR1993-A


30-40 Nm (22-30 lb/ft)
GR1992-A

Seat —Cushion, 40% Portion of Front 60/40 Split Bench

Disassembly

1. For the disassembly of the 40 percent front seat cushion, refer to Seat—Cushion, Front Bucket, Manual .

Assembly

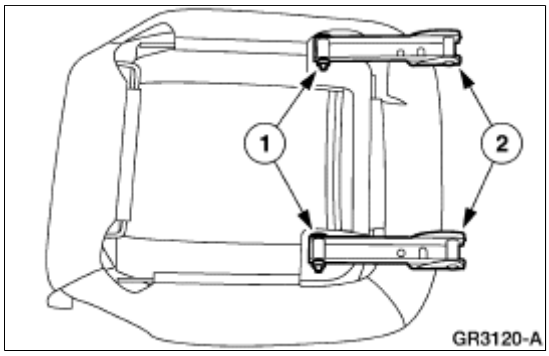
1. For the assembly of the 40 percent front seat cushion, refer to Seat—Cushion, Front Bucket, Manual .

Seat —Cushion, 40% Portion of Rear 60/40 Split Bench

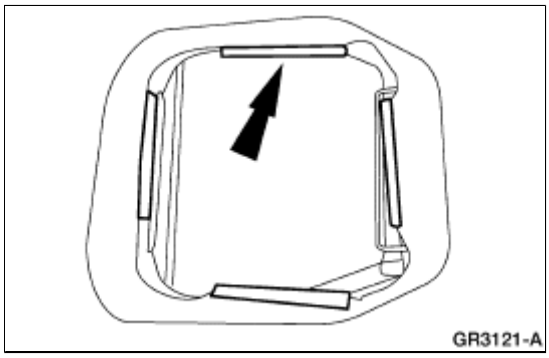
Disassembly

1. Disassemble the rear 40 percent seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

2. Remove the rear seat legs.
   1. Remove the pivot bolts.
   2. Remove the rear seat legs.

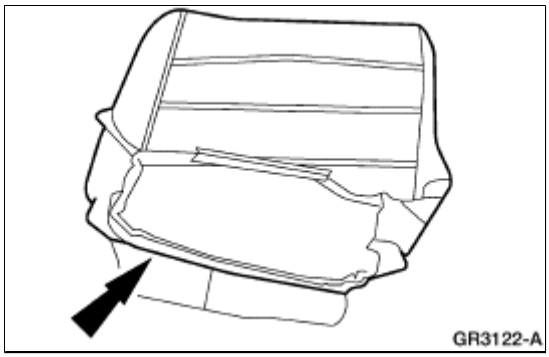


3. Unhook the seat cushion trim cover J-clips.



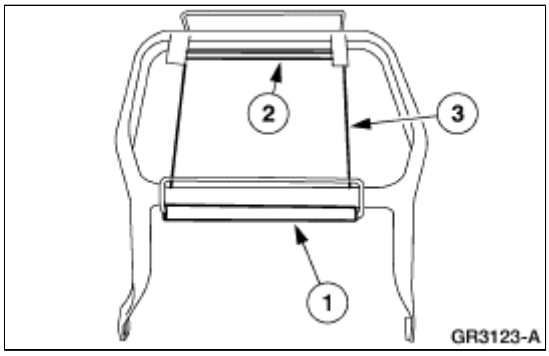
4. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat cushion foam.**

   Remove the seat cushion trim cover.
   - Separate the seat cushion trim cover from the hook and loop strip.



5. **NOTE:** Use the brackets on the seat cushion frame to obtain the necessary leverage to unhook the rear flex mat J-clip.

   Remove the seat cushion flex mat.
   1. Unhook the rear flex mat J-clip.
   2. Unhook the front flex mat J-clip.
   3. Remove the seat cushion flex mat.

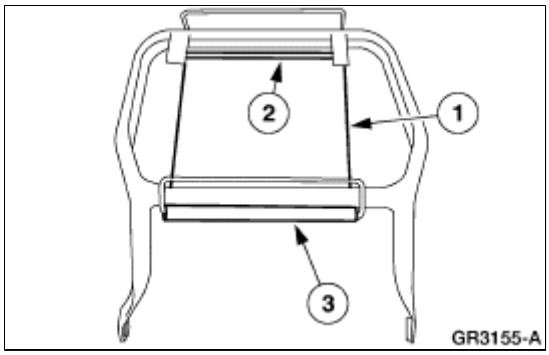


Assembly

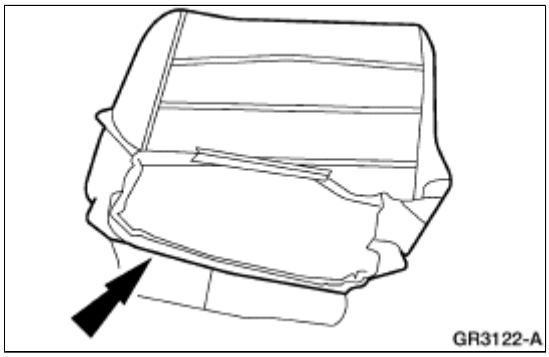
1. **CAUTION: The flex mat J-clips must be installed with the openings facing down or the seat cushion will be damaged.**

   NOTE: Use the brackets on the seat cushion frame to obtain the necessary leverage to hook the rear flex mat J-clip.

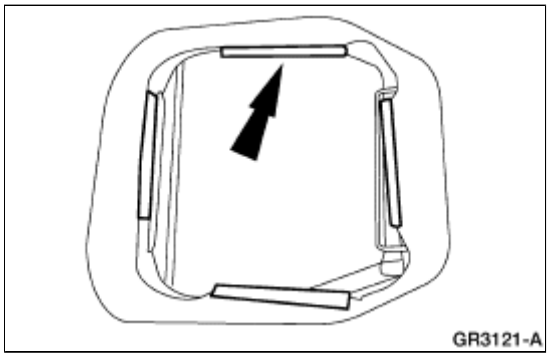
   Install the seat cushion flex mat.
   1. Position the seat cushion flex mat.
   2. Hook the front flex mat J-clip.
   3. Hook the rear flex mat J-clip.



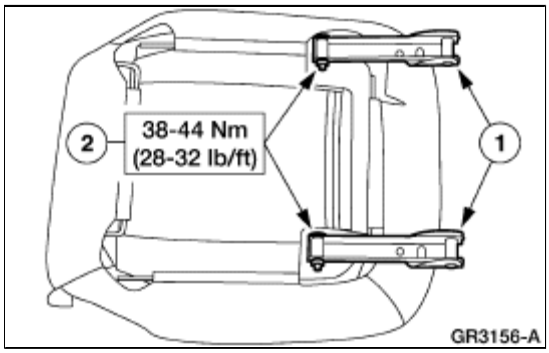
2. Position the seat cushion trim cover on the seat cushion hook and loop strips.



3. Hook the seat cushion trim cover J-clips.



4. Install the rear seat riser pivot bolts.
    1. Position the rear seat legs.
    2. Install the rear seat riser pivot bolts.



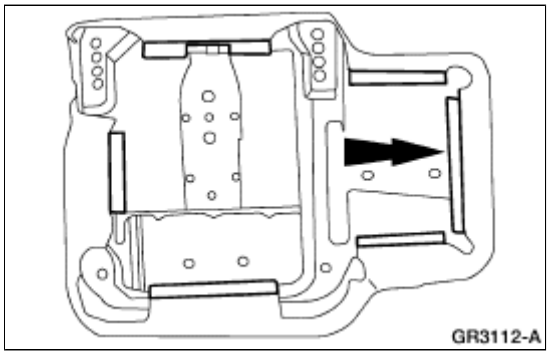
5. Assemble the rear 40 percent seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

Seat —Cushion, 60% Portion of Front 60/40 Split Bench

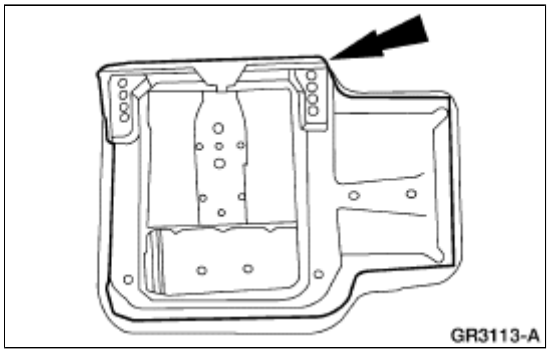
Disassembly

1. Disassemble the seat. For additional information, refer to Seat—60% Portion of Front 60/40 Split Bench .

2. Unhook the seat cushion trim cover J-clips.



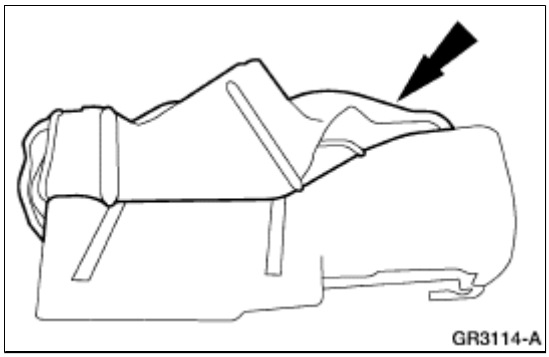
3. Remove the seat cushion frame from the seat cushion foam.



4. Invert the seat cushion trim cover.

5. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat cushion foam.**

   Remove the seat cushion trim cover.
   - Separate the seat cushion trim cover from the hook and loop strip.



Assembly

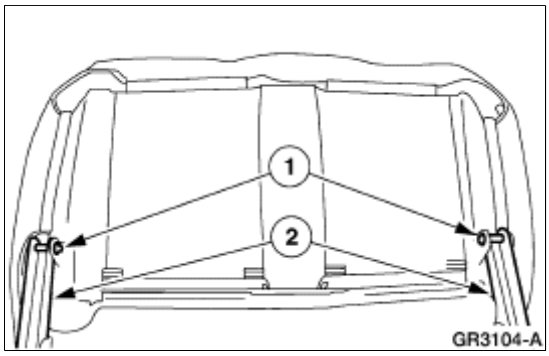
1. To assemble, reverse the disassembly procedure.

Seat —Cushion, 60% Portion of Rear 60/40 Split Bench

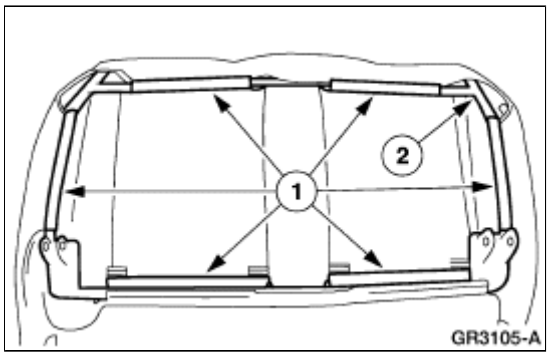
Disassembly

1. Disassemble the 60 percent rear seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

2. Remove the seat cushion legs.
    1. Remove the pivot bolts.
    2. Remove the seat cushion legs.



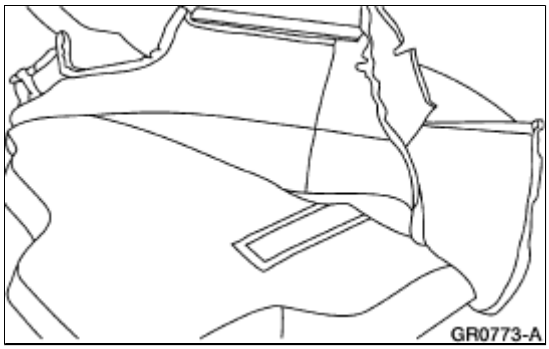
3. Remove the seat cushion frame from the seat cushion foam.
    1. Unhook the seat cushion trim cover J-clips.
    2. Remove the seat cushion frame from the seat cushion foam.



4. Invert the seat cushion trim cover.

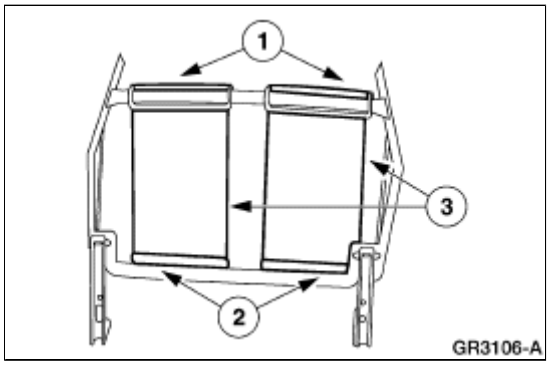
5. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat cushion foam.**

   Remove the seat cushion trim cover.
    - Separate the seat cushion trim cover from the hook and loop strip.



6. **NOTE:** Use the brackets on the seat cushion frame to obtain the necessary leverage to unhook the rear flex mat J-clip.

   Remove the seat cushion flex mats.
   1. Unhook the rear flex mat J-clips.
   2. Unhook the front flex mat J-clips.
   3. Remove the seat cushion flex mats.

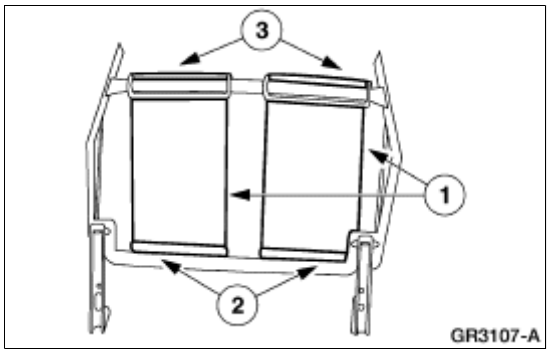


Assembly

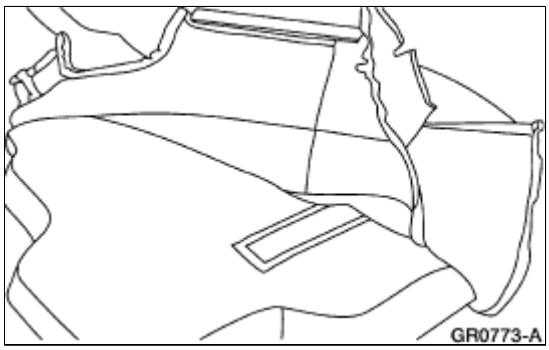
1. **CAUTION: The flex mat J-clips must be installed with the openings facing down or the seat cushion foam will be damaged.**

   NOTE: Use the brackets on the seat cushion frame to obtain the necessary leverage to hook the rear flex mat clip.

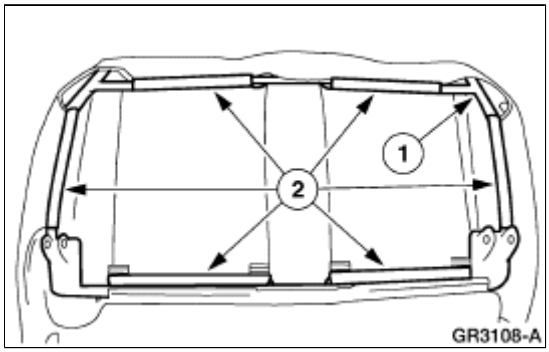
   Install the seat cushion flex mats.
   1. Position the seat cushion flex mats.
   2. Hook the front flex mat J-clips.
   3. Hook the rear flex mat J-clips.



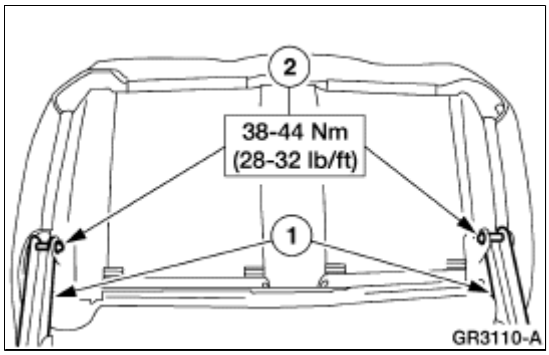
2. Position the seat cushion trim cover on the seat cushion hook and loop strips.



3. Install the seat cushion frame into the seat cushion foam.
    1. Position the seat cushion frame.
    2. Hook the seat cushion trim cover J-clips.



4. Install the seat cushion legs.
    1. Position the seat cushion legs.
    2. Install the rear seat riser pivot bolts.



5. Assemble the 60 percent rear seat. For additional information, refer to Seat—Rear, 60% Portion of 60/40 Split Bench .

Seat —Cushion, Front Bucket, 6-Way Power, Except Limited

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

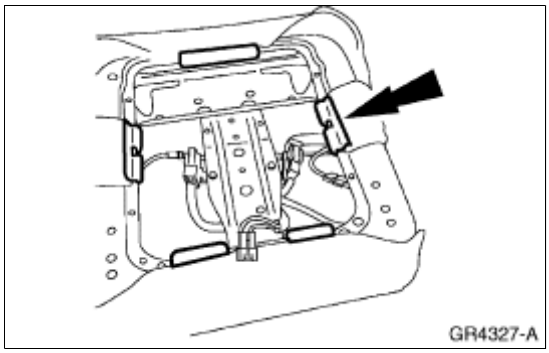
NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

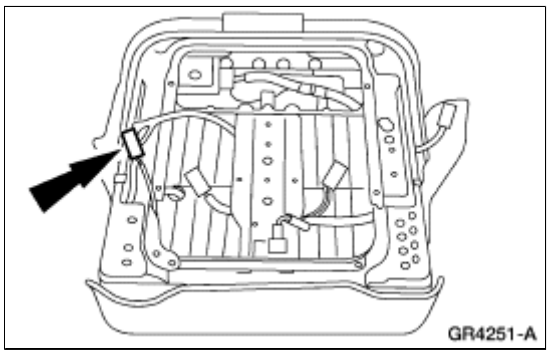
2. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited , Disassembly and Assembly.

   Disassemble the 6-way power front bucket seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited .

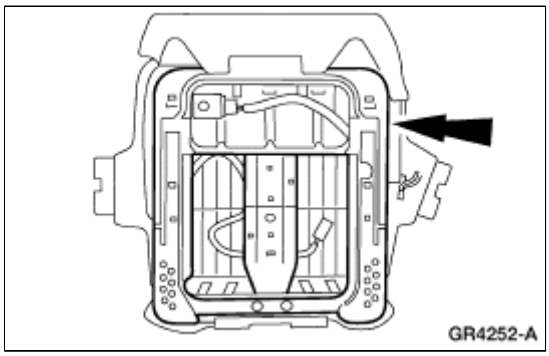
3. Disconnect the seat cushion trim cover J-clips.



4. If equipped, disconnect the seat cushion heating element electrical connector.

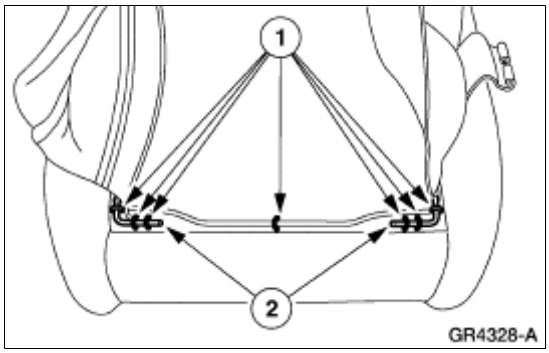


5. Remove the seat cushion frame from the seat cushion foam.



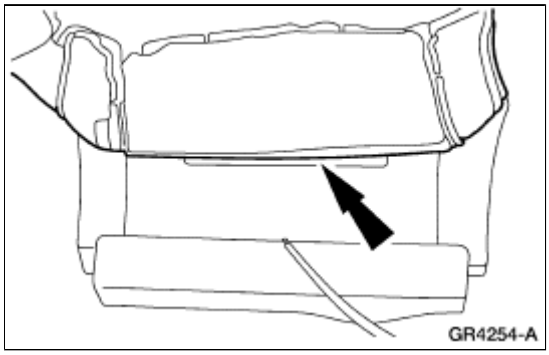
6. Invert the seat cushion trim cover.

7. Remove the swing rods.
    1. Remove and discard the hog rings.
    2. Remove the swing rods.



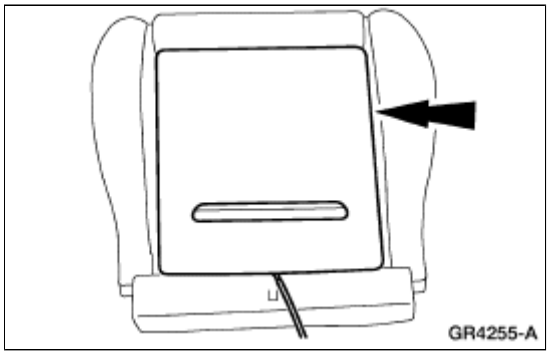
8. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat cushion foam.**

   Remove the seat cushion trim cover.

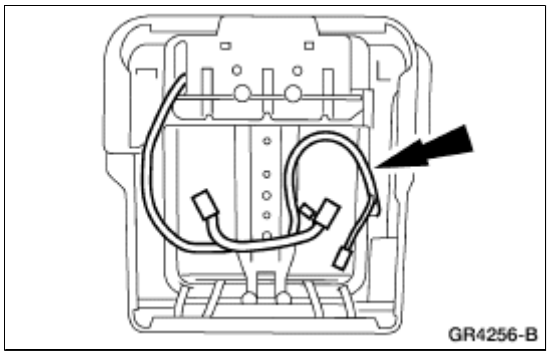


9. **CAUTION: Any time the seat cushion heating element is removed from the seat cushion foam, the foam must be replaced.**

   If equipped, and if necessary, remove the seat cushion heating element from the seat cushion foam.

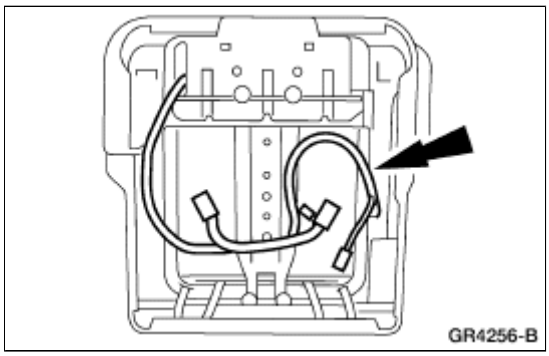


10. Remove the wire harness from the seat cushion frame.

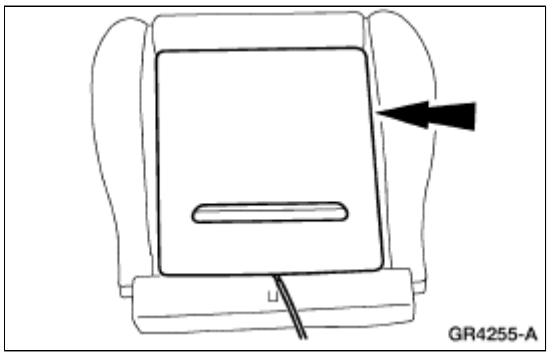


Assembly

1. Install the wire harness.

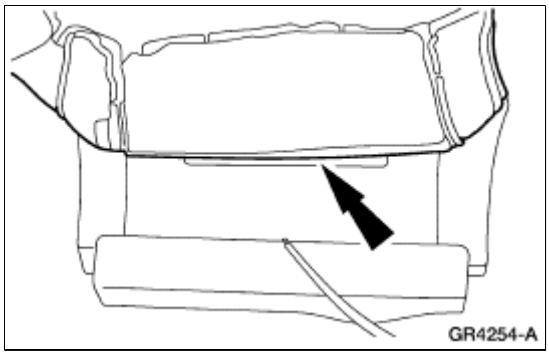


2. If equipped, and if necessary, install the seat cushion heating element.



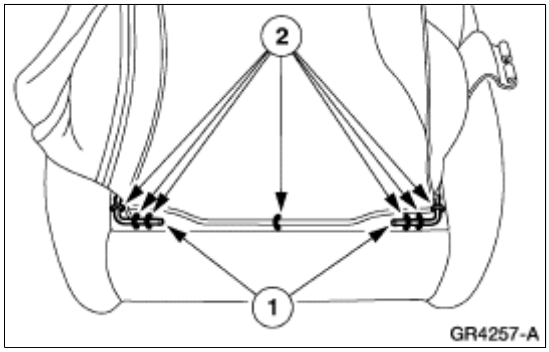
3. **NOTE:** When installing a new seat cushion trim cover, it may be necessary to cut a hole for the front seat back pad adjusting cable, backrest heating element electrical lead, and the side air bag wiring harness. Use the old seat cushion trim cover as a guide for the location of the hole.

   Position the seat cushion trim cover.



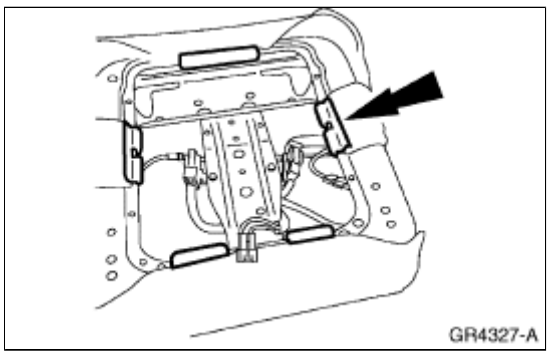
4. Install the seat cushion swing rods.
    1. **NOTE:** Make sure the ends of the swing rods are positioned beneath the listing wires at the rear of the seat cushion foam.

       Position the swing rods.
    2. Install the hog rings.



5. Invert the seat cushion trim cover.

6. Connect the seat cushion trim cover J-clips.



7. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, 6-Way Power, Except Limited , Disassembly and Assembly.

   Assemble the 6-way power front bucket seat. For additional information, refer to Seat—Front Bucket, 6-Way Power, Except Limited .

8. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and**

possible violation of vehicle safety standards.

Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

9. Prove out the air bag system. For additional information, refer to Section 501-20B .
10. Check the restraint system for proper operation.

Seat —Cushion, Front Bucket, Limited

Disassembly

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterward.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

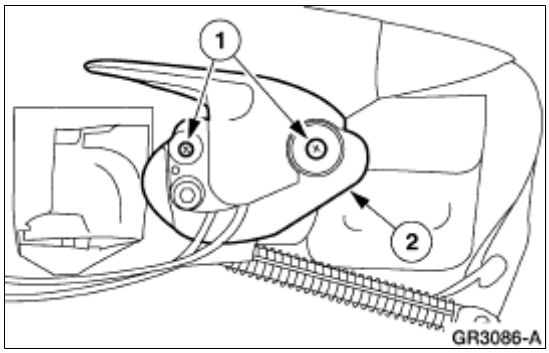
NOTE: Before disconnecting the battery, raise the seat to the highest position, then move and tilt the seat to its most forward position.

1. Deactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

2. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, Limited , Disassembly and Assembly.

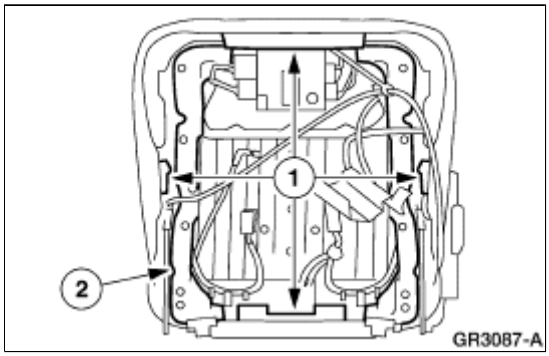
   Disassemble the seat. For additional information, refer to Seat—Front Bucket, Limited .

3. Disconnect the seat backrest recliner actuator.
   1. Remove the screws.
   2. Disconnect the seat backrest recliner actuator.

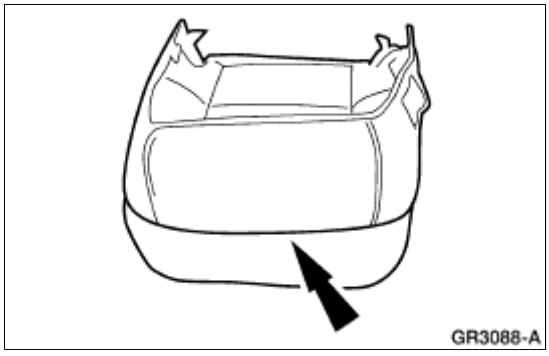


4. If equipped, disconnect the seat cushion heating element electrical connector.

5. Remove the seat cushion frame from the seat cushion foam.
    1. Unhook the seat cushion trim cover J-clips.
    2. Remove the seat cushion frame from the seat cushion foam.

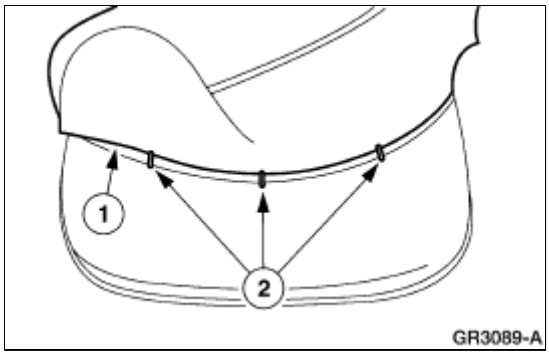


6. Invert the seat cushion trim cover.



7. **NOTE:** The hog rings along the front of the seat are shown, the hog rings along either side are similar.

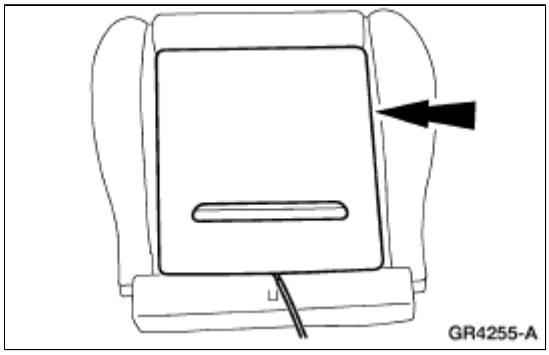
    Remove and discard the hog rings.
    1. Fold back the seat cushion trim cover to expose the hog rings.
    2. Remove and discard the hog rings.



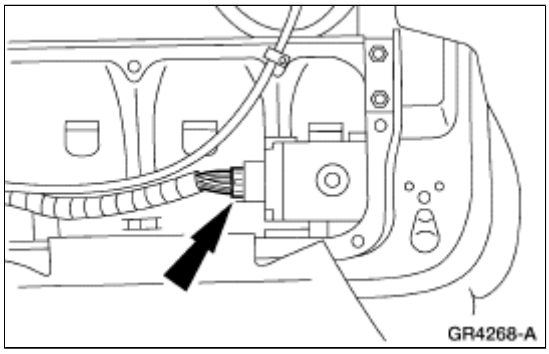
8. **CAUTION: Any time the seat cushion heating element is removed from the seat cushion foam, the foam must be replaced.**

   NOTE: Sport bucket seat shown; Limited seat similar.

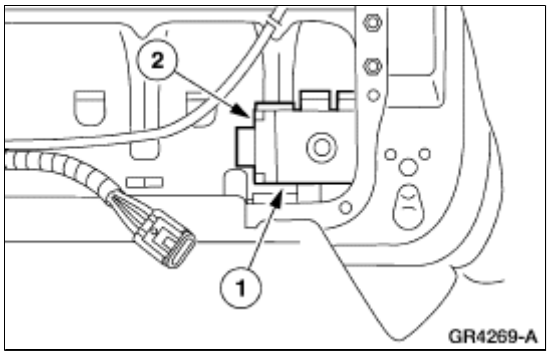
   If equipped, and if necessary, remove the seat cushion heating element from the seat cushion foam.



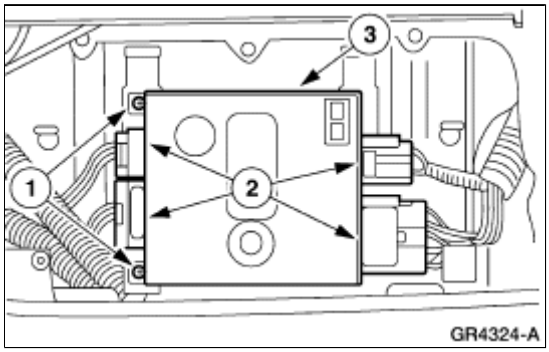
9. Disconnect the heated seat module electrical connector.



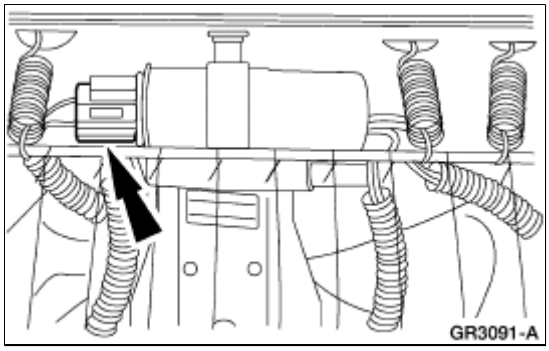
10. Remove the heated seat module.
    1. Release the clip.
    2. Remove the heated seat module.



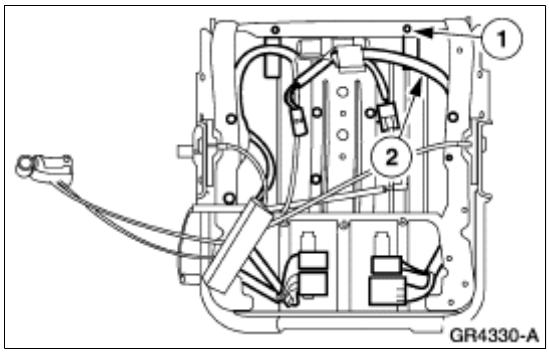
11. Remove the driver seat module (DSM).
    1. Remove the screws.
    2. Disconnect the electrical connectors.
    3. Remove the DSM.



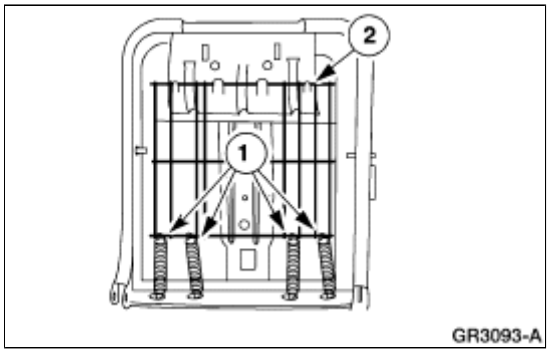
12. Disconnect the lumbar support adjusting pump electrical connector.



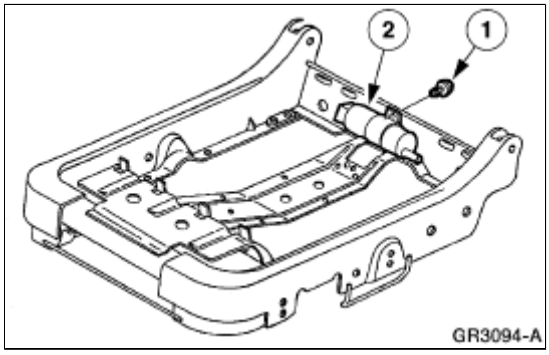
13. Remove the power seat wiring harness.
    1. Disconnect the pin-type retainers.
    2. Remove the power seat wiring harness.



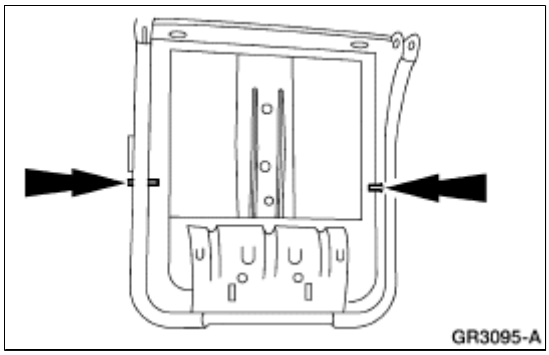
14. Remove the flexilator.
    1. Remove the flexilator springs.
    2. Remove the flexilator.



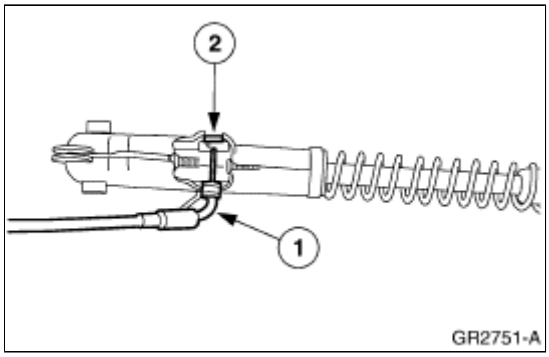
15. Remove the lumbar support adjusting pump.
    1. Remove the bolt.
    2. Remove the lumbar support adjusting pump.



16. Remove the seat backrest recliner roll pins and remove the seat backrest recliners.

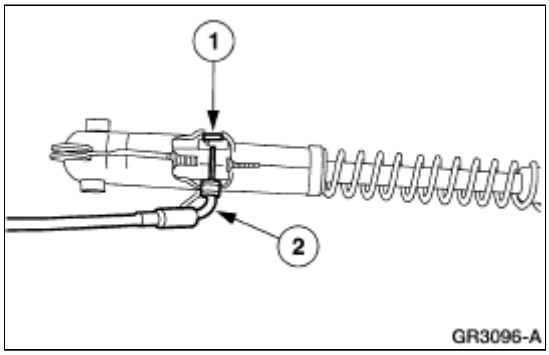


17. Disconnect the seat backrest recliners from the seat backrest recliner actuator.
    1. Disconnect the seat backrest recliner actuator cable housings from the seat backrest recliners.
    2. Unhook the seat backrest recliner actuator cables from the seat backrest recliners.

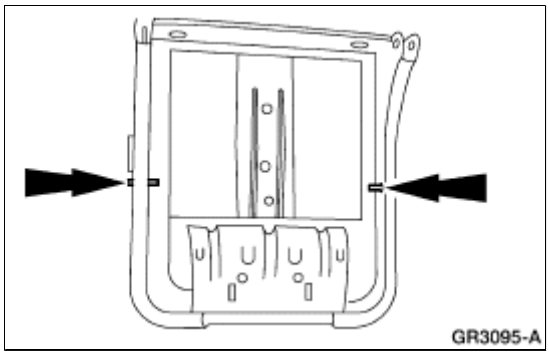


Assembly

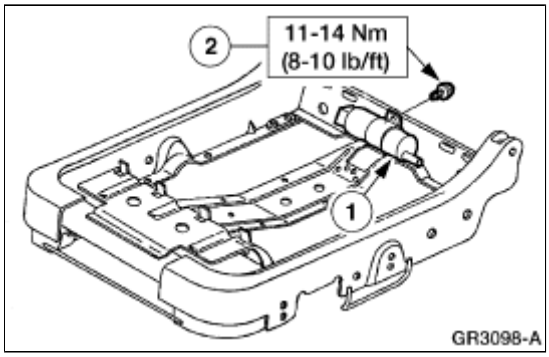
1. Connect the seat backrest recliners to the seat backrest recliner actuator.
    1. Hook the seat backrest recliner actuator cables to the seat backrest recliners.
    2. Connect the seat backrest recliner actuator cable housings to the seat backrest recliners.



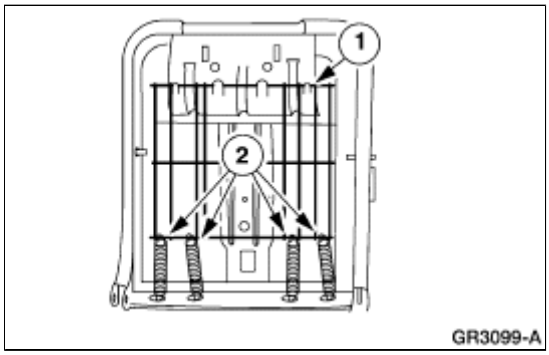
2. Install the seat backrest recliner roll pins.



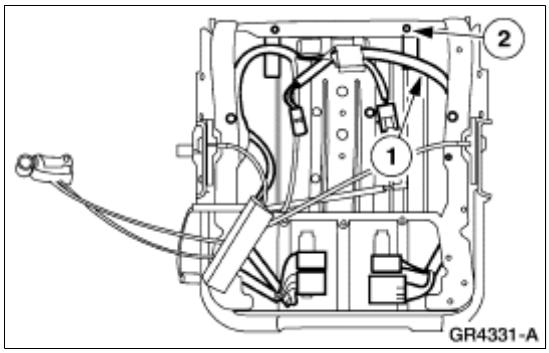
3. Install the lumbar support adjusting pump.
    1. Position the lumbar support adjusting pump.
    2. Install the bolt.



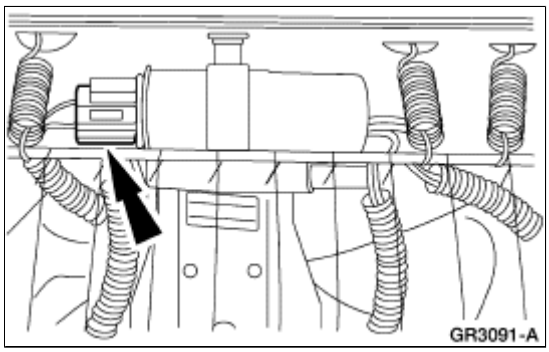
4. Install the flexilator.
    1. Position the flexilator.
    2. Install the flexilator springs.



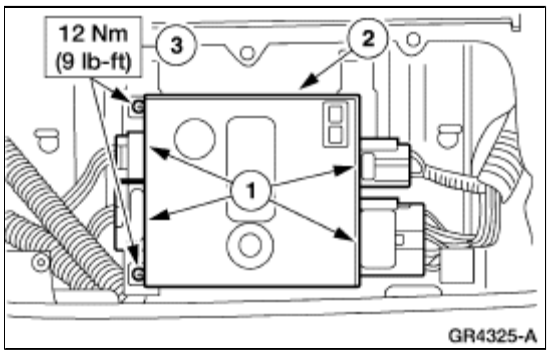
5. Install the power seat wiring harness.
    1. Position the power seat wiring harness.
    2. Install the pin-type retainers.



6. Connect the lumbar support adjusting pump electrical connector.

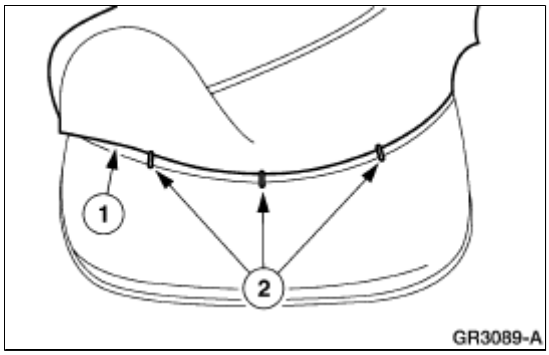


7. Install the DSM.
    1. Connect the electrical connectors.
    2. Position the DSM.
    3. Install the screws.

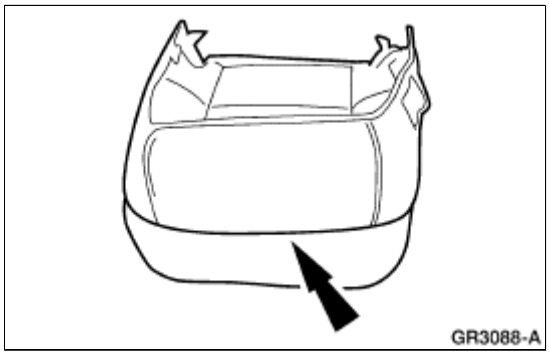


8. **NOTE:** The hog rings along the front of the seat are shown; the hog rings along either side are similar.

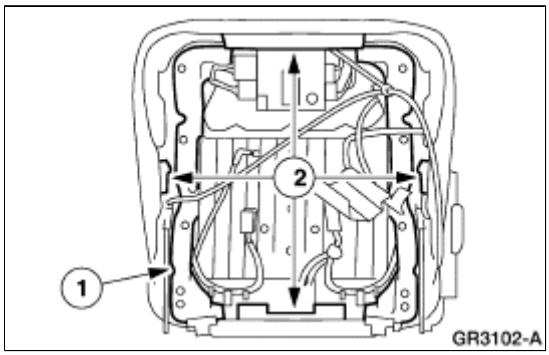
    Install the hog rings.
    1. Fold back the seat cushion trim cover to the hog ring installation position.
    2. Install the hog rings.



9. Invert the seat cushion trim cover.

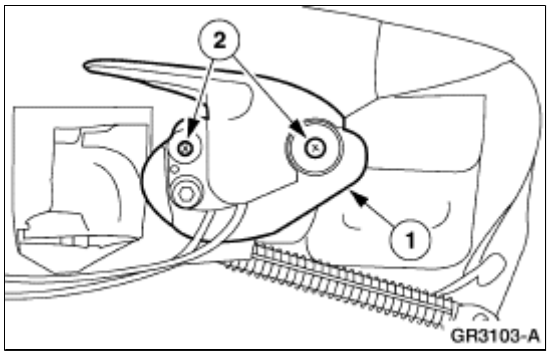


10. Install the seat cushion frame.
    1. Position the seat cushion frame.
    2. Hook the seat cushion trim cover J-clips.



11. If equipped, connect the seat cushion heating element electrical connector.

12. Connect the seat backrest recliner actuator.
    1. Connect the seat backrest recliner actuator.
    2. Install the screws.
       - Tighten until the screws are fully seated.



13. **NOTE:** Be sure to read and follow all air bag warnings in Seat—Front Bucket, Limited , Disassembly and Assembly.

    Assemble the seat. For additional information, refer to Seat—Front Bucket, Limited .

14. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Reactivate the supplemental restraint system. For additional information, refer to Section 501-20B .

15. Prove out the air bag system. For additional information, refer to Section 501-20B .

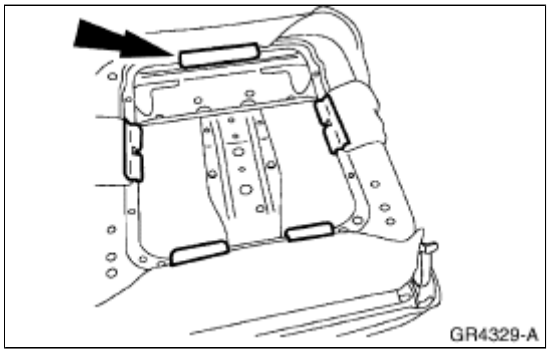
16. Check the restraint system for proper operation.

Seat —Cushion, Front Bucket, Manual

Disassembly

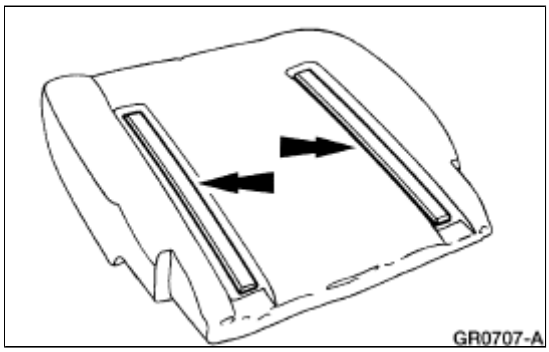
1. Disassemble the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Manual .

2. Disconnect the seat cushion trim cover J-clips.

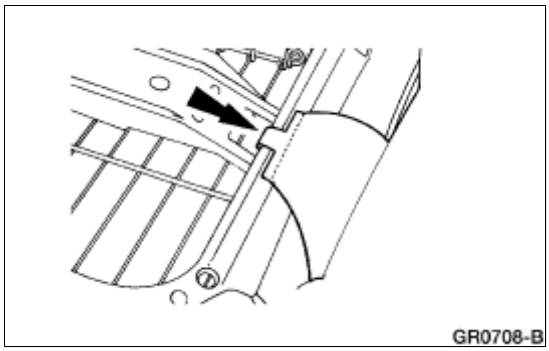


3. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip or the hook and loop strip may be torn from the seat cushion foam.**

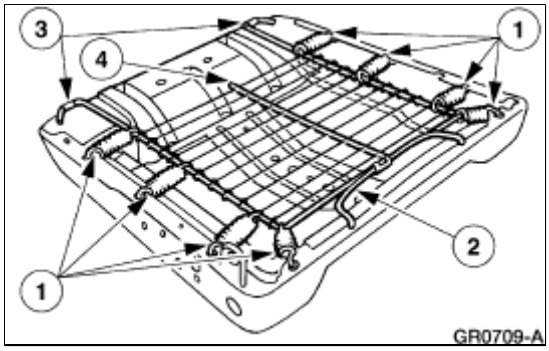
   Remove the seat cushion trim cover.
   - Disconnect the seat trim cover from the hook and loop strips.



4. Remove the seat cushion.
   - Disconnect the front and rear J-clips.

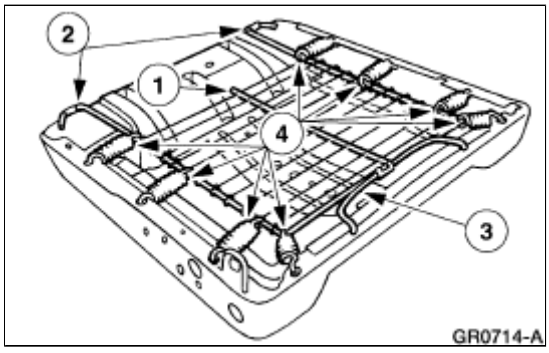


5. Remove the flexilator.
    1. Remove the flexilator to frame springs.
    2. Disengage the spring clip.
    3. Disengage the flexilator hooks from the seat frame.
    4. Remove the flexilator.

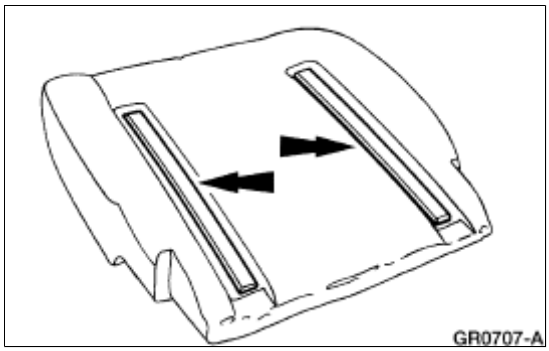


Assembly

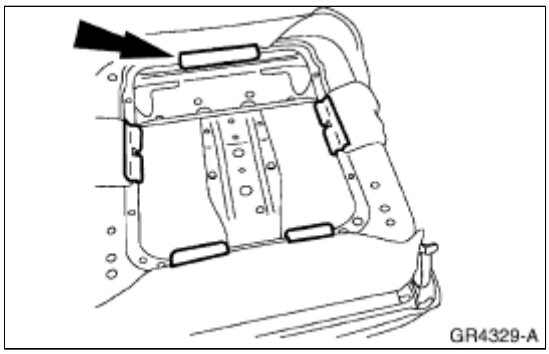
1. Install the flexilator.
    1. Position the flexilator.
    2. Install the flexilator hooks to the seat frame.
    3. Hook the spring clip.
    4. Install the flexilator to frame springs.



2. Position the seat cushion trim cover on the seat cushion hook and loop strips.



3. Connect the seat cushion trim cover J-clips.



4. Assemble the manual front bucket seat. For additional information, refer to Seat—Front Bucket, Manual .

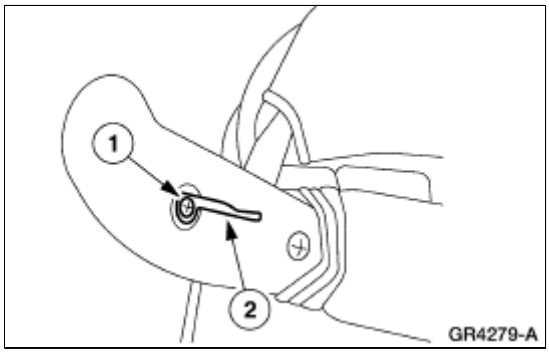
Seat —Rear, 40% Portion of 60/40 Split Bench

Disassembly

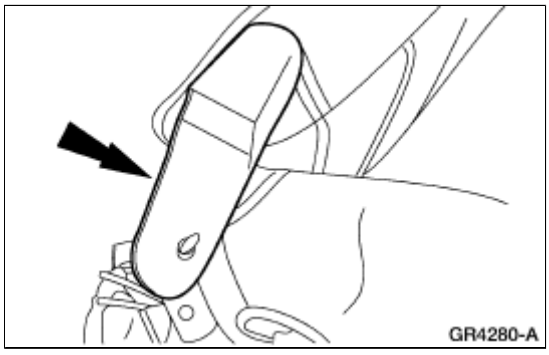
1. Remove the rear seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

2. Place the rear seat on a clean workbench.

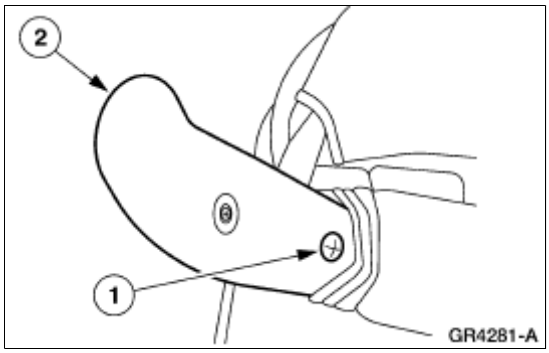
3. Remove the seat backrest latch handle.
    1. Remove the screws.
    2. Remove the seat backrest latch handle.



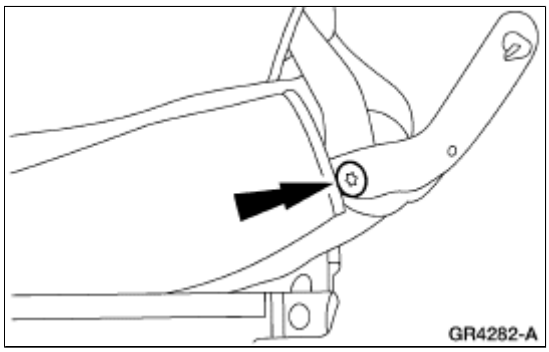
4. Remove the inboard pivot cover.



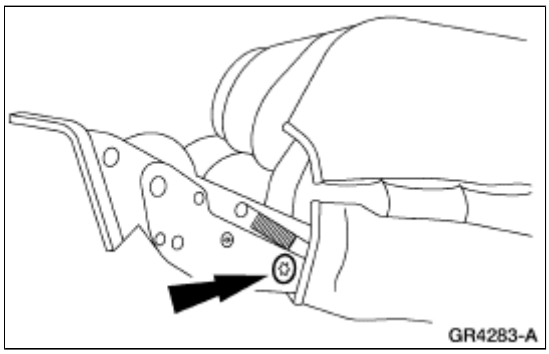
5. Remove the outboard pivot cover.
    1. Remove the screw.
    2. Remove the outboard pivot cover.



6. Remove the inboard pivot bolt.



7. Remove the outboard pivot bolt.



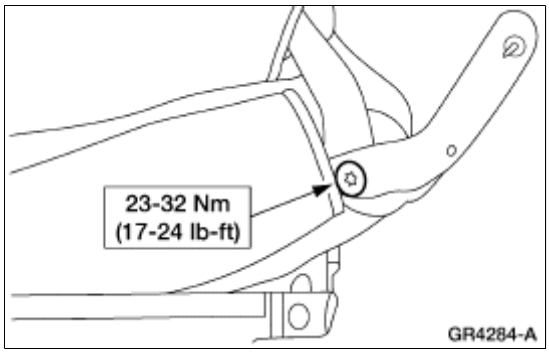
8. Remove the seat cushion.

Assembly

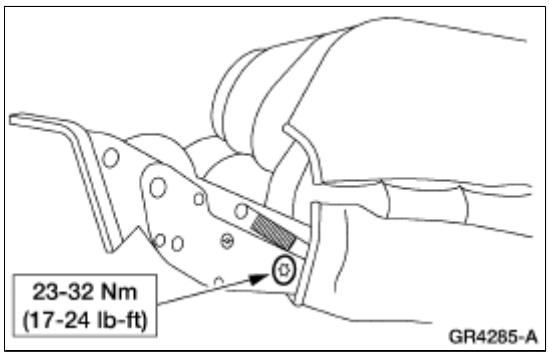
1. Position the seat cushion.

2. **NOTE:** Be sure to install the seat pivot washer between the seat cushion and the seat backrest to allow for smooth operation of the seat backrest.

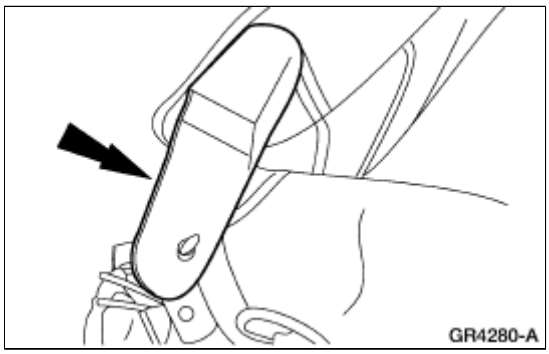
   Install the seat inboard pivot bolt.



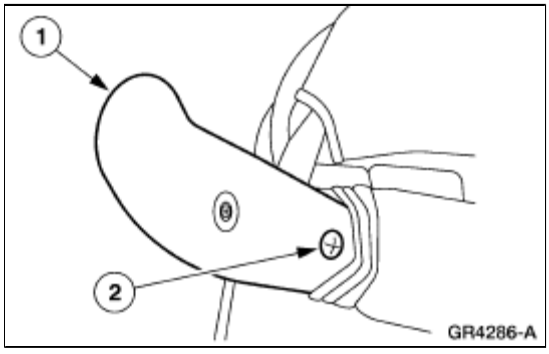
3. Install the outboard pivot bolt.



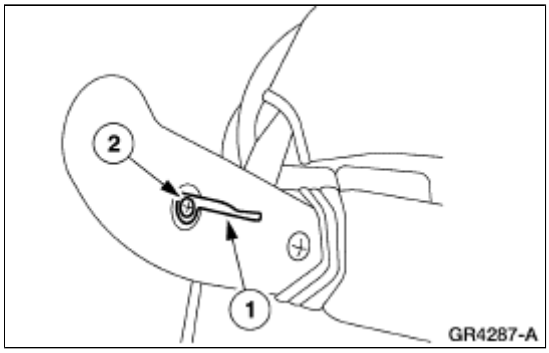
4. Install the inboard pivot cover.



5. Install the outboard pivot cover.
    1. Position the outboard pivot cover.
    2. Install the screw.



6. Install the seat backrest latch handle.
    1. Position the seat backrest latch handle.
    2. Install the screws.



7. Install the rear seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

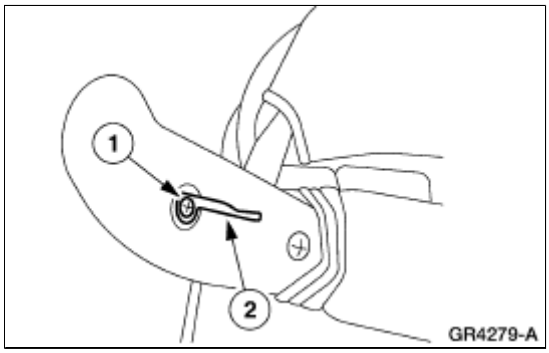
Seat —Rear, 40% Portion of 60/40 Split Bench

Disassembly

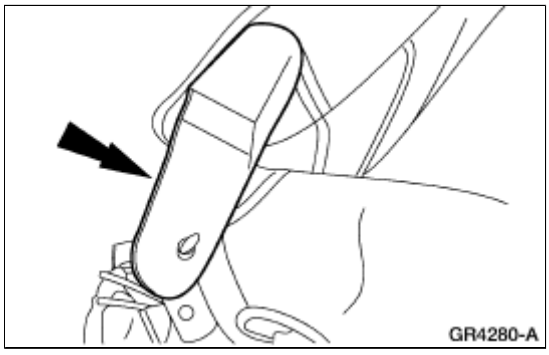
1. Remove the rear seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

2. Place the rear seat on a clean workbench.

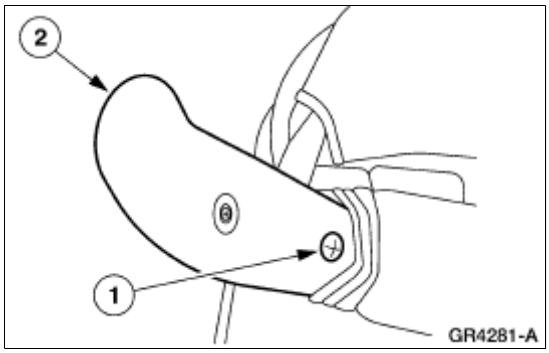
3. Remove the seat backrest latch handle.
    1. Remove the screws.
    2. Remove the seat backrest latch handle.



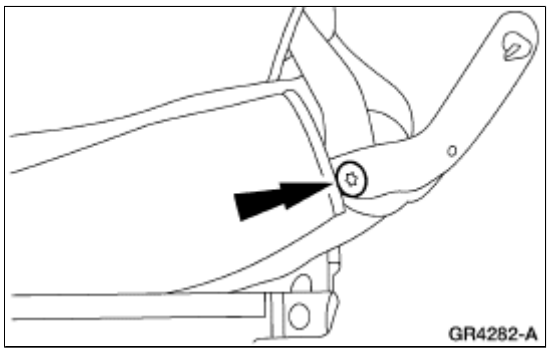
4. Remove the inboard pivot cover.



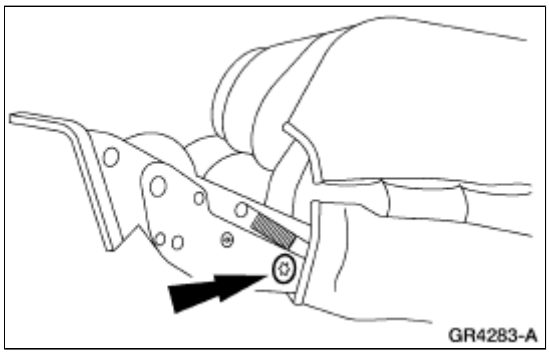
5. Remove the outboard pivot cover.
    1. Remove the screw.
    2. Remove the outboard pivot cover.



6. Remove the inboard pivot bolt.



7. Remove the outboard pivot bolt.



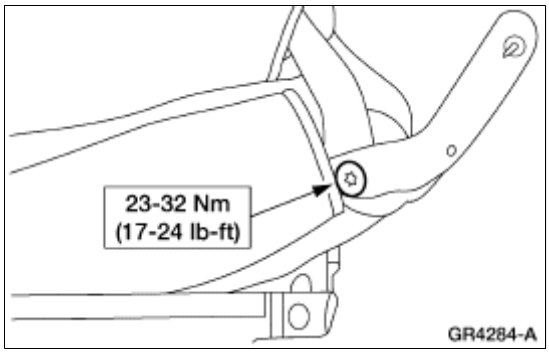
8. Remove the seat cushion.

Assembly

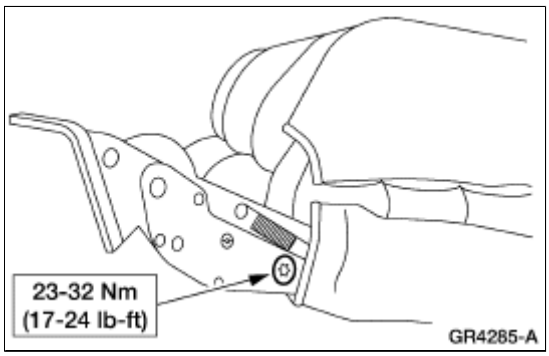
1. Position the seat cushion.

2. **NOTE:** Be sure to install the seat pivot washer between the seat cushion and the seat backrest to allow for smooth operation of the seat backrest.

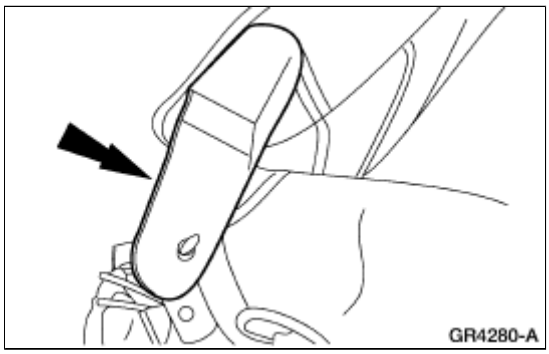
   Install the seat inboard pivot bolt.



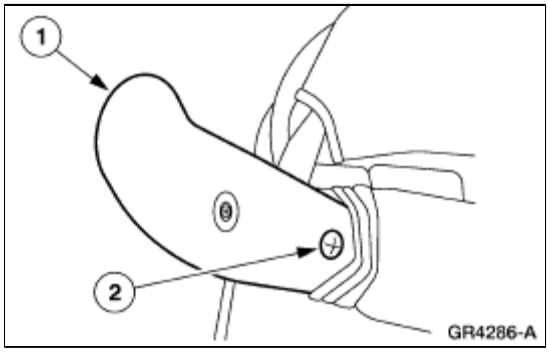
3. Install the outboard pivot bolt.



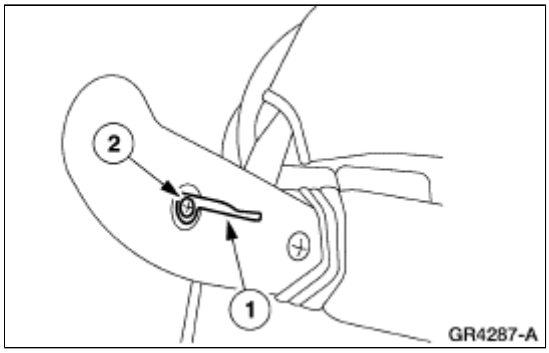
4. Install the inboard pivot cover.



5. Install the outboard pivot cover.
    1. Position the outboard pivot cover.
    2. Install the screw.



6. Install the seat backrest latch handle.
    1. Position the seat backrest latch handle.
    2. Install the screws.



7. Install the rear seat. For additional information, refer to Seat—Rear, 40% Portion of 60/40 Split Bench .

General Specifications

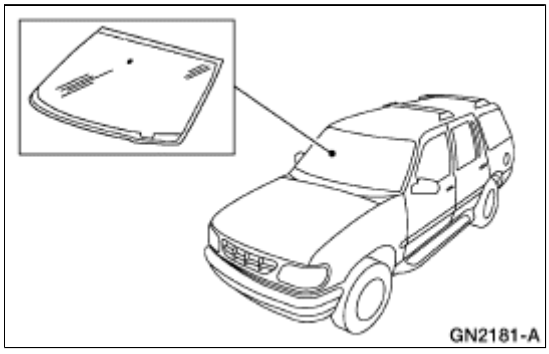
Item	Specification
Foam Butyl	WSB-M2G234-C
Urethane Glass Prep Essex U-401	WSB-M2G314-B
Urethane Glass Primer Essex U-402	WSB-M5B280-C
Urethane Metal Primer Essex U-413	WSB-M2G234-C
Urethane Sealant Essex U-216	WSB-M2G316-B
Urethane Sealant Essex 400-HV	WSB-M2G316-B

Torque Specifications

Description	Nm	lb-in
Battery ground cable bolt	7-10	62-89
Door trim panel screws	1.4-2.0	13-17
Equalizer bracket nuts	9-14	80-123
Inside door handle screw	7.5-10.5	67-93
Liftgate window glass-to-window glass hinge nuts	2-3	18-26
Movable quarter window hinge nuts	11-13	99-115
Power window motor nuts	5.6-9.1	50-81
Quarter window glass nuts	3-4	27-35
Rear window glass regulator nut	10-14	90-124
Rear window regulator switch plate screws	1.4-2.0	13-17
Window regulator switch plate harness assembly	2-3	18-26

Glass, Frames and Mechanisms —Glass

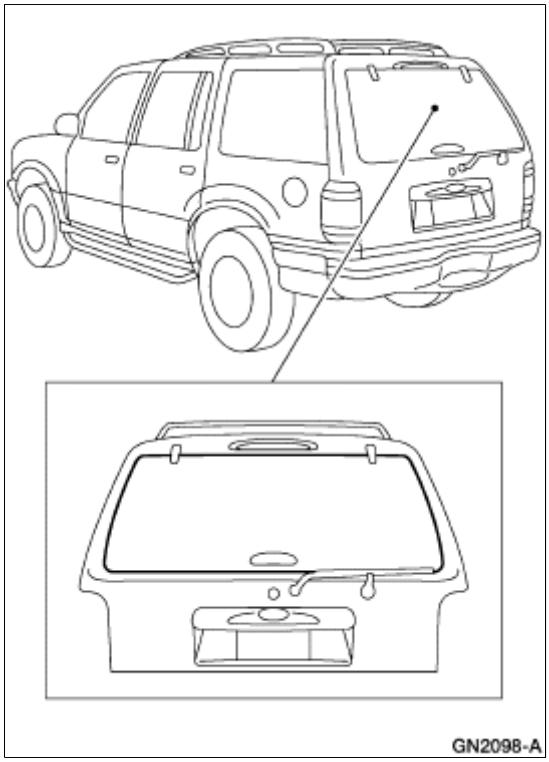
Windshield Glass



The windshield glass (03100) :

- Is standard plastic and glass laminate safety glass.
- Is bonded to the window opening flange with urethane sealant.

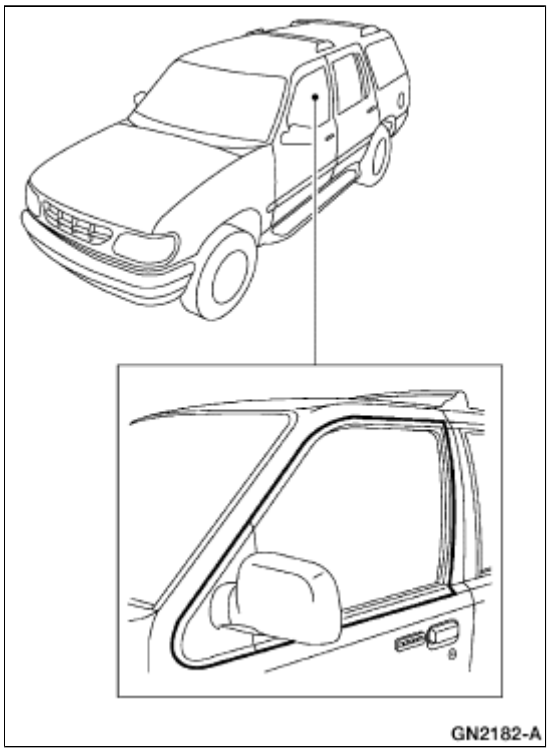
Liftgate Glass



The liftgate window glass:

- Is standard plastic and glass laminate safety glass.
- Houses the rear defogger grid.

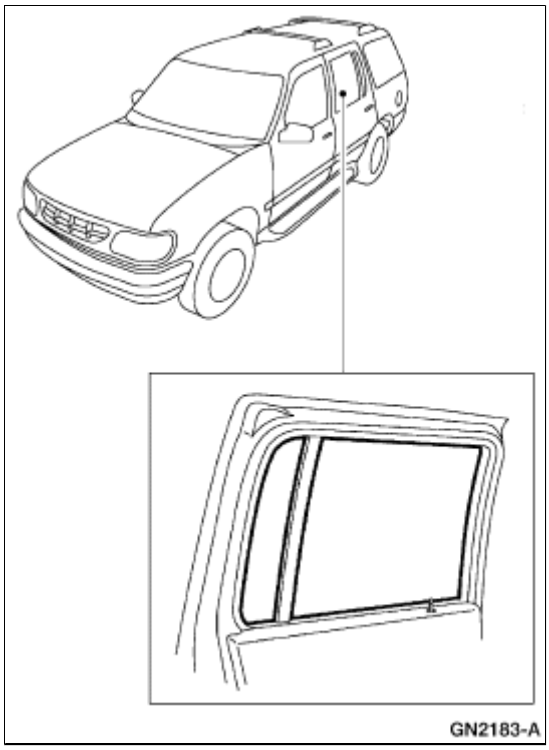
Front Door Glass



The front door window glass:

- Is standard plastic and glass laminate safety glass.
- May be raised and lowered by use of the window regulator handle (standard).
- May be raised and lowered by use of the window regulator control switch (14529) (optional).

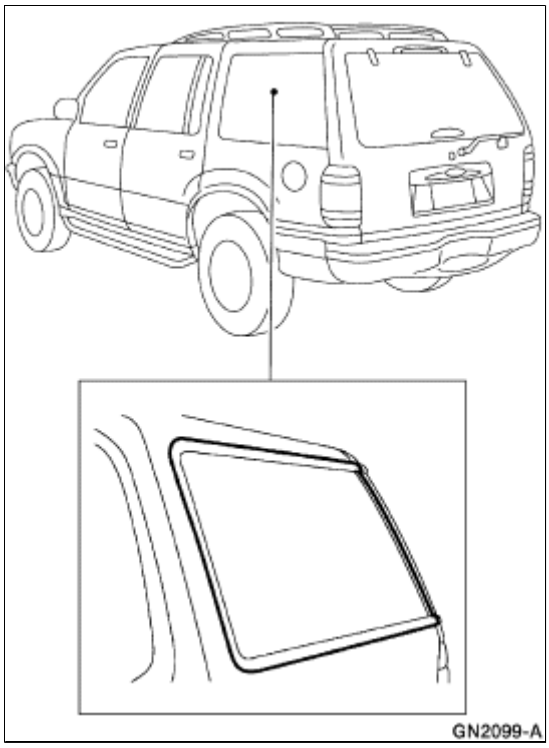
Rear Door Glass



The rear door window glass:

- Is standard plastic and glass laminate safety glass.
- May be raised and lowered by use of the window regulator handle (standard).
- May be raised and lowered by use of the window regulator control switch (optional).

Quarter Window Glass



The quarter window glass:

- Is standard plastic and glass laminate safety glass.

Glass, Frames and Mechanisms —Window Regulator Control

The window regulator control switch:

- Is located on each door trim panel.
- May be used to raise or lower both LH side and RH side windows from the master control on the driver door.
- Includes a window lock feature that is controlled through the master control.
- Can manually lower the driver side window when the master control is depressed longer than 0.4 seconds.
- The driver side window can be completely lowered when the master control is depressed between 0.04 and 0.4 seconds and then released.

Glass, Frames and Mechanisms —Module

Features and Operation:

The generic electronic module (GEM) controls the opening of the LH driver side power window (window down motion) by activating the one touch down (OTD) window relay.

- The driver side window has two downward motions, manual mode and auto mode. The down window mode is selected by pressing the LH window regulator control switch (master control). When the GEM detects that the master control switch has been depressed for a time greater than 0.4 seconds, it enters the manual mode. If the GEM detects that the master control switch was depressed between 0.04 and 0.4 seconds, it enters the auto mode.

The power window system will operate only if:

- The ignition switch is in the RUN or ACC position (or)
- The delayed accessory feature is in the active mode.

Modes of Operation

There are two modes of operation for the power window system:

Manual Mode:

When the LH window regulator control switch is pressed to the down position, the window will move down when the LH window regulator control switch is depressed longer than 0.4 seconds.

Feature Input:

- **NOTE:** Delayed accessory feature must be active.

LH window regulator control switch, first down position.

Feature Output:

- OTD relay coil output (grounded when activated, open circuit when deactivated).

Auto Mode:

Auto mode provides the OTD feature. The OTD feature is activated when the LH window regulator control switch, for the LH window, is pressed between 0.04 and 0.4 seconds, and then released.

Auto mode will be terminated when any of the follow conditions are met:

- The LH window regulator control switch is pushed to the up position or down position.
- Seven seconds have elapsed since auto mode was initiated.
- A window regulator electric drive stall condition is detected on the OTD sense line inputs.

Feature Inputs:

- LH window regulator control switch inputs; refer to the LH Front Window Regulator Control Switch

Inputs Table.

- OTD sense lines, high and low (voltage difference corresponds to window current).
- **NOTE:** Delayed accessory feature must be active.

Door open warning lamp switches (grounded when door is ajar, open circuit when door is closed).

Feature Output:

- Down window relay coil output (grounded when activated, open circuit when deactivated).

One Touch Down Relay

The GEM controls manual down and OTD window movement with the OTD relay.

The relay is activated by applying ground directly to one side of the down window relay coil, and is deactivated by removing the ground signal.

LH Front Window Regulator Control Switch Inputs Table

Switch Position	Input State		
	UP C4-3	DOWN C4-4	OTD C4-4
OFF	GND	GND	OPEN
UP	12V	GND	OPEN
DOWN	GND	12V	OPEN

Delayed Accessory

Features and Operation:

The delayed accessory feature of the GEM provides power for the power window system. The following components are under the control of the delayed accessory relay:

- LH window regulator electric drives.
- RH window regulator electric drives.

The delayed accessory feature is active when:

- The ignition is in the RUN position or ACC position, (or)
- The ignition switch makes a transition from RUN or ACC to OFF, and all doors are closed.

NOTE: Delayed accessory is suspended (off) while the ignition is in the START position. The delayed accessory feature is re-activated when the ignition makes the transition from START to RUN. The delayed accessory feature becomes deactivated if:

- Any passenger door becomes ajar when the ignition switch is in the OFF or KEY OUT positions.
- Ten minutes have elapsed since the ignition made a transition from RUN or ACC to OFF.

Feature Inputs:

- Ignition switch RUN position: 12V on both RUN and RUN/ACC inputs.

- Ignition switch ACC position: 12V on RUN/ACC input only.
- Door open warning lamp switches (grounded when door is ajar, open when door is closed).

Feature Outputs:

Delayed accessory relay coil output (grounded when active, open circuit when inactive).

Heated Backlite and Mirror Timer

When the rear window defrost switch is pressed, a 10-minute timer is started and the GEM energizes a relay that provides battery voltage to the heated backlite and outside rearview mirror (if equipped). The rear window defrost heats up to defog the rear window or melt accumulated snow or ice.

GEM Controlled Functions

The GEM is equipped on four-wheel drive vehicles with power windows. The central timer modules (CTMs) are equipped only on two-wheel drive vehicles without power windows.

NOTE: GEM diagnostics are compatible with scan tool, while CTM diagnostics are not.

The GEM incorporates the functions of several different modules into one, and offers diagnostics to easily locate and repair concerns affecting the subsystems that it controls.

The GEM constantly monitors the systems under its control and reports a concern in the form of a diagnostic trouble code (DTC). A DTC can be retrieved with scan tool through the communications link.

The scan tool is a menu-driven tester that allows the user to run specific diagnostic tests. Scan tool can isolate faults in the GEM subsystems through a symptom-driven diagnostic procedure. Connecting the tester to the GEM communications link will not alert the GEM. If the GEM is "asleep" when then diagnostic connector is plugged in, the GEM must be "awakened." If the communication link cannot be established, it is advised to turn the ignition to RUN.

The GEM has a sleep function to minimize battery consumption. During the sleep mode, the GEM turns off all outputs and monitors the following:

- Door ajar (Both front and rear doors, and liftgate).
- Key in ignition.
- Key in RUN or ACC.
- Door handles (driver or passenger).
- Two-step unlock switch (disarm switch).
- Neutral safety switch.
- Illuminated entry request — RAP module.

If a change of status occurs at one of these inputs while the GEM is asleep, the GEM will "wake up." When the GEM awakens, it performs an internal self test, and begins normal operation of its functions.

The GEM will go into the sleep mode immediately after both of the following conditions have been met:

- Key in OFF or key not in ignition.
- After 45 minutes have elapsed with no change to any wake-up input.

The GEM control system has two modes of operation, the normal operating mode and tester-dependent diagnostics mode.

The normal operation of the GEM can detect errors. An integral part of the normal GEM operation is the continued diagnostic capability. Continuous diagnostics detects errors, and changes the GEM control strategy. There is no warning lamp for the GEM; therefore, a DTC concern will direct you to the GEM. Examples of faults that may be detected during normal operation include:

- GEM continuous self test (RAM, ROM, EEPROM, A/D checking).
- Output driver monitoring (open circuit/short to GND, short to battery).
- Illogical combinations of input signals.

The GEM can only detect open circuit/short to GND faults when the GEM is not energizing a load, and short to battery faults when the GEM is attempting to energize a load.

Delayed Accessory

The GEM controls the delayed accessory feature and the power supply to the power windows through the delayed accessory relay.

The relay is activated by applying ground directly to one side of the delayed accessory relay coil, and is deactivated by removing the ground signal.

Battery Saver

The following components are under the control of the battery saver relay:

- Delayed accessory relay.
- Overhead interior lamp with map lamps.
- Overhead interior lamp switch.
- Interior lamp relay coil.

The battery saver relay becomes active (relay coil is energized) when the GEM is in the awake mode, and is deactivated (relay coil is de-energized) when the GEM is in the sleep mode.

The battery saver will remain active until the ignition state is not ACC or RUN and 45 minutes have passed since the last active input. At that time, the relay will be deactivated and power to the above circuits will terminate.

Five minutes after the battery saver relay has become deactivated, the GEM will go into a lower power state known as sleep mode. In the sleep mode, the GEM will deactivate all outputs and will monitor only select inputs.

Logical characteristics of the GEM battery saver mode are as follows:

Feature Input:

- Sleep/awake mode status.

Feature Output:

- Battery saver relay control (open circuit in sleep mode, grounded when awake).

Glass, Frames and Mechanisms

Refer to Wiring Diagrams Cell 56 , Rear Window Defrost/Mirror Defrost for schematic and connector information.

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module (GEM) for schematic and connector information.

Refer to Wiring Diagrams Cell 100 , Windows for schematic and connector information.

Special Tool(s)

ST1137-A	73III Automotive Meter or equivalent 105-R0057
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Inspection and Verification

1. **NOTE:** The generic electronic module (GEM)/central timer module (CTM) must be reconfigured upon replacement. Refer to the scan tool help screen on the configuration card to program the Tire Size, Axle Ratio.

   The power windows system and rear window defroster system are (GEM) controlled systems.

2. Verify the customer concern by operating the power windows system or rear window defroster system.

3. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Window regulator electric drive • Window glass • Heated back window grid	• Fuse(s) • Damaged wiring harness • Loose or corroded connector(s) • Circuitry

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is properly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

6. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for GEM module, go to Pinpoint Test L.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the GEM.

7. If the DTCs retrieved are related to the concern, go to the GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	GO to Pinpoint Test A .
B1304	Accessory Delay Relay Coil Circuit Open or Short to Battery	GEM	GO to Pinpoint Test A .
B1313	Battery Saver Relay Coil — Circuit Failure	GEM/CTM	GO to Pinpoint Test A .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	GO to Pinpoint Test A .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar Driver Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar Passenger Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit	GEM/CTM	REFER to Section 417-02 .

	Short to Ground		
B1338	RR Door Open Warning Lamp Switch Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated Backlite Input Circuit Short to Ground	GEM	GO to Pinpoint Test K .
B1347	Heated Backlite Relay Circuit Failure	GEM	GO to Symptom Chart.
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	GO to Pinpoint Test K .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window Driver One-Touch Window Relay Circuit Failure	GEM	GO to Symptom Chart.
B1400	Power Window Driver One-Touch Window Relay Coil Circuit Short to Battery	GEM	GO to Symptom Chart.
B1404	Power Window Driver Down Circuit Open	GEM	GO to Symptom Chart.
B1405	Power Window Driver Down Circuit to Battery	GEM	GO to Symptom Chart.
B1410	Power Window Driver Motor Circuit Failure	GEM	GO to Symptom Chart.
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch	GEM/CTM	REFER to Section 501-16 .

	Input Short to Ground		
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Low Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delay Relay Contacts Short to Battery	GEM/CTM	GO to Symptom Chart.
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1571	LR Door Ajar — Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .

B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Rear Wiper Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	REFER to Section 418-01 .
P1763	Transmission Neutral In Tow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral In Tow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
B1894	Rear Wiper Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD Low Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case HI to LO Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft	GEM	REFER to Section 308-07A .

	Speed Sensor Circuit Failure		
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Driver Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G

CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, ON-B-, OFFO-G
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds

WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM only)	UP RELAY	ON, OFF
REAR WIPER (GEM only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage LOW	GEM/CTM
B1322	Door Ajar Driver Circuit Short to Ground	GEM/CTM
B1330	Door Ajar Passenger Circuit Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Power Window Driver Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All Power Windows Are Inoperative — (2 Door and 4 Door)	• Fuse(s). • Circuitry. • GEM. • Battery saver relay. • Accessory delay relay. • Driver window regulator control switch (14529) . • DTC B1302. • DTC B1304. • DTC B1313. • DTC B1315. • DTC B1342.	• GO to Pinpoint Test A .
• Single Power Window Is Inoperative — Driver Power Window	• GEM. • One touch down relay.	• GO to Pinpoint Test B .

(4 Door)	• Circuitry. • Driver window regulator control switch . • Driver window regulator electric drive (23394) . • DTC B1398. • DTC B1400. • DTC B1404. • DTC B1405. • DTC B1410. • DTC B1342.	
• Single Power Window Is Inoperative — Driver Power Window (2 Door)	• Circuitry. • Driver power window regulator control switch. • Driver power window motor. • DTC B1398. • DTC B1400. • DTC B1404. • DTC B1405. • DTC B1410. • DTC B1342.	• GO to Pinpoint Test C .
• Single Power Window Is Inoperative — Passenger Power Window (4 Door)	• Circuitry. • Master window/door lock control switch. • Passenger window regulator control switch. • Passenger window regulator electric drive .	• GO to Pinpoint Test D .
• Single Power Window Is Inoperative — Passenger Power Window (2 Door)	• Circuitry. • Passenger power window regulator control switch. • Passenger power window motor. • Driver power window regulator control switch.	• GO to Pinpoint Test E .
• Single Power Window Is Inoperative — LR Power Window	• Circuitry. • Master window/door lock control switch. • LR window regulator control switch . • LR window regulator electric	• GO to Pinpoint Test F .

	drive .	
• Single Power Window Is Inoperative — RR Power Window	• Circuitry. • Master window/door lock control switch. • RR window regulator control switch . • RR window regulator electric drive .	• GO to Pinpoint Test G .
• The One Touch Down Feature Is Inoperative	• GEM. • Driver window regulator control switch (2 door). • Master window/door lock control switch (4 door). • Circuitry. • DTC B1398. • DTC B1400. • DTC B1342.	• GO to Pinpoint Test H .
• All Windows Operate With the Ignition in the OFF Position	• Circuitry. • Accessory delay relay.	• CHECK the accessory delay relay; REFER to Component Test. If OK, REPAIR circuit 400 (LB/BK). If not OK, REPLACE the accessory delay relay. TEST the system for normal operation.
• The Back Window Will Not Defrost	• GEM. • Circuitry. • Heated back window relay. • Heated backlite. • Heated back window grid. • DTC B1347. • DTC B1349. • DTC B1342.	• GO to Pinpoint Test J .
• The Back Window Defroster Will Not Shut Off Automatically	• Heated back window relay. • Circuitry. • GEM. • Heated backlite. • Heated back window grid. • DTC B1345. • DTC B1347. • DTC B1342.	• GO to Pinpoint Test K .
• No Communication With the Module — Generic Electronic Module	• Fuse. • Circuitry. • GEM.	• GO to Pinpoint Test L .

Pinpoint Test

CAUTION: Electronic modules are sensitive to electrostatic discharges. If exposed to these charges, damage may result.

CAUTION: Disconnect the battery before removing and installing the generic electronic module (GEM) or its connectors. Failure to follow this caution will result in the GEM storing many erroneous DTCs and possibly exhibiting erratic operation after installation.

CAUTION: Be careful when probing the I/P fuse panel, power distribution box or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

NOTE: If continuous diagnostic trouble codes (DTCs) are recorded and the symptom is not present when performing the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: Complete the entire pinpoint test related to the symptom before replacing the GEM.

PINPOINT TEST A: ALL POWER WINDOWS ARE INOPERATIVE — (2 DOOR AND 4 DOOR)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1 2 Scan Tool 3 	3 Monitor the GEM PID IGN_GEM while turning the ignition switch (11572) through the START, RUN, OFF, and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to A2 . → **No** REFER to Section 417-02

A2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)

1

2

Clear Continuous DTCs

3

GEM On-Demand Self-Test

1 Retrieve and document continuous DTCs.

- **Are any DTCs recorded?**

→ **Yes**
If DTC B1302, GO to A4 .

If DTC B1304, GO to A4 .

If DTC B1313, GO to A3 .

If DTC B1315, GO to A3 .

If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to A3 .

A3 CHECK THE BATTERY SAVER RELAY COIL CIRCUIT — MONITOR THE GEM PID BATSAV

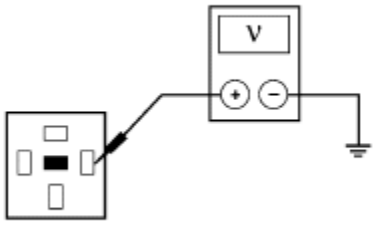
1

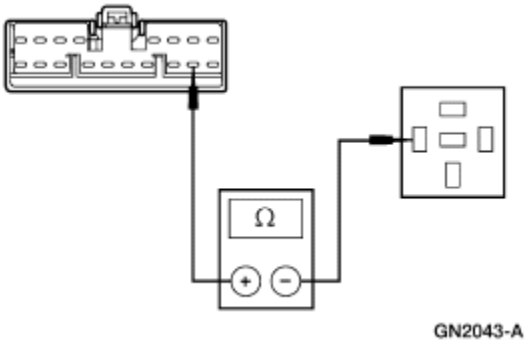
2

2 Monitor the GEM PID BATSAV while triggering the GEM active command BATT SAVR ON and OFF.

- **Does the GEM PID BATSAV value agree with the command mode?**

→ **Yes**
GO to A4 .

	→ **No** If the GEM PID BATSAV displays OFFO-G; REFER to Section 417-02 . If the GEM PID BATSAV displays ON-B-; REFER to Section 417-02 .
A4 CHECK THE ACCESSORY DELAY RELAY COIL CIRCUIT — MONITOR THE GEM PID ACCDLY	
1 	1 Monitor the GEM PID ACCDLY while triggering the GEM active command ACCY RLY ON and OFF. • **Does the GEM PID ACCDLY value agree with the command mode?** → **Yes** If the vehicle is a two door, GO to A11 . If the vehicle is a four door, GO to A10 . → **No** If the GEM PID ACCDLY displays OFFO-G, GO to A5 . If the GEM PID ACCDLY displays ON-B-, GO to A8 .
A5 CHECK THE VOLTAGE TO THE ACCESSORY DELAY RELAY COIL — CIRCUIT 705 (LG/O)	
1 2 Accessory Delay Relay 3  GN0103-A	3 Measure the voltage between accessory delay relay connector pin 86, circuit 705 (LG/O), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** GO to A6 . → **No** REPAIR circuit 705 (LG/O). TEST the system for normal operation.
A6 CHECK THE ACCESSORY DELAY RELAY	
	1 Check the accessory delay relay; refer to Component Test. • **Is the accessory delay relay OK?** → **Yes** GO to A7 . → **No** REPLACE the accessory delay relay. CLEAR the DTCs. TEST the system for normal operation.
A7 CHECK CIRCUIT 1004 (LB/R) FOR OPEN	
1 GEM C283 2 	2 Measure the resistance between accessory delay relay connector pin 85, circuit 1004 (LB/R), and GEM C283-17, circuit 1004 (LB/R). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1004 (LB/R). CLEAR the DTCs. TEST the system for normal operation.

A8 CHECK THE ACCESSORY DELAY RELAY

1

2

Accessory Delay Relay

3 Check the accessory delay relay; refer to Component Test.

- **Is the accessory delay relay OK?**

→ **Yes**
GO to A9 .

→ **No**
REPLACE the accessory delay relay. CLEAR the DTCs. TEST the system for normal operation.

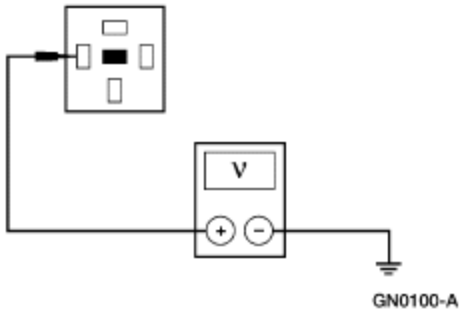
A9 CHECK CIRCUIT 1004 (LB/R) FOR SHORT TO POWER

1

GEM C283

2

3

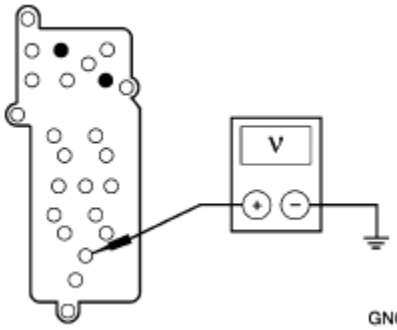


GN0100-A

3 Measure the voltage between accessory delay relay connector pin 85, circuit 1004 (LB/R), and ground.

- **Is any voltage indicated?**

→ **Yes**

	REPAIR circuit 1004 (LB/R). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
A10 CHECK THE VOLTAGE TO THE MASTER WINDOW/DOOR LOCK CONTROL SWITCH — CIRCUIT 400 (LB/BK)	
1 2 Master Window/Door Lock Control Switch C501 3 4 5  GN0106-A	4 Trigger the GEM active command ACCY RLY to ON. 5 Measure the voltage between master window/door lock control switch C501-19, circuit 400 (LB/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A14 . → **No** GO to A11 .
A11 CHECK POWER DISTRIBUTION BOX MAXI-FUSE 4 (30A)	
1	

2

Maxi-Fuse 4 (30A)

- **Is the fuse OK?**

→ **Yes**
GO to A12 .

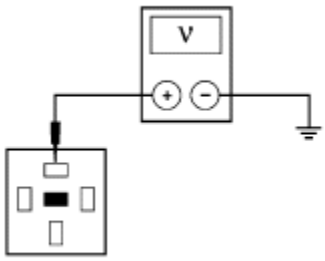
→ **No**
REPLACE maxi-fuse 4 (30A). CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.

A12 CHECK THE VOLTAGE TO THE ACCESSORY DELAY RELAY SWITCH — CIRCUIT 170 (R/LB)

1

Accessory Delay Relay

2



GN0105-A

2 Measure the voltage between accessory delay relay connector pin 87, circuit 170 (R/LB), and ground.

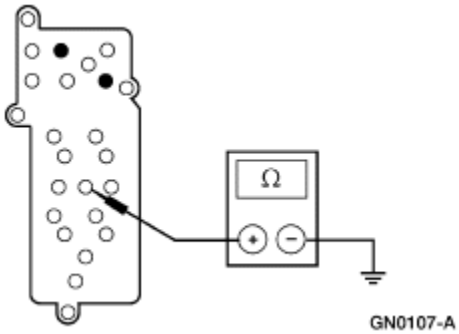
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A13 .

→ **No**
REPAIR circuit 170 (R/LB). CLEAR the DTCs. TEST the system for normal operation.

A13 CHECK THE ACCESSORY DELAY RELAY

1 Check the accessory delay relay; refer to

	Component Test. • **Is the accessory delay relay OK?** → **Yes** REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the accessory delay relay. CLEAR the DTCs. TEST the system for normal operation.
A14 CHECK THE GROUND TO THE MASTER WINDOW/DOOR LOCK CONTROL SWITCH — CIRCUIT 57 (BK)	
1 2  GN0107-A	2 Measure the resistance between master window/door lock control switch C501-13, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST B: SINGLE POWER WINDOW IS INOPERATIVE — DRIVER POWER WINDOW (4 DOOR)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1	

2

Scan Tool

3

3 Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions.

- **Do the PID values agree with the ignition switch positions?**

→ **Yes**
GO to B2.

→ **No**
REFER to Section 417-02.

B2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)

1

2

Clear Continuous DTCs

3

GEM On-Demand Self-Test

1 Retrieve and document continuous DTCs.

- **Are any DTCs recorded?**

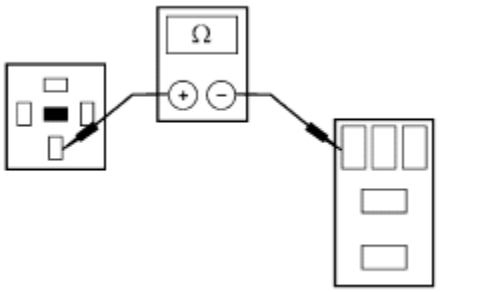
→ **Yes**
If DTC B1398, GO to B3.

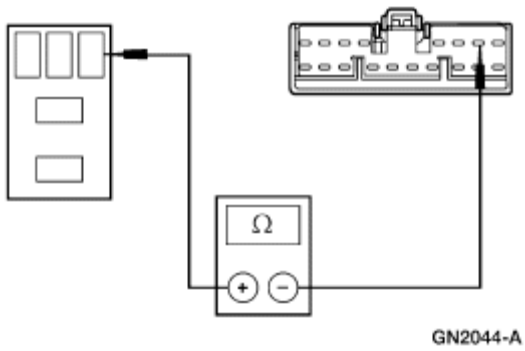
If DTC B1400, GO to B3.

If DTC B1404, GO to B9.

If DTC B1405, GO to B12.

	If DTC B1410, GO to B9. If DTC B1342, REPLACE the GEM; REFER to Section 419-10. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B13.
B3 CHECK THE ONE TOUCH DOWN RELAY COIL CIRCUIT — MONITOR THE GEM PID D_PWRLY	
1 2 3 	2 Trigger the GEM active command ACCY RLY to ON. 3 Monitor the GEM PID D_PWRLY while triggering the active command ONE TOUCH ON and OFF. • **Does the GEM PID D_PWRLY value agree with the command mode?** → **Yes** GO to B9. → **No** If the GEM PID D_PWRLY displays OFFO-G, GO to B4. If the GEM PID D_PWRLY displays ON-B-, GO to B7.
B4 CHECK THE ONE TOUCH DOWN RELAY	
1 2 One Touch Down Relay	3 Check the one touch down relay; refer to Component Test.

	• **Is the one touch down relay OK?** → **Yes** GO to B5 . → **No** REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.
B5 CHECK CIRCUIT 400 (LB/BK) FOR OPEN BETWEEN THE ACCESSORY DELAY RELAY AND THE ONE TOUCH DOWN RELAY	
1 Accessory Delay Relay 2  GN0108-A	2 Measure the resistance between accessory delay relay connector pin 30, circuit 400 (LB/BK), and one touch down relay connector pin 2, circuit 400 (LB/BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to B6 . → **No** REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.
B6 CHECK CIRCUIT 1007 (Y/R) FOR OPEN	
1 GEM C283 2	2 Measure the resistance between one touch down relay connector pin 1, circuit 1007 (Y/R), and GEM C283-7, circuit 1007 (Y/R).



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation.

B7 CHECK THE ONE TOUCH DOWN RELAY

1

2

One Touch Down Relay

3 Check the one touch down relay; refer to Component Test.

- **Is the one touch down relay OK?**

→ **Yes**
GO to B8 .

→ **No**
REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.

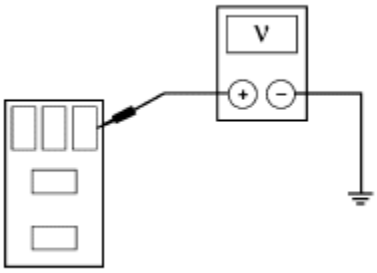
B8 CHECK CIRCUIT 1007 (Y/R) FOR SHORT TO POWER

1

GEM C283

2

3



GN0110-A

3 Measure the voltage between one touch down relay connector pin 1, circuit 1007 (Y/R), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

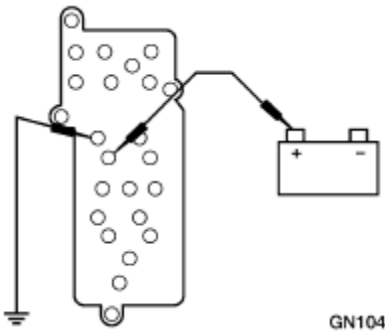
B9 CHECK THE DRIVER POWER WINDOW DOWN OPERATION

1

2

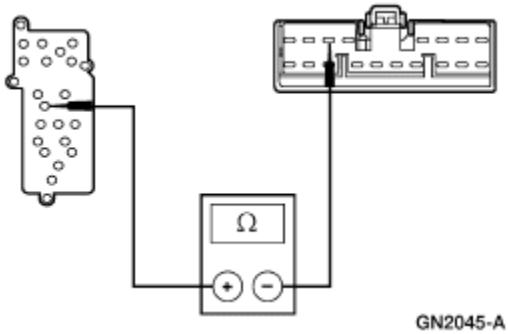
Master Window/Door Lock Control Switch C501

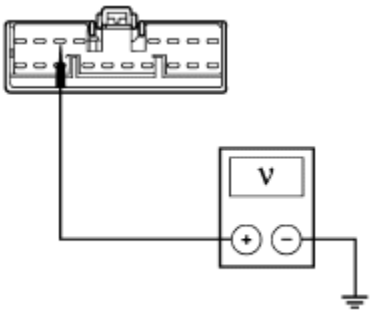
3



GN1043-A

3 Connect a jumper wire between master window/door lock control switch C501-8, circuit 992 (R/Y), and ground; and between master window/door lock control switch C501-10, circuit 991 (T/LB), and the positive battery terminal.

4 	• **Does the driver power window go down?** → **Yes** REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** Remove the jumper wires; GO to B10 .
B10 CHECK CIRCUIT 991 (T/LB) FOR OPEN	
1 GEM C283 2  GN2045-A	2 Measure the resistance between GEM C283-3, circuit 991 (T/LB), and master window/door lock control switch C501-10, circuit 991 (T/LB). • **Is the resistance less than 5 ohms?** → **Yes** GO to B11 . → **No** REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.
B11 CHECK CIRCUIT 991 (T/LB) FOR SHORT TO GROUND	
	1 Measure the resistance between GEM C283-3, circuit 991 (T/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes**

	REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.
B12 CHECK CIRCUIT 991 (T/LB) FOR SHORT TO POWER	
1 2 Master Window/Door Lock Control Switch C501 3 GEM C283 4 5  GN2046-A	5 Measure the voltage between GEM C283-3, circuit 991 (T/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

B13 CHECK THE VOLTAGE TO THE DRIVER POWER WINDOW MOTOR — DOWN CONDITION

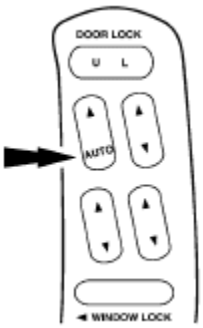
1

2

Driver Power Window Motor C504

3

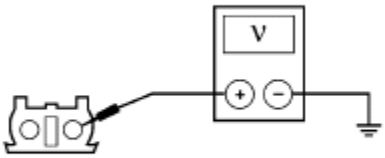
4



GN1045-A

4 Depress the DOWN position and hold on the master window/door lock control switch.

5



GN0114-A

5 Measure the voltage between driver power window motor C504, circuit 903 (R), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B16 .

→ **No**
GO to B14 .

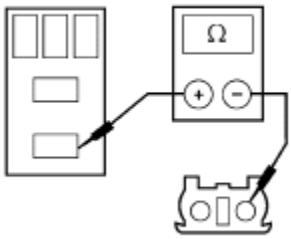
B14 CHECK CIRCUIT 903 (R) FOR OPEN

1

2

One Touch Down Relay

3



GN0115-A

3 Measure the resistance between one touch down relay connector pin 3, circuit 903 (R), and LF power window motor C504, circuit 903 (R).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to B15 .

→ **No**
REPAIR circuit 903 (R). CLEAR the DTCs. TEST the system for normal operation.

B15 CHECK CIRCUIT 991 (T/LB) FOR OPEN

1

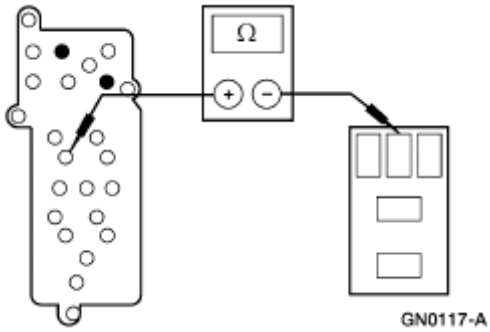
Master Window/Door Lock Control Switch C501

2

One Touch Down Relay

3

3 Measure the resistance between master window/door lock control switch, C501-10, circuit 991 (T/LB), and one touch down relay connector pin 4, circuit 991 (T/LB).



GN0117-A

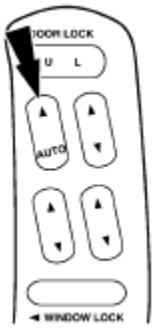
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.

B16 CHECK THE VOLTAGE TO THE DRIVER POWER WINDOW MOTOR — UP CONDITION

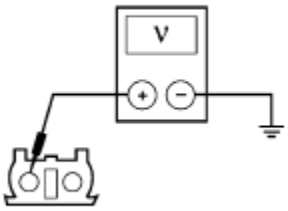
1



GN0118-A

1 Depress the UP position and hold on the master window/door lock control switch.

2



GN0119-A

2 Measure the voltage between driver power window motor C504, circuit 992 (W/BK), and ground.

- **Is the voltage greater than 10 volts?**

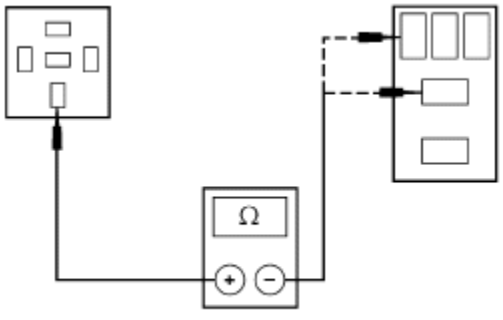
→ **Yes**
REPLACE the driver power window motor; REFER to Motor and Window Regulator—

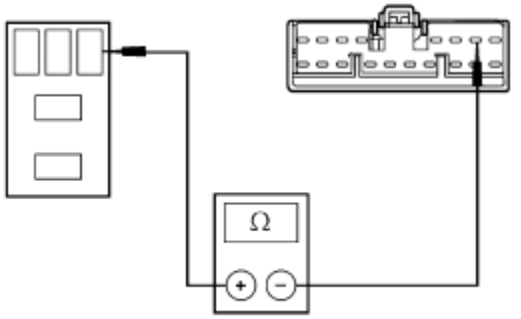
	Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 992 (W/BK). CLEAR the DTCs. TEST the system for normal operation.

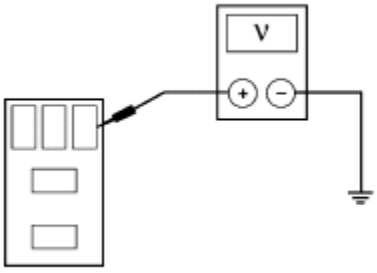
PINPOINT TEST C: SINGLE POWER WINDOW IS INOPERATIVE — DRIVER POWER WINDOW (2 DOOR)

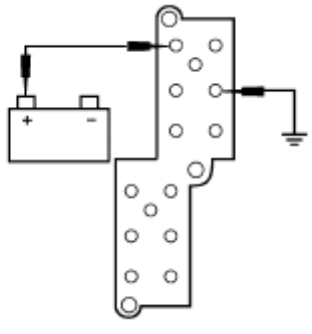
CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN _GEM	
1 2 Scan Tool 3 	3 Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to C2 . → **No** REFER to Section 417-02 .
C2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3	1 Retrieve and document continuous DTCs.

 GEM On-Demand Self-Test	• **Are any DTCs recorded?** → **Yes** If DTC B1398, GO to C3 . If DTC B1400, GO to C3 . If DTC B1404, GO to C9 . If DTC B1405, GO to C12 . If DTC B1410, GO to C9 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C13 .
C3 CHECK THE ONE TOUCH DOWN RELAY COIL CIRCUIT — MONITOR THE GEM PID D_PWRLY	
1 2 3 	2 Trigger the GEM active command ACCY RLY to ON. 3 Monitor the GEM PID D_PWRLY while triggering the active command ONE TOUCH ON and OFF. • **Does the GEM PID D_PWRLY value agree with the command mode?** → **Yes** GO to C9 . → **No** If the GEM PID D_PWRLY displays OFFO-G, GO to C4 . If the GEM PID D_PWRLY displays ON-B-, GO

	to C7 .
C4 CHECK THE ONE TOUCH DOWN RELAY	
1 2 One Touch Down Relay	3 Check the one touch down relay; refer to Component Test. • **Is the one touch down relay OK?** → **Yes** GO to C5 . → **No** REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.
C5 CHECK CIRCUIT 400 (LB/BK) FOR OPEN BETWEEN THE ACCESSORY DELAY RELAY AND THE ONE TOUCH DOWN RELAY	
1 Accessory Delay Relay 2  GN2047-A	2 Measure the resistance between accessory delay relay connector pin 30, circuit 400 (LB/BK), and one touch down relay connector pin 2, circuit 400 (LB/BK); and between accessory delay relay connector pin 30, circuit 400 (LB/BK), and one touch down relay connector pin 5, circuit 400 (LB/BK). • **Are the resistances less than 5 ohms?** → **Yes** GO to C6 . → **No**

	REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.
C6 CHECK CIRCUIT 1007 (Y/R) FOR OPEN	
1 GEM C283 2  	2 Measure the resistance between one touch down relay connector pin 1, circuit 1007 (Y/R), and GEM C283-7, circuit 1007 (Y/R). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation.
C7 CHECK THE ONE TOUCH DOWN RELAY	
1 2 One Touch Down Relay	3 Check the one touch down relay; refer to Component Test. • **Is the one touch down relay OK?** → **Yes** GO to C8 .

	→ **No** REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.
C8 CHECK CIRCUIT 1007 (Y/R) FOR SHORT TO POWER	
1 GEM C283 2 3  GN0110-A	3 Measure the voltage between one touch down relay connector pin 1, circuit 1007 (Y/R), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
C9 CHECK THE DRIVER POWER WINDOW DOWN OPERATION	
1 2 Driver Window Regulator Control Switch C515 3	3 Connect a jumper wire between driver window



4

regulator control switch C515-5, circuit 992 (R/Y), and ground; and between driver window regulator control switch C515-1, circuit 991 (T/LB), and the positive battery terminal.

- **Does the driver power window go down?**

→ **Yes**
REPLACE the driver window regulator control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

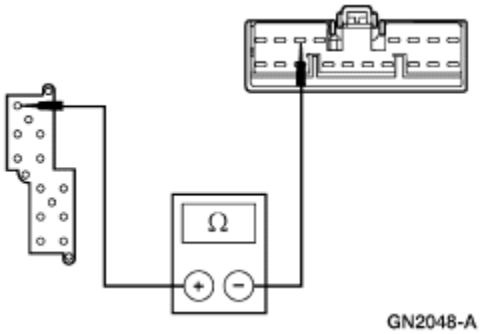
→ **No**
Remove the jumper wires; GO to C10 .

C10 CHECK CIRCUIT 991 (T/LB) FOR OPEN

1

GEM C283

2

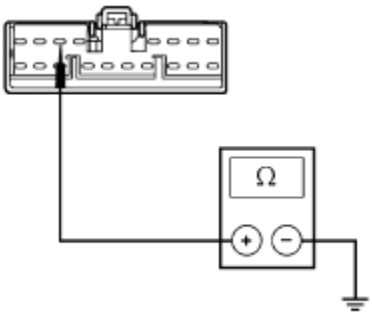


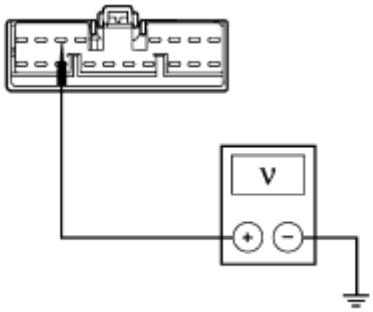
2 Measure the resistance between GEM C283-3, circuit 991 (T/LB), and driver window regulator control switch C515-1, circuit 991 (T/LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to C11 .

→ **No**

	REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.
C11 CHECK CIRCUIT 991 (T/LB) FOR SHORT TO GROUND	
1  GN2049-A	1 Measure the resistance between GEM C283-3, circuit 991 (T/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.
C12 CHECK CIRCUIT 991 (T/LB) FOR SHORT TO POWER	
1 2 Driver Window Regulator Control Switch C515 3 GEM C283 4 5	5 Measure the voltage between GEM C283-3, circuit 991 (T/LB), and ground.



GN2049-B

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

C13 CHECK THE VOLTAGE TO THE DRIVER POWER WINDOW MOTOR — DOWN CONDITION

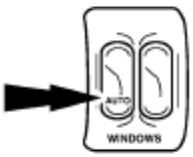
1

2

Driver Power Window Motor C504

3

4

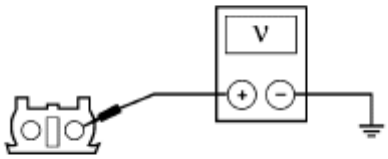


GN1393-A

5

4 Depress the DOWN position and hold on the master window/door lock control switch.

5 Measure the voltage between driver power window motor C504, circuit 903 (R), and



GN0114-A

ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to C16 .

→ **No**
GO to C14 .

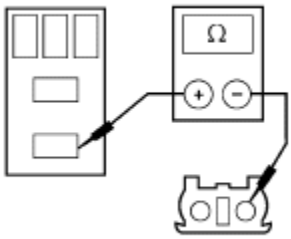
C14 CHECK CIRCUIT 903 (R) FOR OPEN

1

2

One Touch Down Relay

3



GN0115-A

3 Measure the resistance between one touch down relay connector pin 3, circuit 903 (R), and driver power window motor C504, circuit 903 (R).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to C15 .

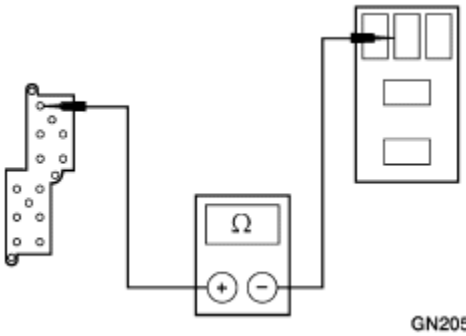
→ **No**
REPAIR circuit 903 (R). CLEAR the DTCs. TEST the system for normal operation.

C15 CHECK CIRCUIT 991 (T/LB) FOR OPEN

1

Driver Power Window Switch C515

2



2 Measure the resistance between driver power window switch C515-1, circuit 991 (T/LB), and one touch down relay connector pin 4, circuit 991 (T/LB).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 991 (T/LB). CLEAR the DTCs. TEST the system for normal operation.

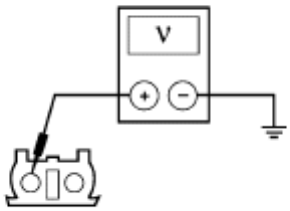
C16 CHECK THE VOLTAGE TO THE DRIVER POWER WINDOW MOTOR — UP CONDITION

1

1 Depress the UP position and hold on the driver power window switch.

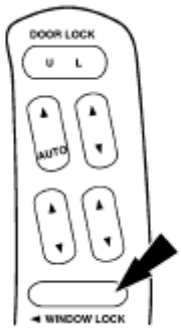
2

2 Measure the voltage between driver power window motor C504, circuit 992 (W/BK), and ground.

 GN0119-A	• **Is the voltage greater than 10 volts?** → **Yes** REPLACE the driver power window motor; REFER to Motor and Window Regulator—Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 992 (W/BK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: SINGLE POWER WINDOW IS INOPERATIVE — PASSENGER POWER WINDOW (4 DOOR)

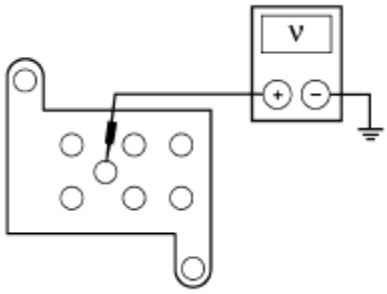
CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE VOLTAGE TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — CIRCUIT 170 (R/LB)	
1 2 Passenger Window Regulator Control Switch C615 3	3 Depress the right side of the window lock switch.



GN0120-A

4

5



GN0121-A

5 Measure the voltage between passenger window regulator control switch C615-4, circuit 170 (R/LB), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to D2 .

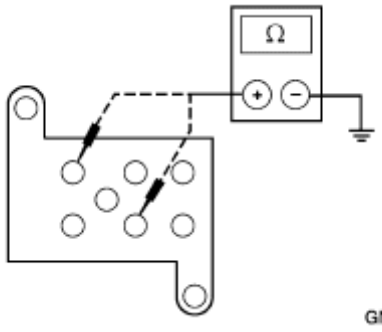
→ **No**
GO to D3 .

D2 CHECK THE GROUNDS TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — CIRCUITS 313 (W/Y) AND 314 (T/LB)

1

2

2 Measure the resistance between passenger window regulator control switch C615-1, circuit 313 (W/Y), C615-6, circuit 314 (T/LB), and ground.



- **Are the resistances less than 14 ohms?**

→ **Yes**
GO to D5 .

→ **No**
GO to D4 .

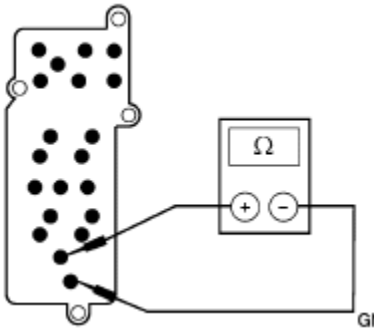
D3 CHECK THE DRIVER MASTER WINDOW/DOOR LOCK CONTROL SWITCH

1

2

Master Window/Door Lock Control Switch C501

3



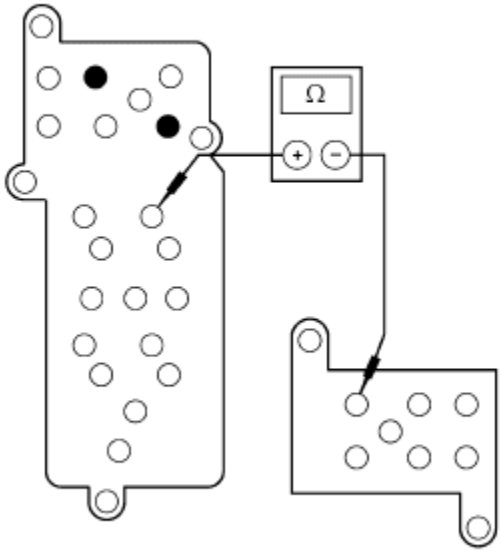
3 **NOTE:** Set the window lock switch in the UNLOCK position.

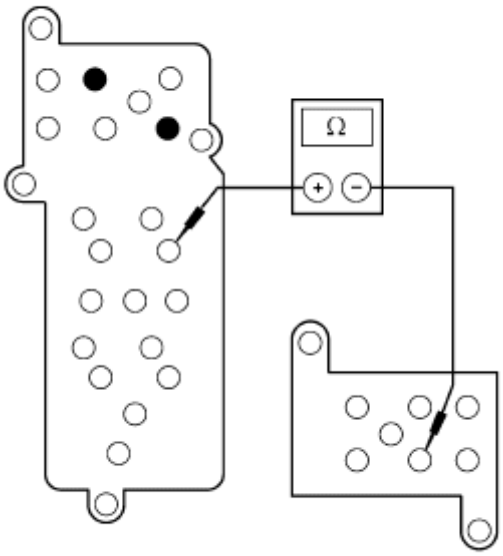
Measure the resistance between master window/door lock control switch terminals 19 and 20.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 170 (R/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator

	Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.
D4 CHECK CIRCUITS 313 (W/Y) AND 314 (T/LB) FOR OPEN	
1 	
2 Master Window/Door Lock Control Switch C501	
3  GN0123-A	3 Measure the resistance between master window/door lock control switch C501-9, circuit 313 (W/Y), and passenger power window switch C615-1, circuit 313 (W/Y).
4	4 Measure the resistance between master window/door lock control switch C501-11, circuit 314 (T/LB), and passenger window regulator control switch C615-6, circuit 314 (T/LB).



GN0124-A

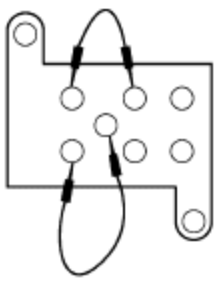
- **Are the resistances less than 5 ohms?**

→ **Yes**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 313 (W/Y) and/or circuit 314 (T/LB). CLEAR the DTCs. TEST the system for normal operation.

D5 CHECK THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — DOWN DIRECTION

1



GN0125-A

2

1 Connect a jumper wire between passenger window regulator control switch C615-1, circuit 313 (W/Y), and C615-2, circuit 333 (Y/R); and between passenger window regulator control switch C615-4, circuit 170 (R/LB), and C615-5, circuit 334 (R/Y).

- **Does the window operate in the downward direction?**

→ **Yes**
If the passenger power window did not operate with the passenger window regulator control switch, REPLACE the passenger window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation.

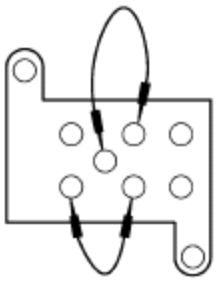
If the passenger power window did operate with the passenger window regulator control switch but not with the master window/door lock control switch, REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
Remove the jumper wires; GO to D6 .

D6 CHECK THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — UP DIRECTION

1

2

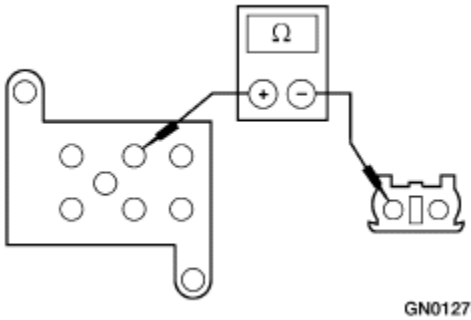


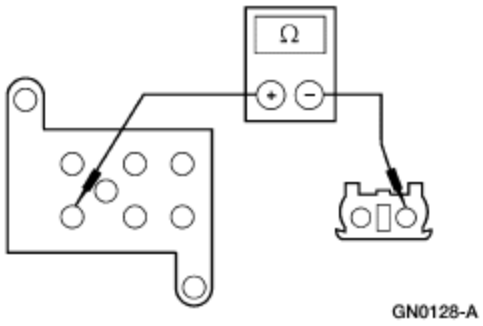
GN0126-A

3

2 Connect a jumper wire between passenger window regulator control switch C615-5, circuit 334 (R/Y), and C615-6, circuit 314 (T/LB); and between passenger window regulator control switch C615-2, circuit 333 (Y/R), and C615-4, circuit 170 (R/LB).

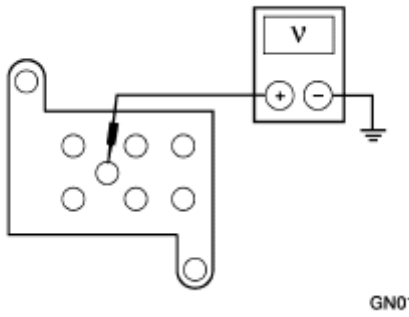
- **Does the window operate in the upward direction?**

	→ **Yes** If the passenger power window does not operate with the passenger window regulator control switch, REPLACE the passenger window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation. If the passenger power window did operate with the passenger window regulator control switch but not with the master window/door lock control switch, REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** Remove the jumper wires; GO to D7 .
D7 CHECK CIRCUIT 333 (Y/R) FOR OPEN	
1 2 RF Power Window Motor C604 3  GN0127-A	3 Measure the resistance between passenger window regulator control switch C615-2, circuit 333 (Y/R), and passenger window motor C604, circuit 333 (Y/R). • **Is the resistance less than 5 ohms?** → **Yes** GO to D8 . → **No** REPAIR circuit 333 (Y/R). CLEAR the DTCs. TEST the system for normal operation.
D8 CHECK CIRCUIT 334 (R/Y) FOR OPEN	

1  	1 Measure the resistance between passenger power window switch C615-5, circuit 334 (R/Y), and passenger power window motor C604, circuit 334 (R/Y). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the passenger power window motor; REFER to Motor and Window Regulator—Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 334 (R/Y). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST E: SINGLE POWER WINDOW IS INOPERATIVE — PASSENGER WINDOW REGULATOR CONTROL (2 DOOR)

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE VOLTAGE TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — CIRCUIT 400 (LB/BK)	
1 2 Passenger Power Window Switch C615 3 4	4 Measure the voltage between passenger window regulator control switch C615-4, circuit 400 (LB/BK), and ground.



- **Is the voltage greater than 10 volts?**

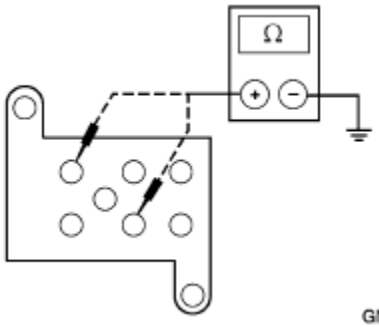
→ **Yes**
GO to E2 .

→ **No**
REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

E2 CHECK THE GROUNDS TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — CIRCUITS 313 (W/Y) AND 314 (T/LB)

1

2



2 Measure the resistance between passenger window regulator control switch C615-1, circuit 313 (W/Y), C615-6, circuit 314 (T/LB), and ground.

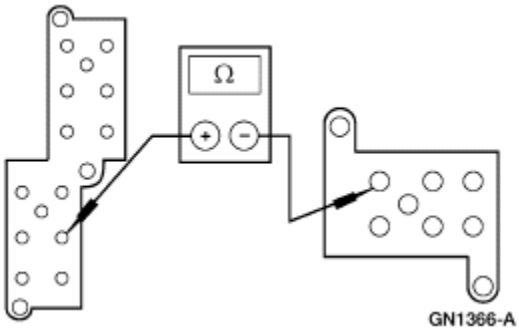
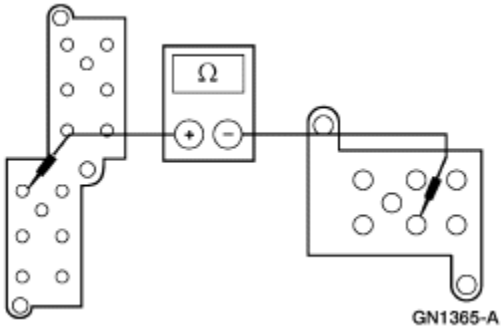
- **Are the resistances less than 14 ohms?**

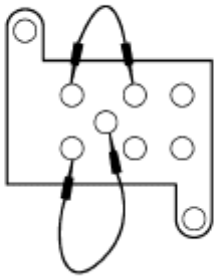
→ **Yes**
GO to E4 .

→ **No**
GO to E3 .

E3 CHECK CIRCUITS 313 (W/Y) AND 314 (T/LB) FOR OPEN

1

 Driver Window Regulator Control Switch C515 2  3  	2 Measure the resistance between driver window regulator control switch C515-12, circuit 313 (W/Y), and passenger window regulator control switch C615-1, circuit 313 (W/Y). 3 Measure the resistance between driver window regulator control switch C515-8, circuit 314 (T/LB), and passenger window regulator control switch C615-6, circuit 314 (T/LB). • **Are the resistances less than 5 ohms?** → **Yes** REPLACE the passenger window regulator control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 313 (W/Y) and/or circuit 314 (T/LB). CLEAR the DTCs. TEST the system for normal operation.
E4 CHECK THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — DOWN DIRECTION	
1	1 Connect a jumper wire between passenger window regulator control switch C615-1, circuit 313 (W/Y), and C615-2, circuit 333 (Y/R); and between passenger window regulator control switch C615-4, circuit 400 (LB/BK), and C615-5, circuit 334 (R/Y).



GN0125-A

2

- **Does the window operate in the downward direction?**

→ **Yes**
If the passenger power window did not operate with the passenger window regulator control switch, REPLACE the passenger window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation.

If the passenger power window did operate with the passenger window regulator control switch but not with the driver window regulator control switch, REPLACE the driver window regulator control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

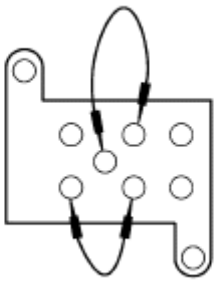
→ **No**
Remove the jumper wires; GO to E5 .

E5 CHECK THE PASSENGER WINDOW REGULATOR CONTROL SWITCH — UP DIRECTION

1

2

2 Connect a jumper wire between passenger window regulator control switch C615-5, circuit 334 (R/Y), and C615-6, circuit 314 (T/LB); and between passenger window regulator control switch C615-2, circuit 333 (Y/R), and C615-4, circuit 400 (LB/BK).



GN0126-A

3

- **Does the window operate in the upward direction?**

→ **Yes**
If the passenger power window does not operate with the passenger window regulator control switch, REPLACE the passenger window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation.

If the passenger power window did operate with the passenger window regulator control switch but not with the driver window regulator control switch, REPLACE the driver window switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
Remove the jumper wires; GO to E6 .

E6 CHECK CIRCUIT 333 (Y/R) FOR OPEN

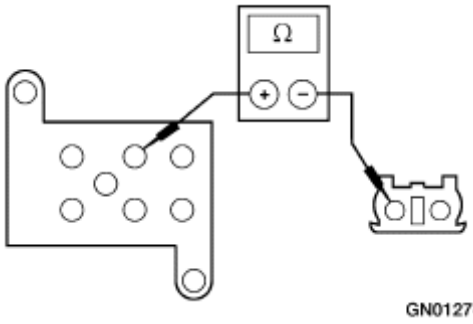
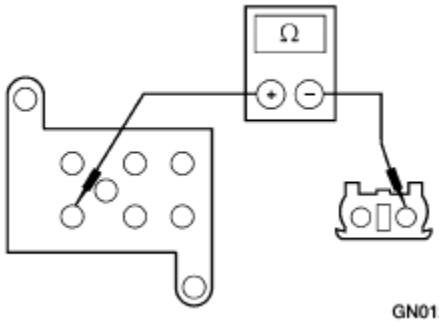
1

2

Passenger Power Window Motor C604

3

3 Measure the resistance between passenger window regulator control switch C615-2, circuit 333 (Y/R), and passenger power

	window motor C604, circuit 333 (Y/R). • **Is the resistance less than 5 ohms?** → **Yes** GO to E7 . → **No** REPAIR circuit 333 (Y/R). CLEAR the DTCs. TEST the system for normal operation.
E7 CHECK CIRCUIT 334 (R/Y) FOR OPEN	
1 	1 Measure the resistance between passenger window regulator control switch C615-5, circuit 334 (R/Y), and passenger power window motor C604, circuit 334 (R/Y). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the passenger power window motor; REFER to Motor and Window Regulator—Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 334 (R/Y). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST F: SINGLE POWER WINDOW IS INOPERATIVE — LR POWER WINDOW

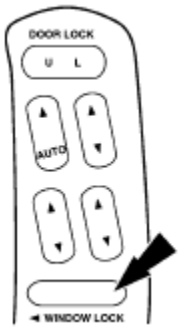
CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE VOLTAGE TO THE LR WINDOW REGULATOR CONTROL SWITCH — CIRCUIT 170 (R/LB)	

1

2

LR Power Window Switch C702

3

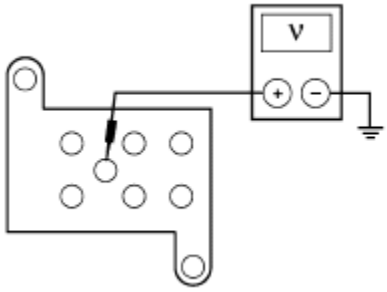


GN0120-A

3 Depress the right side of the window lock switch.

4

5



GN0121-A

5 Measure the voltage between LR window regulator control switch C702-4, circuit 170 (R/LB), and ground.

- **Is the voltage greater than 10 volts?**

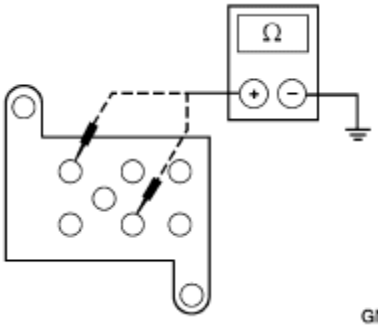
→ **Yes**
GO to F2 .

→ **No**
GO to F3 .

F2 CHECK THE GROUNDS TO THE LR WINDOW REGULATOR CONTROL SWITCH — CIRCUITS 316 (Y/LB) AND 317 (GY/O)

1

2



GN0122-A

2 Measure the resistance between LR window regulator control switch C702-1, circuit 317 (GY/O), C702-6, circuit 316 (Y/LB), and ground.

- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to F6 .

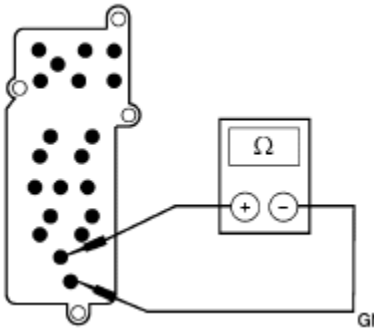
→ **No**
GO to F4 .

F3 CHECK THE MASTER WINDOW/DOOR LOCK CONTROL SWITCH

1

Master Window/Door Lock Control Switch C501

2



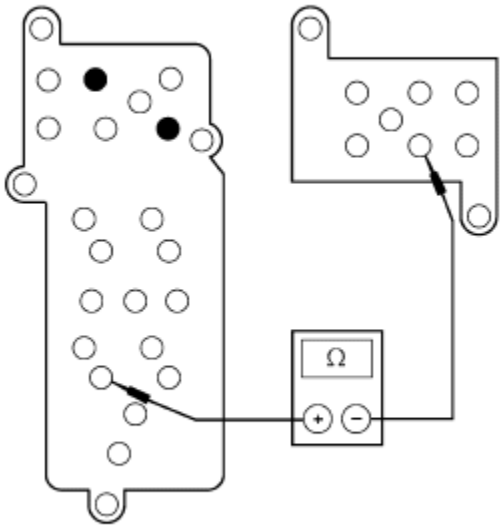
GN1388-A

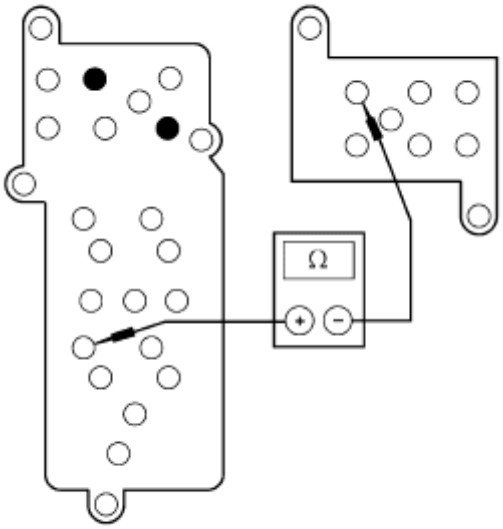
2 Measure the resistance between master window/door lock control switch terminals 19 and 20.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 170 (R/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator

	Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.
F4 CHECK CIRCUIT 316 (Y/LB) FOR OPEN	
1 Master Window/Door Lock Control Switch C501	
2  GN0129-A	2 Measure the resistance between master window/door lock control switch C501-17, circuit 316 (Y/LB), and LR window regulator control switch C701-6, circuit 316 (Y/LB). • **Is the resistance less than 5 ohms?** → **Yes** GO to F5 . → **No** REPAIR circuit 316 (Y/LB). CLEAR the DTCs. TEST the system for normal operation.
F5 CHECK CIRCUIT 317 (GY/O) FOR OPEN	
1	1 Measure the resistance between master window/door lock control switch C501-15, circuit 317 (GY/O), and LR window regulator control switch C702-1, circuit 317 (GY/O).



GN0130-A

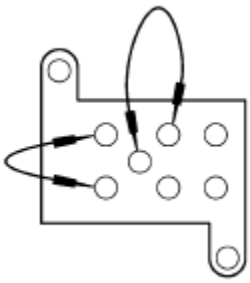
- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 317 (GY/O). CLEAR the DTCs. TEST the system for normal operation.

F6 CHECK THE LR WINDOW REGULATOR CONTROL SWITCH — DOWNWARD DIRECTION

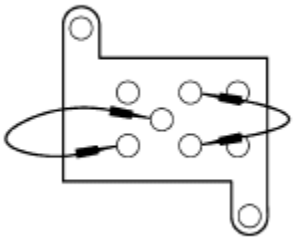
1

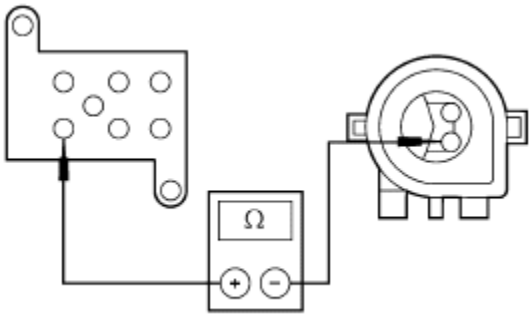


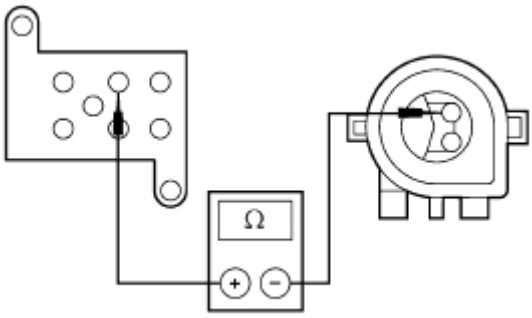
GN0131-A

2

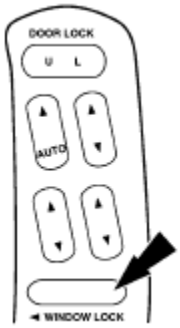
1 Connect a jumper wire between LR window regulator control switch C702-1, circuit 317 (GY/O), and C702-5, circuit 884 (Y/BK); and between LR window regulator control switch C702-2, circuit 885 (Y/LB), and C702-4, circuit 170 (R/LB).

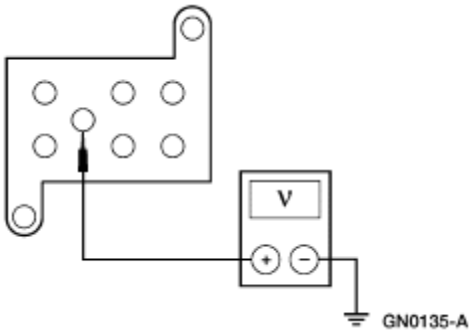
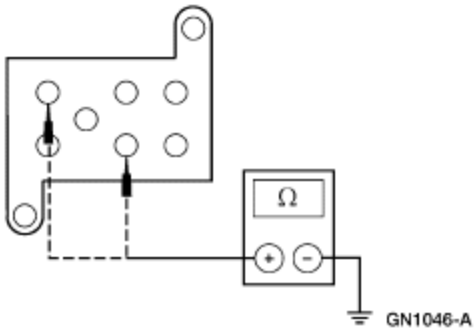
	• **Does the window operate in the downward direction?** → **Yes** If the LR power window did not operate with the LR window regulator control switch, REPLACE the LR window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation. If the LR power window did operate with the LR window regulator control switch but not with the master window/door lock control switch, REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** Remove the jumper wires; GO to F7 .
F7 CHECK THE LR WINDOW REGULATOR CONTROL SWITCH — UPWARD DIRECTION	
1 2  GN0132-A 3 	2 Connect a jumper wire between LR window regulator control switch C702-2, circuit 885 (Y/LB), and C702-6, circuit 316 (Y/LB); and between LR window regulator control switch C702-4, circuit 170 (R/LB), and C702-5, circuit 884 (Y/BK). • **Does the window operate in the upward direction?** → **Yes** If the LR power window did not operate with the LR window regulator control switch, REPLACE the LR window regulator control switch; REFER to Switch—Window Regulator

	Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation. If the LR power window did operate with the LR window regulator control switch but not with the master window/door lock control switch, REPLACE the master window/door lock window control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation. → **No** Remove the jumper wires; GO to F8 .
F8 CHECK CIRCUIT 884 (Y/BK) FOR OPEN	
1 2 LR Power Window Motor C701 3  	3 Measure the resistance between LR window regulator control switch C702-5, circuit 884 (Y/BK), and LR power window motor C701, circuit 884 (Y/BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to F9 . → **No** REPAIR circuit 884 (Y/BK). CLEAR the DTCs. TEST the system for normal operation.
F9 CHECK CIRCUIT 334 (Y/LB) FOR OPEN	
1	1 Measure the resistance between LR window regulator control switch C702-2, circuit 885 (Y/LB), and LR power window motor C701, circuit 885 (Y/LB).

 GN2052-A	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the LR power window motor; REFER to Motor and Window Regulator—Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 885 (Y/LB). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST G: SINGLE POWER WINDOW IS INOPERATIVE — RR POWER WINDOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE VOLTAGE TO THE RR WINDOW REGULATOR CONTROL SWITCH — CIRCUIT 170 (R/LB)	
1 2 RR Window Regulator Control Switch C802 3  GN0120-A	3 Depress the right side of the window lock switch.

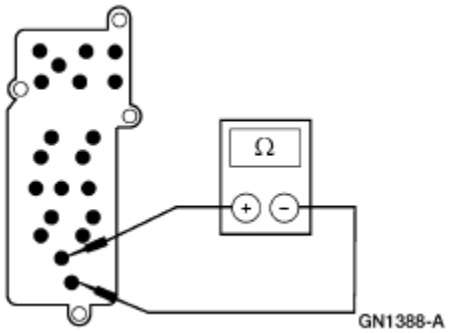
4 5  GN0135-A	5 Measure the voltage between RR window regulator control switch C802-4, circuit 170 (R/LB), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to G2 . → **No** GO to G3 .
G2 CHECK THE GROUNDS TO THE RR WINDOW REGULATOR CONTROL SWITCH — CIRCUITS 319 (Y/BK) AND 320 (R/BK)	
1 2  GN1046-A	2 Measure the resistance between RR window regulator control switch C802-6, circuit 320 (R/BK), C802-1, circuit 319 (Y/BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** GO to G6 . → **No** GO to G4 .

G3 CHECK THE MASTER WINDOW/DOOR LOCK CONTROL SWITCH

1

Master Window/Door Lock Control Switch C501

2



2 Measure the resistance between master window/door lock control switch terminals 19 and 20.

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPAIR circuit 170 (R/LB). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

G4 CHECK CIRCUIT 319 (Y/BK) FOR OPEN

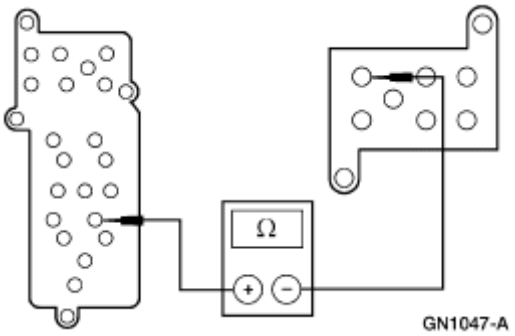
1

2

Master Window/Door Lock Control Switch C501

3

3 Measure the resistance between master window/door lock control switch C501-16, circuit 319 (Y/BK), and RR window regulator control switch C802-1, circuit 319 (Y/BK).



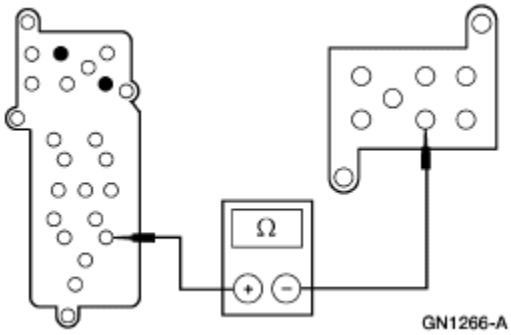
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to G5 .

→ **No**
REPAIR circuit 319 (Y/BK). CLEAR the DTCs. TEST the system for normal operation.

G5 CHECK CIRCUIT 320 (R/BK) FOR OPEN

1



1 Measure the resistance between master window/door lock control switch C501-18, circuit 320 (R/BK), and RR window regulator control switch C802-6, circuit 320 (R/BK).

- **Is the resistance less than 5 ohms?**

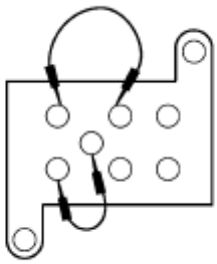
→ **Yes**
REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 320 (R/BK). CLEAR the DTCs. TEST the system for normal operation.

G6 CHECK THE RR WINDOW REGULATOR CONTROL SWITCH — DOWNWARD DIRECTION

1

1 Connect a jumper wire between RR window regulator control switch C802-1, circuit 319 (Y/BK), and C802-2, circuit 881 (BR); and between RR window regulator control switch C802-4, circuit 170 (R/LB), and C802-5, circuit 882 (BR/Y).



GN1048-A

2

- **Does the window operate in the downward direction?**

→ **Yes**
If the RR power window did not operate with the RR window regulator control switch, REPLACE the RR window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation.

If the RR power window did operate with the RR window regulator control switch but not with the master window/door lock control switch, REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

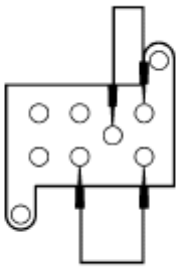
→ **No**
Remove the jumper wires; GO to G7 .

G7 CHECK THE RR WINDOW REGULATOR CONTROL SWITCH — UPWARD DIRECTION

1

2

2 Connect a jumper wire between RR window regulator control switch C802-5, circuit 882 (BR/Y), and C802-6, circuit 320 (R/BK); and between RR window regulator control switch C802-2, circuit 881 (BR), and C802-4, circuit 170 (R/LB).



GN1376-A

3

- **Does the window operate in the upward direction?**

→ **Yes**
If the RR power window did not operate with the RR window regulator control switch, REPLACE the RR window regulator control switch; REFER to Switch—Window Regulator Control, Rear Door . CLEAR the DTCs. TEST the system for normal operation.

If the RR power window did operate with the RR window regulator control switch, but not with the master window/door lock control switch, REPLACE the master window/door lock control switch; REFER to Switch—Window Regulator Control, Driver Door . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
Remove the jumper wires; GO to G8 .

G8 CHECK CIRCUIT 881 (BR) FOR OPEN

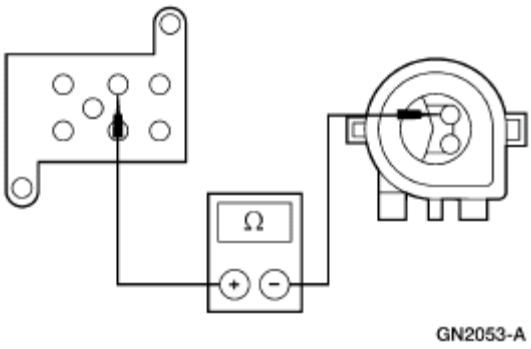
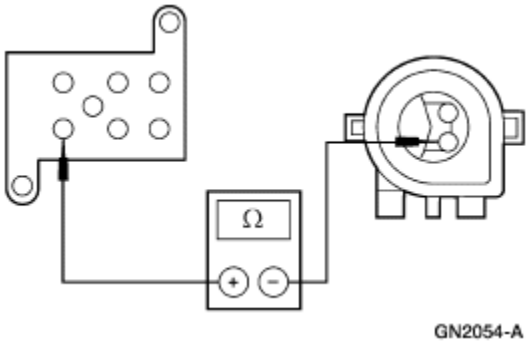
1

2

RR Power Window Motor C801

3

3 Measure the resistance between RR window regulator control switch C802-2, circuit 881 (BR), and RR power window motor C801, circuit 881 (BR).

	• **Is the resistance less than 5 ohms?** → **Yes** GO to G9 . → **No** REPAIR circuit 881 (BR). CLEAR the DTCs. TEST the system for normal operation.
G9 CHECK CIRCUIT 882 (BR/Y) FOR OPEN	
1 	1 Measure the resistance between RR window regulator control switch C802-5, circuit 882 (BR/Y), and RR power window motor C801, circuit 882 (BR/Y). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the RR power window motor; REFER to Motor and Window Regulator—Front Door . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 882 (BR/Y). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST H: THE ONE TOUCH DOWN FEATURE IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1	

2

Scan Tool

3

3 Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions.

- **Do the PID values agree with the ignition switch positions?**

→ **Yes**
GO to H2 .

→ **No**
REFER to Section 417-02 .

H2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)

1

2

Clear Continuous DTCs

3

GEM On-Demand Self-Test

1 Retrieve and document continuous DTCs.

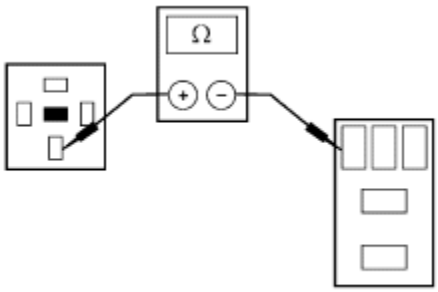
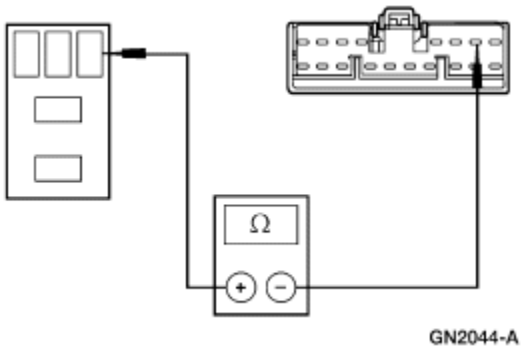
- **Are any DTCs recorded?**

→ **Yes**
If DTC B1398, GO to H3 .

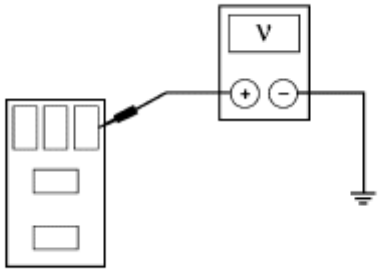
If DTC B1400, GO to H3 .

If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** GO to H3.
H3 CHECK THE ONE TOUCH DOWN RELAY COIL CIRCUIT — MONITOR THE GEM PID D_PWRLY	
1 2 3 	2 Trigger the GEM active command ACCY RLY to ON. 3 Monitor the GEM PID D_PWRLY while triggering the active command ONE TOUCH ON and OFF. • **Does the GEM PID D_PWRLY agree with the command mode?** → **Yes** GO to H9. → **No** If the GEM PID D_PWRLY displays OFFO-G, GO to H4. If the GEM PID D_PWRLY displays ON-B-, GO to H7.
H4 CHECK THE ONE TOUCH DOWN RELAY	
1 2 One Touch Down Relay	3 Check the one touch down relay; refer to Component Test. • **Is the one touch down relay OK?** → **Yes** GO to H5.

	→ **No** REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.
H5 CHECK CIRCUIT 400 (LB/BK) FOR OPEN	
1 Accessory Delay Relay 2  	2 Measure the resistance between one touch down relay connector pin 2, circuit 400 (LB/BK), and accessory delay relay connector pin 30, circuit 400 (LB/BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to H6 . → **No** REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.
H6 CHECK CIRCUIT 1007 (Y/R) FOR OPEN	
1 GEM C283 2  	2 Measure the resistance between one touch down relay connector pin 1, circuit 1007 (Y/R), and GEM C283-7, circuit 1007 (Y/R).

	• **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation.
H7 CHECK THE ONE TOUCH DOWN RELAY	
1 2 One Touch Down Relay	3 Check the one touch down relay; refer to Component Test. • **Is the one touch down relay OK?** → **Yes** GO to H8 . → **No** REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.
H8 CHECK CIRCUIT 1007 (Y/R) FOR SHORT TO POWER	
1 GEM C283 2 3	3 Measure the voltage between one touch down relay connector pin 1, circuit 1007 (Y/R), and ground.



GN0110-A

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 1007 (Y/R). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

H9 CHECK THE ONE TOUCH DOWN RELAY

1

2

One Touch Down Relay

3 Check the one touch down relay; refer to Component Test.

- **Is the one touch down relay OK?**

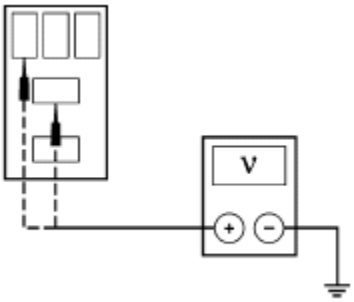
→ **Yes**
GO to H10 .

→ **No**
REPLACE the one touch down relay. CLEAR the DTCs. TEST the system for normal operation.

H10 CHECK THE VOLTAGE TO THE SWITCH SIDE OF THE ONE TOUCH DOWN RELAY — CIRCUIT 400 (LB/BK)

1

2



GN2056-A

2 Measure the voltage between one touch down relay connector pin 5, connector pin 2, circuit 400 (LB/BK), and ground.

- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to H11 .

→ **No**
REPAIR circuit 400 (LB/BK). CLEAR the DTCs. TEST the system for normal operation.

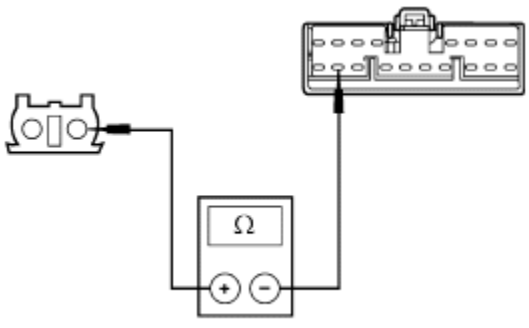
H11 CHECK CIRCUIT 995 (GY) FOR OPEN

1

2

GEM C283

3

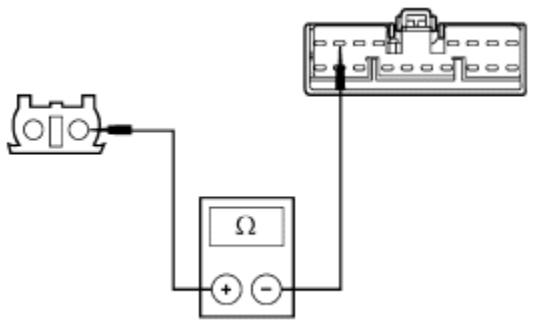


GN2057-A

3 Measure the resistance between GEM C283-10, circuit 995 (GY), and driver power window motor C504, circuit 903 (R).

- **Is the resistance less than 5 ohms?**

→ **Yes**

	GO to H12 . → **No** REPAIR circuit 995 (GY). CLEAR the DTCs. TEST the system for normal operation.
H12 CHECK CIRCUIT 996 (O/W) FOR OPEN	
1  GN2058-A	1 Measure the resistance between GEM C283-2, circuit 996 (O/W), and driver power window motor C504, circuit 903 (R). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM: REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 996 (O/W). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST J: THE BACK WINDOW DEFROSTER WILL NOT DEFROST

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE IGNITION STATES — MONITOR THE GEM PID IGN_GEM	
1 2 Scan Tool 3 	3 Monitor the GEM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF, and ACC positions.

	• **Do the PID values agree with the ignition switch positions?** → **Yes** GO to J2 . → **No** REFER to Section 417-02 .
J2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Clear Continuous DTCs 3 GEM On-Demand Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1343, GO to J13 . If DTC B1347, GO to J3 . If DTC B1349, GO to J3 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to J3 . If the rear window defroster does not operate properly in some places, GO to J19 . If the rear window defrost switch does not illuminate but the rear window defrost operates properly, GO to J20 .
J3 CHECK THE REAR WINDOW DEFROST RELAY COIL CIRCUIT — MONITOR THE GEM PID RDEFRLY	
1	1 Monitor the GEM PID RDEFRLY while triggering the GEM active command RLY

CNTRL ON and OFF.

- **Does the GEM PID RDEFRLY value agree with the command mode?**

→ **Yes**
GO to J10 .

→ **No**
If the GEM PID RDEFRLY displays OFFO-G, GO to J4 .

If the GEM PID RDEFRLY displays ON-B-, GO to J8 .

J4 CHECK THE VOLTAGE TO THE REAR WINDOW DEFROST RELAY COIL — CIRCUIT 298 (P/O)

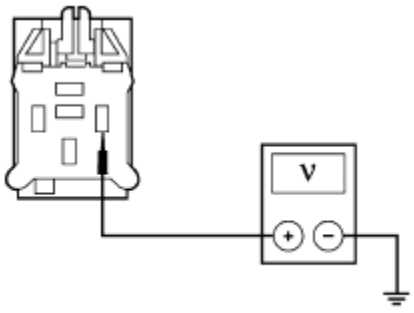
1

2

3

Rear Window Defrost Relay C273

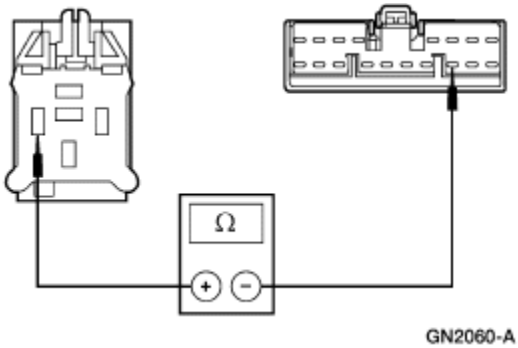
4

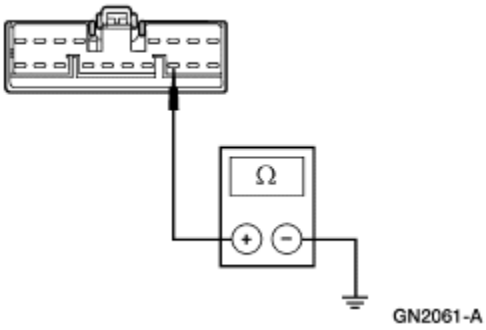


4 Measure the voltage between rear window defrost relay C273-86, circuit 298 (P/O), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to J5 .

	→ **No** CHECK fuse 26 (10A). If the fuse is OK, REPAIR circuit 298 (P/O). CLEAR the DTCs. TEST the system for normal operation. If the fuse is not OK, REPLACE the fuse. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
J5 CHECK THE REAR WINDOW DEFROST RELAY	
1 	2 Check the rear window defrost relay; refer to Component Test. • **Is the rear window defrost relay OK?** → **Yes** GO to J6 . → **No** REPLACE the rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.
J6 CHECK CIRCUIT 1009 (O/Y) FOR OPEN	
1 GEM C283 2  	2 Measure the resistance between rear window defrost relay C273-86, circuit 1009 (O/Y), and GEM C283-16, circuit 1009 (O/Y). • **Is the resistance less than 5 ohms?** → **Yes** GO to J7 .

	→ **No** REPAIR circuit 1009 (O/Y). CLEAR the DTCs. TEST the system for normal operation.
J7 CHECK CIRCUIT 1009 (O/Y) FOR SHORT TO GROUND	
1  	1 Measure the resistance between GEM C283-16, circuit 1009 (O/Y), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1009 (O/Y). CLEAR the DTCs. TEST the system for normal operation.
J8 CHECK THE REAR WINDOW DEFROST RELAY	
1 2 Rear Window Defrost Relay C273	3 Check the rear window defrost relay; refer to Component Test. • **Is the rear window defrost relay OK?** → **Yes** GO to J9 . → **No** REPLACE the rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.

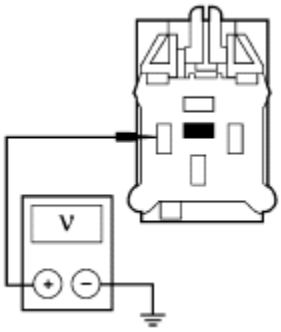
J9 CHECK CIRCUIT 1009 (O/Y) FOR SHORT TO POWER

1

GEM C283

2

3



GN1392-A

3 Measure the voltage between rear window defrost relay C273-85, circuit 1009 (O/Y), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 1009 (O/Y). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

J10 CHECK THE VOLTAGE TO THE REAR WINDOW DEFROST RELAY SWITCHING CIRCUIT

1

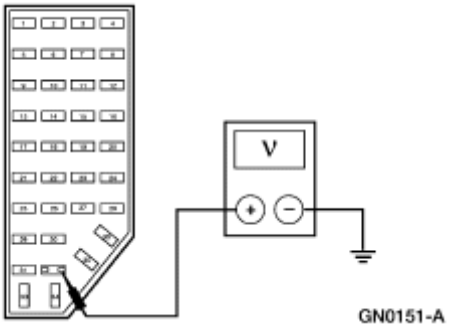
Fuse 32 (7.5A)

2

2 Trigger the GEM active command RLY CNTRL to ON.

3

3 Measure the voltage between fuse 32 (7.5A), pin 2, circuit 186 (BR/LB), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
RECONNECT fuse 32 (7.5A). GO to J13 .

→ **No**
GO to J11 .

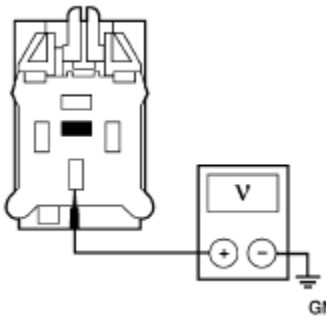
J11 CHECK THE VOLTAGE TO THE REAR WINDOW DEFROST RELAY SWITCH — CIRCUIT 185 (BK)

1

2

Rear Window Defrost Relay C273

3



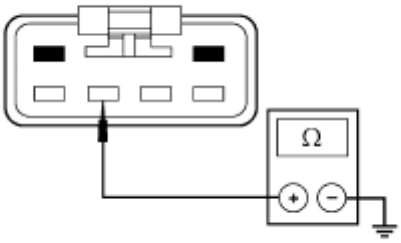
3 Measure the voltage between rear window defrost relay C273-30, circuit 185 (BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to J12 .

→ **No**
CHECK fuse 14 (30A). If the fuse is not OK, REPLACE the fuse. TEST the system for

	normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary. If the fuse is OK, REPAIR circuit 185 (BK). CLEAR the DTCs. TEST the system for normal operation.
J12 CHECK THE REAR WINDOW DEFROST RELAY	
	1 Check the rear window defrost relay; refer to Component Test. • **Is the rear window defrost relay OK?** → **Yes** REPAIR circuit 186 (BR/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.
J13 CHECK THE HEATED BACKLITE SWITCH INPUT — MONITOR THE GEM PID RDEF_SW	
1 	1 Monitor the GEM PID RDEF_SW while pressing the heated backlite switch ON and OFF. • **Does the GEM PID RDEF_SW agree with the switch position?** → **Yes** GO to J17 . → **No** GO to J14 .
J14 CHECK THE GROUND TO THE HEATED BACKLITE SWITCH — CIRCUIT 57 (BK)	
1 2 Heated Backlite Switch C248 3	3 Measure the resistance between heated backlite switch C248-4, circuit 57 (BK), and ground.



GN0154-A

- **Is the resistance less than 5 ohms?**

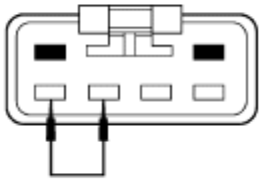
→ **Yes**
GO to J15 .

→ **No**
REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

J15 CHECK THE HEATED BACKLITE SWITCH — MONITOR THE GEM PID RDEF_SW

1

2


GN0155-A

3

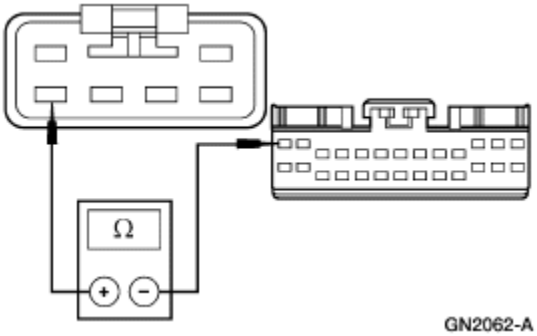
1 Monitor the GEM PID RDEF_SW.

2 Connect a jumper wire between heated backlite switch C248-3, circuit 1010 (DB/O), and C248-4, circuit 57 (BK).

- **Does the GEM PID RDEF_SW indicate ON?**

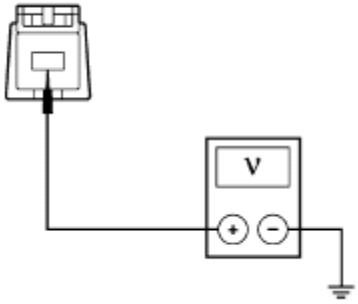
→ **Yes**
REPLACE the heated backlite switch. CLEAR the DTCs. TEST the system for normal operation.

→ **No**

	GO to J16 .
J16 CHECK CIRCUIT 1010 (DB/O) FOR OPEN	
1 2 GEM C280 3  GN2062-A	3 Measure the resistance between heated backlite switch C248-3, circuit 1010 (DB/O), and GEM C280-1, circuit 1010 (DB/O). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1010 (DB/O). CLEAR the DTCs. TEST the system for normal operation.
J17 CHECK THE VOLTAGE TO THE REAR WINDOW DEFROST GRID — CIRCUIT 186 (BR/LB)/185 (BK)	
1 2 Rear Window Defrost Grid C420 3	

4

5



4 Trigger the GEM active command RLY CNTRL to ON.

5 Measure the voltage between rear window defrost grid C420, circuit 185 (BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to J18 .

→ **No**
REPAIR circuit 186 (BR/LB)/185 (BK). CLEAR the DTCs. TEST the system for normal operation.

J18 CHECK THE GROUND TO THE REAR WINDOW DEFROST GRID — CIRCUIT 57 (BK)

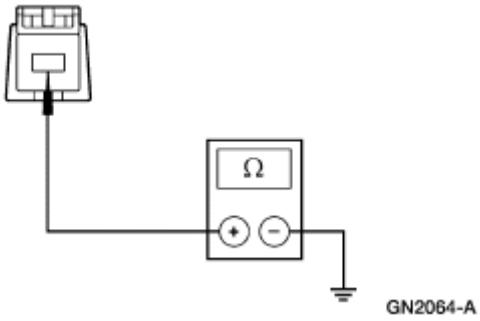
1

2

Rear Window Defrost Grid C421

3

3 Measure the resistance between rear window defrost grid C421, circuit 57 (BK), and ground.



- **Is the resistance less than 5 ohms?**

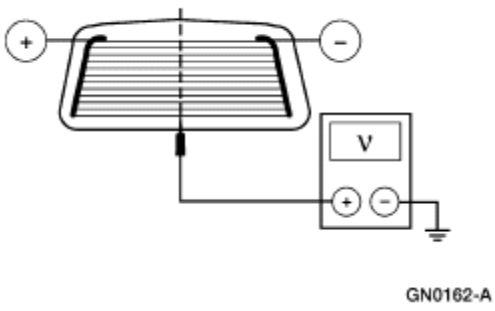
→ **Yes**
REPAIR or REPLACE the rear window defrost grid. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

J19 CHECK THE REAR WINDOW DEFROST GRID

1 Press the rear defrost control switch to the ON position.

2



2 **NOTE:** The standard grid voltage is 6 to 7 volts. A high voltage indicates an open toward the ground side and a low voltage indicates an open toward the power supply side.

Measure the voltage between the center of each grid, and ground.

- **Is the voltage greater than 7 volts or less than 6 volts?**

→ **Yes**
REPAIR the rear window defrost grid between the center and ground side. TEST the system for normal operation.

→ **No**
REPAIR the rear window defrost grid between the center and power supply side. TEST the system for normal operation.

J20 CHECK FUSE JUNCTION PANEL FUSE 32 (7.5A)

1

2

Fuse 32 (7.5A)

- **Is the fuse OK?**

→ **Yes**
RECONNECT fuse junction panel fuse 32 (7.5A); GO to J21 .

→ **No**
REPLACE fuse junction panel fuse 32 (7.5A). TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground; REPAIR as necessary.

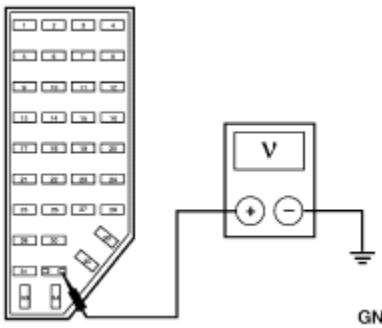
J21 CHECK THE VOLTAGE TO FUSE 32 (7.5A) — CIRCUIT 186 (BR/LB)

1

2 Press the rear defrost control switch to the ON position.

3 Measure the voltage between fuse junction panel fuse 32 (7.5A) pin 2, circuit 186 (BR/LB), and ground.

3



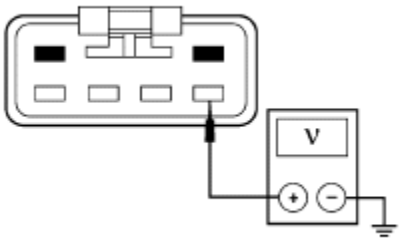
GN0151-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to J22 .

→ **No**
REPAIR circuit 186 (BR/LB). CLEAR the DTCs. TEST the system for normal operation.

J22 CHECK THE VOLTAGE TO THE HEATED BACKLIGHT INDICATOR — CIRCUIT 59 (DG/P)

1 2 Rear Window Defrost Grid C420 3 4  GN0153-A	4 Measure the voltage between heated backlite switch C248-6, circuit 59 (DG/P), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the heated backlite switch. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 59 (DG/P). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST K: THE BACK WINDOW DEFROSTER WILL NOT SHUT OFF AUTOMATICALLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2	

Scan Tool

3

4

Clear Continuous DTCs

5

GEM On-Demand Self-Test

3 Retrieve and document continuous DTCs.

- **Are any DTCs recorded?**

→ **Yes**
If DTC B1345, GO to K4 .

If DTC B1347, GO to K2 .

If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to K2 .

K2 CHECK THE REAR WINDOW DEFROST RELAY

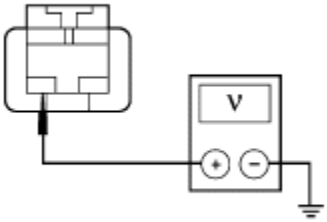
1

2

Rear Window Defrost Relay C273

3 Check the rear window defrost relay; refer to Component Test.

- **Is the rear window defrost relay OK?**

	→ **Yes** GO to K3 . → **No** REPLACE the rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.
K3 CHECK CIRCUIT 186 (BR/LB)/185 (BK) FOR SHORT TO POWER	
1 2 Rear Window Defrost Grid C420 3 4  GN1404-A	1 Fuse junction panel fuse 32 (7.5A). 4 Measure the voltage between rear window defrost grid C420, circuit 185 (BK), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 186 (BR/LB)/185 (BK). CLEAR the DTCs. TEST the system for normal operation. → **No** RECONNECT the rear window defrost relay; GO to K4 .
K4 CHECK THE OPERATION OF THE HEATED BACKLITE SWITCH — MONITOR THE GEM PID RDEF_SW	
1	1 Monitor the GEM PID RDEF_SW while pressing the heated backlite switch ON and OFF.

- **Does the GEM PID RDEF_SW indicate ON continuously?**

→ **Yes**
GO to K6 .

→ **No**
GO to K5 .

K5 CHECK CIRCUIT 1009 (O/Y) FOR SHORT TO GROUND

1

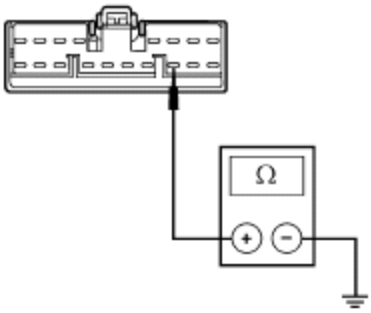
2

Rear Window Defrost Relay C273

3

GEM C283

4



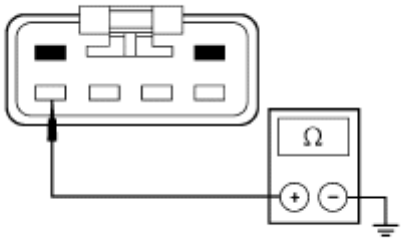
4 Measure the resistance between GEM C283-16, circuit 1009 (O/Y), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

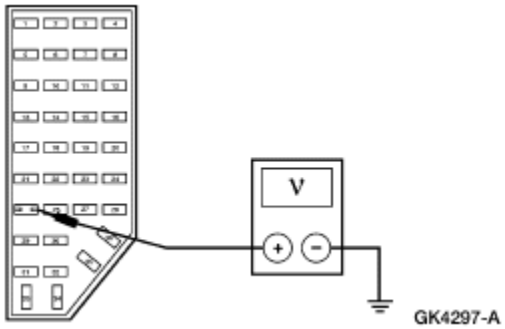
→ **No**

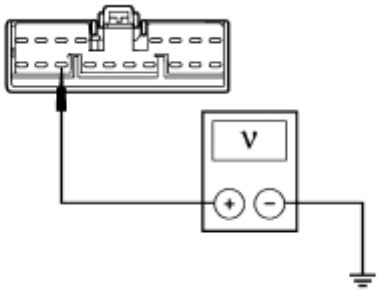
	REPAIR circuit 1009 (O/Y). CLEAR the DTCs. TEST the system for normal operation.
K6 CHECK THE HEATED BACKLITE SWITCH — MONITOR THE GEM PID RDEF_SW	
1 2 Heated Backlite Switch C248 3 4 	4 Monitor the GEM PID RDEF_SW. • **Does the GEM PID RDEF_SW indicate ON continuously?** → **Yes** GO to K7 . → **No** REPLACE the heated backlite switch. CLEAR the DTCs. TEST the system for normal operation.
K7 CHECK CIRCUIT 1010 (DB/O) FOR SHORT TO GROUND	
1 2 GEM C280 3	3 Measure the resistance between rear defrost control switch C248-3, circuit 1010 (DB/O), and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1010 (DB/O). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST L: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK POWER DISTRIBUTION BOX MAXI-FUSE 1 (50A)	
1 Maxi-Fuse 1 (50A)	• **Is the fuse OK?** → **Yes** GO to L2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
L2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 	

Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to L3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.
L3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE	
1  	1 Measure the voltage between fuse junction panel fuse 25 (7.5A) pin 2, circuit 1052 (T/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to L4 . → **No** REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.
L4 CHECK THE VOLTAGE TO THE GEM — CIRCUIT 1001 (W/Y)	
1 2 GEM C283 3	3 Measure the voltage between GEM C283-11, circuit 1001 (W/Y), and ground.



GK6043-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to L5 .

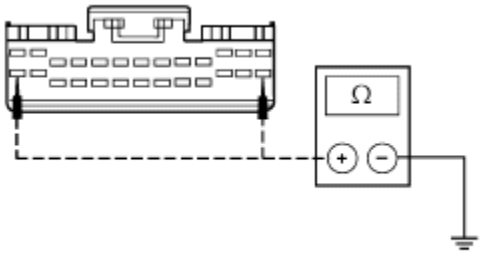
→ **No**
REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.

L5 CHECK CIRCUIT 570 (BK/W) FOR OPEN

1

GEM C280

2



GC1770-A

2 Measure the resistance between GEM C280-14, circuit 570 (BK/W), and ground; and between GEM C280-26, circuit 570 (BK/W), and ground.

- **Are the resistances less than 5 ohms?**

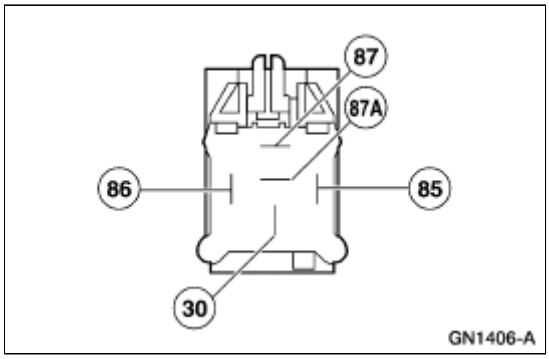
→ **Yes**
REFER to Section 418-00 .

→ **No**
REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

Component Tests

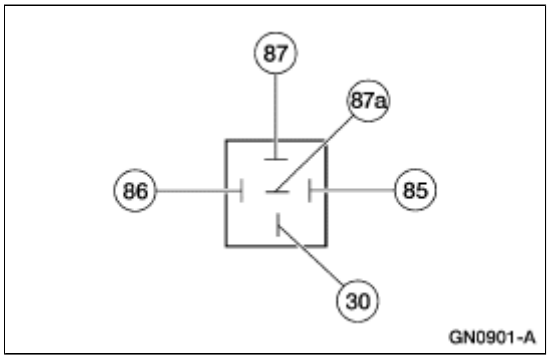
Relay — Heated Back Window

Use 73III Automotive Meter to check for the continuity between terminal 85 and all other terminals. If resistance is 5 ohms or less between terminal 2 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue with the test. Use two jumper wires to connect relay terminals 86 and 30 directly to the positive battery terminal. Use 73III Automotive Meter set in the volts position to check for voltage at terminal 87A. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect a third jumper wire to terminal 85, and ground the jumper wire to a known good ground. Check for voltage at terminal 87. If battery voltage is not indicated, replace the relay.



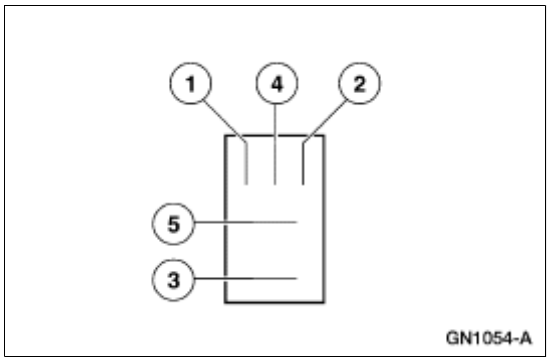
Relay — Mini ISO

Use 73III Automotive Meter to check for the continuity between terminal 85 and all other terminals. If resistance is 5 ohms or less between terminal 85 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue with the test. Use two jumper wires to connect relay terminals 86 and 30 directly to the positive battery terminal. Use 73III Automotive Meter set in the volts position to check for voltage at terminal 87A. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect a third jumper wire to terminal 85 and ground the jumper wire to a known good ground. Check for voltage at terminal 87. If battery voltage is not indicated, replace the relay.



Relay — Micro ISO

Use 73III Automotive Meter to check for the continuity between terminal 2 and all other terminals. If resistance is 5 ohms or less between terminal 2 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue with the test. Use two jumper wires to connect relay terminals 1 and 3 directly to the positive battery terminal. Use 73III Automotive Meter set in the volts position to check for voltage at terminal 4. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect a third jumper wire to terminal 2 and ground the jumper wire to a known good ground. Check for voltage at terminal 5. If battery voltage is not indicated, replace the relay.


1
4
2
5
3
GN1054-A

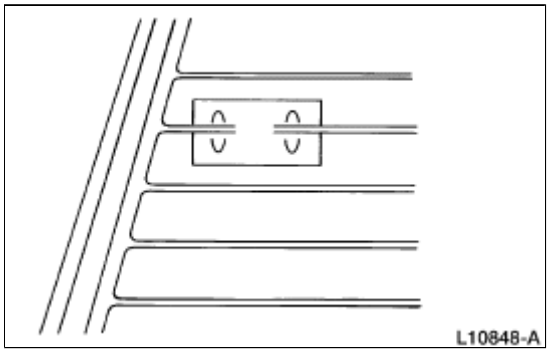
Heated Window Grid Wire Repair

Special Tool(s)

ST1171-A	Heat Gun 107-R0300 or equivalent

NOTE: Any breaks longer than 25 mm (1 inch) in one grid cannot be repaired. The back window glass must be replaced. Breaks equal to or shorter than 25 mm (1 inch) the heated back window grid wire can be successfully repaired by using the following procedure.

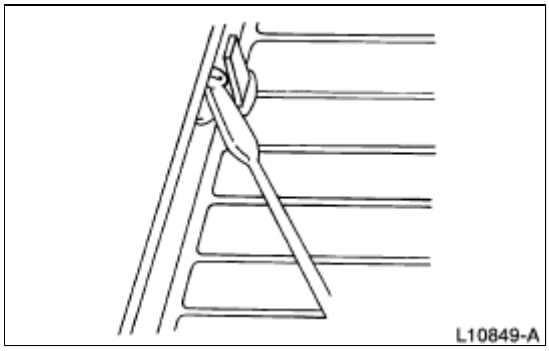
1. Obtain the following repair kit:
   - Repair Kit Order Number 50-25-0584-0029.
2. The vehicle should be allowed to reach 16°C (60°F) or above.
3. Clean the repair area with denatured alcohol.
4. Place the grid line mask over the break aligning the cut-out slots on either side of the repair area.



5. Apply the epoxy to the repair area.
6. Remove the mask without disturbing the epoxy.
7. Use the special tool to heat the repair area for 1 to 2 minutes at a distance of about 25-50 mm (1-2 inches). This procedure should heat the repair area to approximately 149° C (300° F).
8. The heated back window may be energized immediately after the repair. Optimum hardness and adhesion will occur after 24 hours. Do not disturb the repair area until that time.

Lead Terminal Repair

1. Obtain the following repair kit:
   - Repair Kit Order Number 50-25-0584-0029.
2. The vehicle should be allowed to reach 16°C (60°F) or above.
3. Clean the area with denatured alcohol.
4. Apply the epoxy to the repair area.
5. Hold the terminal in place on the bus bar with an appropriate tool.

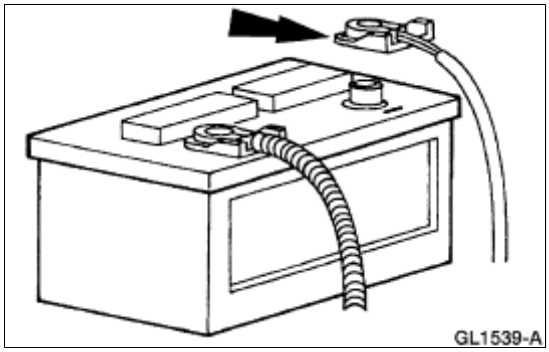


6. Apply epoxy to the repair area.

Switch —Window Regulator Control, Driver Door

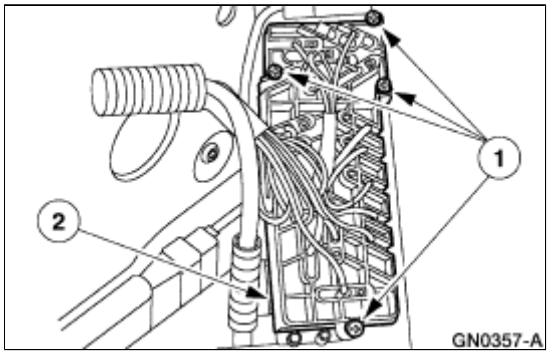
Removal

1. Disconnect the battery ground cable (14301).

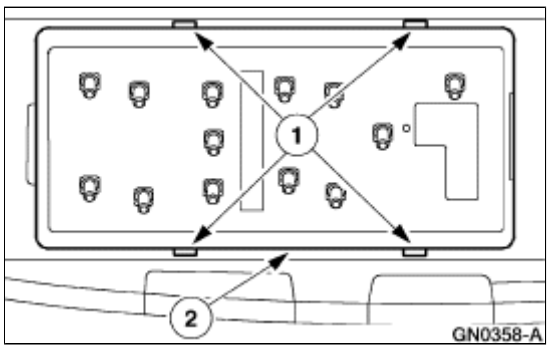


2. Remove the front door trim panel; refer to Section 501-05 .

3. Remove the window regulator switch plate harness assembly.
    1. Remove the screws.
    2. Remove the harness assembly.



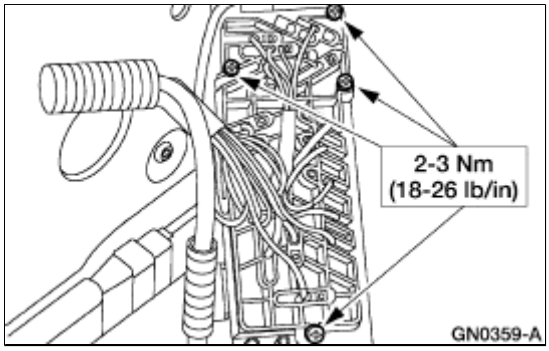
4. Remove the window regulator control switch (14529).
    1. Pry the release tabs.
    2. Remove the window regulator control switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

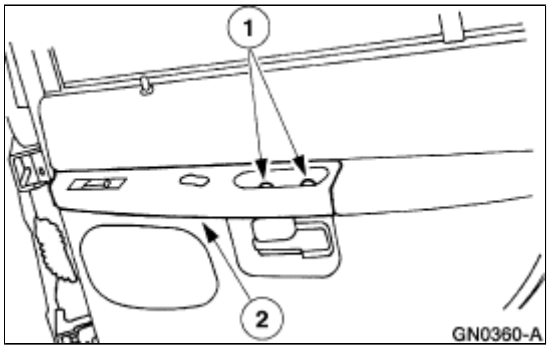
   To install, reverse the removal procedure.



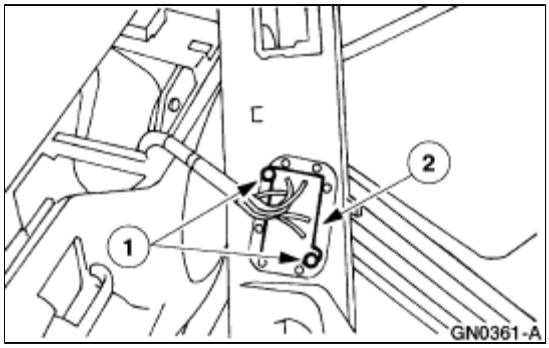
Switch —Window Regulator Control, Rear Door

Removal

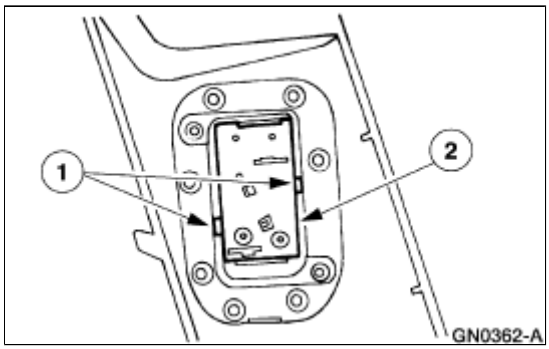
1. Remove the rear window regulator switch plate.
    1. Remove the screws.
    2. Remove the rear window regulator switch plate.



2. Remove the window regulator switch plate harness assembly.
    1. Remove the screws.
    2. Remove the harness assembly.



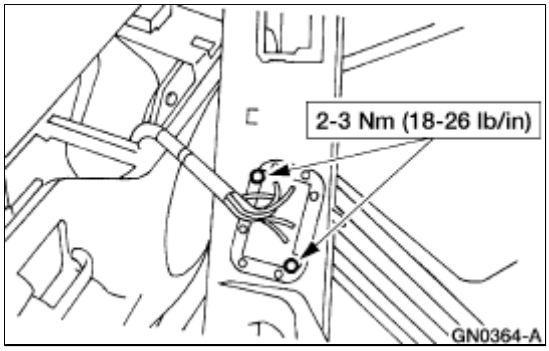
3. Remove the window regulator control switch (14529).
    1. Pry the release tabs.
    2. Remove the window regulator control switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

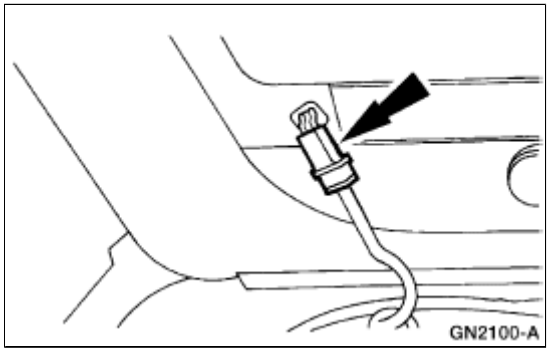
   To install, reverse the removal procedure.



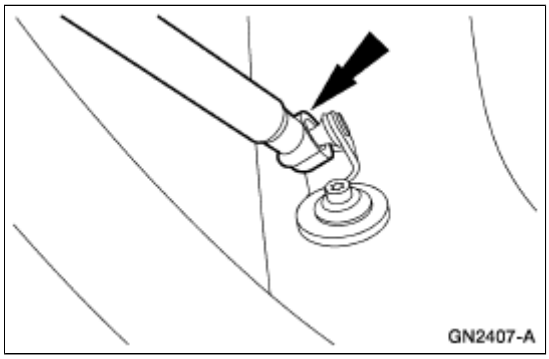
Window Glass —Liftgate

Removal

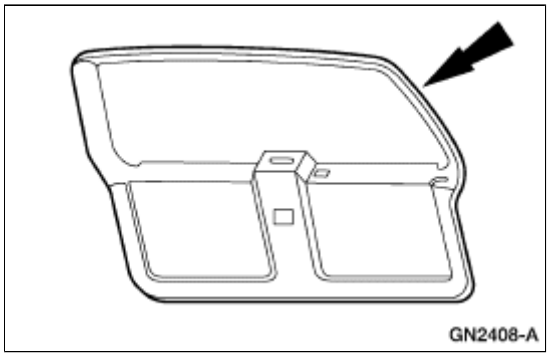
1. Open the liftgate glass.
2. Disconnect the two rear window defogger electrical connectors (one on each side).



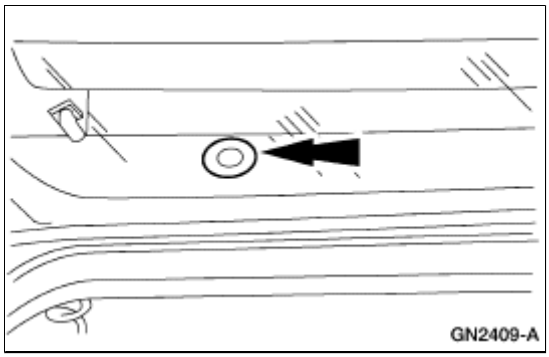
3. Disconnect the two liftgate cylinders (one on each side).



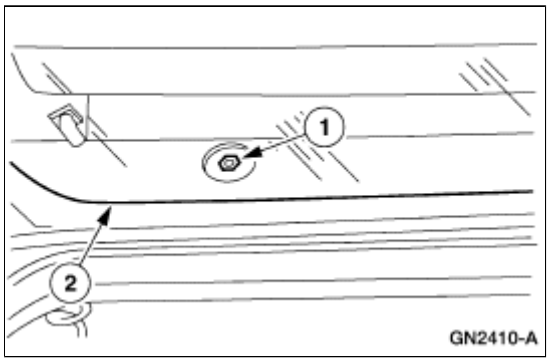
4. Release the upper liftgate trim panel clips to gain access to liftgate window glass access plugs.



5. Remove the liftgate glass hinge access plugs.

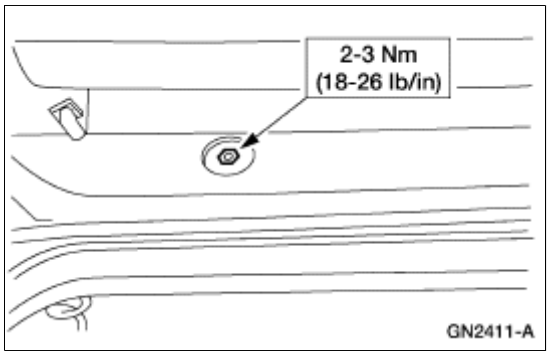


6. Remove the liftgate window glass.
    1. Remove the two liftgate window glass to window hinge nuts.
    2. Remove the liftgate window glass.



Installation

1. To install, reverse the removal procedure.



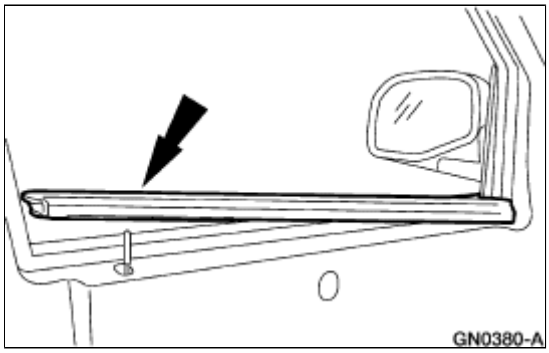
Window Glass —Front Door

Special Tool(s)

ST1132-A	Heavy Duty Riveter or equivalent 501-D011 (D80L-23200-A)

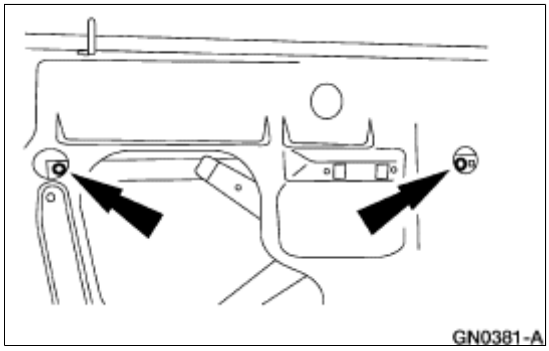
Removal

1. Remove the front door trim panel; refer to Section 501-05 .
2. Remove the inside glass weatherstrip.


GN0380-A

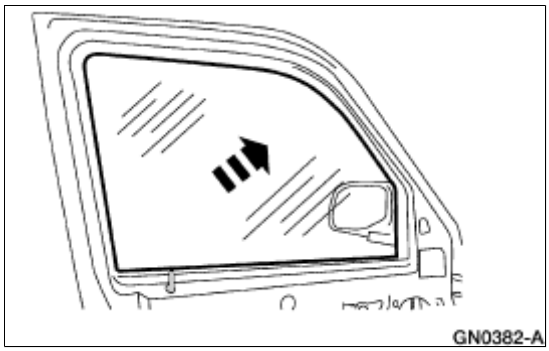
3. **NOTE:** Lower the window glass to access the two rivets.

   Drill out the window regulator arm to window glass rivets.


GN0381-A

4. **NOTE:** Slide the glass through the outboard side of the front door (20124) .

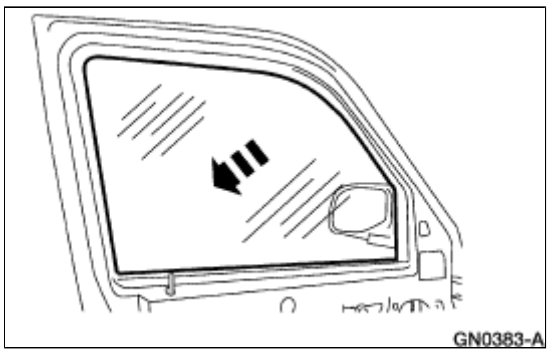
   Remove the front door window glass (21410).



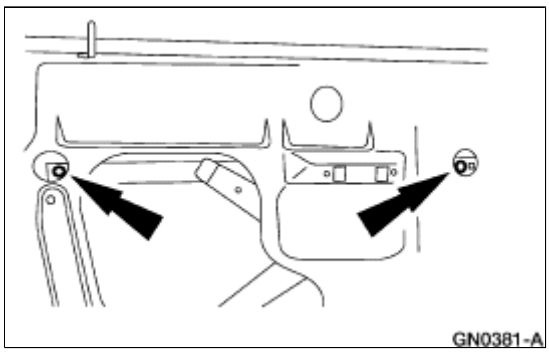
Installation

1. **NOTE:** Slide the glass through the outboard side of the front door .

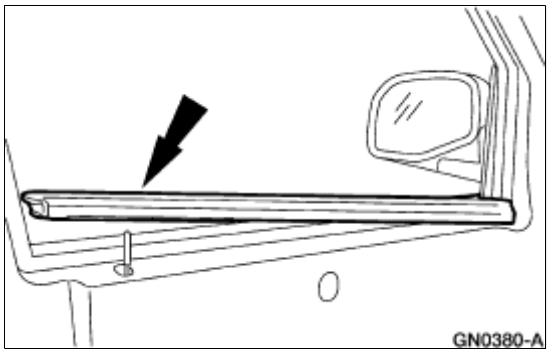
   Position the front door window glass.



2. Use Heavy Duty Riveter to install the window regulator arm to window glass rivets.



3. Install the inside glass weatherstrip.



4. Install the front door trim panel; refer to Section 501-05 .

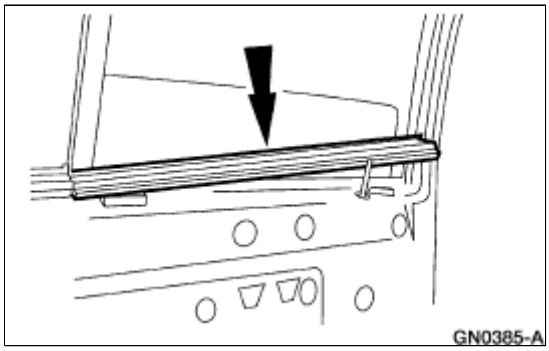
Window Glass —Rear Door

Special Tool(s)

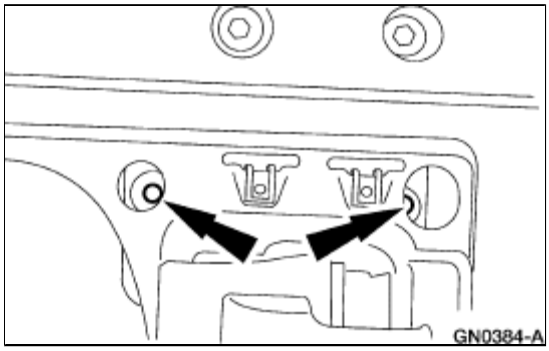
ST1132-A	Heavy Duty Riveter or equivalent 501-D011 (D80L-23200-A)

Removal

1. Remove the rear door trim panel; refer to Section 501-05 .
2. Remove the inside glass weatherstrip.

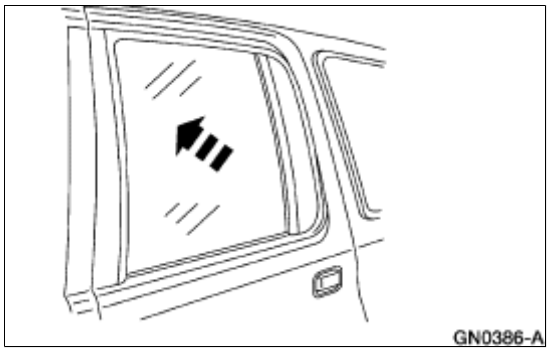

GN0385-A

3. Drill out the window regulator arm to window glass rivets.


GN0384-A

4. **NOTE:** Slide the glass through the outboard side of the rear door (24630) .

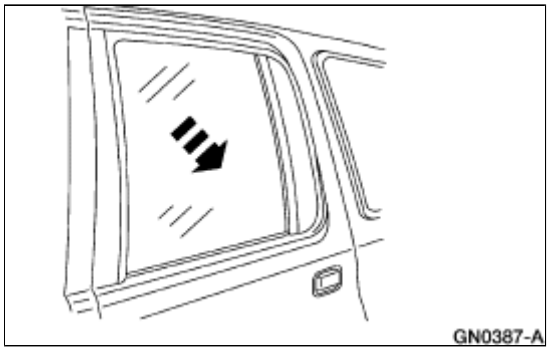
   Remove the rear door window glass (25712).



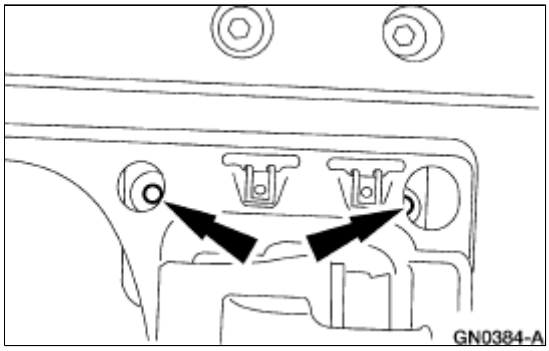
Installation

1. **NOTE:** Slide the glass through the outboard side of the rear door .

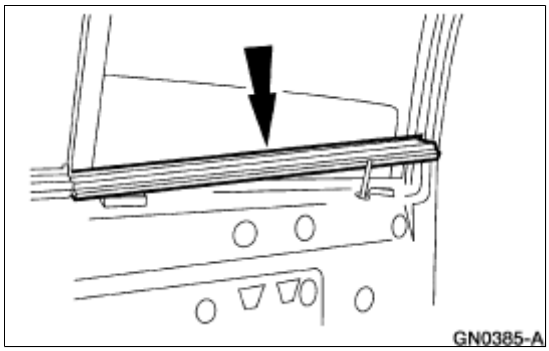
   Position the rear door window glass.



2. Use Heavy Duty Riveter to install the window regulator arm to window glass rivets.



3. Install the inside glass weatherstrip.



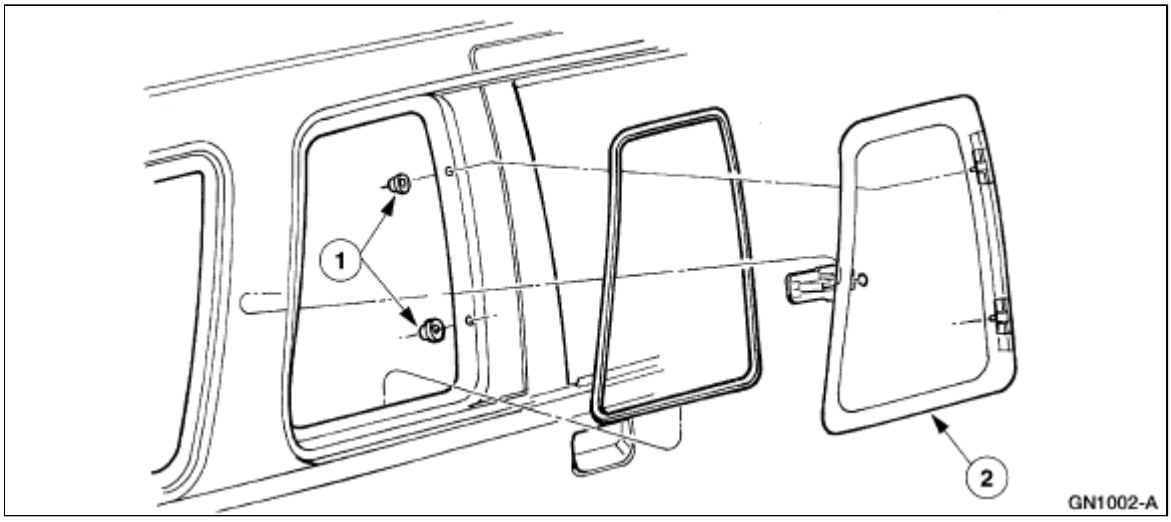
4. Install the rear door trim panel; refer to Section 501-05 .

Window Glass —Movable Quarter

Removal

1. Remove the quarter trim panel; refer to Section 501-05 .

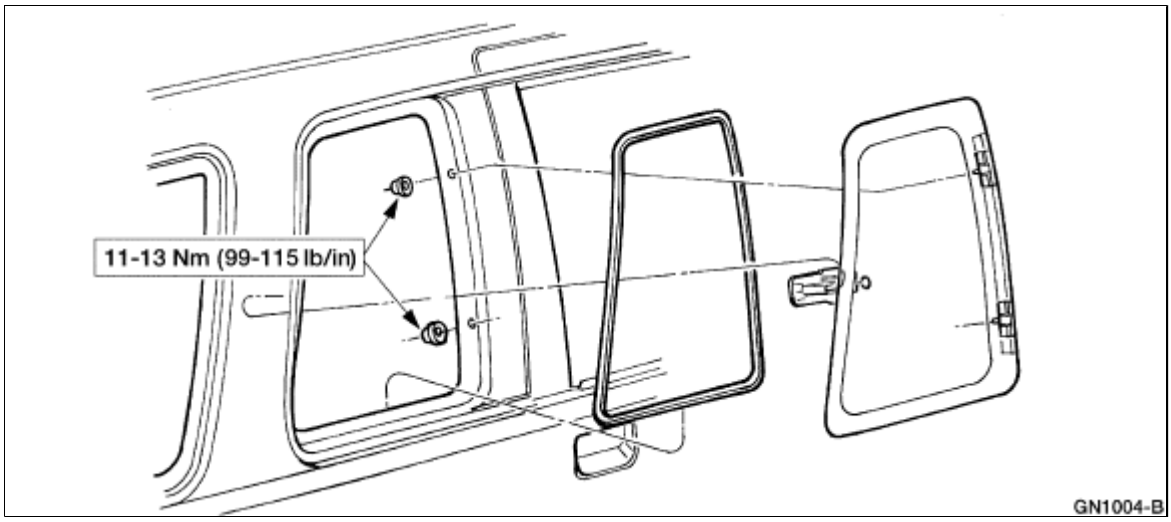
2. Remove the quarter window glass.
    1. Remove the nuts.
    2. Remove the quarter window glass.



Installation

1. **NOTE:** If the seal requires adjustment, disconnect the quarter trim panel. Rotate the quarter window latch clockwise to increase seal pressure or counterclockwise to reduce seal pressure. Reconnect the quarter window latch.

   To install, reverse the removal procedure.

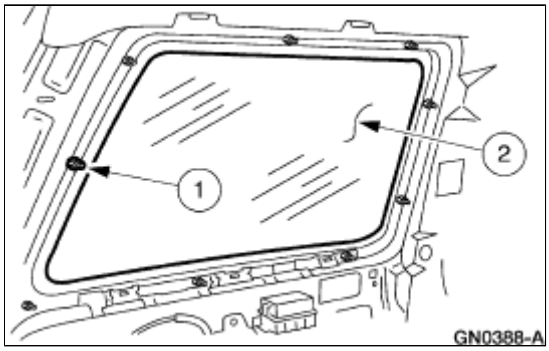

11-13 Nm (99-115 lb/in)
GN1004-B

Window Glass —Quarter

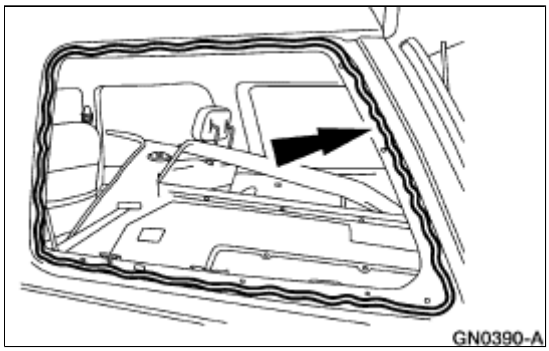
Removal

1. Remove the quarter trim panel (31012) ; refer to Section 501-05 .

2. Remove the rear quarter window glass.
   1. Remove the ten nuts.
   2. Carefully push the rear quarter window glass outward to release the butyl seal.



3. Remove the excess foam butyl from the window opening.



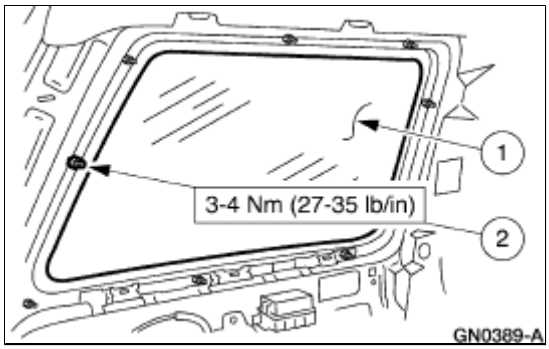
Installation

1. **NOTE:** When applying foam butyl, leave a slight overlap at the bottom to allow for drainage.

   Apply 6 mm (0.23 in) foam butyl or equivalent meeting Ford specification WSB-M2G234-C to the rear quarter window glass frame.
   - Start at the bottom middle and work around the frame.

2. Install the rear quarter window glass.
   1. Position the rear quarter window glass.
   2. **NOTE:** Loosely install the ten nuts before tightening.

      Tighten the ten nuts to specification.

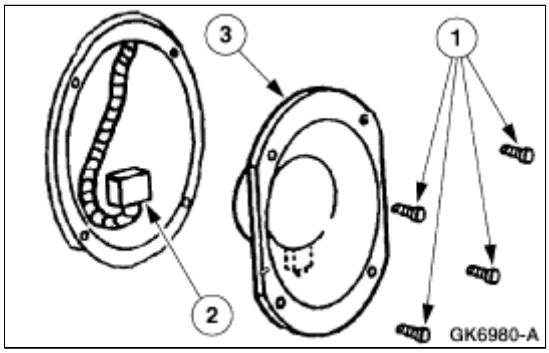


3. Install the quarter trim panel ; refer to Section 501-05 .

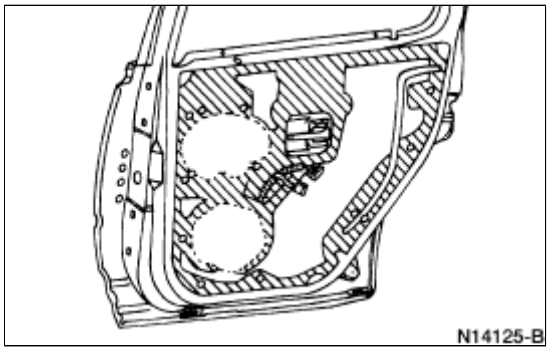
Motor —Rear Door

Removal

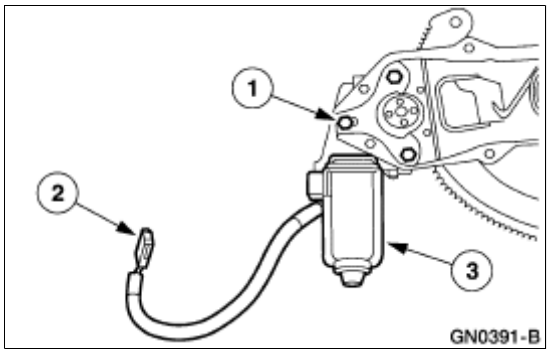
1. Raise and support the rear door window glass to the full up position.
2. Disconnect the battery ground cable.
3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
4. Remove the speaker.
    1. Remove the screws.
    2. Disconnect the electrical connector.
    3. Remove the speaker.



5. Remove the watershield.



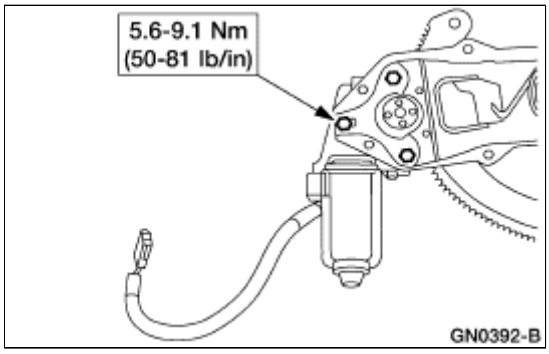
6. Remove the power window motor.
    1. Remove the bolts.
    2. Disconnect the electrical connector.
    3. Remove the power window motor.



Installation

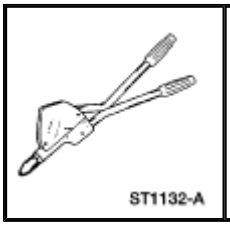
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   To install, reverse the removal procedure.
   - Cycle the door glass to ensure engagement of the drive mechanism.



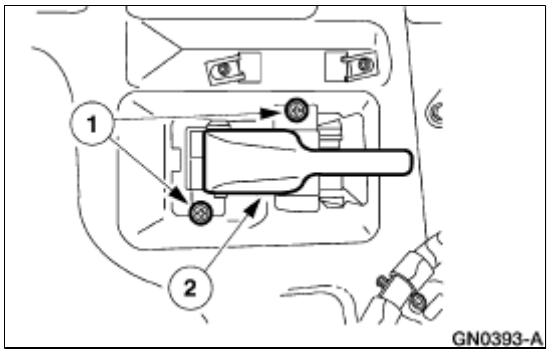
Motor and Window Regulator —Front Door

Special Tool(s)

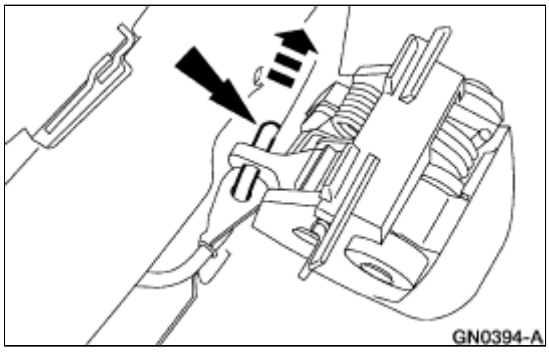
 ST1132-A	Heavy Duty Riveter or equivalent 501-D011 (D80L-23200-A)

Removal

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Disconnect the inside front door handle from the front door (20124).
    1. Remove the screws.
    2. Disconnect the inside front door handle.



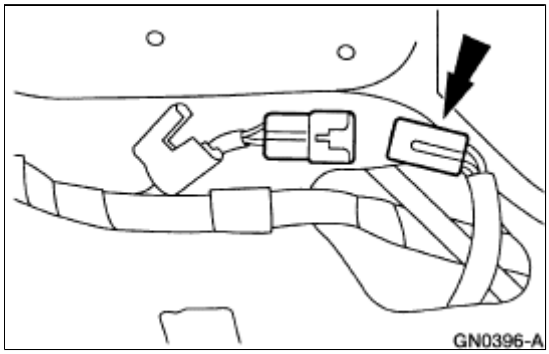
3. Disconnect the rod from the inside front door handle.



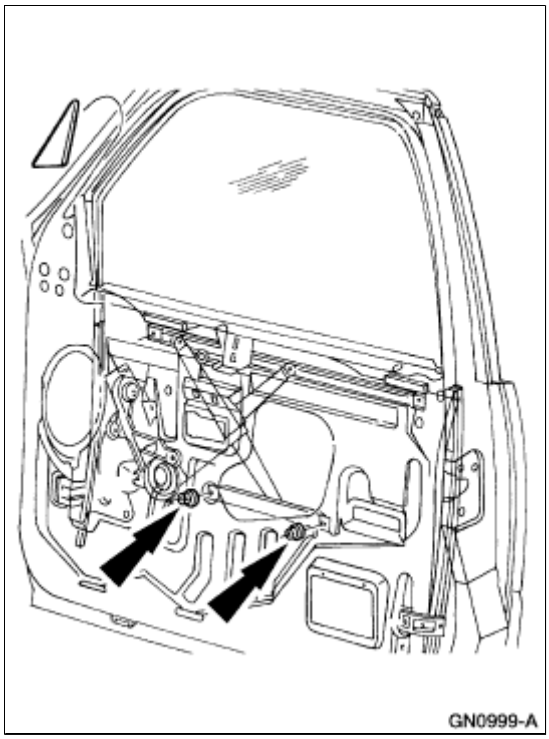
4. Remove the water shield.
5. Position the front door window glass to access the track rivets through the door openings.

6. Support the front door window glass.

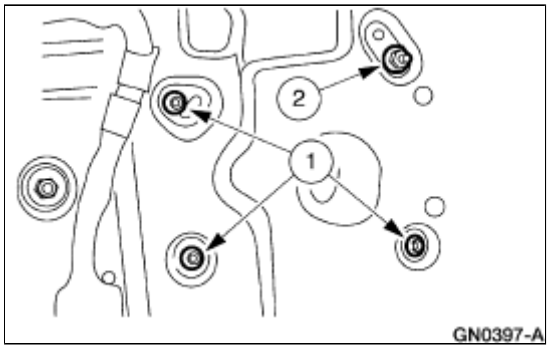
7. Disconnect the battery ground cable (14301).
8. Remove the regulator to window rivets.
9. If equipped, disconnect the power window motor electrical connector.



10. If equipped, remove the equalizer bracket to front door inner panel nuts.

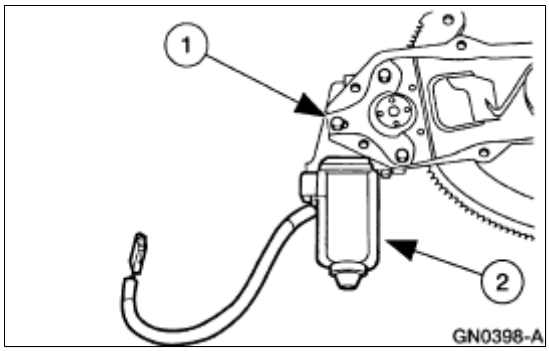


11. Remove the window regulator/motor assembly.
    1. Drill out the rivets.
    2. Remove the nut.



12. **WARNING: Prior to power window removal, make sure the regulator arms are in a fixed position to prevent counterbalance spring unwind. failure to place the regulator arms in a fixed position can cause the spring to suddenly release resulting in personal injury.**

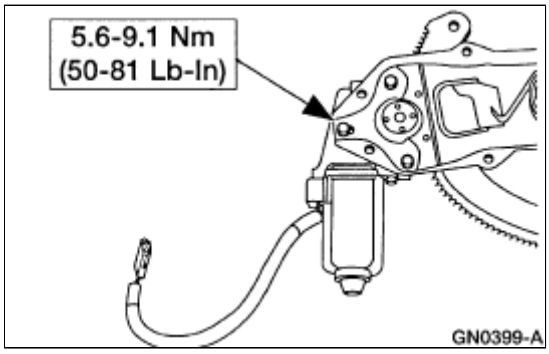
    If equipped, remove the power window motor.
    1. Remove the bolts.
    2. Remove the power window motor.

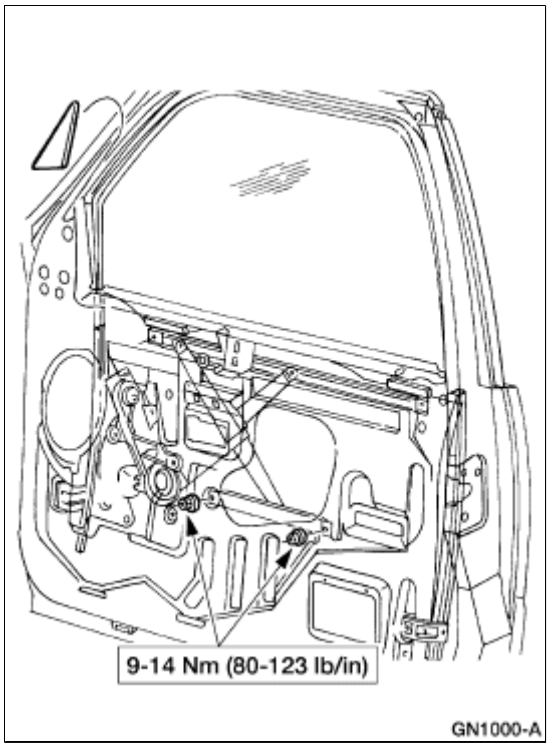


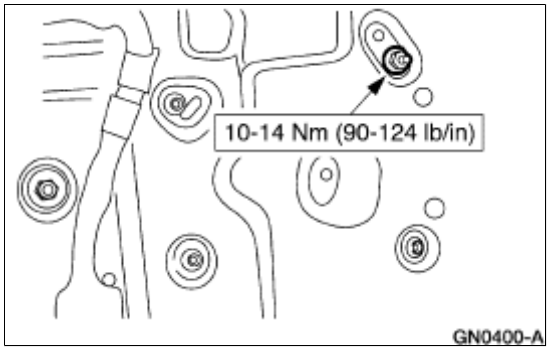
Installation

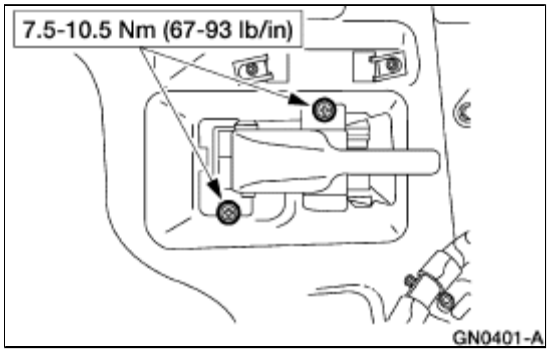
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.
   - Use Heavy Duty Riveter to install the new rivets.
   - Cycle the door glass to ensure engagement of the drive mechanism.




9-14 Nm (80-123 lb/in)
GN1000-A


10-14 Nm (90-124 lb/in)
GN0400-A


7.5-10.5 Nm (67-93 lb/in)
GN0401-A

Windshield Glass

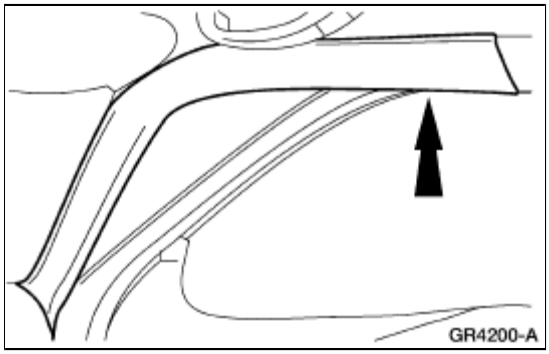
Special Tool(s)

ST1320-A	Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent
ST1109-A	Pneumatic Knife with Offset Blade 107-R1511 or equivalent
ST2085-A	The Pumper 164-R2459 or equivalent

Removal

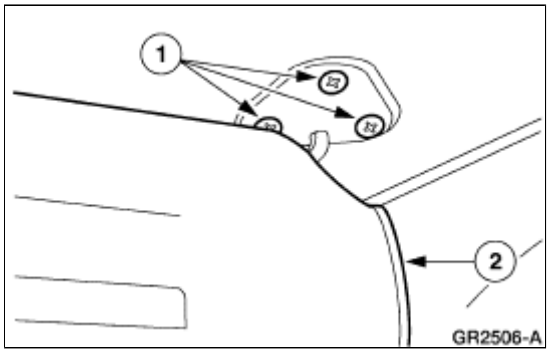
WARNING: To prevent glass splinters from entering the eyes or cutting hands, wear safety glasses and heavy gloves when cutting the glass from the vehicle.

1. Remove the windshield side garnish moldings.

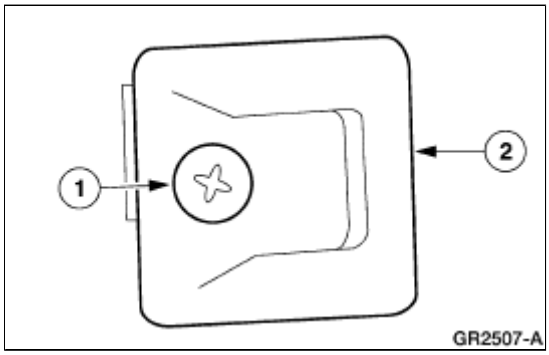


2. Remove the interior rear view mirror. For additional information, refer to Section 501-09 .
3. If equipped, remove the overhead console.
4. Remove the sun visors.

1. Remove the sun visor screws.
2. Remove the sun visors.
   - If equipped, disconnect the electrical connector.



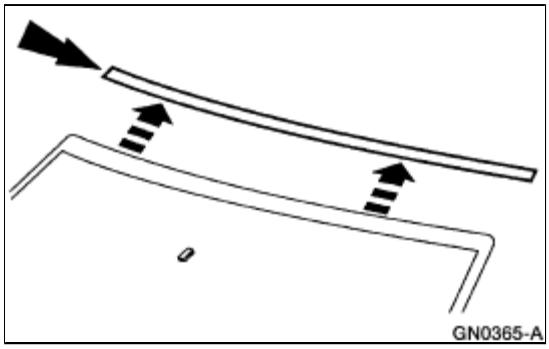
5. Remove the sun visor clips.
   1. Remove the sun visor clip screws.
   2. Remove the sun visor clips.



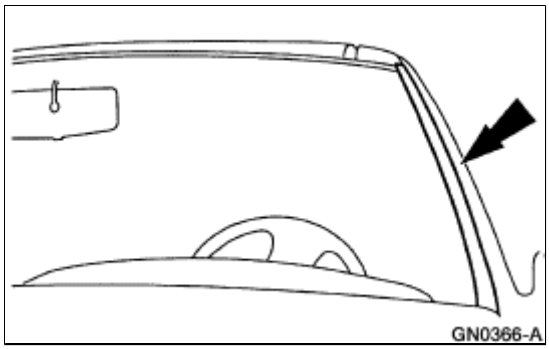
6. Lower the front portion of the headliner.

7. Remove the cowl grille. For additional information, refer to Section 501-02 .

8. Remove the upper windshield weatherstrip.



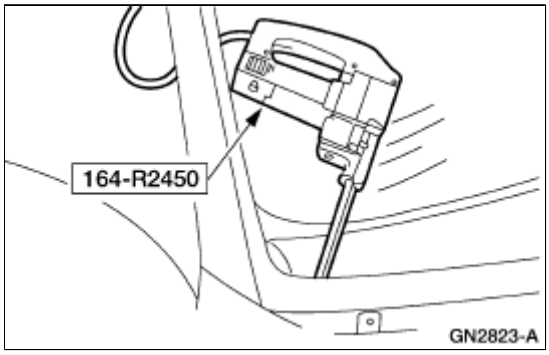
9. Remove the LH and RH windshield mouldings.



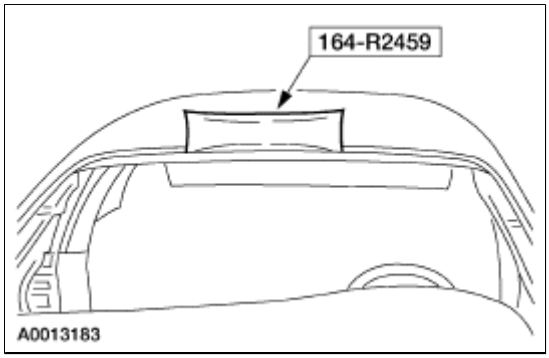
10. Using a soft brush or vacuum, remove any dirt or foreign material from the pinch weld.

11. **NOTE:** Lubricate the urethane sealant with water to aid the special tool when cutting.

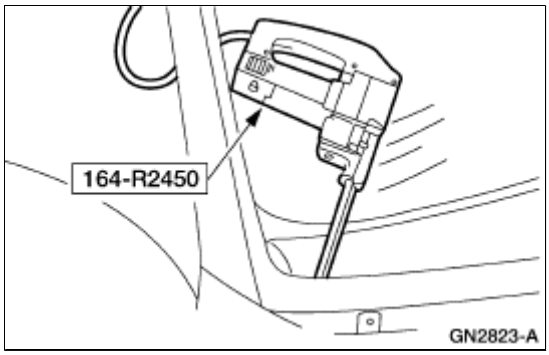
    Using the special tool, cut the urethane sealant from the windshield glass starting at the top center and work toward the bottom corners.



12. Using the special tool, distance the windshield from the body.



13. Using the special tool, cut the remaining urethane sealant and remove the windshield glass.



14. Using a soft brush or vacuum, remove any foreign material or dirt from the pinch weld.

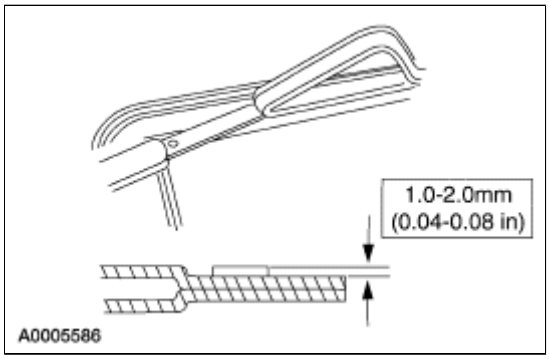
Installation

CAUTION: After installing the urethane installed glass, the vehicle should not be driven until the urethane has cured. The curing times at temperatures above 13°C (55°F) and relative humidity above 50% is 12-24 hours (decreasing at higher temperatures and lower humidities). Inadequate curing of the urethane may adversely affect the strength of the urethane bond.

1. Dry fit the windshield. Make alignment marks with tape or non-staining grease pencil.

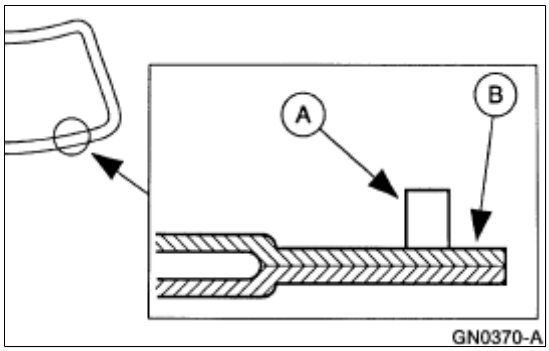
2. **CAUTION: Do not scratch the pinch weld area.**

   Trim the remaining urethane sealant on the pinch weld to within the specification.
   - The existing urethane sealant surface should be smooth and free of cuts and contamination.



3. Use a wool applicator to apply Urethane Metal Primer Essex U-413 meeting Ford specification WSB-M2G234-C to any exposed metal on the pinch weld. Allow six to ten minutes to dry.

4. Apply (A) Foam Butyl meeting Ford specification WSB-M2G234-C to the (B) pinch weld.



5. If reinstalling original windshield, remove the excess urethane sealant from the windshield glass.

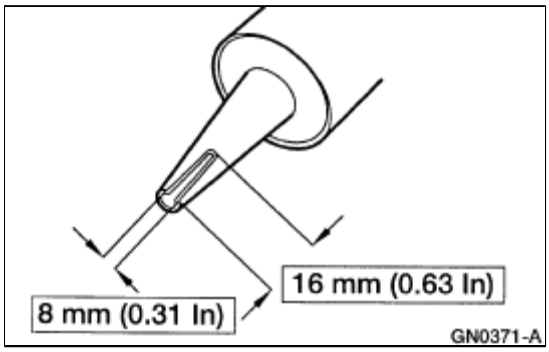
6. Clean the inside of the glass surface with an alcohol-free cleaner making sure the ceramic coated area is clean .

7. **NOTE:** Wipe off the Glass Prep immediately after each application because it flash dries.

   Apply Urethane Glass Prep Essex U-401 meeting Ford specification WSB-M2G314-B twice around the glass surface to be urethaned.

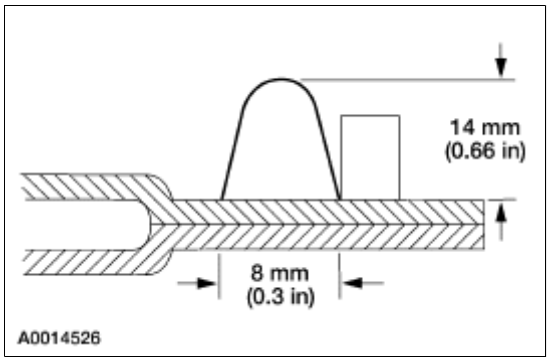
8. Apply Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was prepped in the pervious step. Allow five minutes to dry.

9. Cut the urethane applicator tip to specification.

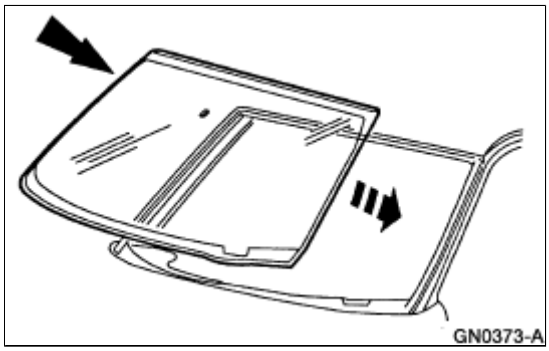


10. **CAUTION: If the vehicle is to be driven within 24 hours of urethane application, urethane sealant Essex U-216 must be used due to its one hour cure time.**

    Apply a bead of urethane sealant Essex 400-HV or Essex U-216, which meets Ford specification WSB-M2G316-B to the pinch weld just outside the foam dam.

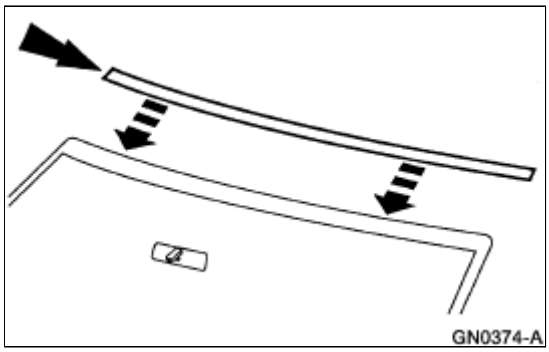


11. Install the windshield glass aligning it to the marks previously made.



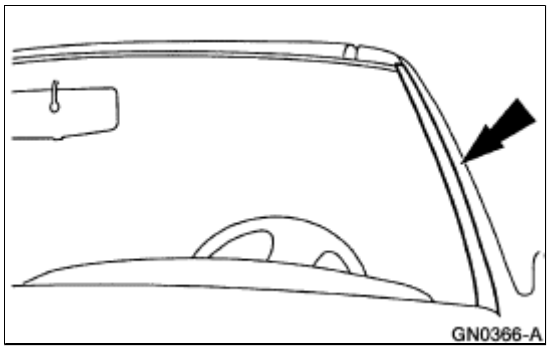
12. After the windshield glass is set , check for water leaks and add urethane sealant where needed.

13. Install the upper windshield weatherstrip.



14. If necessary, remove excess urethane from the outside surface of the windshield glass.

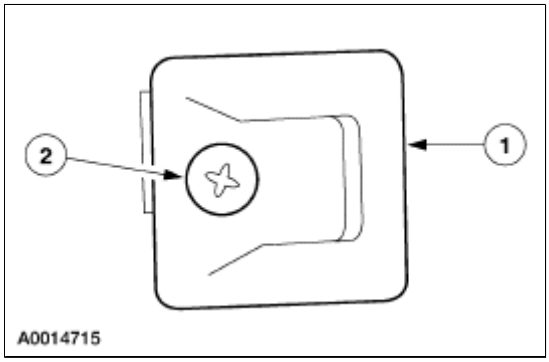
15. Install the LH and RH windshield mouldings.



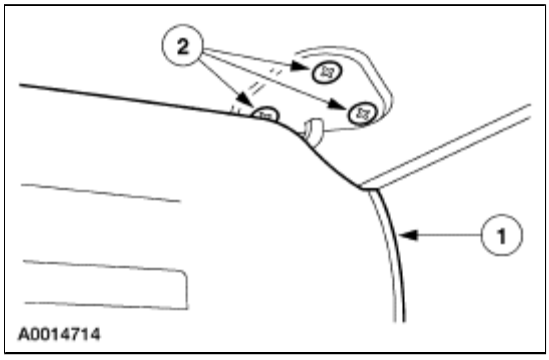
16. Install the cowl grille. For additional information, refer to Section 501-02 .

17. If equipped, install the overhead console.

18. Install the sun visor clips.
    1. Install the sun visor clips.
    2. Install the screws.



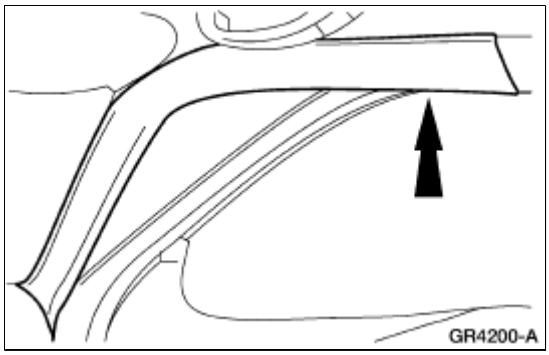
19. Install the sun visors.
    1. Install the sun visors.
    - If equipped, connect the electrical connector.
    3. Install the screws.



20. Install the front portion of the headliner.

21. Install the interior rear view mirror. For additional information, refer to Section 501-09 .

22. Install the windshield side garnish mouldings.

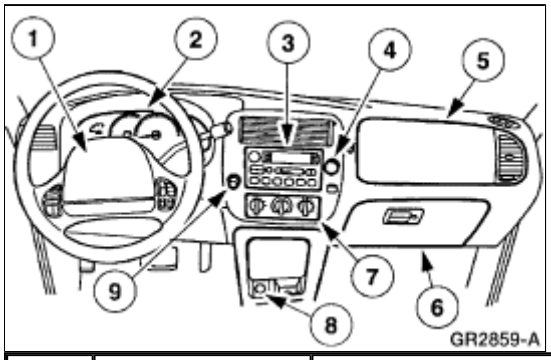

GR4200-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery Cable Clamp Bolts	7-10	—	62-89
Instrument Panel Cowl Side Bolts	25.5-34.5	19-25	—
Bulkhead Wiring Harness Connector Bolts	4.0-5.5	—	36-49
Upper Series Floor Console Bolts	9	—	80
Upper Series Floor Console Electrical Connector Bolt	4.0-5.5	—	36-49
Upper Series Front Floor Console Bolts	3.4-4.6	—	30-41
Base Series Floor Console Front Screws	3-4	—	26-35
Base Series Floor Console Rear Screw	2-3	—	18-26
Instrument Panel Cowl Side Bolts	25.5-34.5	19-25	—
Ground Wire Screws	2-3	—	18-26
Instrument Panel Cowl Top Bolts (Inner)	2-3	—	18-26
Instrument Panel Cowl Top Bolts (Outer)	25.5-34.5	19-25	—
Instrument Panel to Body Harness Bolt	4.0-5.5	—	36-49
Instrument Panel Brace Bolt	7.2-10.8	—	64-96

Instrument Panel

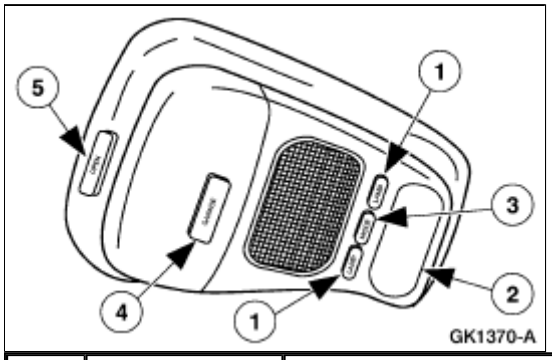
Instrument Panel Components



Item	Part Number	Description
1	043B13	Driver Side Air Bag Module
2	10849	Instrument Cluster
3	18806	Radio Chassis
4	—	Rear Windshield Wiper/Washer Switch
5	044A74	Passenger Side Air Bag Module
6	06024	Glove Compartment Door
7	—	Climate Control Head
8	—	Power Point
9	15052	Cigar Lighter Knob and Element

Console —Overhead

Overhead Console



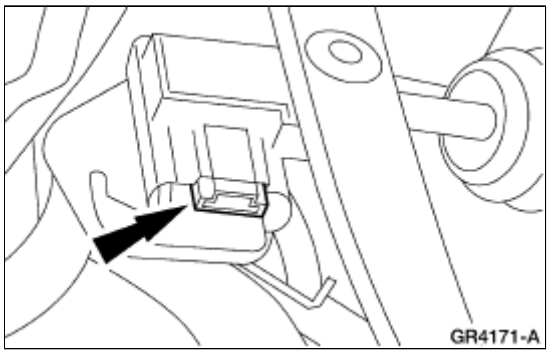
Item	Part Number	Description
1	—	Map Lamp Switch
2	—	Compass/Thermometer Display
3	—	Mode Switch
4	—	Garage Door Remote Button
5	—	Garage Door Remote Holder Release Button

Instrument Panel

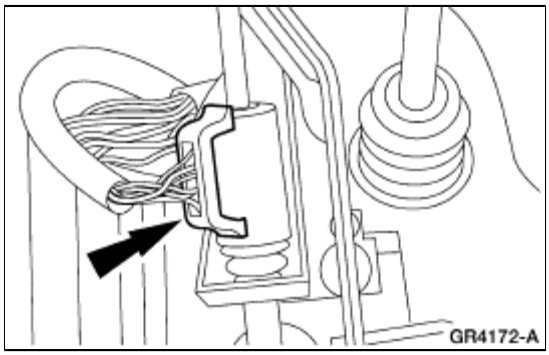
Removal

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

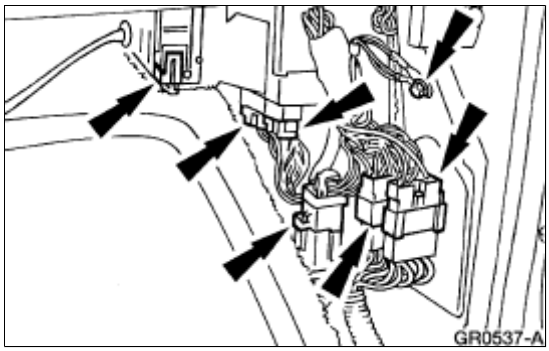
1. Remove the steering column; refer to Section 211-04 .
2. Disconnect the brake pedal position (BPP) switch electrical connector.



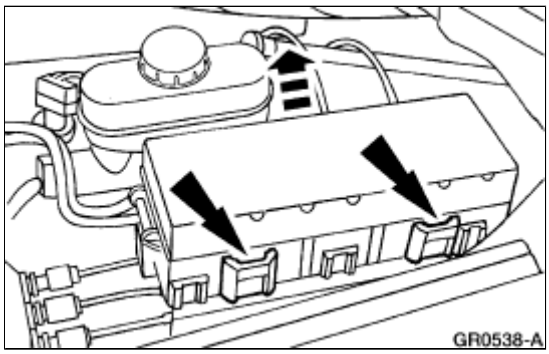
3. If equipped, disconnect the clutch pedal position (CPP) switch electrical connector.



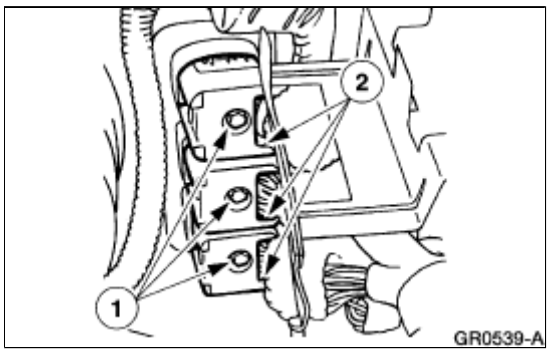
4. Remove the LH and RH cowl side trim panels. For additional information, refer to Section 501-05 .
5. Disconnect the electrical connectors and the ground wires on the RH cowl panel.



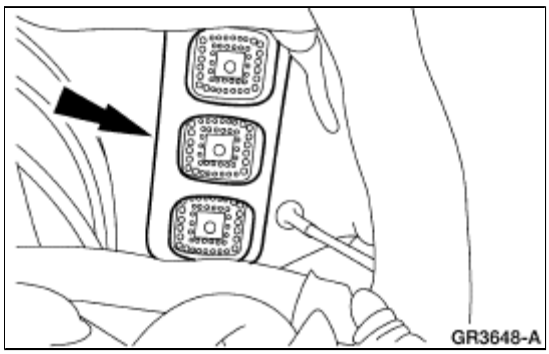
6. Disconnect the power distribution box from the bracket and position aside.



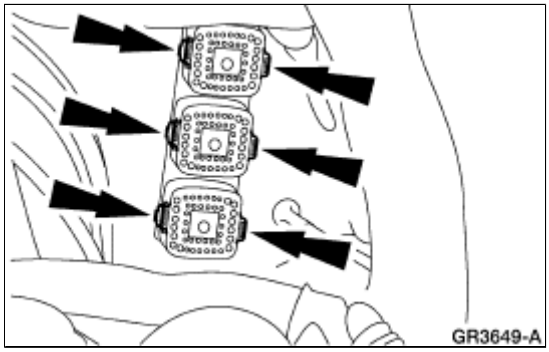
7. Disconnect the bulkhead wiring harness connectors from inside the engine compartment.
    1. Loosen the bolts.
    2. Disconnect the electrical connectors.



8. Remove the bulkhead connector insulator.

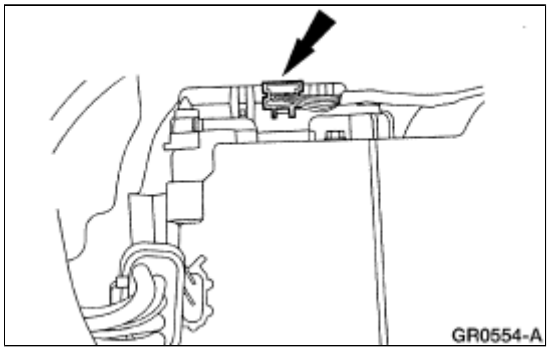


9. Unclip the bulkhead electrical connectors from the dash panel.

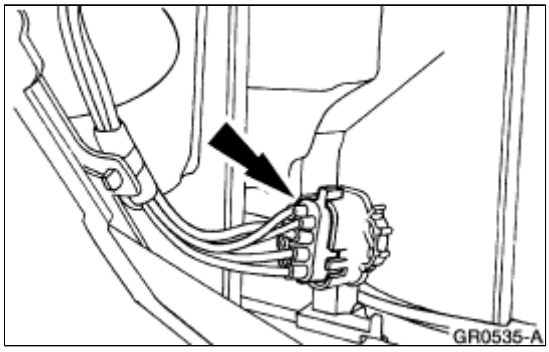


10. Remove the passenger side air bag module (044A74) ; refer to Section 501-20B .

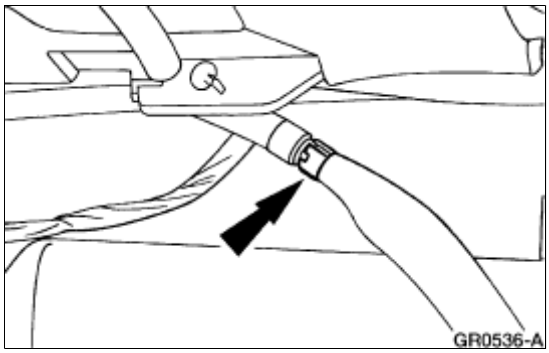
11. Disconnect the blend door actuator electrical connector.



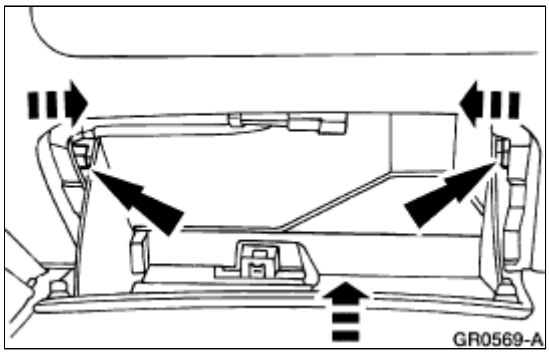
12. Disconnect the climate control vacuum harness connector.



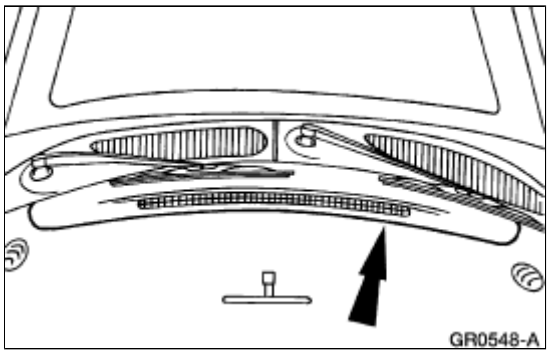
13. Disconnect the radio antenna cable in-line connector.



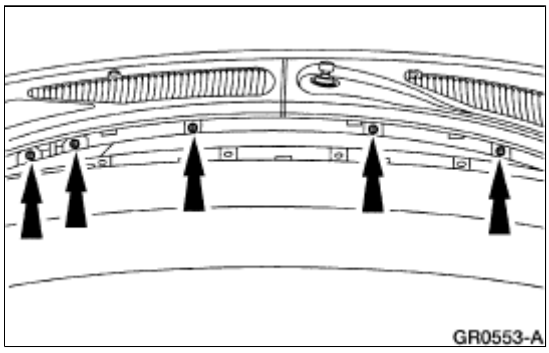
14. Raise the glove compartment.
    - Press the glove compartment release tabs inward while raising the glove compartment.



15. Remove the instrument panel defroster opening grille.

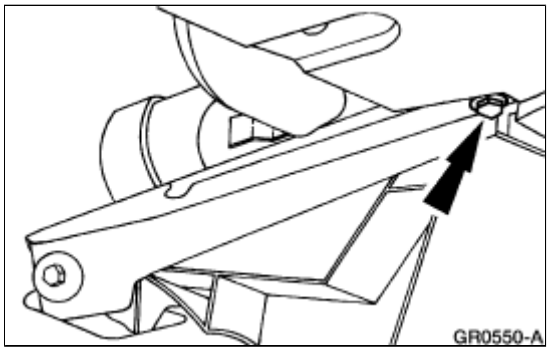


16. Remove the instrument panel cowl top bolts.

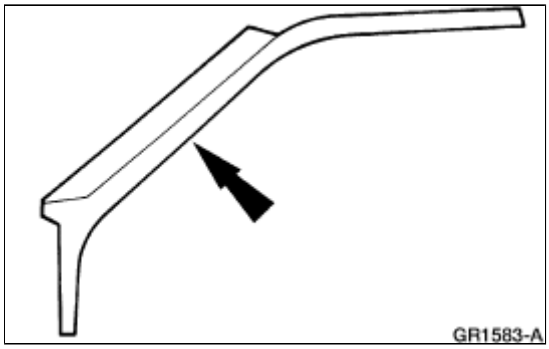


17. If equipped, remove the upper series floor console; refer to Console—Floor, Upper Series .

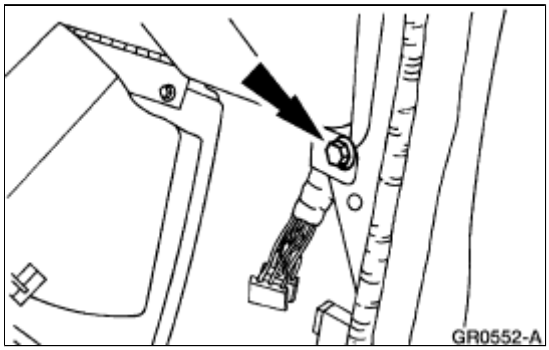
18. Remove the instrument panel brace bolt from under the steering column opening.



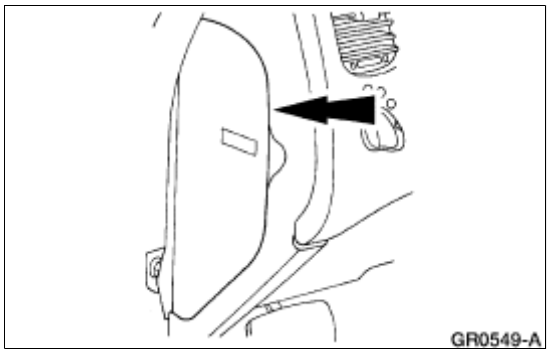
19. Remove the windshield side garnish mouldings.



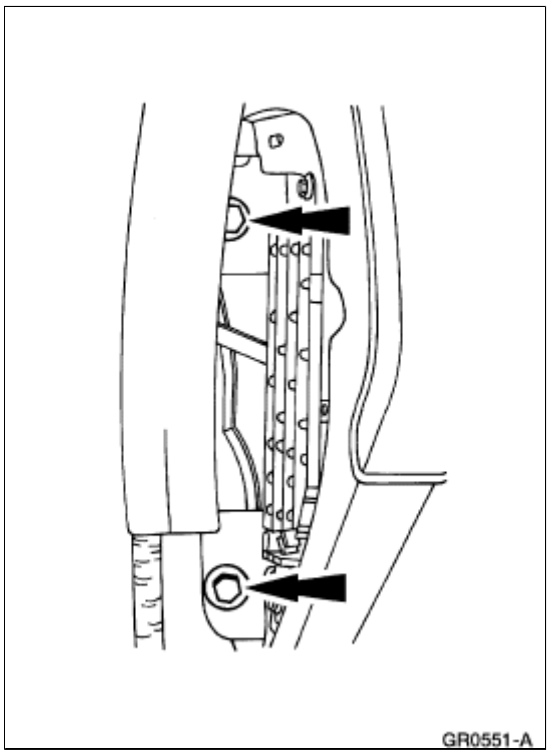
20. Remove the RH instrument panel cowl side bolt.



21. Remove the instrument panel fuse panel door.

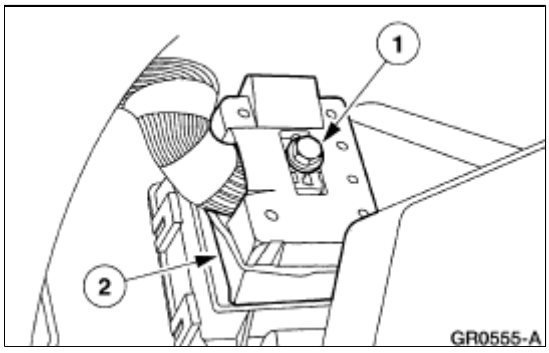


22. Remove the LH instrument panel cowl side bolts.



23. Position the instrument panel away from the dash panel.

24. Disconnect the instrument panel to body harness.
    1. Loosen the bolt.
    2. Disconnect the harness.



25. **NOTE:** Two technicians are required to carry out this step.

    Remove the instrument panel.
    - If necessary, transfer components to the new instrument panel.

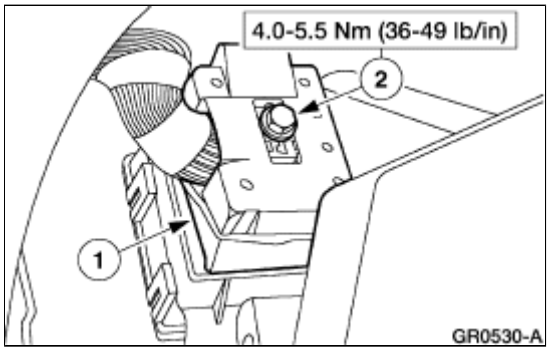
Installation

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

1. **NOTE:** Two technicians are required to carry out this step.

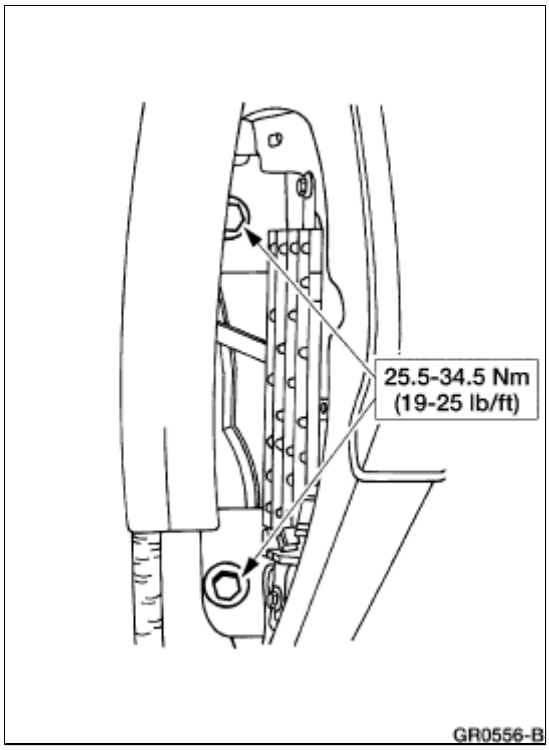
   Position the instrument panel.

2. Connect the instrument panel to body harness.
   1. Connect the harness.
   2. Tighten the bolt.

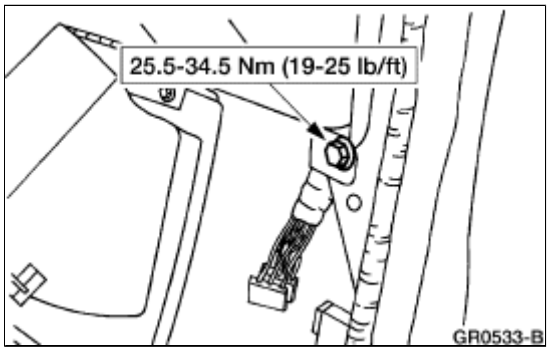


3. Align and install the instrument panel.

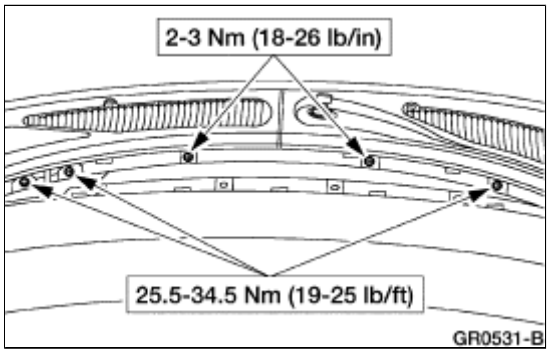
4. Install the LH instrument panel cowl side bolts.



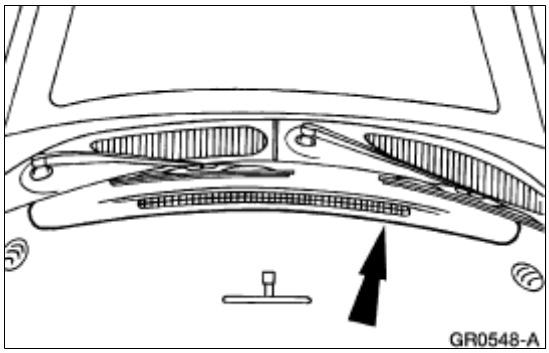
5. Install the RH instrument panel cowl side bolt.



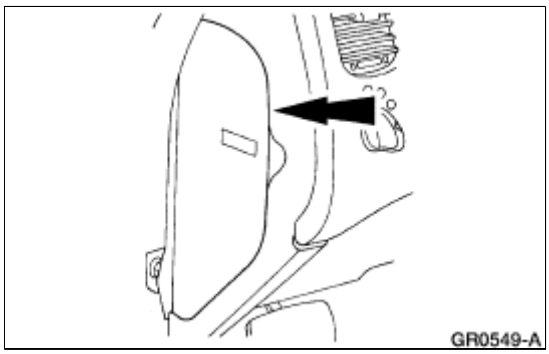
6. Install the instrument panel cowl top bolts.



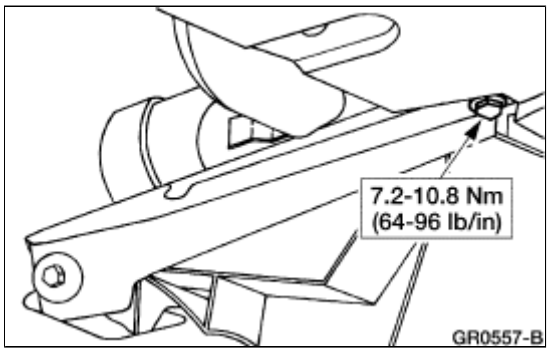
7. Install the instrument panel defroster opening grille.



8. Install the instrument panel fuse panel door.

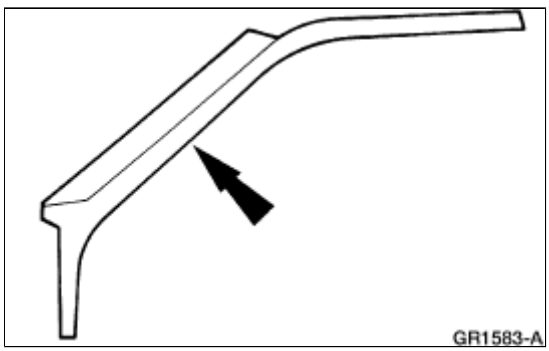


9. Install the instrument panel brace bolt from under the steering column opening.

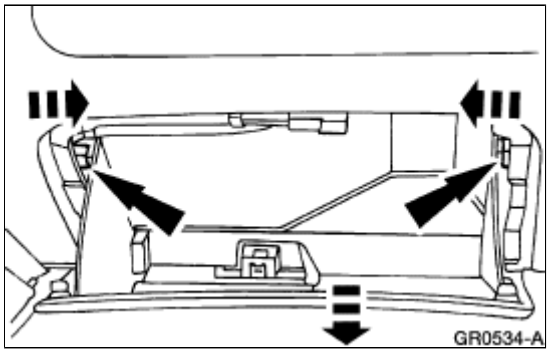


10. If equipped, install the floor console; refer to Console—Floor, Upper Series .

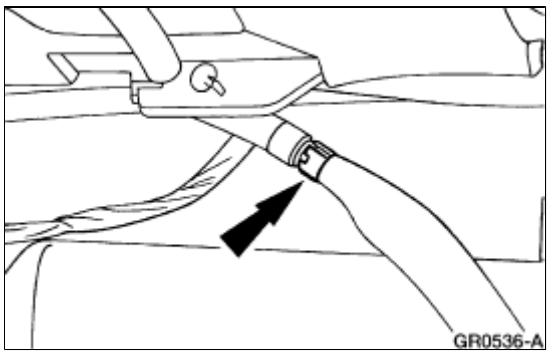
11. Install the windshield side garnish mouldings.



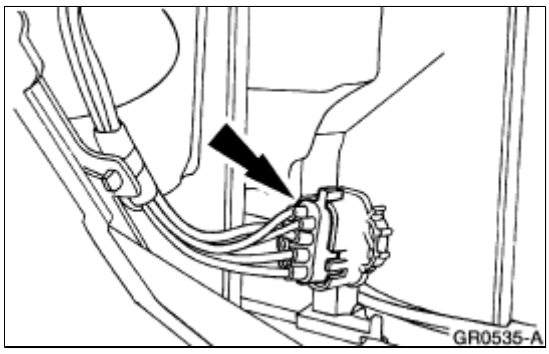
12. Lower the glove compartment.
    - Press the glove compartment release tabs inward while pulling downward on the glove compartment.



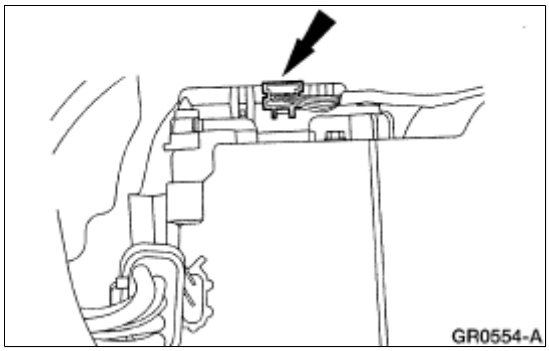
13. Connect the radio antenna cable in-line connector.



14. Connect the climate control vacuum harness connector.

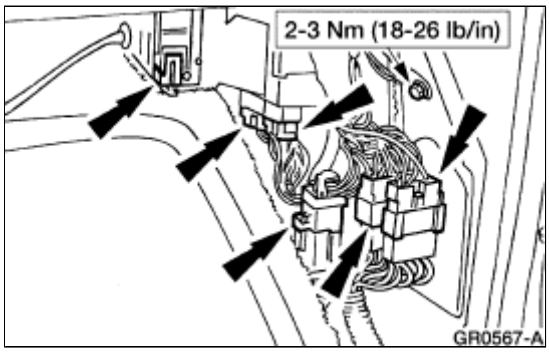


15. Connect the blend door actuator electrical connector.

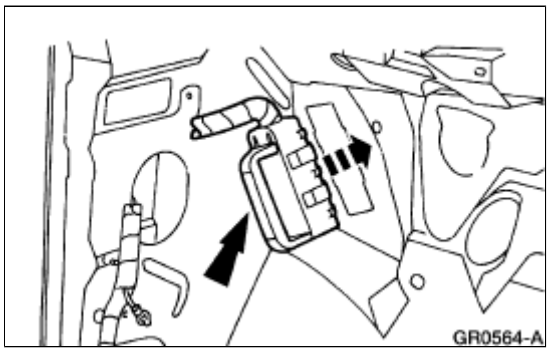


16. Install the passenger side air bag module ; refer to Section 501-20B .

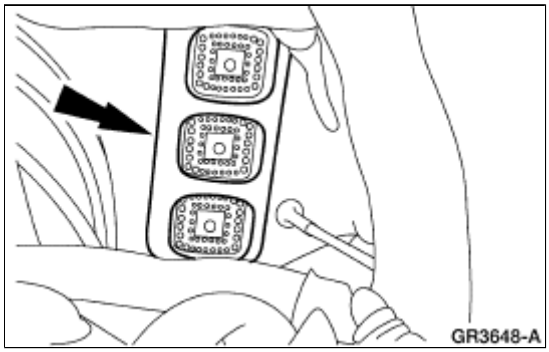
17. Connect the electrical connectors and the ground wires on the RH cowl panel.



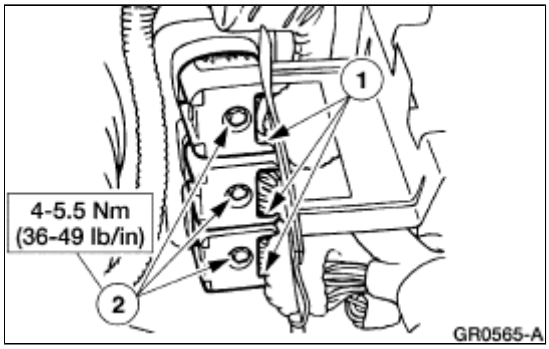
18. Position the bulkhead electrical connector handle.



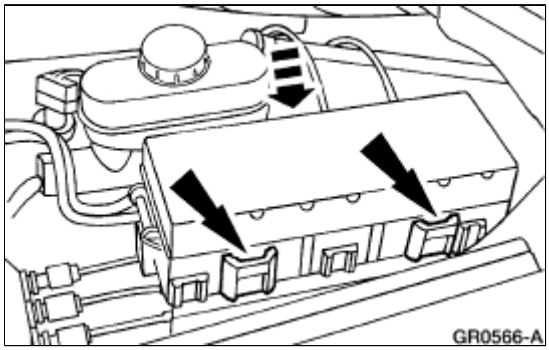
19. Install the bulkhead connector insulator.



20. Install the bulkhead wiring harness connectors.
    1. Connect the electrical connectors.
    2. Tighten the bolts.

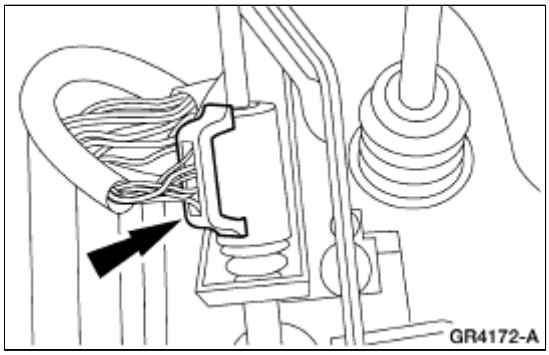


21. Install the power distribution box onto the power distribution box bracket.

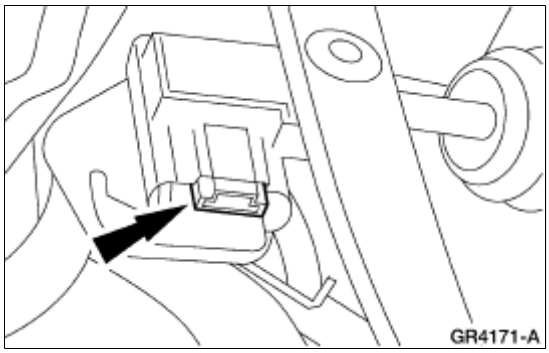


22. Install the LH and RH cowl side trim panels. For additional information, refer to Section 501-05 .

23. If equipped, connect the CPP switch electrical connector.



24. Connect the BPP switch electrical connector.



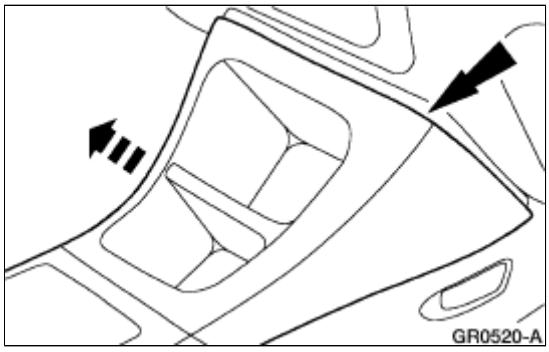
25. Install the steering column; refer to Section 211-04 .

Console —Floor, Upper Series

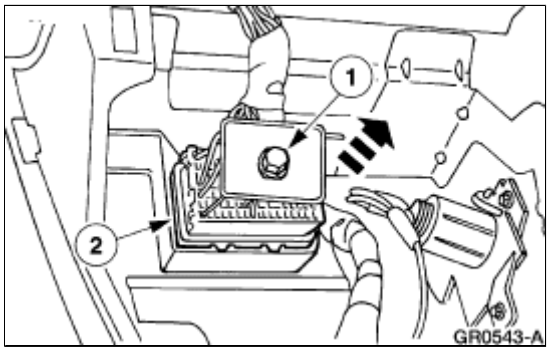
Removal

1. Disconnect the battery ground cable.

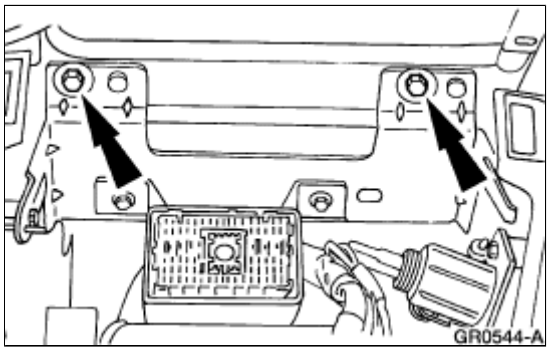
2. Remove the front floor console tray.
   - If equipped with message center, disconnect the three connectors.



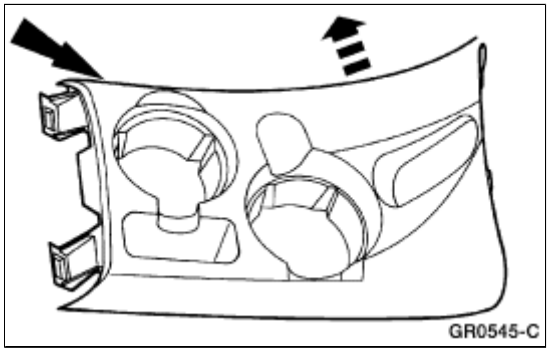
3. Disconnect the floor console electrical connector.
   1. Remove the bolt.
   2. Disconnect the electrical connector.



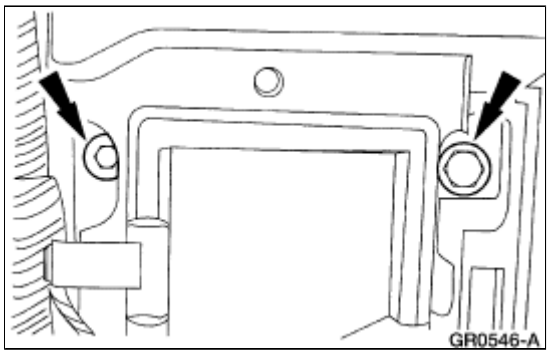
4. Remove the front floor console bolts.



5. Remove the center cupholder panel.

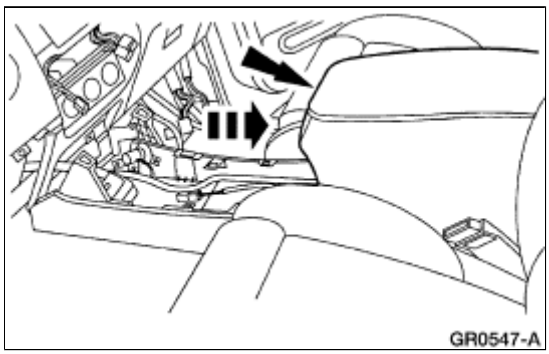


6. Remove the center floor console bolts.



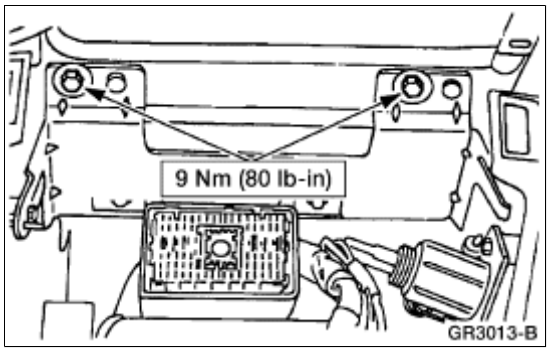
7. **NOTE:** The console must be moved rearward to disengage the rear mounting bracket.

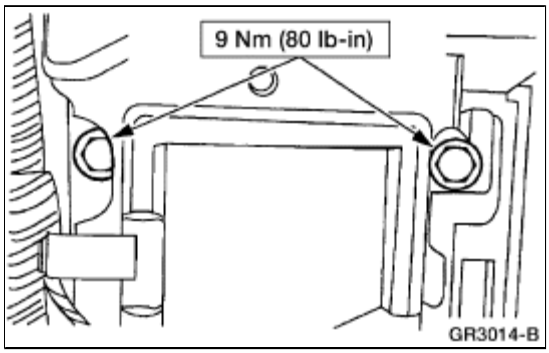
   Remove the floor console.

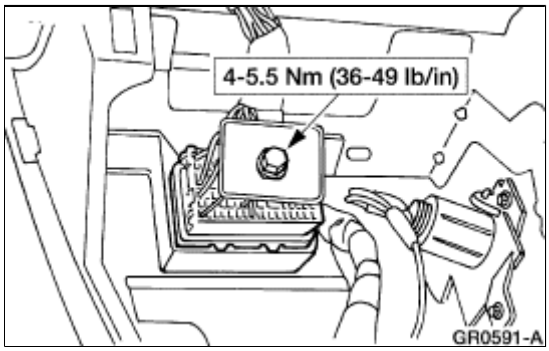


Installation

1. To install, reverse the removal procedure.


9 Nm (80 lb-in)
GR3013-B


9 Nm (80 lb-in)
GR3014-B

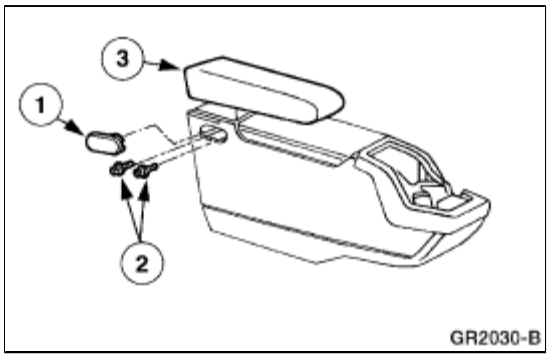

4-5.5 Nm (36-49 lb/in)
GR0591-A

Console —Floor, Base Series Explorer

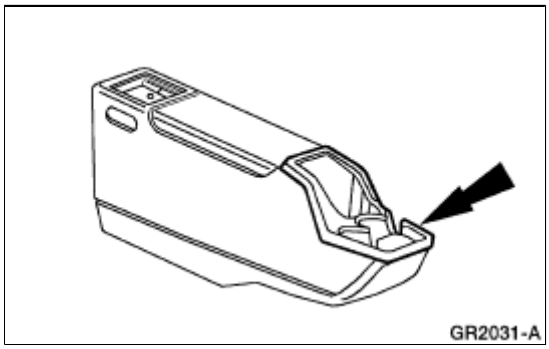
Removal

NOTE: The base floor console is shown; floor console with removable storage bin is similar.

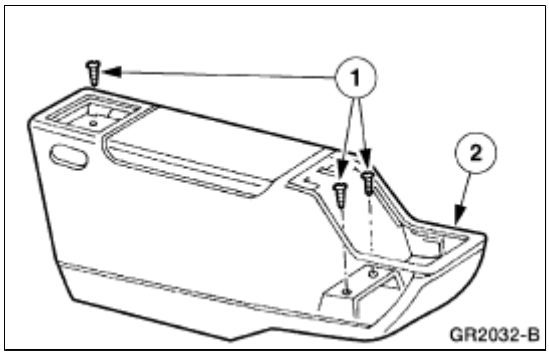
1. Remove the front seat center armrest.
    1. Remove the two covers.
    2. Remove the four bolts.
    3. Remove the armrest.



2. Remove the utility tray beverage holder.

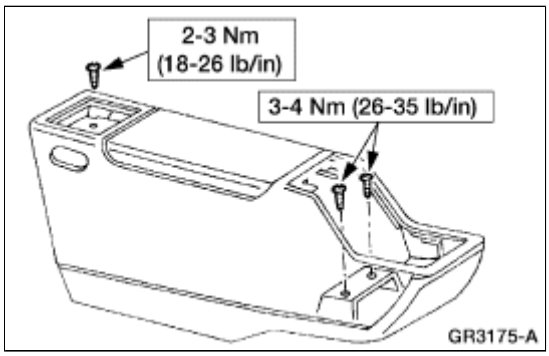


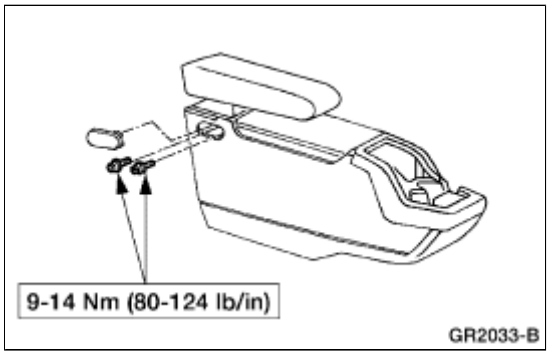
3. Remove the floor console.
    1. Remove the screws.
    2. Remove the floor console.



Installation

1. To install, reverse the removal procedure.

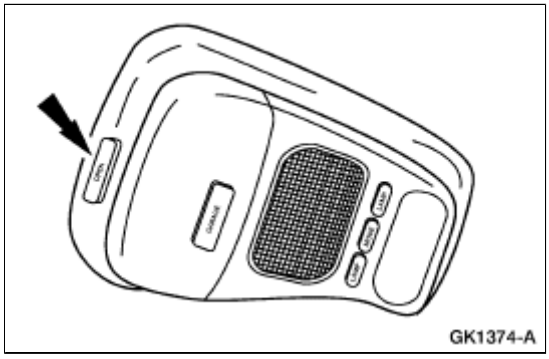




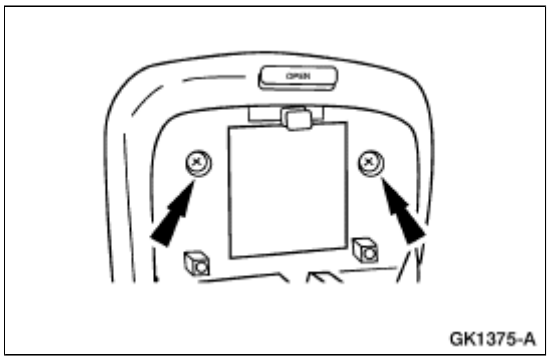
Console —Overhead

Removal

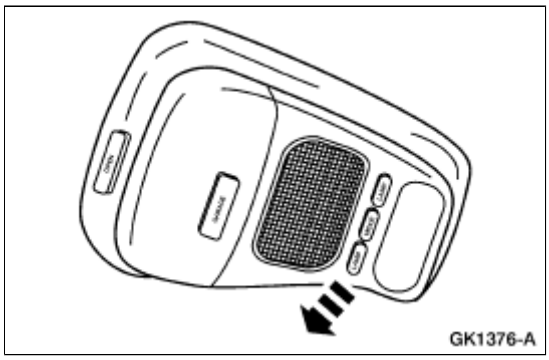
1. Disconnect the battery ground cable.
2. If equipped, open the garage door remote cover.


GK1374-A

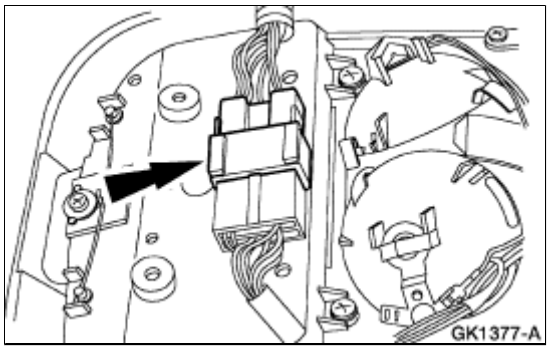
3. If equipped, remove the screws.


GK1375-A

4. Remove the overhead console.


GK1376-A

5. Disconnect the two electrical connectors (three connectors on moonroof equipped vehicles).



Installation

1. To install, reverse the removal procedure.

General Specifications

Item	Specification
Liftgate glass flushness mm (in)	-1.50 (-.06)

Lock Repair/Replacement Specifications

Part Number	Lock Repair Package Name
F85Z-11582-AA	Ignition Cylinder Lock Kit
F87Z-7821990-BA	Door Lock Kit
F87Z-7843432-CA	Liftgate Lock Kit

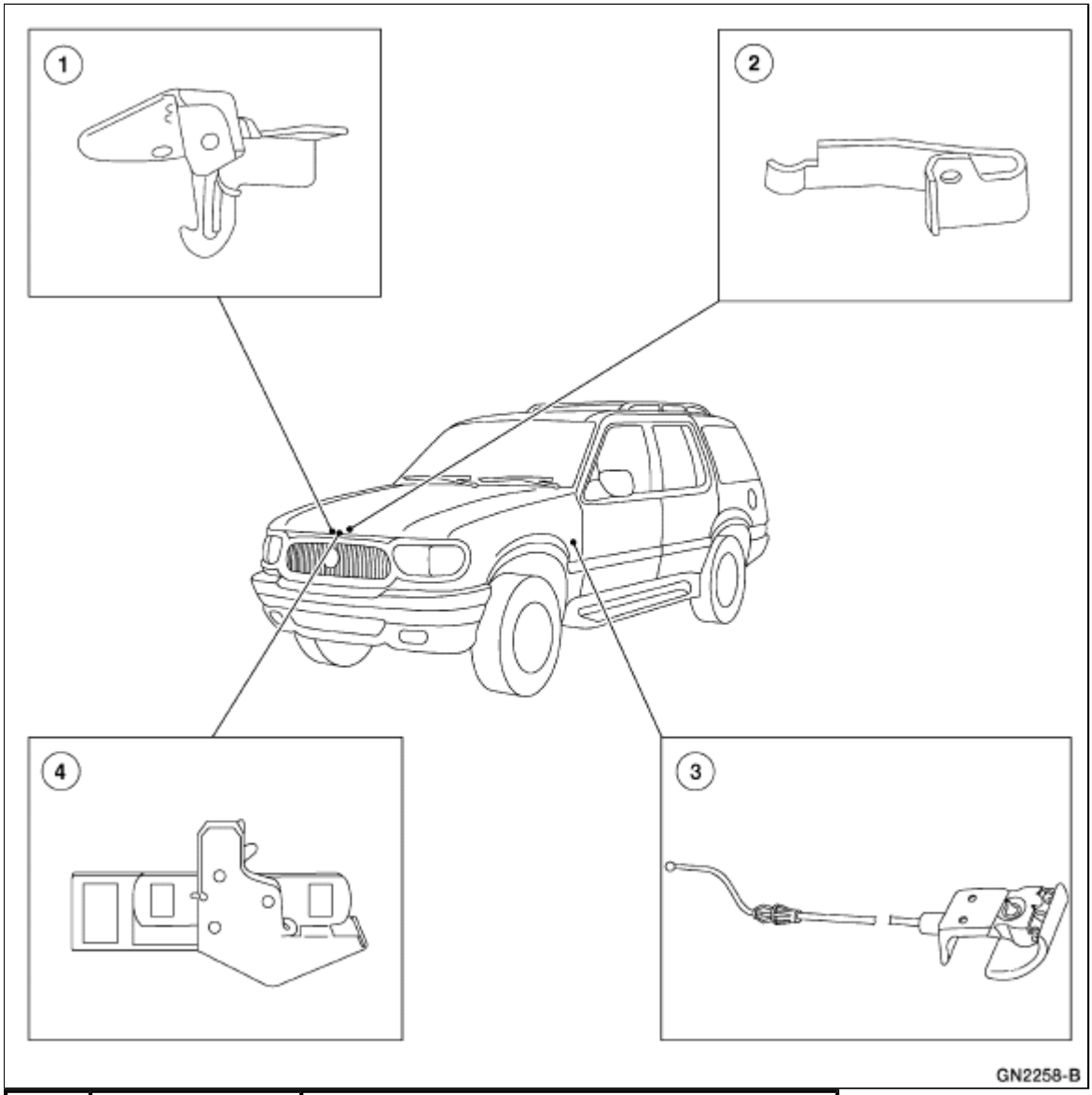
Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable	7-10	—	62-89
Door latch screws	4-8	—	36-70
Hood auxiliary catch hook bolts	11-13	—	91-123
Hood assist spring bolt	24-31	18-23	—
Hood latch bolts	10.5-13.5	8-9	—
Hood latch control handle screws	2-4	—	16-41
Inside door handle screws	7.5-10.5	—	67-93
License plate lamp shield screws	3	—	27
Liftgate latch bolt	9-14	7-10	—
Liftgate latch remote control	11-13	—	91-123
Liftgate lock actuator nuts	11-13	—	91-123
Liftgate lock cylinder nuts	6-7	—	54-62
Liftgate window latch nuts	12	9	—
Radiator grille sight shield bolts	6-8	—	54-70
Door latch striker	40	30	—

Handles, Locks, Latches and Mechanisms

Hood

Hood Latch Components

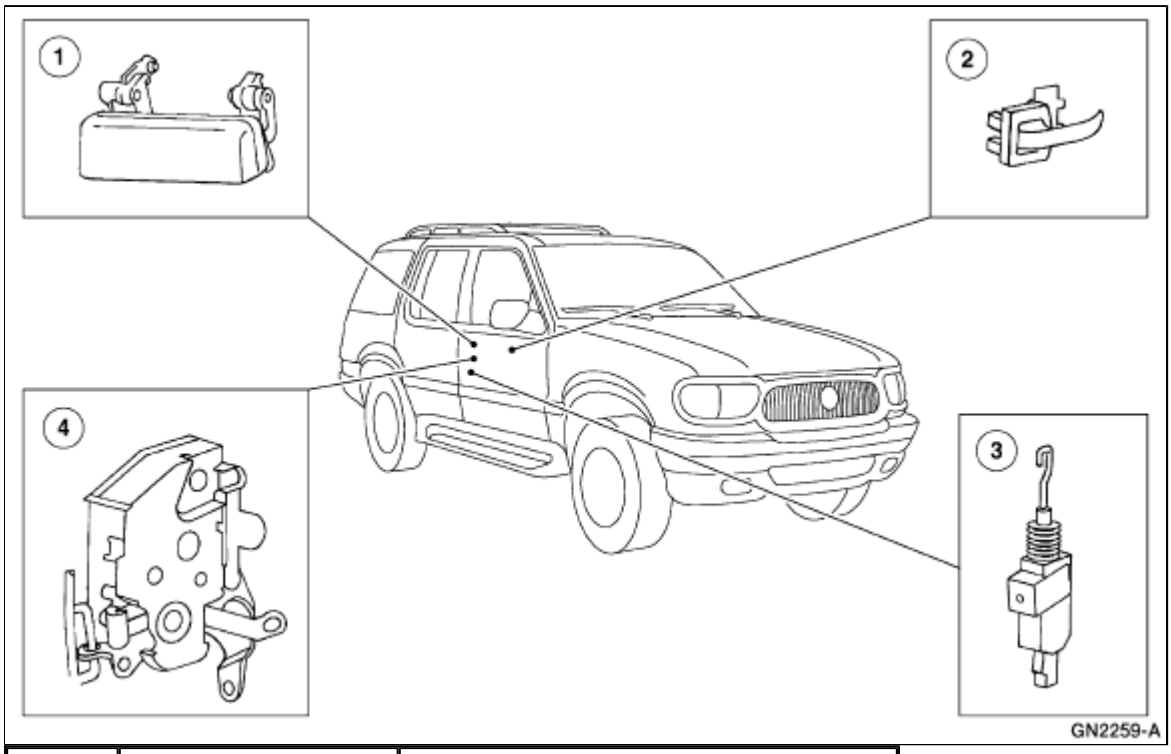


Item	Part Number	Description
1	16892	Hood auxiliary catch hook
2	16C644	Hood assist spring
3	—	Hood latch control handle and Cable

4	16700	Hood latch

Door

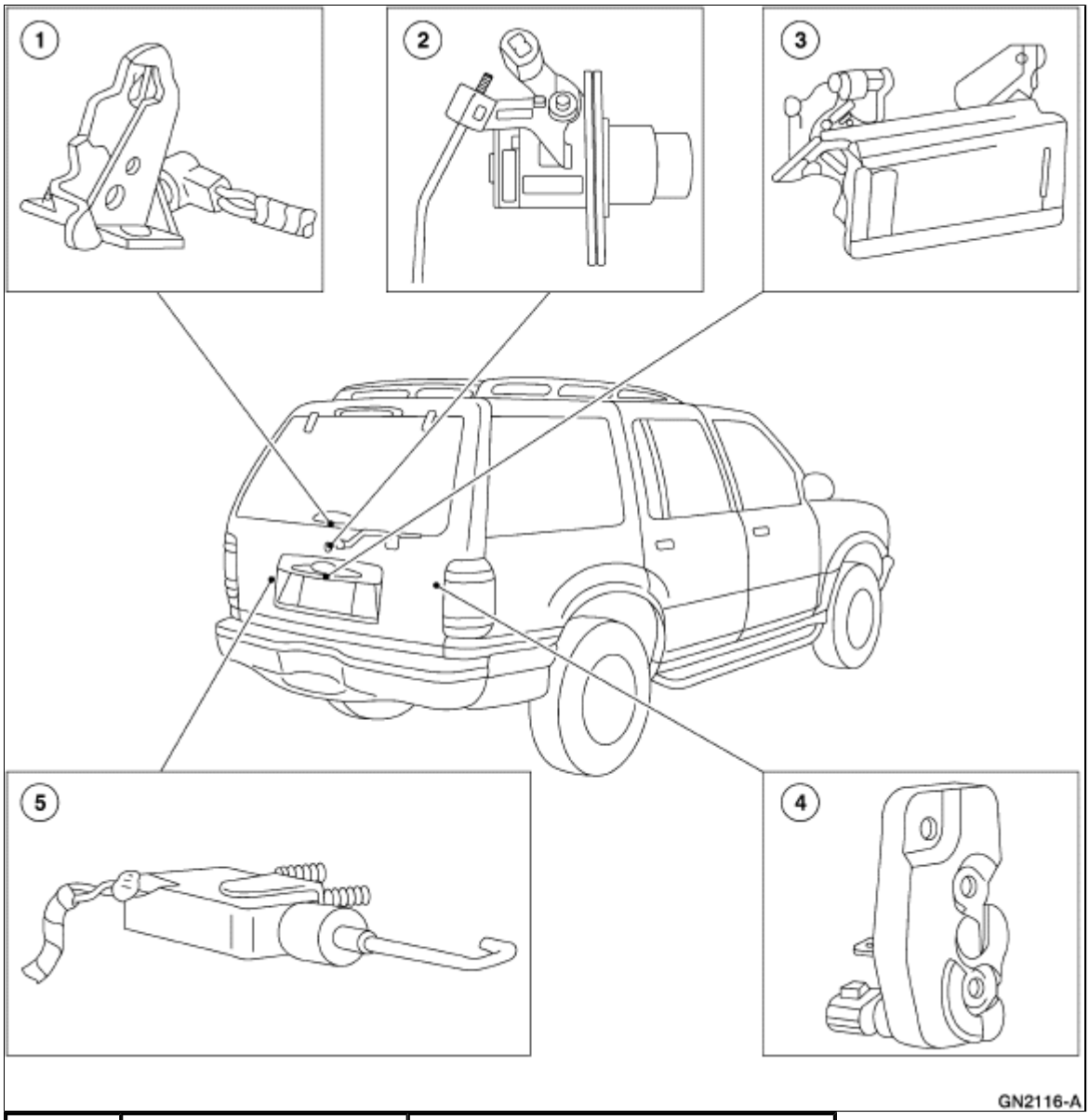
Door Latch Components



Item	Part Number	Description
1	22404	Door handle
2	—	Inside door handle
3	218A42	Power door lock Actuator
4	21812	Front door latch

Liftgate

Liftgate Latch Components



Item	Part Number	Description
1	—	Liftgate glass latch
2	—	Lock cylinder
3	—	Liftgate handle
4	—	Liftgate latch
5	—	Liftgate lock actuator

Locks, Latches and Mechanisms

Refer to Wiring Diagrams Cell 110 , Power Door Locks for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Inspection and Verification

1. Verify the customer concern by operating the handles, locks, latches and mechanisms.
2. **NOTE:** Be sure the battery (10655) is fully charged. Refer to Section 414-00 . Before starting electrical diagnosis, check for mechanical binds by manually operating the door lock. Then operate the lock system several times from each switch, while observing the operation of all door locks.

   Visually inspect for obvious signs of mechanical and electrical damage using the following chart.

   Visual Inspection Chart

Mechanical	Electrical
• Binding latches • Door lock cylinder • Misaligned door • Lock actuator	• Fuse • Relays • Switch • Wiring harness • Loose or corroded connections

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

Symptom Chart

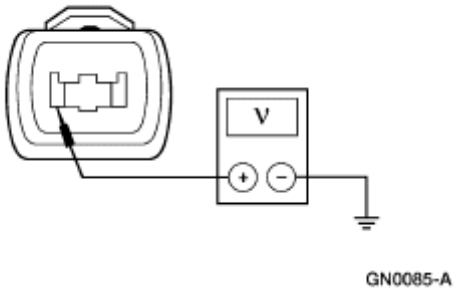
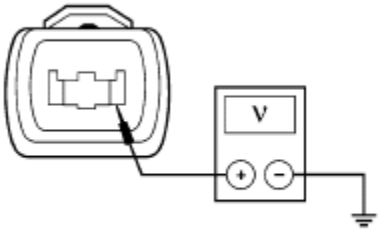
Condition	Possible Sources	Action
• The door lock is inoperative	• Circuitry. • Power door lock actuator (218A42).	• GO to Pinpoint Test A .
• The door locks are inoperative	• Fuse. • Circuitry. • Door lock switch.	• GO to Pinpoint Test B .

	• All lock and unlock relay(s).	
• All the locks operate from one switch only	• Circuitry. • Door lock switch.	• GO to Pinpoint Test C .
• The door locks are inoperative — door locks operate one way only	• Circuitry. • Door lock switch. • All lock or unlock relay(s).	• GO to Pinpoint Test D .
• The door locks only operate with the engine running	• Battery discharged.	• CHECK the battery voltage; REFER to Section 414-00 .

Pinpoint Tests

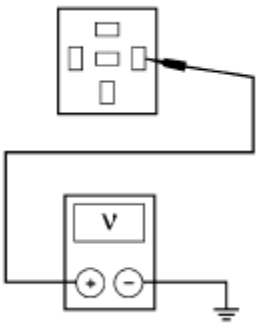
PINPOINT TEST A: THE DOOR LOCK IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE OPERATION OF THE SUSPECT DOOR LOCK	
	1 Check for binding or stuck conditions by manually operating the inoperative door lock. • **Is the lock stuck or binding?** → **Yes** REPAIR or REPLACE the binding components. TEST the system for normal operation. → **No** GO to A2 .
A2 CHECK THE POWER DOOR LOCK ACTUATOR FOR LOCK OPERATION — CIRCUIT 117 (PK/BK)	
1 Inoperative Power Door Lock Actuator	
2	2 Measure the voltage at the inoperative power door lock actuator connector Pin 1, Circuit 117 (PK/BK), and ground while operating the door lock switch to the LOCK position.

 GN0085-A	• **Is the voltage greater than 10 volts?** → **Yes** GO to A3 . → **No** REPAIR Circuit 117 (PK/BK). TEST the system for normal operation.
A3 CHECK THE POWER DOOR LOCK ACTUATOR FOR UNLOCK OPERATION — CIRCUIT 118 (PK/O)/163 (R/O)	
1  GN0086-A	1 Measure the voltage at the inoperative power door lock actuator connector Pin 2, Circuit 118 (PK/O) or 163 R/O, and ground while operating the door lock switch to the UNLOCK position. • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new power door lock actuator. TEST the system for normal operation. → **No** REPAIR Circuit 118 (PK/O) and/or 163 (R/O). TEST the system for normal operation.

PINPOINT TEST B: ALL THE DOOR LOCKS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK FUSE JUNCTION PANEL FUSE 18 (25A)	
1	

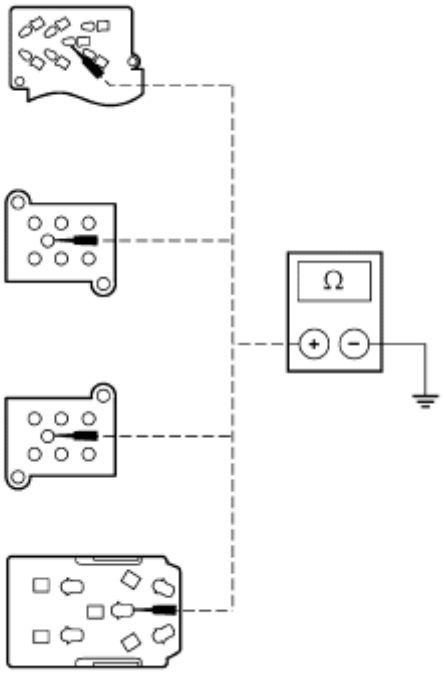
 2 Fuse 18 (25A)	• **Is the fuse OK?** → **Yes** GO to B2 . → **No** INSTALL a new fuse. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
B2 CHECK RELAY CONNECTORS	
	1 Check the all lock and unlock relays for damaged terminals and/or wiring. • **Are all of the terminals and wiring OK?** → **Yes** GO to B3 . → **No** REPAIR the damaged connector. TEST the system for normal operation.
B3 CHECK THE VOLTAGE TO THE UNLOCK RELAY — CIRCUIT 171 (BK/W)	
1 All Unlock Relay 2  GN1481-A	2 Measure the voltage between all unlock relay connector Pin 86, Circuit 171 (BK/W), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** REPAIR Circuit 57 (BK). TEST the system for normal operation. → **No** REPAIR Circuit 171 (BK/W). TEST the system for normal operation.

PINPOINT TEST C: ALL THE LOCKS OPERATE FROM ONE SWITCH ONLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE INOPERATIVE DOOR LOCK SWITCH	
1 2 Inoperative Door Lock Switch	3 Check the inoperative door lock switch. Refer to Wiring Diagrams, Cell 149, Component Testing.. • **Is the switch OK?** → **Yes** GO to C2 . → **No** INSTALL a new door lock switch. TEST the system for normal operation.
C2 CHECK THE GROUND TO THE INOPERATIVE DOOR LOCK SWITCH — CIRCUIT 57 (BK)	
1	1 Measure the resistance between the inoperative door lock switch Circuit 57 (BK), and ground; refer to the following chart:

Switch	Connector/Pin
Liftgate	C404-3
Passenger	C614-4
Driver (2 door)	C514-4
Driver (4 door)	C501-4



- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to C3 .

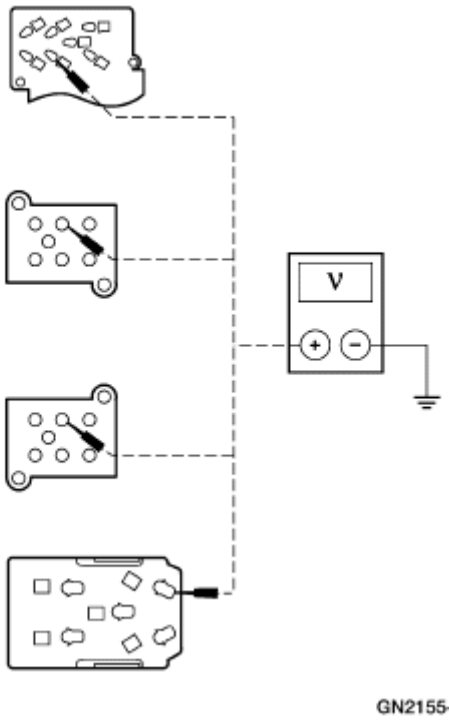
→ **No**
REPAIR Circuit 57 (BK). TEST the system for normal operation.

C3 CHECK THE VOLTAGE TO THE INOPERATIVE SWITCH — CIRCUIT 119 (PK/Y)

1

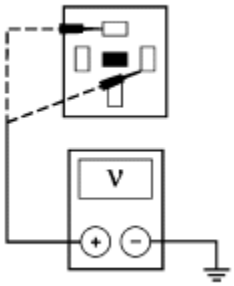
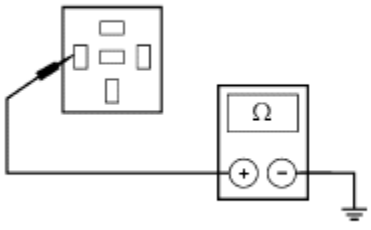
1 Measure the voltage between the inoperative door lock switch Circuit 119 (PK/Y), and ground; refer to the following chart:

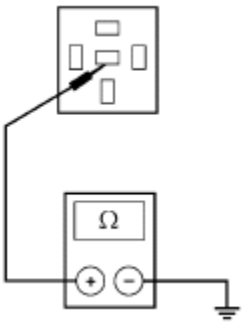
Switch	Connector/Pin
Liftgate	C404-2
Passenger	C614-2
Driver (2 door)	C514-2
Driver (4 door)	C501-6

	• **Is the voltage greater than 10 volts?** → **Yes** REPAIR Circuit 120 (PK/LG). TEST the system for normal operation. → **No** REPAIR Circuit 119 (PK/Y). TEST the system for normal operation.

PINPOINT TEST D: THE DOOR LOCKS ARE INOPERATIVE — DOOR LOCKS OPERATE ONE WAY ONLY

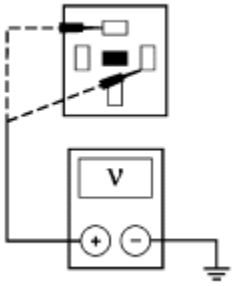
CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK LOCK OPERATION	
	1 Actuate the door lock switch to the LOCK position. • **Do the doors lock?** → **Yes** GO to D2 . → **No** GO to D6 .
D2 CHECK THE VOLTAGE TO THE ALL UNLOCK RELAY — CIRCUIT 171 (BK/W)	

1 2 All Unlock Relay 3  GN2508-A	3 Measure the voltage between all unlock relay connector Pin 86, Circuit 171 (BK/W), and ground; and between all unlock relay connector Pin 87, Circuit 171 (BK/W), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to D3 . → **No** REPAIR Circuit 171 (BK/W). TEST the system for normal operation.
D3 CHECK ALL UNLOCK RELAY CONTROL GROUND — CIRCUIT 120 (PK/LG)	
1  GN1480-A	1 Measure the resistance between the all unlock relay connector Pin 85, Circuit 120 (PK/LG), and ground while pressing the UNLOCK button on a power door lock switch. • **Is the resistance less than 5 ohms?** → **Yes** GO to D4 . → **No** REPAIR Circuit 120 (PK/LG). TEST the system

	for normal operation.
D4 CHECK ALL UNLOCK RELAY GROUND CIRCUIT FROM THE ALL LOCK RELAY — CIRCUIT 57 (BK)	
1 All Lock Relay 2  	2 Measure the resistance between all lock relay connector Pin 87A, Circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to D5 . → **No** REPAIR Circuit 57 (BK). TEST the system for normal operation.
D5 CHECK THE ALL UNLOCK RELAY	
	1 Check the all unlock relay. Refer to Wiring Diagrams, Cell 149 Component Testing. • **Is the all unlock relay OK?** → **Yes** INSTALL a new all lock relay. TEST the system for normal operation. → **No** INSTALL a new all unlock relay. TEST the system for normal operation.
D6 CHECK THE VOLTAGE TO THE ALL LOCK RELAY — CIRCUIT 171 (BK/W)	
1 2	

All Lock Relay

3



GN2508-A

3 Measure the voltage between all lock relay connector Pins 86 and 87, Circuit 171 (BK/W), and ground.

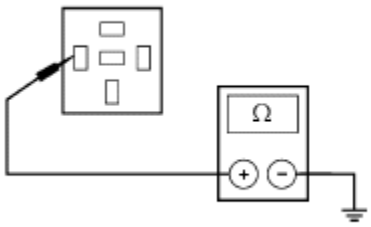
- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to D7 .

→ **No**
REPAIR Circuit 171 (BK/W). TEST the system for normal operation.

D7 CHECK ALL LOCK RELAY CONTROL GROUND — CIRCUIT 119 (PK/Y)

1



GN1480-A

1 Measure the resistance between all lock relay connector Pin 85, Circuit 119 (PK/Y), and ground while pressing the LOCK button on a power door lock switch.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to D8 .

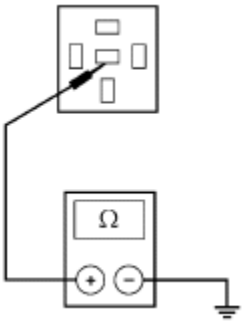
→ **No**
REPAIR circuit 119 (PK/Y). TEST the system for normal operation.

D8 CHECK ALL LOCK RELAY GROUND CIRCUIT FROM THE ALL UNLOCK RELAY — CIRCUIT 57 (BK)

1

All Unlock Relay

2



2 Measure the resistance between all unlock relay connector Pin 87A, Circuit 57 (BK), and ground.

- **Is the resistance less the 5 ohms?**

→ **Yes**
GO to D9 .

→ **No**
REPAIR Circuit 57 (BK). TEST the system for normal operation.

D9 CHECK THE ALL LOCK RELAY

1 Check the all lock relay. Refer to Wiring Diagrams, Cell 149, Component Testing.

- **Is the all lock relay OK?**

→ **Yes**
INSTALL a new all unlock relay. TEST the system for normal operation.

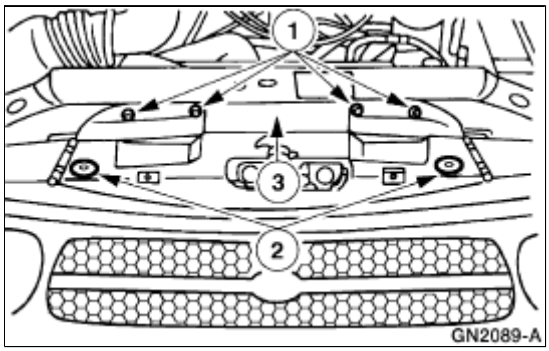
→ **No**
INSTALL a new all lock relay. TEST the system for normal operation.

Latch —Hood

Removal

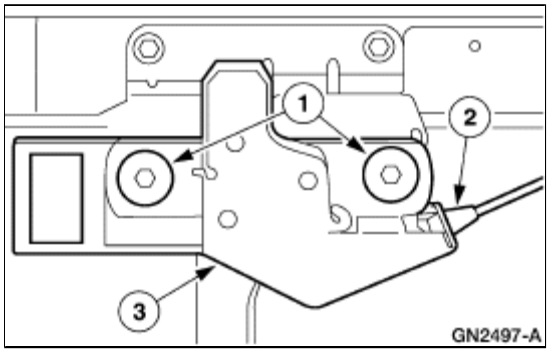
1. Raise and support the hood (16612).

2. Remove the radiator grille sight shield (8C031).
    1. Remove the bolts.
    2. Remove the rivets.
    3. Remove the radiator grille sight shield.



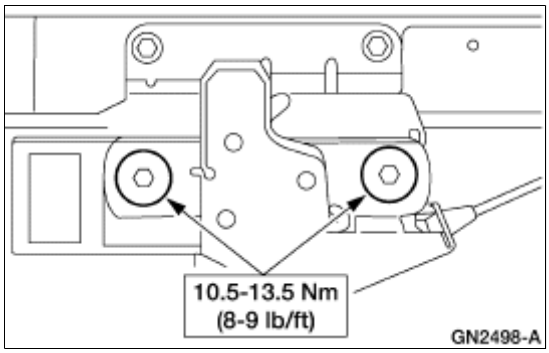
3. **NOTE:** Mark the hood latch position prior to removal of the bolts.

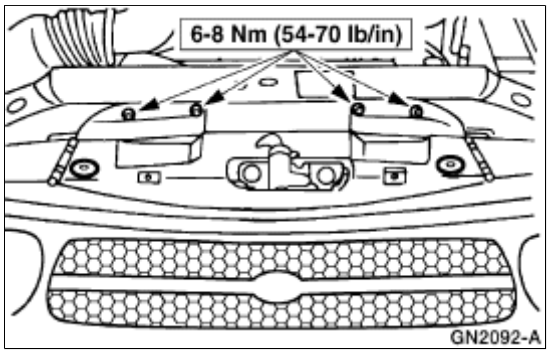
    Remove the hood latch (16700)
    1. Remove the bolts.
    2. Disconnect the hood latch cable from the hood latch.
    3. Remove the hood latch.



Installation

1. To install, reverse the removal procedure.
    - Adjust the hood latch; refer to Latch—Hood, Adjustment .

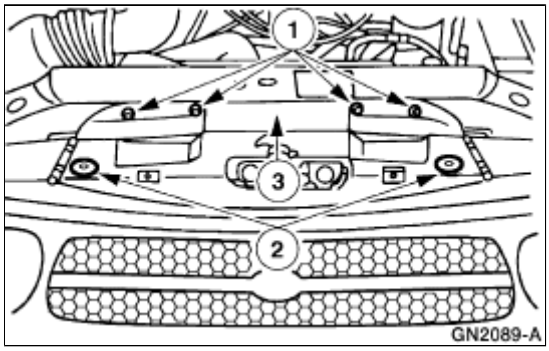

10.5-13.5 Nm
(8-9 lb/ft)
GN2498-A


6-8 Nm (54-70 lb/in)
GN2092-A

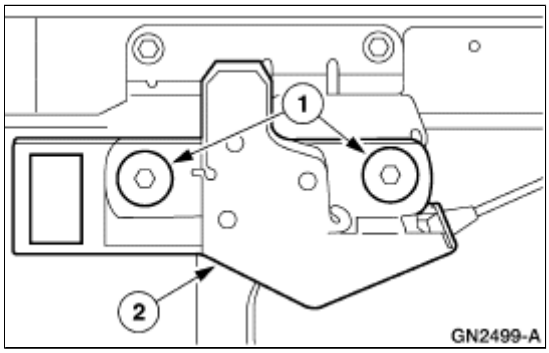
Latch —Hood, Adjustment

1. Verify the hood alignment.

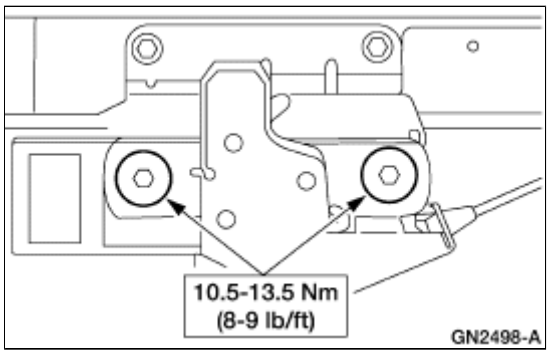
2. Remove the radiator grille sight shield (8C031).
    1. Remove the bolts.
    2. Remove the rivets.
    3. Remove the radiator grille sight shield.



3. Align the hood latch.
    1. Loosen the hood latch bolts enough to allow for movement of the hood latch.
    2. Align the hood latch with the hood latch striker.



4. Tighten the hood latch bolts.



5. Verify the hood latch striker is fully engaging the hood latch.
    - Repeat the procedure as necessary.

Latch —Door

Special Tool(s)

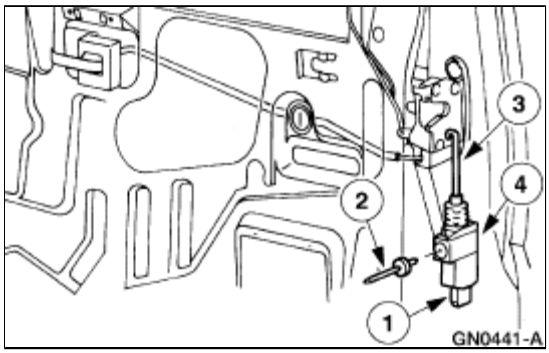
ST1132-A	Heavy Duty Riveter 501-D011 (D80L-23200-A) or equivalent

Removal and Installation

NOTE: Front door shown, rear door similar.

Front door

1. Remove the door lock cylinder; refer to Lock Cylinder—Door .
2. If equipped, remove the power door lock actuator.
    1. Disconnect the electrical connector.
    2. Drill out the rivet.
    3. Disconnect the actuator rod.
    4. Remove the actuator.

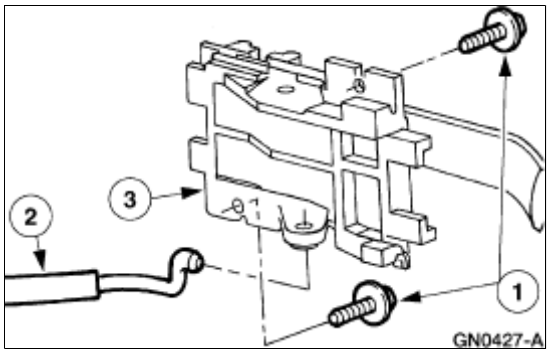


Rear door

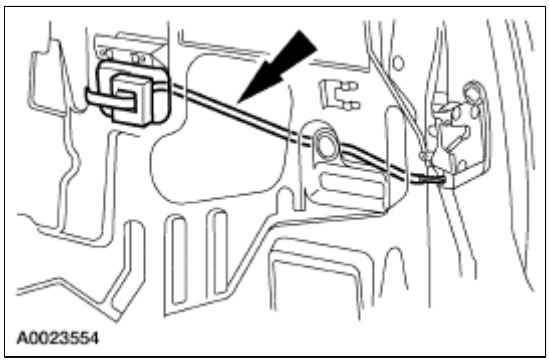
3. If equipped, remove the power door lock actuator. For additional information, refer to Actuator—Door, Rear in this section.

All doors

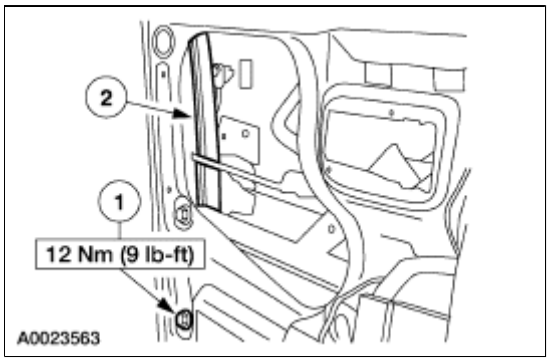
4. Remove the door latch remote control.
    1. Remove the screws.
    2. Disconnect the door latch remote control link from the door latch remote control.
    3. Remove the door latch remote control.



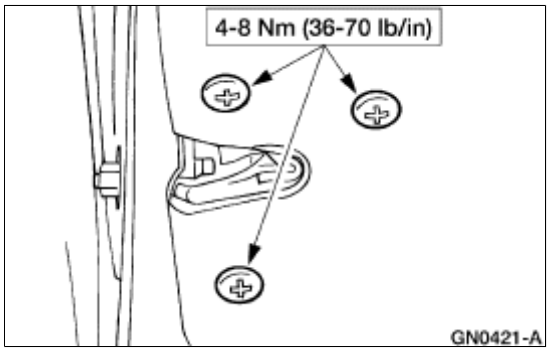
5. Disconnect the door latch actuating rod from the door latch.



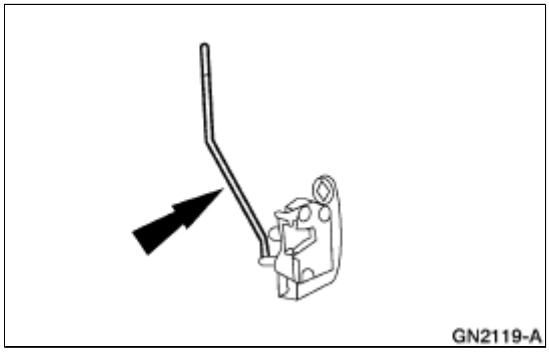
6. Remove the rear glass run channel.
    1. Remove the bolt.
    2. Remove the rear glass run channel.



7. Remove the screws and the door latch.



8. Disconnect the door latch push button rod from the door latch.



9. **NOTE:** Connect the remote control rod, door latch push button rod and lock cylinder rod to the front door latch (21812) before installing the new latch.

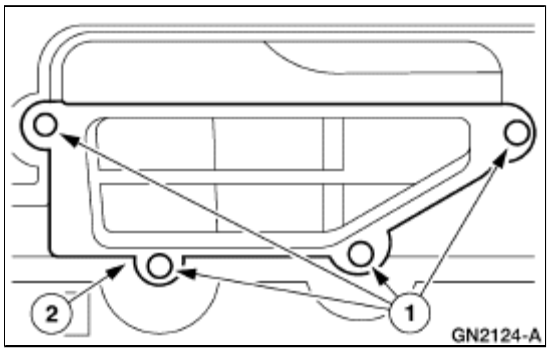
   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.
   - Use the special tool to install the new rivet.

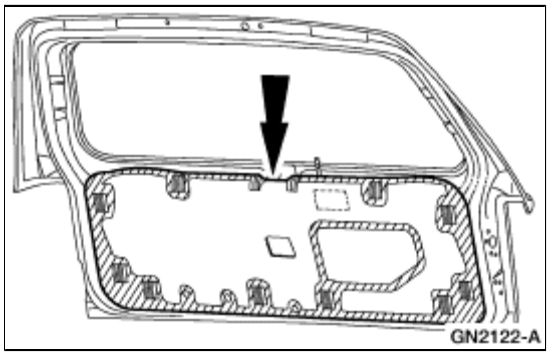
Latch —Liftgate Window

Removal

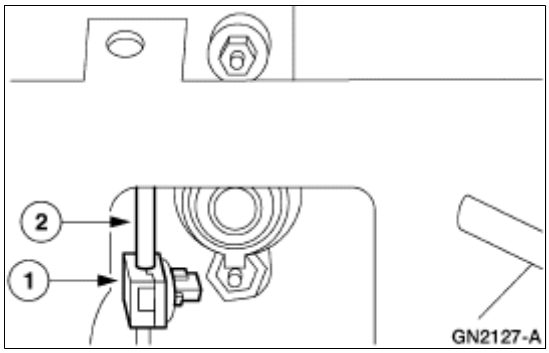
1. Open the liftgate window glass.
2. Remove the liftgate trim panel. For additional informatioin, refer to Section 501-05 .
3. Remove the vent panel.
    1. Remove the pin-type retainers.
    2. Remove the vent panel.



4. Remove the liftgate watershield.

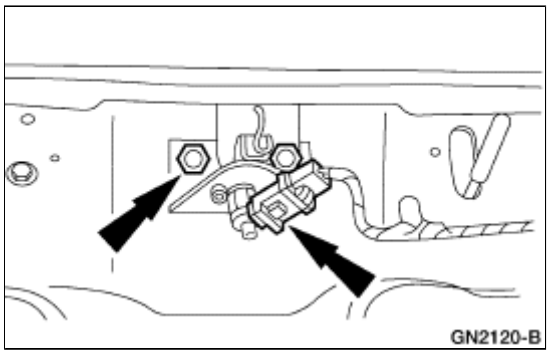


5. Disconnect the liftgate window latch actuating rod.
    1. Open the clip.
    2. Disconnect the liftgate window latch actuating rod.

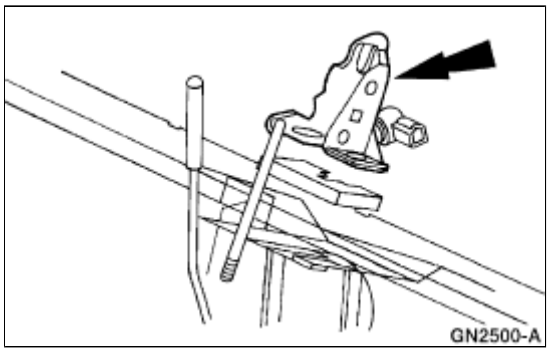


6. **NOTE:** Mark the position of the liftgate window latch prior to removing the nuts.

   Disconnect the electrical connector and remove the nuts.



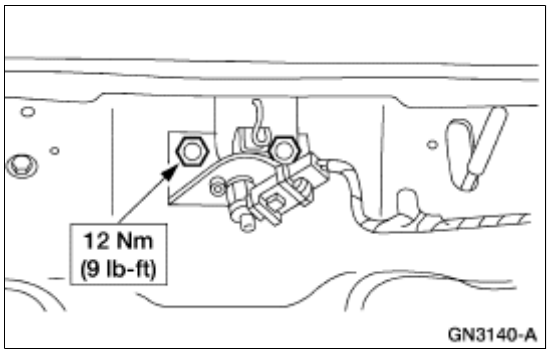
7. Remove the liftgate window latch.



Installation

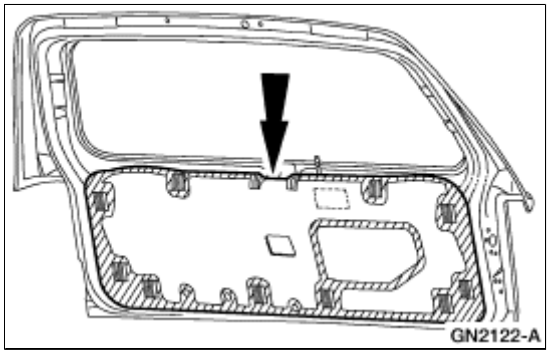
1. **NOTE:** Manually close the liftgate window latch to set the latch control rod length.

   To install, reverse the removal procedure.
   - Before installing the liftgate trim panel, adjust the liftgate window latch; refer to Latch—Liftgate Window, Adjustment .

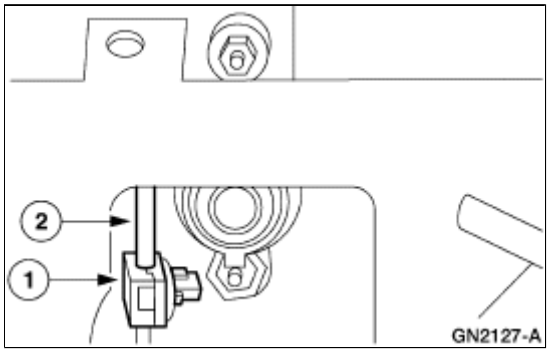

12 Nm
(9 lb-ft)
GN3140-A

Latch —Liftgate Window, Adjustment

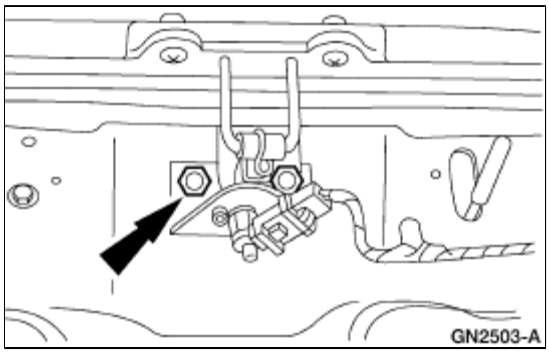
1. Remove the liftgate trim panel. For additional informatioin, refer to Section 501-05 .
2. Remove the liftgate watershield.



3. Close the liftgate window glass.
4. Disconnect the liftgate window latch actuating rod.
    1. Open the clip.
    2. Disconnect the liftgate window latch actuating rod.

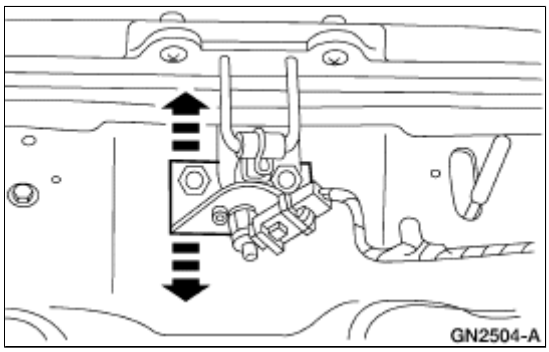


5. Loosen the liftgate window latch nuts.

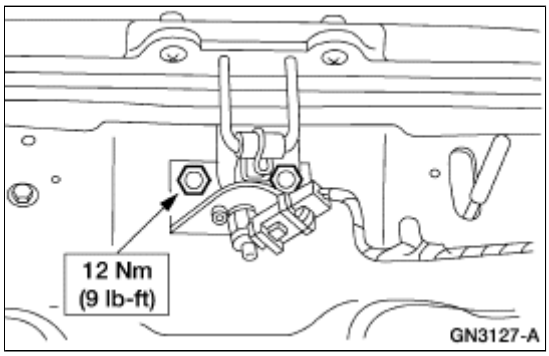


6. Adjust the liftgate window latch.

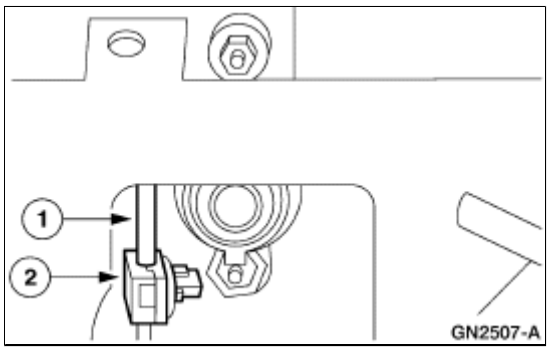
- Set the liftgate window glass flushness to 1.5mm (0.06 in) under flush.



7. Tighten the liftgate window latch nuts.

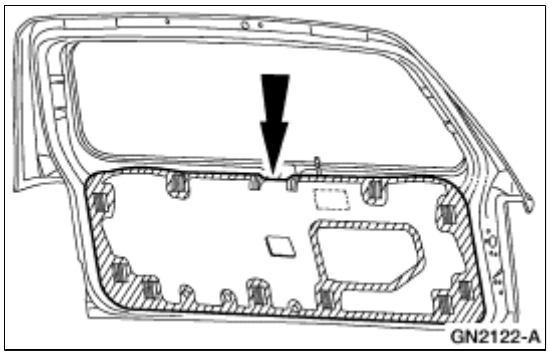


8. Connect the liftgate window latch activating rod.
    1. Connect the liftgate window latch actuating rod.
    2. Lock the clip.



9. Verify the liftgate window glass flushness.

10. Install the liftgate watershield.

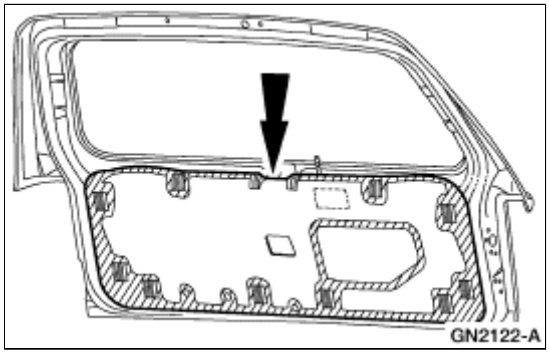


11. Install, the liftgate trim panel. For additional information, refer to Section 501-05 .

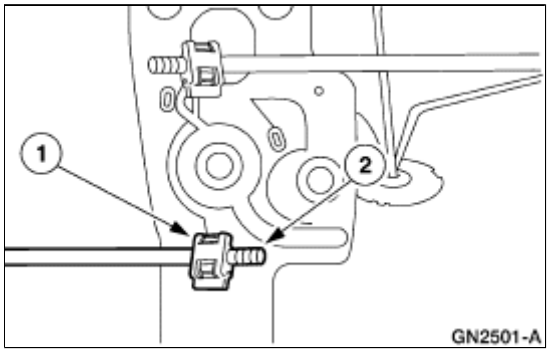
Latch —Liftgate

Removal

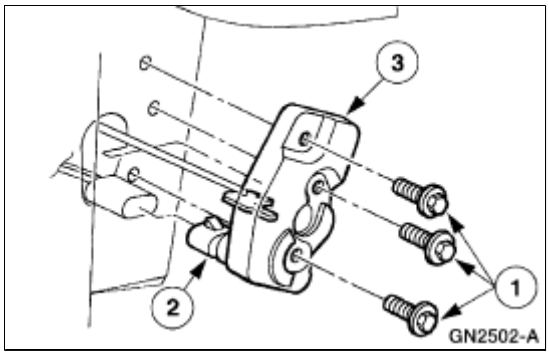
1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. Remove the liftgate watershield.



3. Disconnect the liftgate latch release rod from the liftgate latch remote control.
    1. Open the clip.
    2. Disconnect the liftgate latch release rod.



4. Remove the liftgate latch.
    1. Remove the bolts.
    2. Disconnect the electrical connector.
    3. Remove the liftgate latch and the liftgate release rod.



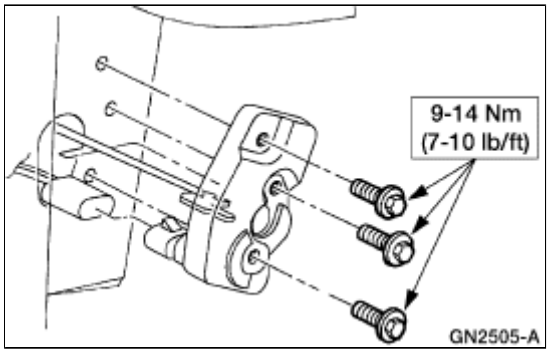
Installation

1. **NOTE:** If replacement of the liftgate latch release rods necessary, be sure to match the color coded rods for proper installation.

   NOTE: Make sure the liftgate latch release rod is not preloading the latch. It should be clipped in a relaxed state with no slack.

   NOTE: Position the liftgate latch release rod by pushing outboard to remove the slack.

   To install, reverse the removal procedure.

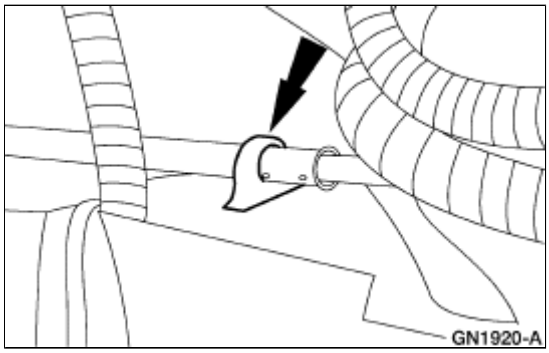


Handle —Hood Latch Release

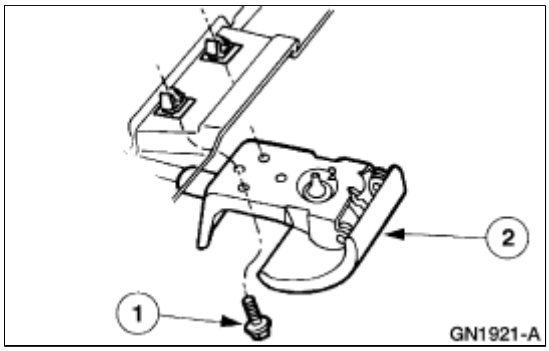
Removal

NOTE: The hood latch control handle and cable are replaced as an assembly.

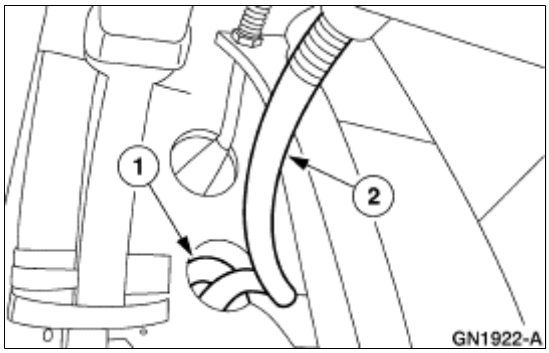
1. Remove the hood latch. For additional information, refer to Latch—Hood .
2. Unclip the hood latch control handle and cable retainer from the inner fender splash shield.



3. Position the hood latch control handle and cable aside.
    1. Remove the two screws.
    2. Position the hood latch control handle and cable aside.

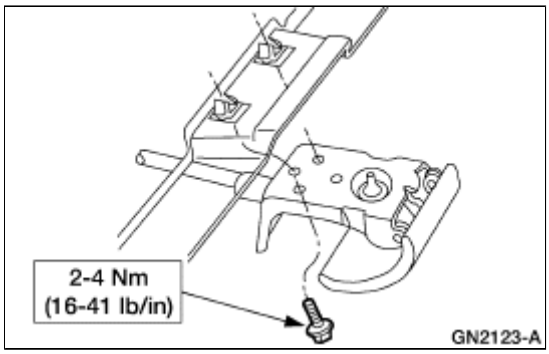


4. Remove the hood latch control handle and cable.
    1. Remove the hood latch control and cable grommet from the dash panel.
    2. Remove the hood latch control handle and cable.



Installation

1. To install, reverse the removal procedure.



Handle —Door, Outside

Special Tool(s)

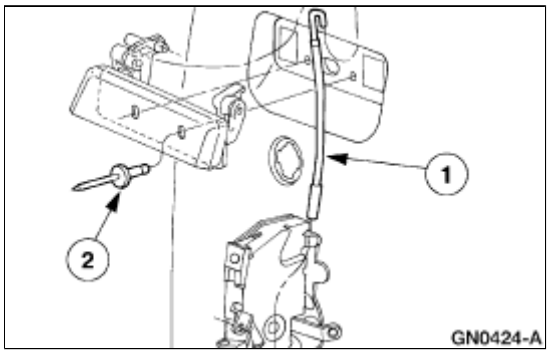
ST1132-A	Heavy-Duty Riveter or equivalent D80-23200-A

Removal

NOTE: Front door shown, rear door similar.

1. Remove the door trim panel. For additional information, refer to Section 501-05 .
2. Remove the watershield.
3. **NOTE:** The front door window glass must be completely up.

   Remove the outside door handle.
   1. Disconnect the front door latch to door handle rod.
   2. Drill out the two rivets and remove the outside door handle.



Installation

1. **NOTE:** Front door shown, rear door similar.

   To install, reverse the removal procedure.
   - Use Heavy-Duty Riveter to install the rivets.

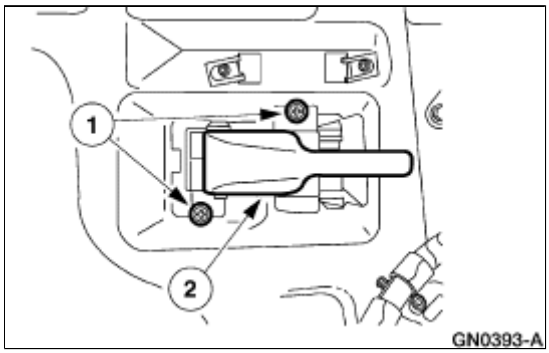
Handle —Door, Inside

Removal

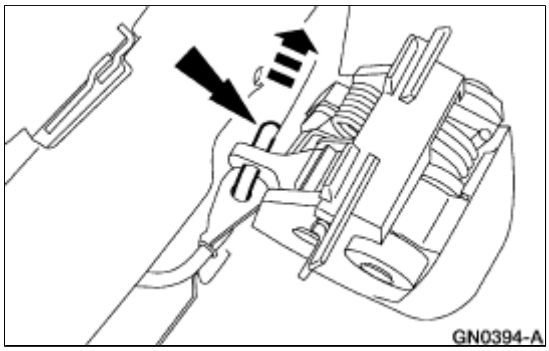
NOTE: Front door shown, rear door similar.

1. Remove the door trim panel. For additional information, refer to Section 501-05 .

2. Disconnect the inside door handle (22600) from the door.
    1. Remove the screws.
    2. Disconnect the inside door handle.



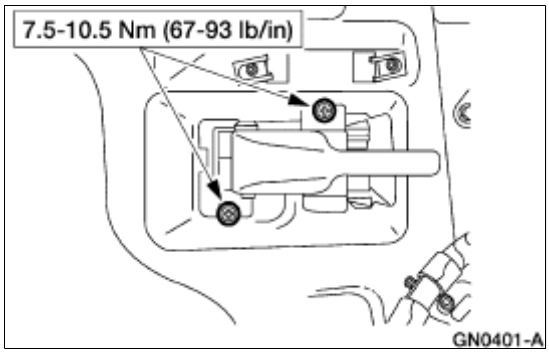
3. Disconnect the rod from the inside door handle.



Installation

1. **NOTE:** Front door shown, rear door similar.

   To install, reverse the removal procedure.


7.5-10.5 Nm (67-93 lb/in)
GN0401-A

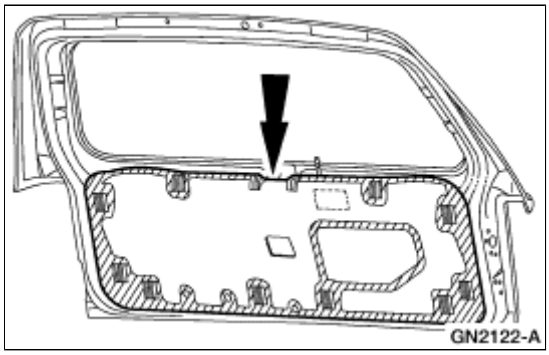
Handle —Liftgate

Special Tool(s)

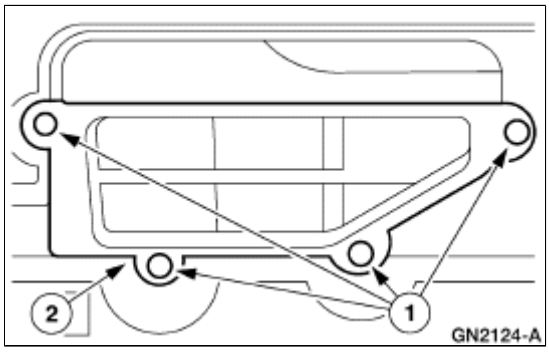
ST1132-A	Heavy-Duty Riveter or equivalent D80-23200-A

Removal

1. Remove the liftgate trim panel For additional information, refer to Section 501-05 .
2. Remove the liftgate watershield.

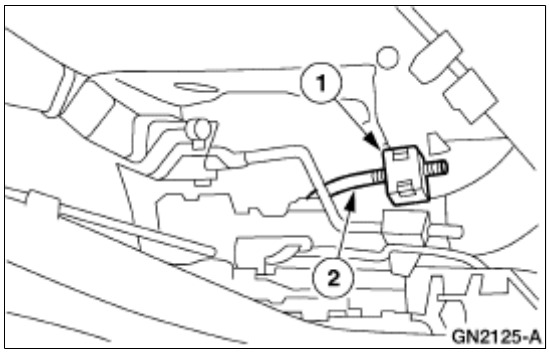

GN2122-A

3. Remove the vent panel.
   1. Remove the pin-type retainers.
   2. Remove the vent panel.

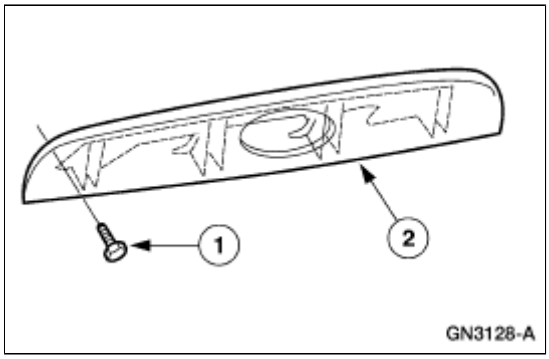


GN2124-A

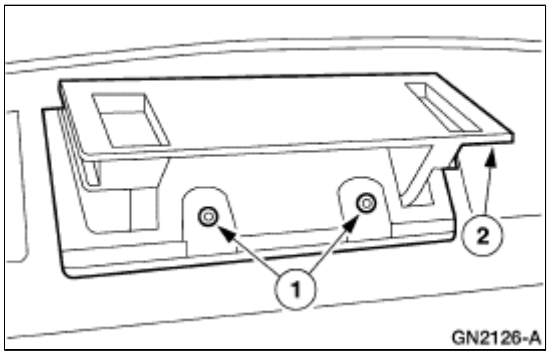
4. Disconnect the outside liftgate handle actuating rod.
   1. Open the clip.
   2. Disconnect the outside liftgate handle actuating rod.



5. Remove the license plate lamp shield.
    1. Remove the screws.
    2. Remove the license plate lamp shield.

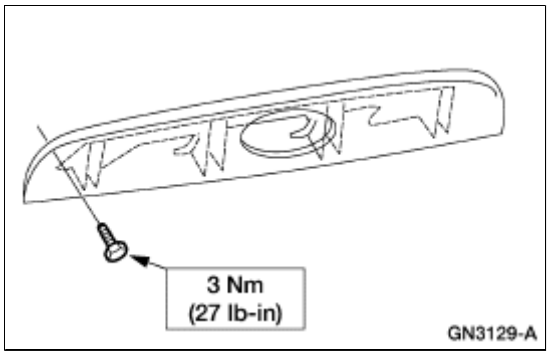


6. Remove the outside liftgate handle.
    1. Drill out the rivets.
    2. Remove the outside liftgate handle.



Installation

1. To install, reverse the removal procedure.
    - Use Heavy-Duty Riveter to install the rivets.


3 Nm
(27 lb-in)
GN3129-A

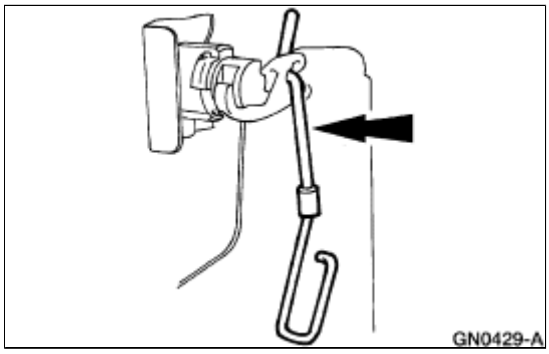
Lock Cylinder —Door

Removal and Installation

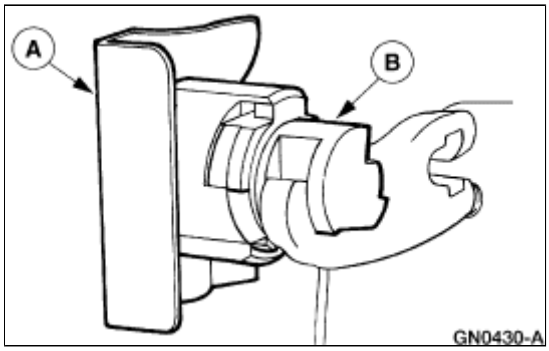
NOTE: When a lock cylinder is replaced, both door lock cylinders, liftgate lock cylinders and ignition lock cylinder should be replaced as a set. This will eliminate carrying an extra key which will fit only one lock. If a key is to be replaced, the new key code number is stamped on a metal tag attached to the key.

NOTE: Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

1. Remove the front door trim panel (23942). For additional information, refer to Section 501-05 .
2. If equipped with power windows, connect the battery ground cable. For additional information, refer to Section 414-01 .
3. Raise the window to the closed position.
4. Position the watershield aside.
5. Disconnect the front door latch control cylinder rod from the door lock cylinder lever.



6. Slide the (A) door lock cylinder retainer away from the (B) lock cylinder and remove the cylinder.



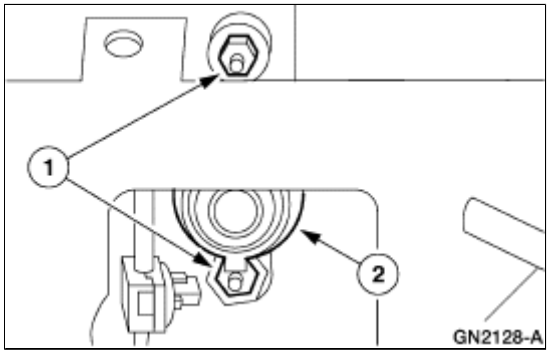
7. To install, reverse the removal procedure.

Lock Cylinder —Liftgate

Removal

NOTE: Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

1. If equipped, remove the liftgate lock actuator. For additional information, refer to Actuator—Liftgate Lock .
2. Remove the liftgate latch remote control. For additional information, refer to Latch Remote Control—Liftgate .
3. Remove the liftgate lock cylinder.
    1. Remove the nuts.
    2. Remove the liftgate lock cylinder.
        - If equipped, disconnect the electrical connector.

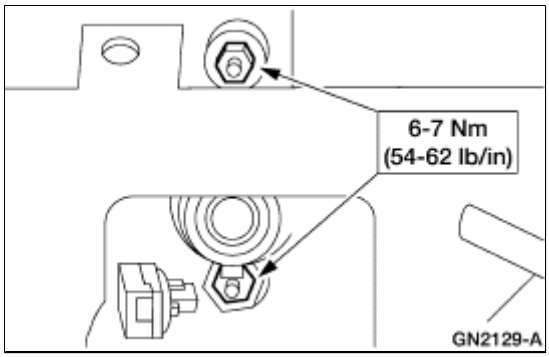


Installation

1. **NOTE:** Manually close the liftgate window latch to set the latch control rod length.

   NOTE: Make sure the liftgate window latch actuating rod is not preloading the liftgate window latch. It should be clipped in a relaxed state with no slack.

   To install, reverse the removal procedure.

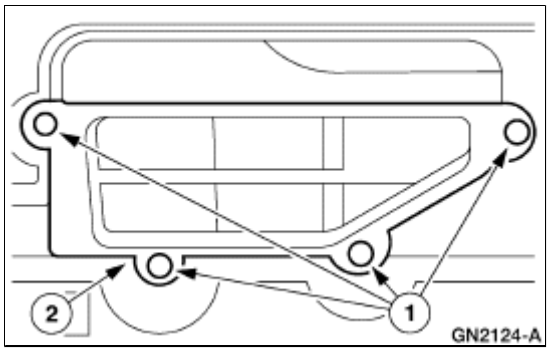

6-7 Nm
(54-62 lb/in)
GN2129-A

Latch Remote Control —Liftgate

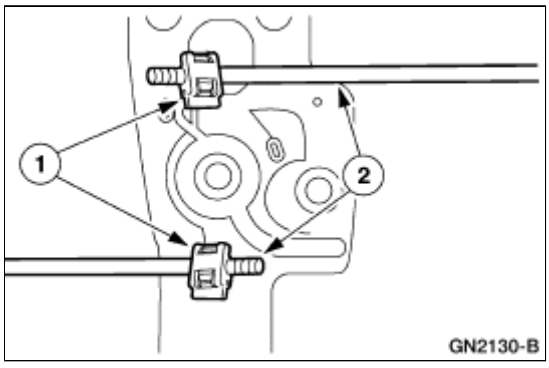
Removal

NOTE: If equipped with power locks, perform steps one and eight.

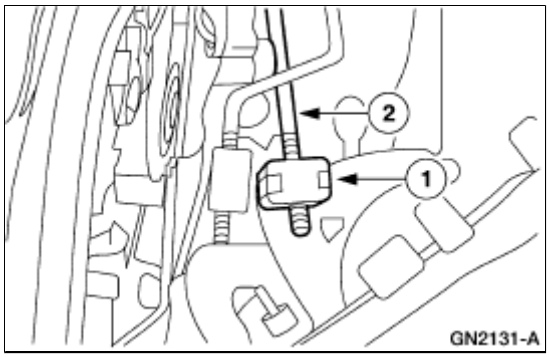
1. Remove the liftgate lock actuator. For additional information, refer to Actuator—Liftgate Lock .
2. Remove the liftgate window latch. For additional information, refer to Latch—Liftgate Window .
3. Remove the vent panel.
    1. Remove the pin-type retainers.
    2. Remove the vent panel.



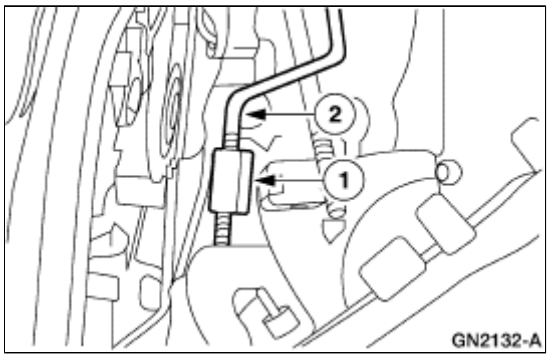
4. Disconnect the liftgate latch release rods.
    1. Open the clips.
    2. Disconnect the liftgate latch release rods.



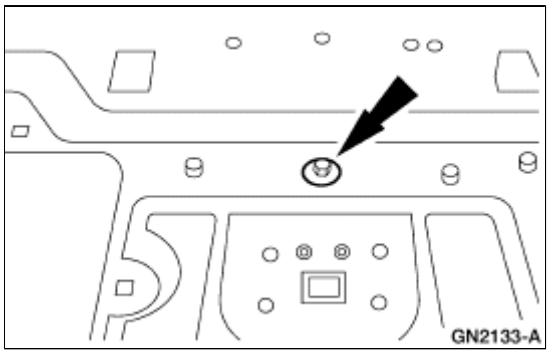
5. Disconnect the liftgate handle rod.
    1. Open the clip.
    2. Disconnect the liftgate handle rod.



6. Disconnect the lock cylinder rod.
    1. Open the clip.
    2. Disconnect the lock cylinder rod.



7. Remove the liftgate latch remote control bolt.

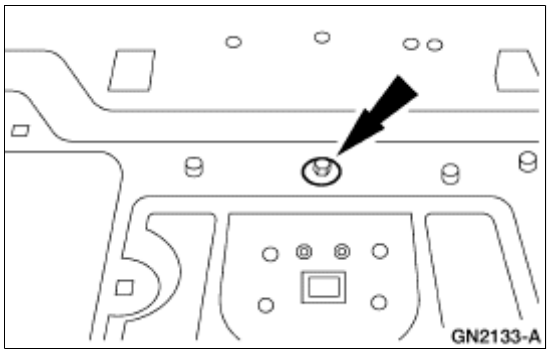


8. Remove the liftgate latch remote control from the liftgate.

Installation

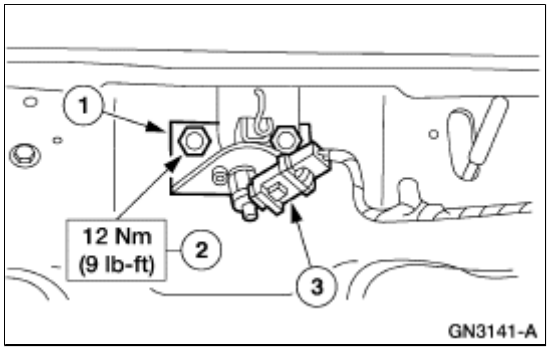
NOTE: If equipped with power locks, perform steps one and two.

1. Install the latch remote control and (if equipped) the push button rod into the liftgate.
2. Install the liftgate lock actuator. For additional information, refer to Actuator—Liftgate Lock .
3. Loosely install the liftgate latch remote control bolt.

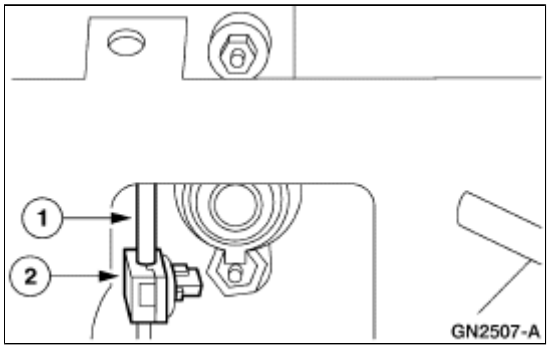


4. **NOTE:** Manually close the liftgate window latch to set the latch control rod length.

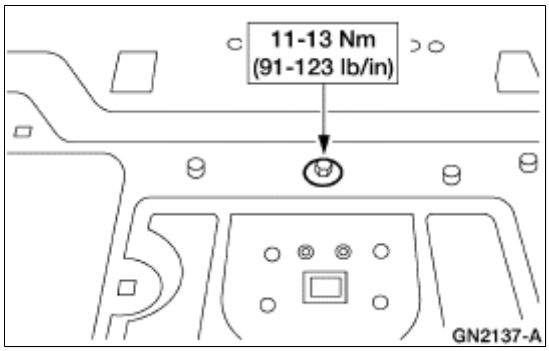
   Install the liftgate window latch.
   1. Position the liftgate window latch.
   2. Install the nuts.
   3. Connect the electrical connector.



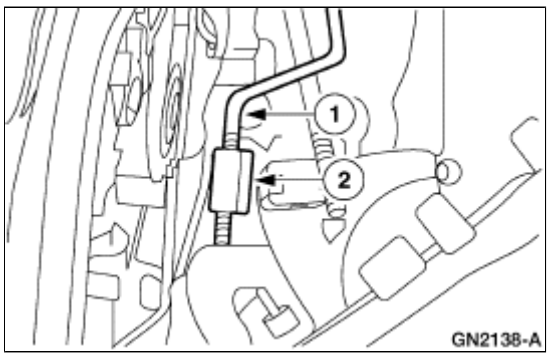
5. Connect the liftgate window latch actuating rod.
   1. Position the liftgate window latch actuating rod.
   2. Close the clip.



6. Tighten the liftgate latch remote control bolt.

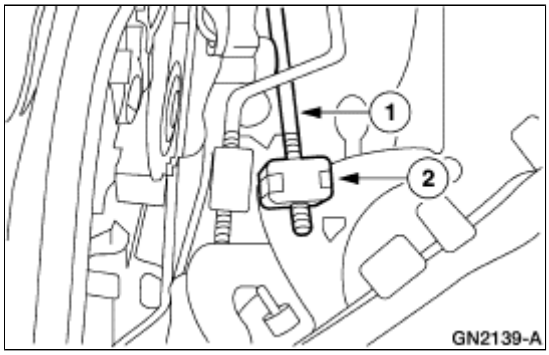


7. Connect the lock cylinder rod.
    1. Position the lock cylinder rod.
    2. Close the clip.



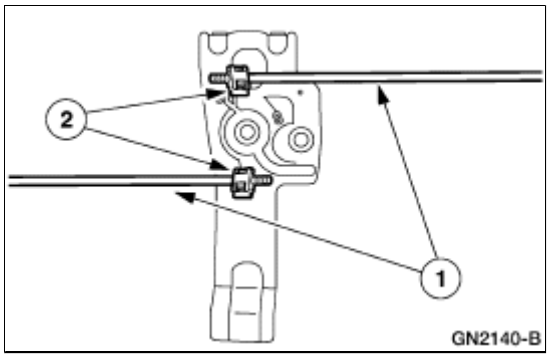
8. **NOTE:** Make sure the liftgate handle rod is not preloading the liftgate latch remote control. It should be clipped in a relaxed state with no slack.

    Connect the liftgate handle rod.
    1. Position the liftgate handle rod.
    2. Close the clip.

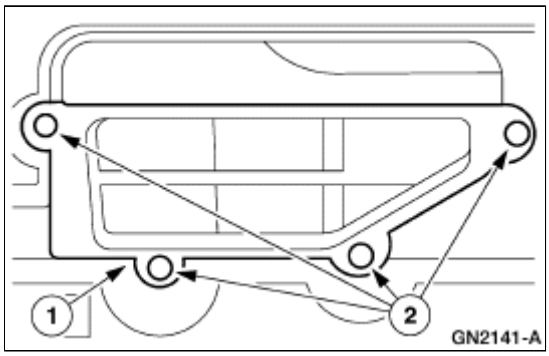


9. **NOTE:** Make sure the latch release rods are not preloading the liftgate latch remote control. They should be clipped in a relaxed state with no slack.

    Connect the liftgate latch release rods.
    1. Position the liftgate latch release rods by pushing outboard to remove the slack.
    2. Close the clips.

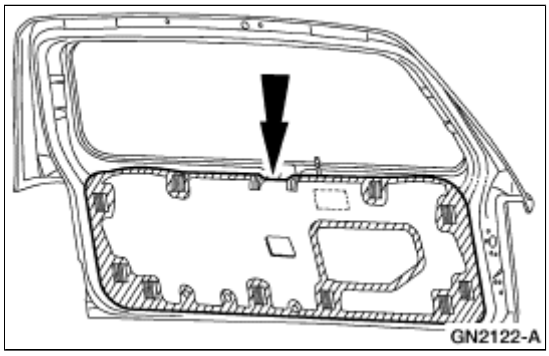


10. Install the vent panel.
    1. Position the vent panel.
    2. Install the pin-type retainers.



11. Adjust the liftgate window latch. For additional information, refer to Latch—Liftgate Window, Adjustment .

12. Install the liftgate watershield.



13. Install the liftgate trim panel. For additional information, refer to Section 501-05 .

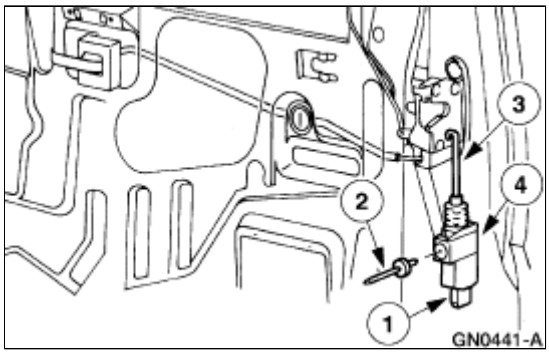
Actuator —Door, Front

Special Tool(s)

ST1132-A	Heavy-Duty Riveter or equivalent 501-D011 (D80L-23200-A)

Removal

1. Remove the front door trim panel (23942). For additional information, refer to Section 501-05 .
2. Remove the watershield.
3. Remove the power door lock actuator.
    1. Disconnect the electrical connector.
    2. Drill out the rivet.
    3. Disconnect the actuator rod.
    4. Remove the actuator.



Installation

1. To install, reverse the removal procedure.
    - Use Heavy-Duty Riveter to install the actuator rivet.

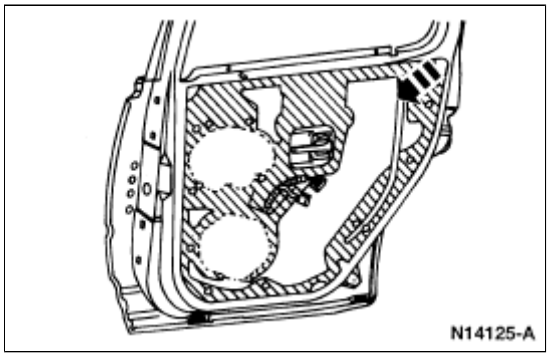
Actuator —Door, Rear

Special Tool(s)

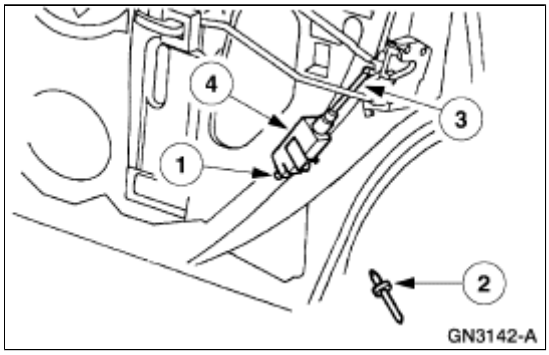
ST1132-A	Heavy-Duty Riveter or equivalent 501-D011 (D80L-23200-A)

Removal

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Remove the rear door watershield.


N14125-A

3. Remove the power door lock actuator.
    1. Disconnect the electrical connector.
    2. Drill out the rivet.
    3. Disconnect the actuator rod.
    4. Remove the actuator.



GN3142-A

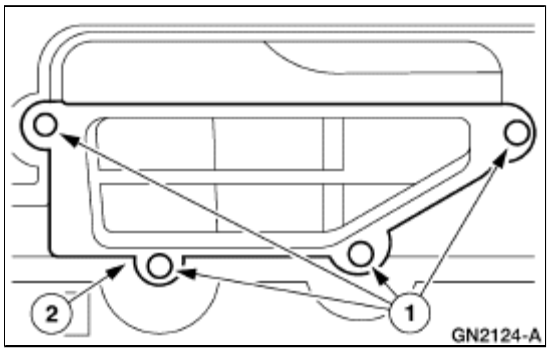
Installation

1. To install, reverse the removal procedure.
    - Use Heavy-Duty Riveter to install the actuator rivet.

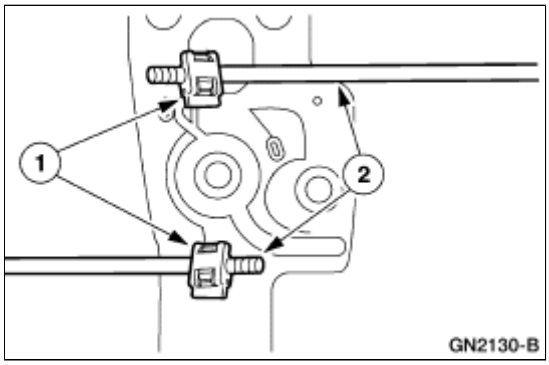
Actuator —Liftgate Lock

Removal

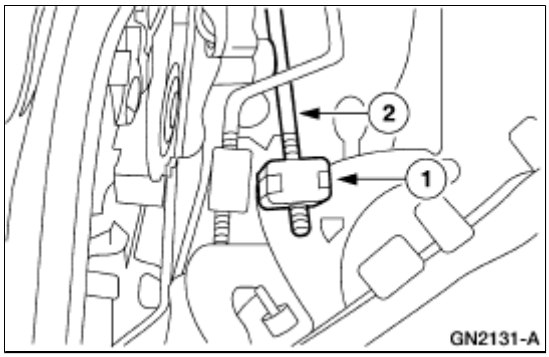
1. Disconnect the battery ground cable (14301).
2. Remove the liftgate window latch. For additional information, refer to Latch—Liftgate Window .
3. Remove the vent panel.
    1. Remove the pin-type retainers.
    2. Remove the vent panel.



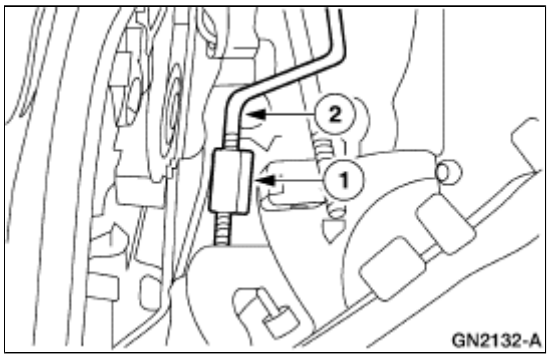
4. Disconnect the liftgate latch release rods.
    1. Open the clips.
    2. Disconnect the liftgate latch release rods.



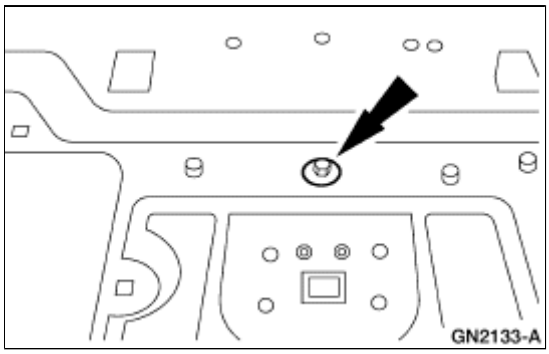
5. Disconnect the liftgate handle rod.
    1. Open the clip.
    2. Disconnect the liftgate handle rod.



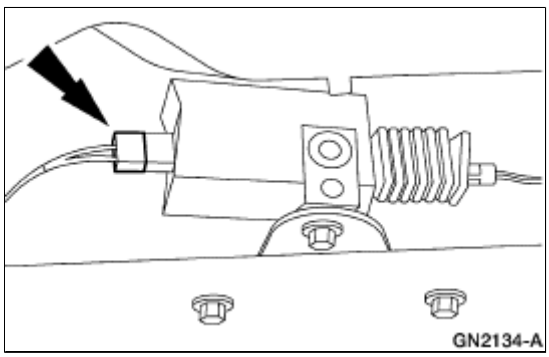
6. Disconnect the lock cylinder rod.
    1. Open the clip.
    2. Disconnect the lock cylinder rod.



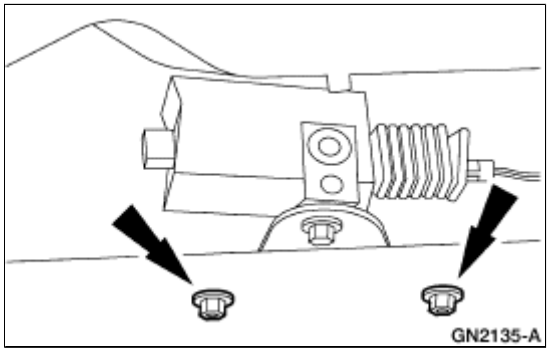
7. Remove the liftgate latch remote control bolt.



8. Disconnect the liftgate lock actuator electrical connector.



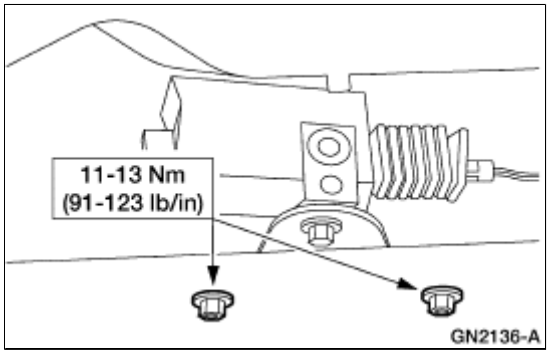
9. Remove the liftgate lock actuator nuts.



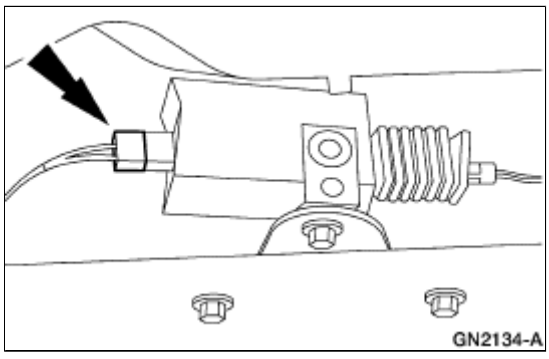
10. Move the liftgate latch remote control to the LH opening and remove the liftgate lock actuator.

Installation

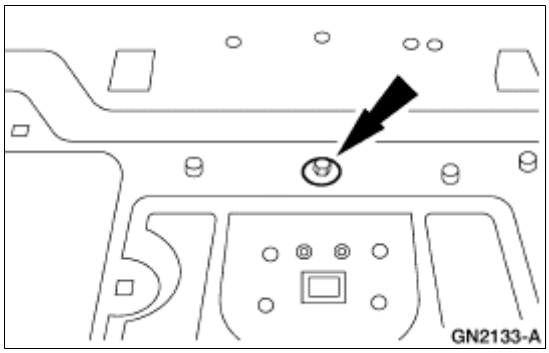
1. Connect and position the liftgate lock actuator.
2. Install the liftgate lock actuator nuts.



3. Connect the liftgate lock actuator electrical connector.

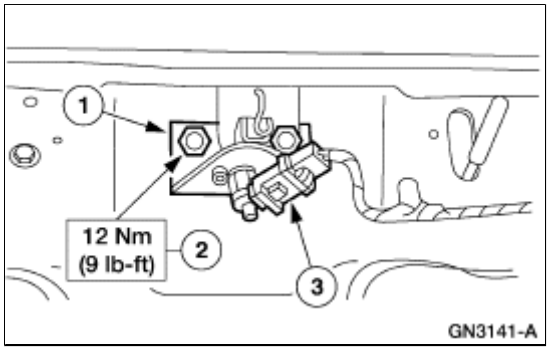


4. Position the liftgate latch remote control.
5. Loosely install the liftgate latch remote control bolt.

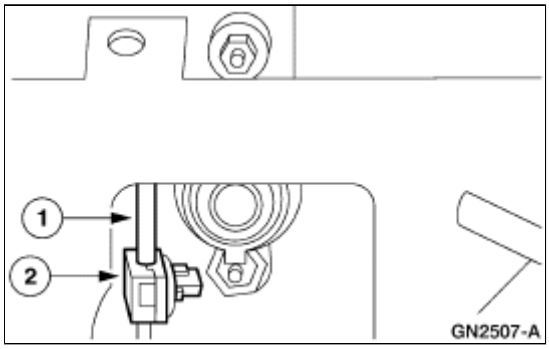


6. **NOTE:** Manually close the liftgate window latch to set the latch control rod length.

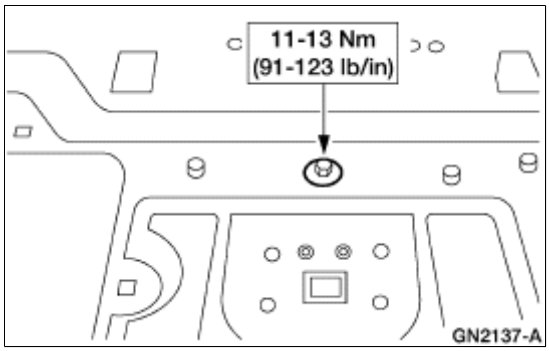
   Install the liftgate window latch.
   1. Position the liftgate window latch.
   2. Install the nuts.
   3. Connect the electrical connector.



7. Connect the liftgate window latch actuating rod.
   1. Position the liftgate window latch actuating rod.
   2. Close the clip.

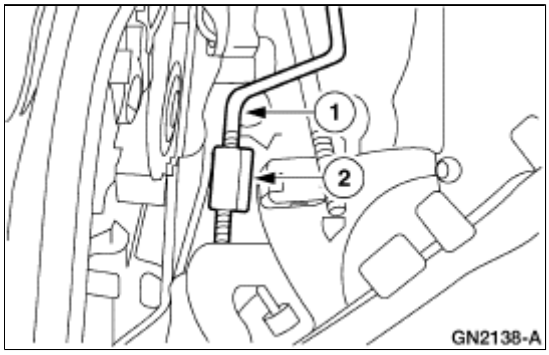


8. Tighten the liftgate latch remote control bolt.



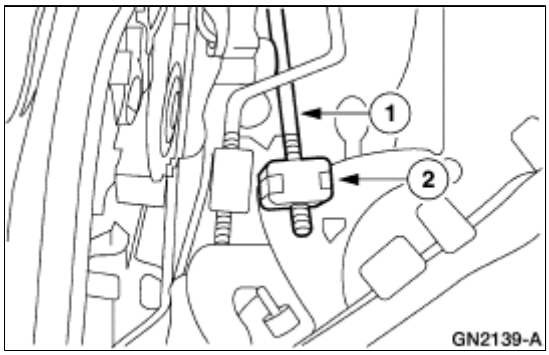
9. **NOTE:** Be sure the bell crank of the liftgate latch remote control is in the unlocked position (upward) for proper lock cylinder rod length.

   Connect the lock cylinder rod.
   1. Position the lock cylinder rod.
   2. Close the clip.



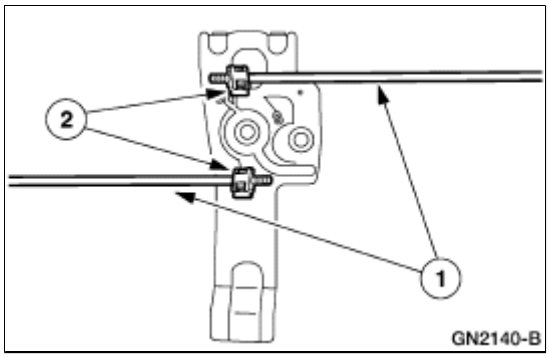
10. **NOTE:** Make sure the liftgate handle rod is not preloading the liftgate latch remote control. It should be clipped in a relaxed state with no slack.

    Connect the liftgate handle rod.
    1. Position the liftgate handle rod.
    2. Close the clip.



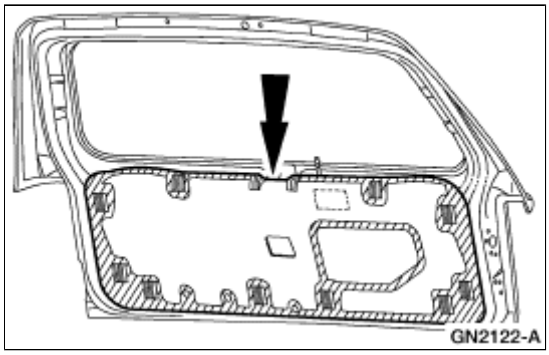
11. **NOTE:** Make sure the latch release rods are not preloading the liftgate latch. They should be clipped in a relaxed state with no slack.

    Connect the liftgate latch release rods.
    1. Position the liftgate latch release rods by pushing outboard to remove the slack.
    2. Close the clips.

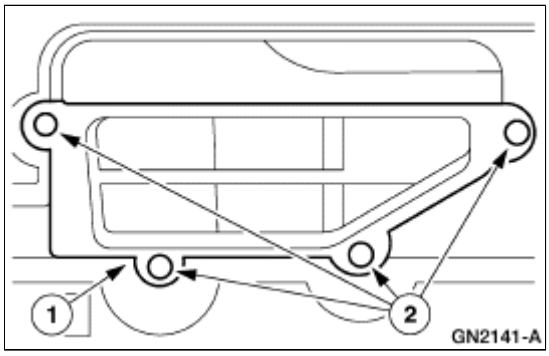


12. Adjust the liftgate window latch. For additional information, refer to Latch—Liftgate Window, Adjustment .

13. Install the liftgate watershield.



14. Install the vent panel.
    1. Position the vent panel.
    2. Install the pin-type retainers.



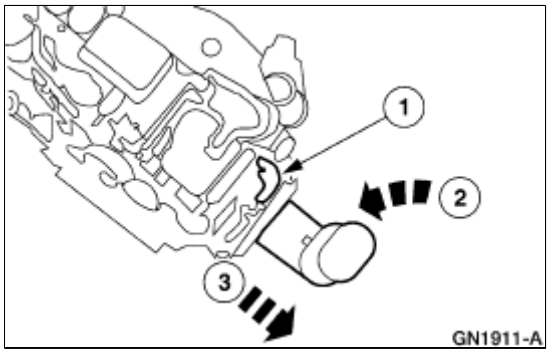
15. Install the liftgate trim panel. For additional information, refer to Section 501-05 .

16. Connect the battery ground cable.

Switch —Door Open Warning

Removal

1. Remove the door trim panel. For additional information, refer to Section 501-05 .
2. Remove the door latch. For additional information, refer to Latch—Door .
3. Remove the door opening warning lamp switch.
    1. Lift the locking tab.
    2. Rotate the door opening warning lamp switch counterclockwise.
    3. Remove the door opening warning lamp switch.



Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89

Keyless Entry

The keyless entry system components consist of the following:

- keyless entry remote transmitter (15K601)
- remote anti-theft personality (RAP) module (15K602)
- driver unlock relay (if equipped with two step unlocking)
- all unlock relay
- all lock relay
- keyless entry keypad (14A626)

The electronic door lock system has three main components: the remote anti-theft personality (RAP) module, attached to the rear left hand quarter panel, the three-button (hand held) keyless entry remote transmitter (15K601), and the keyless entry keypad (14A626) on the driver side door.

The door locks are controlled by the RAP module through three external relays: the driver unlock relay (if equipped with two step unlocking), the all unlock relay, and the all lock relay. These relays are located in the relay box on the LH rear quarter panel.

The keyless entry remote transmitter initiates the following electronic door lock system functions:

- Unlocks the driver door (if equipped with two step unlocking).
- Unlocks all doors.
- Locks all doors.
- Enables the panic alarm.
- Issues the interior lamps on (when unlocking) and off (when locking) commands to the generic electronic module (GEM).
- Sounds the horn (13832) once when LOCK on keyless entry remote transmitter is pressed twice, and doors are closed.
- Sounds the horn twice when LOCK on the keyless entry remote transmitter is pressed twice, and any door or the liftgate window is ajar.
- Allows up to four keyless entry remote transmitters to be programmed.
- The order that the transmitters are programmed into the module will set the memory seat to the corresponding position when the driver door is unlocked with the transmitter.

NOTE: The remote entry features will not function when the ignition switch (11572) is in the RUN or ACC position.

The keyless entry remote transmitters are reprogrammable and must be set at the same time.

To confirm that the doors have been locked and that the anti-theft system has armed, press the LOCK button again, within five seconds of the first press. The horn will sound once if the doors have locked and all doors are closed.

To activate the panic alarm:

- Press the red PANIC button on the keyless entry remote transmitter. The horn will sound and the headlamps (13008) and exterior lamps will flash for a maximum of two minutes and 45 seconds.

To deactivate the panic alarm:

- Press the red PANIC button again on the keyless entry remote transmitter.
- Turn the ignition switch to RUN/ACC.

The keyless entry keypad can be used to unlock the driver door (if equipped with two step unlocking) or lock and unlock all the doors and the liftgate. It also lights the keypad lamp, allows one user code to be programmed and issues illuminated entry on/off requests to the GEM when locking and unlocking.

The system (permanent) entry code is located on the owner's wallet card in the glove box; it is also electronically accessible by asking for the RAP KEYCODE PID on the scan tool and on the receiver assembly housing.

The receiver assembly is programmed at the factory with a five-digit entry code. A replacement receiver assembly includes a new owner's code card.

To turn on the interior lamps and light all illuminated components, press any button on the keyless entry keypad.

To program a temporary access code:

- Enter the permanent code on the keyless entry keypad.
- Press the 1/2 button within 5 seconds of last digit of permanent code. (This alerts system to accept temporary code.)
- Enter alternate 5-digit code. Do not exceed 5 seconds between entering digits or between pressing the 1/2 button and entering the first digit.

If equipped with two step unlocking:

To unlock the driver door, enter the permanent factory code or enter the owner's alternate code. To unlock the passenger door(s) and liftgate, press the 3/4 button within five seconds of unlocking the driver door.

If not equipped with two step unlocking:

To unlock all the doors and the liftgate, enter the permanent factory code or enter the owner's alternate code.

To lock all doors, press the 7/8 and 9/0 buttons at the same time. (It is not necessary to enter the key code first.) This will turn off courtesy lamps.

NOTE: The doors will not lock if the vehicle is started in neutral and passed into any forward gear.

If the autolock feature is enabled, the autolock feature will activate when the ignition switch is in the RUN/ACC position, the shift control selector is passed into or through the reverse (R) position and all doors, liftgate and liftgate window are closed when the driver releases the brake pedal (2455).

After the initial lock, all doors will automatically relock when any door is opened and then closed followed by the release of the brake pedal. However, the doors will not relock if the ignition switch is in the OFF position.

NOTE: The door ajar state will be monitored continuously for 500 ms after locking has occurred. If a door is opened again within 500 ms, the driver door will unlock.

The door may not automatically lock if the vehicle is shifted quickly into gear after starting the engine (6007).

Autolock Enable/Disable — Using the Keypad

A manual enable/disable mode allows the autolock and memory seat features to be turned off and on; there are PIDs in RAP (autolock and memory seat) which reflect if the feature is ON or OFF. The RAP module configuration can be used to turn the "autolock" on/off and turn the "move mem. seat w/ key fob" on/off. These PIDs (AUTOLOCK and MEMSEAT) are only available on the Ford Service Function (FSF) Card. RAP module configuration will not be available at the beginning of the 1998 model year.

To enable or disable autolock using the keyless entry keypad:

1. Enter the five-digit permanent entry code into the keyless entry keypad.
2. Within five seconds of entering the code, press and hold the 7/8 button on the keypad.
3. Within five seconds of Step 2, and while holding the 7/8 button, press the 3/4 button on the keypad and release it.
4. Within five seconds of Step 3, release the 7/8 button on the keypad.

If the autolock sound is disabled, the horn will chirp once. If the autolock feature is enabled, the horn will chirp once shortly and then sound a second time with a longer sound of the horn once the above sequence is completed.

Autolock Enable/Disable — Using the Ignition Switch

Another way to turn the autolock off/on is by following this series of steps:

1. Close all doors.
2. Confirm that the ignition switch is in the OFF position.
3. **NOTE:** Steps 4 through 8 must be performed within 30 seconds.

   Turn the ignition switch from OFF to RUN.
4. Press the driver interior power door lock UNLOCK button three times.
5. Turn the ignition switch from RUN to OFF.
6. Press the driver interior power door lock UNLOCK button three times.
7. Turn the ignition switch from OFF to RUN.
8. Verify that the RAP module chirps the horn. This indicates that the RAP module is now in the enable/disable mode and ready to accept program changes.
9. Press the driver interior power door lock UNLOCK button one time to command the RAP module to toggle the autolock/relock feature OFF.
10. Press the driver interior power door lock LOCK button once to enter the command.
11. Verify that the horn chirps one time to signal the RAP module confirmation of the command. There should only be one chirp indicating that autolock/relock feature has been disabled. If one chirp is heard, followed by a longer sound of the horn, the autolock/relock feature has just been enabled.

Return to step 10.

12. Turn the ignition switch to the OFF position to exit the enable/disable mode.

13. Exit the vehicle and verify that the RAP module chirps the horn once to indicate that a feature has been changed and that autolock/relock has been disabled.

Keyless Entry

Refer to Wiring Diagrams Cell 117 , Remote Control Alarm and Lock System for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR Tester 418-F052, or equivalent

Inspection and Verification

1. Verify the customer concern by operating the electronic door lock control system.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Binding latches	• Fuse(s) 20 (7.5A), 9 (20A), 18 (10A), 1 (60A), and 25 (7.5A) • Relays • Wiring harness • Loose or corroded connections • Keyless entry keypad • Remote transmitter • Door open warning lamp switch

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If scan tool does not communicate with the vehicle:
   - check that the program card is properly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
4. If scan tool still does not communicate with the vehicle, refer to the scan tool manual.
5. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for RAP, go to Pinpoint Test A.
- NO RESP/NOT EQUIP for GEM/CTM, go to Pinpoint Test G.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the RAP.

6. If the DTCs retrieved are related to the concern, go to RAP Diagnostic Trouble Code (DTC) Index or GEM/CTM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

RAP Module Diagnostic Trouble Code (DTC) Index

RAP Module Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
B1309	Power Door Lock Circuit Short to Ground	RAP	GO to Pinpoint Test C .
B1341	Power Door Unlock Circuit Short to Ground	RAP	GO to Pinpoint Test C .
B1485	Brake Pedal Input Circuit Short to Battery	RAP	GO to Pinpoint Test D .
B1526	Keyless Entry Keypad Switch Circuit Short to Ground	RAP	GO to Pinpoint Test B .
B1629	PRNDL Reverse Input Short to Battery	RAP	GO to Pinpoint Test E .
B1845	Ignition Tamper Circuit Failure	RAP	Invalid DTC. Ignore this DTC.
B2425	Keyless Entry Out of Synchronization	RAP	GO to Pinpoint Test C .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	RAP	REFER to Section 417-02 .

RAP Module Parameter Identification (PID) Index

RAP Module Parameter Identification (PID) Index

PID	Description	Expected Value
AL_EVT#	Last 8 Alarm Events	DROPEN, HOODTR, IGNTAM, PANIC, T_AJAR, NOEVNT
BOO	Brake Switch Input	OFF, ON
D_DOOR	Left Front Door Ajar Switch	CLOSED, AJAR
DECKLID	Decklid / Hatch Ajar	CLOSED, AJAR
DR_LOCK	Driver Door Lock Output State	NO, YES
DR_UNLK	All Doors Unlock Output State	NO, YES
DRLKCYL	Door Lock Cylinder	notACT, ACTIVE
HOOD_SW	Decklid/Hatch Or Hood Punchout	notPUN, PUNCHD
IGN_A	Ignition Switch -ACCY Position	NO, YES
IGN_R	Ignition Switch -RUN Position	NO, YES

IGN_RES	Ignition Tamper Sensor	HIGH
KEY_PAD	Keypad	1/2, 3/4, 5/6, 7/8, 9/0
KEYCODE	Factory Keyless Entry Code	5 Digit #, INVLD
TRANSGR	Transmission Gear	notREV, REV

RAP Active Command Index

RAP Active Command Index

Active Command	Display	Action
THEFT LED	ALARM	ON, OFF
ILLUMINATED ENTRY	INT LAMPS	ON, OFF
HEAD/PARKING LAMPS	PARKLAMPS	ON, OFF
HEAD/PARKING LAMPS	HEADLAMPS	ON, OFF
DOOR LOCK CONTROL	LOCK	ON, OFF
DOOR LOCK CONTROL	UNLOCK	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF
HORN CONTROL	HORN	ON, OFF
STARTER INTERRUPT CONTROL	STARTER	ON, OFF
KEYPAD BACKLIGHTING	LIGHT	ON, OFF
SEAT MEMORY SELECT CONTROL	MEMORY 1	ON, OFF
SEAT MEMORY SELECT CONTROL	MEMORY 2	ON, OFF

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .

B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window Driver One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window Driver One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window Driver Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window Driver Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit	GEM/CTM	REFER to Section 413-01 .

	Short to Battery		
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delay Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input	GEM	REFER to Section 308-07A .

	Short Circuit to Battery		
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	GO to Pinpoint Test F .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	GO to Pinpoint Test F .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	GO to Pinpoint Test F .
B1839	Wiper Rear Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size and axle ratio.

			TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral "In Tow" Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral "In Tow" Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1812	4WD Mode Select Switch Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD LOW Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case	GEM	REFER to Section 308-07A .

	CONTACT PLATE "B" Circuit Failure		
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Driver Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM	ON---, OFF--, ON-B--, OFFO-G

	Only)	
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, ON-B-, OFFO-G
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK

WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By

B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage LOW	GEM/CTM
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM
B1330	Passenger Door Ajar Circuit Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Driver Power Window Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No Communication With the Module — Remote Anti-Theft Personality (RAP)	• Fuse(s) 20 (7.5A) and 9 (20A). • Circuitry. • RAP module.	• GO to Pinpoint Test A .
• The Doors Do Not Lock/Unlock Using the Keyless Entry Keypad	• Keyless entry keypad. • Circuitry. • RAP module.	• GO to Pinpoint Test B .
• The Doors Do Not Lock/Unlock Using the Remote Transmitter — If Equipped With Two Step Unlocking	• Keyless entry remote transmitter. • Antenna. • Keyless entry remote transmitter program. • Radio/TV tower.	• GO to Pinpoint Test C .
• The Illuminated Entry Does Not Operate From Remote Transmitter	• GEM. • Circuitry. • RAP module.	• REFER to Section 417-02 .
• The Auto-lock Does Not Operate Properly	• Circuitry. • Door open	• GO to Pinpoint Test D .

	warning lamp switch. • Brake Pedal Position (BPP) switch. • Digital TR sensor.	
• The Memory Seat Does Not Operate Properly Using the Remote Transmitter	• Circuitry. • RAP module. • Seat module (DSM).	• GO to Pinpoint Test E .
• All Door Locks Are Inoperative — Two Step Unlock Does Not Operate Properly (If Equipped)	• Switches. • Circuitry. • Door unlock relay. • GEM. • DTC B1833. • DTC B1834. • DTC B1836. • Fuse 18 (10A).	• GO to Pinpoint Test F .
• No Communication With The Module — Generic Electronic Module/Central Timer Module	• Circuitry. • Fuse(s) 1 (60A) and 25 (7.5A). • GEM.	• GO to Pinpoint Test G .
• The Panic Button Does Not Operate Using the Remote Transmitter (Unlock and Lock Operate Properly)	• Keyless entry remote transmitter. • RAP module.	• CHECK both transmitters for panic operation. If only one transmitter does not operate, REPLACE the batteries. TEST the transmitter panic operation. If the transmitter still does not operate, REPLACE the transmitter. If both transmitters do not operate, REPLACE the RAP module; REFER to Section 419-10 . TEST the system for normal operation.

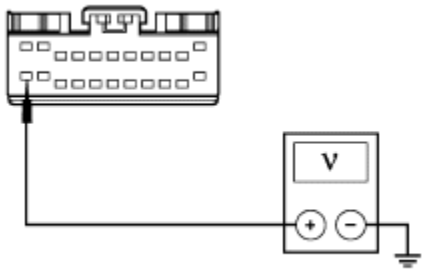
Pinpoint Tests

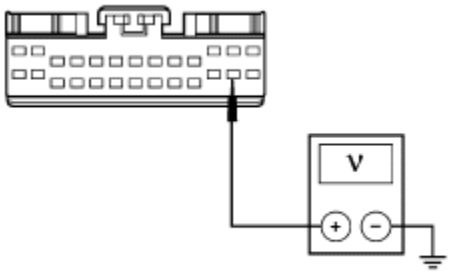
CAUTION: Be careful when probing the fuse junction panel, battery junction box or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

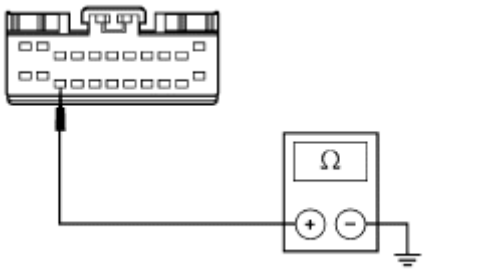
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when performing the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

PINPOINT TEST A: NO COMMUNICATION WITH THE MODULE — REMOTE ANTI-THEFT PERSONALITY (RAP)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FUSE JUNCTION PANEL FUSE 20 (7.5A) AND BATTERY JUNCTION BOX MINI-FUSE 9 (20A)	
1 2 Fuse 20 (7.5A) 3 Fuse 9 (20A)	• **Are the fuses OK?** → **Yes** GO to A2 . → **No** REPLACE the fuse(s). TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
A2 CHECK VOLTAGE TO THE RAP MODULE — CIRCUIT 645 (W/LB)	
1 RAP Module C338 2  GN2209-A	2 Measure the voltage between RAP module C338-12, circuit 645 (W/LB), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** GO to A3 . → **No** REPAIR circuit 645 (W/LB). TEST the system for normal operation.
A3 CHECK CIRCUIT 1002 (BK/PK) FOR VOLTAGE	
1 RAP Module C336 2 3  GN2210-A	3 Measure the voltage between RAP module C336-25, circuit 1002 (BK/PK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to A4 . → **No** REPAIR circuit 1002 (BK/PK). TEST the system for normal operation.
A4 CHECK RAP MODULE GROUND FOR OPEN — CIRCUIT 570 (BK/W)	
1 2	2 Measure the resistance between RAP module C338-14, circuit 570 (BK/W), and ground.

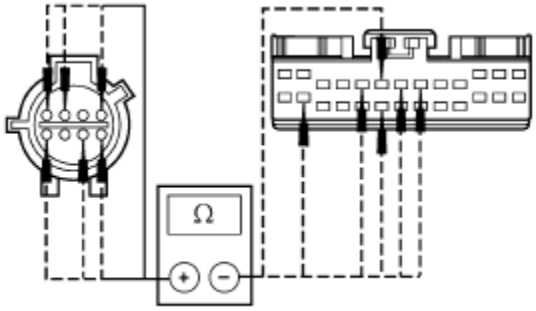
	• **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 570 (BK/W). TEST the system for normal operation.

PINPOINT TEST B: THE DOORS DO NOT LOCK/UNLOCK USING THE KEYLESS ENTRY KEYPAD

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CONFIRM NORMAL KEYLESS ENTRY KEYPAD OPERATION	
	1 Unlock the driver door with keypad code. 2 Confirm keyless entry keypad back lighting and interior lamp illumination after first keypad button pressed. 3 Press the 3/4 button within five seconds of unlocking driver door with keypad code to unlock all doors. 4 Press 7/8 and 9/0 buttons to lock all doors. Keypad back lighting and interior lamp illumination should turn off. • **Do all functions operate as expected?** → **Yes** VERIFY the concern. RETURN to the Symptom Chart. → **No** If keyless entry keypad code does not operate (or has been lost), GO to B2 . If the doors unlock, but the keyless entry keypad back lighting does not operate, GO to B7 .

	If interior lights do not illuminate, but keyless entry keypad back lighting does illuminate when buttons are pressed, REFER to Section 417-02 . If only a certain button is inoperative on the keypad, GO to B5 .
B2 RETRIEVE THE DTCS	
1 2 Scan Tool 3 4 Clear continuous DTCs 5 RAP On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Are any DTCs retrieved?** → **Yes** If DTC B1526, GO to B3 . → **No** GO to B4 .
B3 CHECK THE KEYLESS ENTRY KEYPAD — MONITOR THE RAP PID KEY_PAD	
1 	1 Monitor the RAP PID KEY_PAD. • **Does the RAP PID KEY_PAD show any button(s) as active?**

	→ **Yes** GO to B11 . → **No** GO to B4 .
B4 CHECK THE KEYLESS ENTRY KEYPAD CODE — MONITOR THE RAP PID KEY_CODE	
1 2 	2 Monitor the RAP PID KEY_CODE. • **Does the keypad code retrieved match the keycode entered in test step B1?** → **Yes** GO to B5 . → **No** REPEAT test step **B1** to confirm operation. INFORM customer of correct keycode.
B5 CHECK KEYLESS ENTRY KEYPAD BUTTONS — MONITOR THE RAP PID KEY_PAD	
1 3 	1 Monitor the RAP PID KEY_PAD. 2 Verify the numbers are not displayed. 3 **NOTE:** Only the odd numbers will be displayed when the keyless entry keypad buttons are pressed. Monitor the RAP PID KEY_PAD while pressing each keyless entry keypad button separately. Verify only the button pressed is displayed. • **Are all keyless entry keypad buttons displayed correctly?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . TEST the system for normal operation. → **No**

	GO to B6 .
B6 CHECK KEYLESS ENTRY KEYPAD BUTTON CIRCUITS	
1 2 RAP Module C336 3 Keyless Entry Keypad 4  GN2436-A	4 Measure the resistance between RAP module C336 and keyless entry keypad C516; refer to the following table. **RAP** / **Keypad** / **Circuit** C336-5 / C516-3 / 78 (LB/Y) C336-6 / C516-4 / 79 (LG/R) C336-19 / C516-5 / 121 (Y/BK) C336-7 / C516-6 / 122 (Y) C336-8 / C516-1 / 123 (R) C336-15 / C516-8 / 124 (BR) • **Are the resistances less than 5 ohms?** → **Yes** REPLACE the keyless entry keypad; REFER to Keypad—Keyless Entry . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR the circuit(s) in question. CLEAR the DTCs. TEST the system for normal operation.
B7 CHECK KEYLESS ENTRY KEYPAD BACK LIGHTING OPERATION	
1 2	

Scan Tool

3

4 Trigger the RAP active command KEYPAD BACK LIGHTING to ON.

- **Does the keypad back lighting illuminate when the RAP active command is triggered ON?**

→ **Yes**
GO to B5 .

→ **No**
GO to B8 .

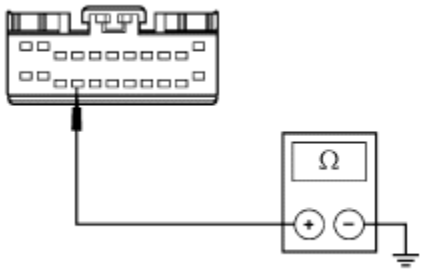
B8 CHECK KEYLESS ENTRY KEYPAD BACK LIGHTING ACTIVATION CIRCUIT

1

2

RAP Module C338

3

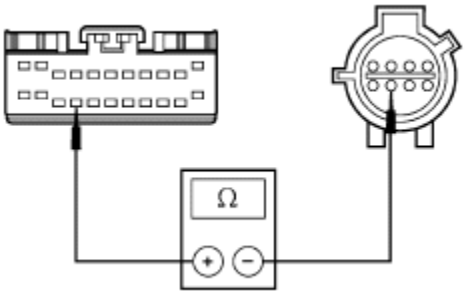
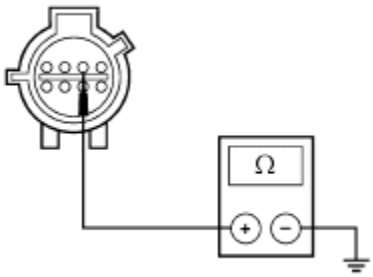


GN2213-A

3 Measure the resistance between RAP module C338-15, circuit 66 (LB), and ground.

- **Does continuity exist?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . TEST the system for normal operation.

	→ **No** GO to B9 .
B9 CHECK CIRCUIT 66 (LB) FOR OPEN	
1 Keyless Entry Keypad C516 2  GN2214-A	2 Measure the resistance between RAP module C338-15, circuit 66 (LB), and keyless entry keypad C516-7, circuit 66 (LB). • **Is the resistance less than 5 ohms?** → **Yes** GO to B10 . → **No** REPAIR circuit 66 (LB). TEST the system for normal operation.
B10 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GN2215-A	1 Measure the resistance between keyless entry keypad C516-2, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the keyless entry keypad; REFER to Keypad—Keyless Entry . TEST the system for normal operation.

→ **No**
REPAIR circuit 57 (BK). TEST the system for normal operation.

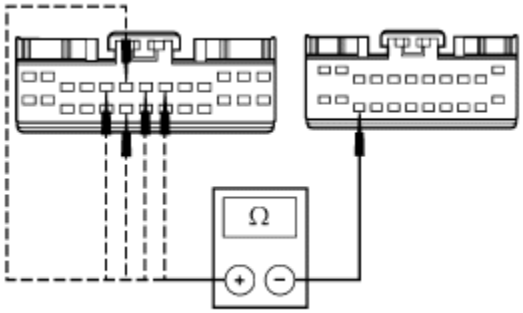
B11 CHECK THE KEYLESS ENTRY KEYPAD CIRCUITS FOR SHORT TO GROUND — KEYPAD CONNECTED

1

2

RAP Module

3



GN2207-B

3 Measure the resistance between RAP module C338-14 circuit 570 (BK/W), and RAP module C336. Refer to the following chart:

RAP Module	Circuit
C336-5	78 (LB/Y)
C336-6	79 (LG/R)
C336-19	121 (Y/BK)
C336-7	122 (Y)
C336-8	123 (R)

- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to B12 .

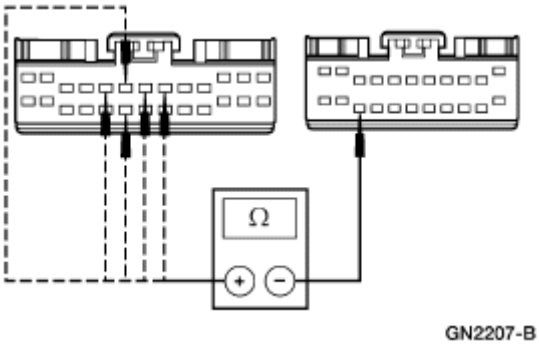
B12 CHECK THE KEYLESS ENTRY KEYPAD CIRCUITS FOR SHORT TO GROUND — KEYPAD DISCONNECTED

1

Keyless Entry Keypad C516

2

2 Measure the resistance between RAP module C338-14 circuit 570 (BK/W), and RAP module C336. Refer to the following chart:



RAP Module	Circuit
C336-5	78 (LB/Y)
C336-6	79 (LG/R)
C336-19	121 (Y/BK)
C336-7	122 (Y)
C336-8	123 (R)

- **Are the resistances greater than 10,000 ohms?**

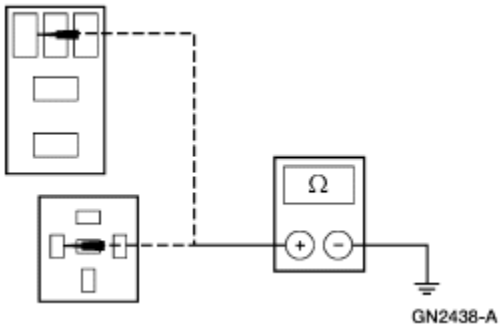
→ **Yes**
REPLACE the keyless entry keypad; REFER to Keypad—Keyless Entry . CLEAR the DTCs. TEST the system for normal operation.

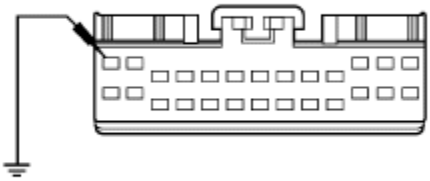
→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST C: THE DOORS DO NOT LOCK/UNLOCK USING THE REMOTE TRANSMITTER — IF EQUIPPED WITH TWO STEP UNLOCKING

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK DOOR LOCK/UNLOCK OPERATION USING THE REMOTE TRANSMITTER	
1	2 **NOTE:** Verify that the doors are locked. Press the keyless entry remote transmitter UNLOCK button. The driver door should unlock. 3 Press the keyless entry remote transmitter UNLOCK button again within 5 seconds. The rest of the doors should unlock. 4 **NOTE:** Verify that all the doors are unlocked. Press the keyless entry remote transmitter LOCK button. All doors should lock. • **Do the power locks operate as described?**

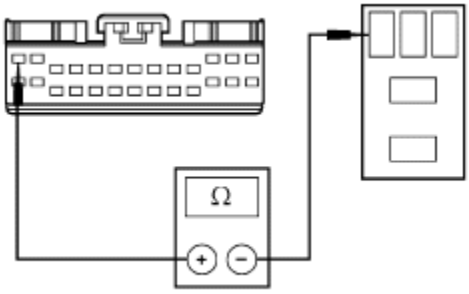
	→ **Yes** System is OK. → **No** If all the doors do not lock and unlock properly, GO to C17 . If all the doors do not lock properly, GO to C10 . If all the doors do not unlock properly, GO to C2 . If the driver door does unlock but the rest of the doors do not unlock properly, GO to C9 . If the driver door does not unlock properly but the rest of the doors do unlock, GO to C6 .
C2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 Scan Tool 2 3 Clear Continuous DTCs 4 RAP On-Demand Self-Test	2 Retrieve and document continuous DTCs. • **Is DTC B1309 or B2425 retrieved?** → **Yes** If DTC B1309, GO to C3 . If DTC B2425, GO to C31 . → **No** GO to C21 .
C3 CHECK THE RAP PID DD_LOCK	

1 	1 Monitor the RAP PID DD_LOCK. • **Does the RAP PID DD_LOCK indicate LOCK?** → **Yes** GO to C4 . → **No** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
C4 CHECK CIRCUIT 119 (PK/Y) FOR SHORT TO GROUND	
1 RAP Module C338 2 All Lock Relay 3 4 	3 Disconnect master window/door lock control switch C501 or driver power door lock switch C514, passenger power door lock switch C614 and liftgate lock switch C404. 4 Measure the resistance between all lock relay connector pin 85 or pin 2, circuit 119 (PK/Y), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C5 .

	→ **No** REPAIR circuit 119 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.
C5 CHECK THE POWER DOOR LOCK SWITCHES	
	1 Check the power door lock switches; refer to Wiring Diagrams cell 149. • **Are the power door lock switches OK?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the power door lock switch in question; REFER to Section 501-14A . CLEAR the DTCs. TEST the system for normal operation.
C6 CHECK DRIVER DOOR UNLOCK OPERATION OF RAP MODULE	
1 RAP Module C336 2  GN1542-A	2 **NOTE:** Verify the driver door is locked. Connect a jumper wire between RAP module C336-1, circuit 129 (LG), and ground. • **Does the driver door unlock?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REMOVE the jumper wire. GO to C7 .
C7 CHECK CIRCUIT 129 (LG) FOR OPEN	
1	

Driver Unlock Relay

2



GN2216-A

2 Measure the resistance between driver unlock relay connector pin 2, circuit 129 (LG), and RAP module C336-1, circuit 129 (LG).

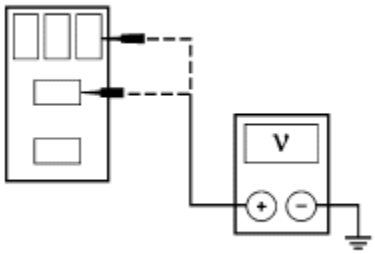
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to C8 .

→ **No**
REPAIR circuit 129 (LG). CLEAR the DTCs. TEST the system for normal operation.

C8 VERIFY THE VOLTAGE TO THE DRIVER UNLOCK RELAY — CIRCUIT 171 (BK/W)

1



GN2217-A

1 Measure the voltage between driver unlock relay connector pin 1, circuit 171 (BK/W), and ground; and between driver unlock relay connector pin 5, circuit 171 (BK/W).

- **Are the voltages greater than 10 volts?**

→ **Yes**
REPLACE the driver unlock relay. CLEAR the DTCs. TEST the system for normal operation.

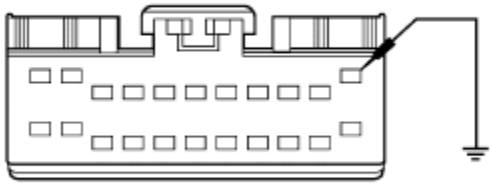
→ **No**
REPAIR circuit 171 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

C9 CHECK PASSENGER DOOR UNLOCK OPERATION OF RAP MODULE

1

RAP Module C338

2



GN1543-A

2 **NOTE:** Verify all doors are locked.

Connect a jumper wire between the RAP module C338-11, circuit 120 (PK/LG), and ground.

- **Do all doors unlock?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation

C10 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)

1

Scan Tool

2

3

Clear Continuous DTCs

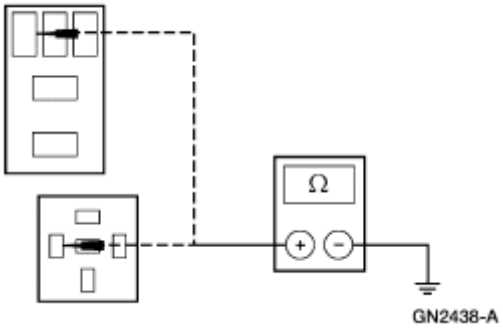
4

RAP On-Demand Self-Test

2 Retrieve and document continuous DTCs.

- **Is DTC B1341 retrieved?**

	→ **Yes** GO to C11 . → **No** GO to C14 .
C11 CHECK THE RAP PID DD_LOCK	
1 2 	2 Monitor the RAP PID DD_LOCK. • **Does the RAP PID DD_LOCK indicate UNLOCK?** → **Yes** GO to C12 . → **No** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
C12 CHECK CIRCUIT 120 (PK/LG) FOR SHORT TO GROUND	
1 RAP Module C338 2 All Unlock Relay 3 4	3 Disconnect master window/door lock control switch C501 or driver power door lock switch C514, passenger power door lock switch C614 and liftgate lock switch C404. 4 Measure the resistance between all unlock relay connector pin 85 or pin 2, circuit 120 (PK/LG), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to C13 .

→ **No**
REPAIR circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation.

C13 CHECK THE POWER DOOR LOCK SWITCHES

1 Check the power door lock switches; refer to Wiring Diagrams cell 149.

- **Are the power door lock switches OK?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the power door lock switch in question. CLEAR the DTCs. TEST the system for normal operation.

C14 CHECK ALL DOOR LOCK OPERATION OF RAP MODULE

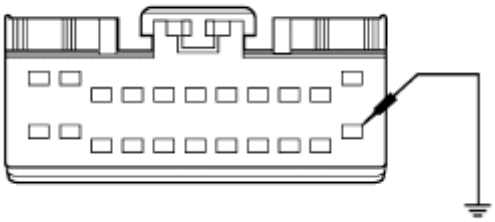
1

RAP Module C338

2

2 **NOTE:** Verify all doors are unlocked.

Connect a jumper wire between RAP module C338-22, circuit 119 (PK/Y), and ground.


GN1544-A

- **Do all the doors lock?**

→ **Yes**
REMOVE the jumper wire. RECONNECT RAP module C338. GO to C21 .

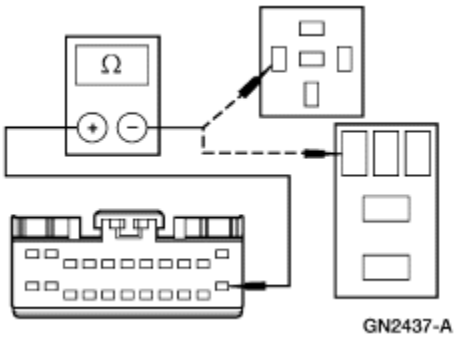
→ **No**
REMOVE the jumper wire. GO to C15 .

C15 CHECK CIRCUIT 119 (PK/Y) FOR OPEN

1

All Lock Relay

2



GN2437-A

2 Measure the resistance between all lock relay connector pin 85 or pin 2, circuit 119 (PK/Y), and RAP module C338-22, circuit 119 (PK/Y).

- **Is the resistance less than 5 ohms?**

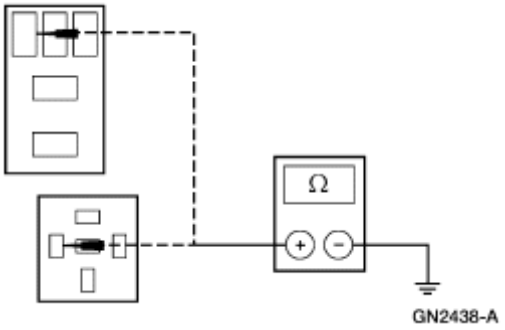
→ **Yes**
GO to C16 .

→ **No**
REPAIR circuit 119 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

C16 CHECK CIRCUIT 119 (PK/Y) FOR SHORT TO GROUND

1

1 Measure the resistance between all lock relay connector pin 85 or pin 2, circuit 119 (PK/Y), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the driver unlock relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 119 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

C17 CHECK RAP PID DD_LOCK FOR SHORT

1

Scan Tool

2

3

3 Monitor the RAP PID DD_LOCK.

- **Does the RAP PID DD_LOCK indicate SHORT?**

→ **Yes**
GO to C18 .

→ **No**
GO to C19 .

C18 CHECK CIRCUIT 119 (PK/Y) AND CIRCUIT 120 (PK/LG) FOR SHORT TO POWER

1

2

RAP Module C338

3

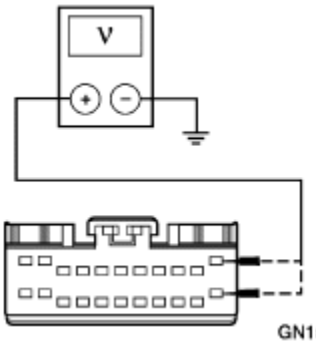
All Lock Relay

4

All Unlock Relay

5

6



6 Measure the voltage between RAP module C338-11, circuit 120 (PK/LG), and ground; and between RAP module C338-22, circuit 119 (PK/Y), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 119 (PK/Y) and/or circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

C19 CHECK TRANSMITTER LOCK INPUT — MONITOR THE RAP PID DD_LOCK

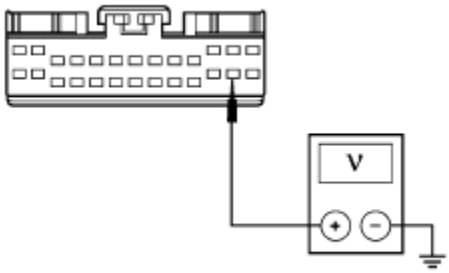
1

 2 	2 Monitor the RAP PID DD_LOCK. 3 Press the lock button on the keyless entry remote transmitter. • **Does the RAP PID DD_LOCK change from OFF to LOCK to OFF?** → **Yes** GO to C20 . → **No** GO to C21 .
C20 CHECK TRANSMITTER UNLOCK INPUT — MONITOR THE RAP PID DD_LOCK	
1 	1 Monitor the RAP PID DD_LOCK 2 Press the unlock button on the keyless entry remote transmitter. • **Does the RAP PID DD_LOCK change from OFF to UNLOCK to OFF?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C21 .
C21 CHECK TRANSMITTER OPERATION	
	1 **NOTE:** If the vehicle is within 0.8 km (1/2 mi) of radio or TV towers, the operating distance of the remote transmitter may be reduced. Press each button on the keyless entry remote transmitter while standing 3 m (10 ft) away from the vehicle and confirm that operation is as described in Description and Operation. • **Is there an appropriate response for**

	each button pressed? → **Yes** System is OK. → **No** GO to C22 .
C22 CHECK FOR ANY RESPONSE FROM TRANSMITTER NO. 1	
	1 Stand next to or sit inside the vehicle. 2 Press each button on the keyless entry remote transmitter. • **Does the system respond to any button pressed from transmitter No. 1?** → **Yes** GO to C24 . → **No** GO to C23 .
C23 CHECK FOR ANY RESPONSE FROM TRANSMITTER NO. 2	
	1 Stand next to or sit inside the vehicle. 2 Press each button on the keyless entry remote transmitter. • **Does the system respond to any button pressed from transmitter No. 2?** → **Yes** GO to C24 . → **No** GO to C30 .
C24 CHECK TRANSMITTER TIC/DATA	
NOTE: When TRANSMITTER TIC/DATA screen first appears, different eight digit letter/number codes should appear next to the TIC 1: and TIC 2: symbols. These are the stored transmitter identification codes (TICs) for the No. 1 and No. 2 transmitters.	
	1 Enter RAP, FUNCTION TESTS, TRANSMITTER TIC/DATA through the scan tool menus. • **Is there at least one transmitter stored and displayed next to TIC 1?** → **Yes** GO to C25 . → **No**

	PROGRAM all of the keyless entry remote transmitters. REFER to Programming . CLEAR the DTCs. TEST the system for normal operation.
C25 CHECK LAST TIC RECEIVED	
1 TIC/DATA	1 **NOTE:** It is normal for LAST TIC RECEIVED and LAST DATA RECEIVED to flash different information momentarily when the button is pressed. Information will lock in on the correct values. The tester is seeing the computer update its memory. **NOTE:** Pressing CLEAR will clear the last transmission received, but will not clear stored TICs in memory. Press and release the UNLOCK button of a keyless entry remote transmitter. The transmission received contains TICs for the keyless entry remote transmitter being operated and DATA for which the button has been pressed. • **Does an eight digit letter/number code appear under LAST TIC RECEIVED: and the word UNLOCK appear under LAST DATA RECEIVED:?** → **Yes** GO to C28 . → **No** GO to C26 .
C26 CHECK TRANSMITTER TIC/DATA—SECOND TRANSMITTER	
	1 Repeat step C25 for the second keyless entry remote transmitter. • **Does an eight digit letter/number code appear under LAST TIC RECEIVED: and the word UNLOCK appear under LAST DATA RECEIVED:?** → **Yes** GO to C27 . → **No** GO to C29 .
C27 TEST KEYLESS ENTRY REMOTE TRANSMITTER BATTERIES	
	1 Switch batteries from the No. 2 to the No. 1 keyless entry remote transmitter. 2 Repeat step C25 for the No. 1 keyless entry

	remote transmitter. • **Does an eight digit letter/number code appear under LAST TIC RECEIVED: and the word UNLOCK appear under LAST DATA RECEIVED:?** → **Yes** RETURN original batteries to both keyless entry remote transmitters; REPLACE batteries in the No. 1 keyless entry remote transmitter. CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the No. 1 keyless entry remote transmitter. CLEAR the DTCs. TEST the system for normal operation.
C28 CHECK TIC/DATA FOR TIC MATCH	
1 TIC/DATA	• **Does the TIC under LAST TIC RECEIVED: match TIC 1 or TIC 2?** → **Yes** GO to C29 . → **No** PROGRAM all of the keyless entry remote transmitters to be used with this system (at least two). REFER to Programming . REPEAT **C21** .
C29 CHECK TIC/DATA FOR DATA MATCH	
1 TIC/DATA	• **Do all buttons pressed for each transmitter create expected LAST DATA RECEIVED response?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** If one keyless entry remote transmitter is not operating properly, PROGRAM all keyless entry remote transmitters to be used with this system (at least two). REFER to Programming . REPEAT test step **C21** . If the concern remains. REPLACE the keyless entry remote transmitter. CLEAR the DTCs. TEST the system for normal operation. If both keyless entry remote transmitters are not operating properly, PROGRAM all keyless entry remote transmitters to be used with this system (at least two). REFER to Programming . REPEAT step **C21** . If the concern remains, GO to C32 .
C30 CHECK CIRCUIT 1002 (BK/PK) FOR SHORT TO POWER — KEY OFF	
1 2 RAP Module C336 3  GN2218-A	3 Measure the voltage between RAP module C336-25, circuit 1002 (BK/PK), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 1002 (BK/PK). TEST the system for normal operation. → **No** REPROGRAM transmitter No. 1; REFER to Programming . TEST the system for normal operation. If the transmitter still does not operate, CHECK the transmitter batteries. If OK, REPLACE the transmitter. TEST the system for normal operation.

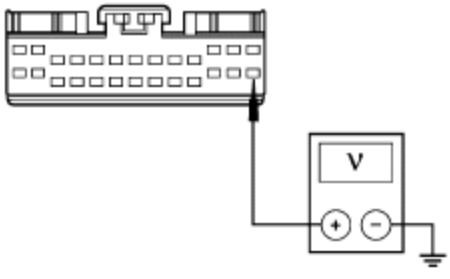
C31 RESYNCHRONIZE KEYLESS ENTRY REMOTE TRANSMITTER	
	1 Press any button on the inoperative keyless entry remote transmitter four times consecutively. • **Does the keyless entry remote transmitter operate properly?** → **Yes** CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C32 .
C32 CHECK FOR SECOND KEYLESS ENTRY REMOTE TRANSMITTER	
	1 Check for another keyless entry remote transmitter that works with the vehicle. • **Is there another keyless entry remote transmitter that works with the vehicle?** → **Yes** GO to C33 . → **No** GO to C34 .
C33 RESYNCHRONIZE THE INOPERATIVE KEYLESS ENTRY REMOTE TRANSMITTER USING THE SECOND KEYLESS ENTRY REMOTE TRANSMITTER	
	1 Press any button on the operational keyless entry remote transmitter. 2 Within 30 seconds press a button on the inoperative keyless entry remote transmitter. 3 Check the inoperative keyless entry remote for proper operation. • **Does the keyless entry remote transmitter in question operate properly?** → **Yes** CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C34 .
C34 REPROGRAM THE INOPERATIVE KEYLESS ENTRY REMOTE TRANSMITTER	
	1 Reprogram all keyless entry remote transmitters; refer to Programming .

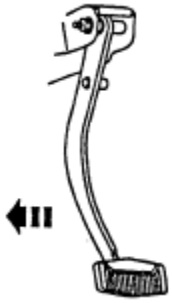
	• **Does the keyless entry remote transmitter operate properly?** → **Yes** CLEAR the DTC. INFORM the customer that any additional keyless entry remote transmitters not present during the programming mode will not operate with the vehicle. All keyless entry remote transmitters must be programmed at the same time. TEST the system for normal operation. → **No** GO to C17 .

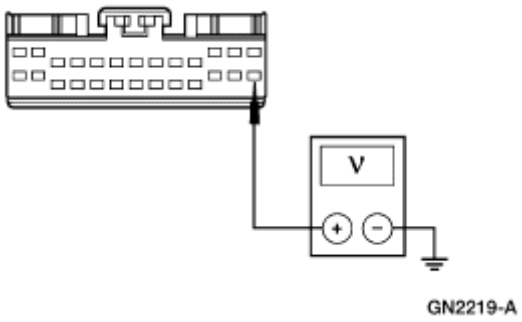
PINPOINT TEST D: THE AUTO-LOCK DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 ATTEMPT NORMAL AUTOLOCK/RELOCK OPERATION	
	1 **NOTE:** Understand the conditions required for autolock to function; refer to Description and Operation. Perform the autolock and relock sequences. • **Do the autolock and relock features work?** → **Yes** Autolock/relock functions are OK. CLARIFY with owner and RETURN to Symptom Chart. → **No** GO to D2 .
D2 CONFIRM AUTOLOCK IS ENABLED	
	1 Perform enable/disable sequence for autolock/relock feature. Refer to Description and Operation. • **As this sequence is performed for the first time, does the horn chirp once followed by a longer honk?** → **Yes** GO to D1 (a feature became enabled which was previously disabled). → **No** If one horn chirp sounded, but no longer horn

	honk followed, ENABLE autolock feature again with same sequence, but with a longer honk. (Autolock feature was enabled originally, and was disabled in **D2**). GO to D3 after enabling autolock.
D3 RETRIEVE THE DIAGNOSTIC TROUBLE CODES(DTCS)	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 RAP On-Demand Self-Test	3 Retrieve and document continuous DTCs. • **Are any DTCs retrieved?** → **Yes** If DTC B1485, GO to D4 . If DTC B1629, GO to D9 . → **No** GO to D12 .
D4 CHECK THE RAP PID BOO_RAP	
1 	1 Monitor the RAP PID BOO_RAP. • **Does the RAP PID BOO_RAP indicate ON?**

	→ **Yes** GO to D6 . → **No** GO to D5 .
D5 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH INPUT — MONITOR THE RAP PID BOO_RAP	
1 	1 Monitor the RAP PID BOO_RAP while pressing and releasing the brake pedal. • **Does the RAP PID BOO_RAP indicate ON when the brake pedal is depressed and OFF when the brake pedal is released?** → **Yes** GO to D9 . → **No** If the RAP PID BOO_RAP always displays ON, GO to D6 . If the RAP PID BOO_RAP always displays OFF, GO to D7 .
D6 CHECK CIRCUIT 511 (LG) FOR SHORT TO POWER	
1 2 RAP C336 3  GN2219-A	3 Measure the voltage between RAP module C336-26, circuit 511 (LG), and ground. • **Is any voltage indicated?**

	→ **Yes** REPAIR circuit 511 (LG). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
D7 CHECK THE STOPLAMP OPERATION	
1  GN0237-A	1 Press the brake pedal. • **Do the stoplamps operate?** → **Yes** GO to D8 . → **No** DIAGNOSE the stoplamps; REFER to Section 417-01 .
D8 CHECK THE BPP SWITCH INPUT — BRAKE PEDAL PRESSED	
1 2 RAP C336 3	3 Measure the voltage between RAP module C336-26, circuit 511 (LG), and ground while pressing the brake pedal.



- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 511 (LG). CLEAR the DTCs. TEST the system for normal operation.

D9 CHECK THE RAP PID TRANSGR

1

1 Monitor the RAP PID TRANSGR.

- **Does the RAP PID TRANSGR indicate REV?**

→ **Yes**
GO to D11 .

→ **No**
GO to D10 .

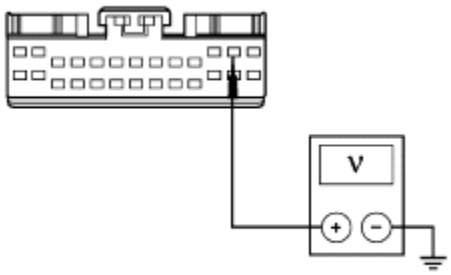
D10 CHECK THE REVERSE INPUT — MONITOR THE RAP PID TRANSGR

1

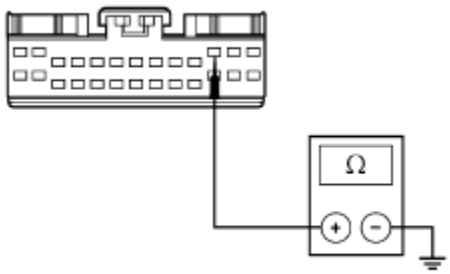
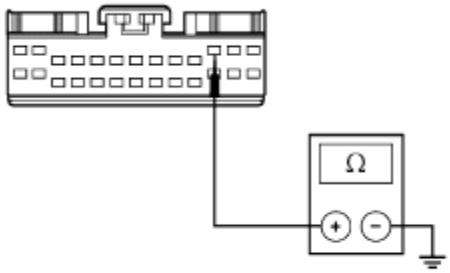
1 Monitor the RAP PID TRANSGR.

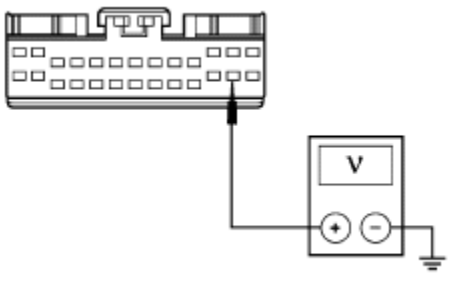
2

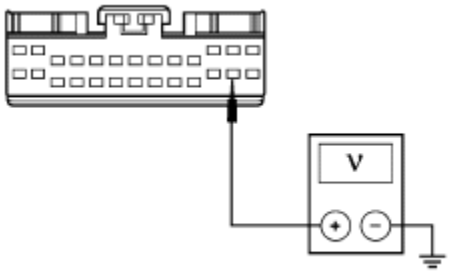
3

	• **Does the RAP PID TRANSGR indicate REV when the gearshift lever (7210) is in reverse and notREV when the gearshift lever is in park?** → **Yes** CLEAR the DTCs. PERFORM the RAP On-Demand Self-Test. If DTC B1629 is retrieved, REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D11 .
D11 CHECK CIRCUIT 140 (BK/PK) FOR SHORT TO POWER	
1 2 RAP Module C336 3  GN2208-A	3 Measure the voltage between RAP module C336-12, circuit 140 (BK/PK), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 140 (BK/PK). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
D12 CHECK THE DOOR AJAR INPUT — MONITOR THE RAP PID DOORRAP	
	1 Verify all doors are closed.

2 	2 Monitor the RAP PID DOORRAP while opening and closing the driver door. • **Does the RAP PID DOORRAP indicate CLOSED when all doors are closed and AJAR when the driver door is opened?** → **Yes** GO to D16. → **No** If the RAP PID DOORRAP indicates AJAR, GO to D13. If the RAP PID DOORRAP indicates CLOSED, GO to D15.
D13 CHECK THE GEM FOR DTCS	
1 GEM On-Demand Self-Test	• **Is DTC B1332, B1330, B1574, B1338, or B1334 retrieved?** → **Yes** REFER to Section 417-02. → **No** GO to D14.
D14 CHECK CIRCUIT 999 (LB/W) FOR SHORT TO GROUND	
1 2 RAP C336 3 GEM C281	

4  GN2220-A	4 Measure the resistance between RAP module C336-11, circuit 999 (LB/W), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 999 (LB/W). CLEAR the DTCs. TEST the system for normal operation.
D15 CHECK DOOR AJAR CIRCUIT 999 (LB/W) INPUT TO RAP MODULE	
1 2 RAP C336 3  GN2220-A	3 While a door is ajar, measure the resistance between RAP module C336-11, circuit 999 (LB/W), and ground. • **Is the resistance less than 10,000 ohms?** → **Yes** REPLACE the RAP module; REFER to Section

	419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 999 (LB/W). CLEAR the DTCs. TEST the system for normal operation.
D16 CHECK THE IGNITION INPUT TO THE RAP MODULE — MONITOR THE RAP PID IGN_RAP	
1 	1 Monitor the RAP PID IGN_RAP while turning the ignition from OFF to RUN. • **Does the RAP PID IGN_RAP indicate OFF when the ignition switch is in the off position and RUN/ACC when the ignition switch is in the run position?** → **Yes** All inputs are OK. CLARIFY with owner and return to Symptom Chart. → **No** If the RAP PID IGN_RAP indicates ON, GO to D17 . If the RAP PID IGN_RAP indicates OFF, GO to D18 .
D17 CHECK CIRCUIT 1002 (BK/PK) FOR SHORT TO POWER — KEY OFF	
1 2 RAP Module C336 3  GN2218-A	3 Measure the voltage between RAP module C336-25, circuit 1002 (BK/PK), and ground.

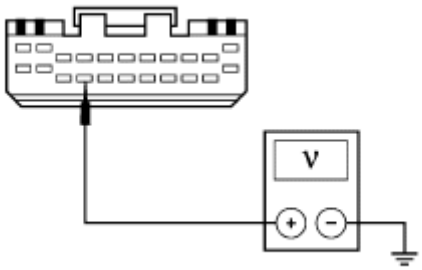
	• **Is any voltage present?** → **Yes** REPAIR circuit 1002 (BK/PK). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
D18 CHECK CIRCUIT 1002 (BK/PK) FOR VOLTAGE	
1 2 RAP Module C336 3 4  GN2218-A	4 Measure the voltage between RAP module C336-25, circuit 1002 (BK/PK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 1002 (BK/PK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST E: THE MEMORY SEAT DOES NOT OPERATE PROPERLY USING THE REMOTE

TRANSMITTER

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 DETERMINE TRANSMITTER ONE AND TWO	
1 2 Scan Tool 3 5	4 With the ignition off, press any button on the remote transmitter. 5 **NOTE:** Transmitter with TIC1, TIC2, or TIC3 will cause the memory seat to move to corresponding locations 1, 2, or 3 as set by the memory seat control switches. A transmitter under TIC4 does not cause any seat movement. Select TRANSMITTER TIC/DATA from the scan tool RAP FUNCTION TEST list. 6 Compare the LAST TIC RECEIVED with the data stored in TIC1, TIC2, TIC3, TIC4, to determine transmitter 1 (TIC1), transmitter 2 (TIC2), transmitter 3 (TIC3), and transmitter 4 (TIC4). 7 Repeat step 5 for the second remote transmitter. • **Are remote transmitters one and two identified?** → **Yes** GO to E2 . → **No** If remote transmitters do not match any stored TICs, REPROGRAM all transmitters; REFER to Programming .
E2 CHECK REMOTE TRANSMITTER ONE FOR MEMORY SEAT OPERATION	
	1 Press the UNLOCK button on remote

	transmitter one. • **Does the seat move to the memory seat position one?** → **Yes** GO to E3 . → **No** GO to E7 .
E3 CHECK REMOTE TRANSMITTER TWO FOR MEMORY SEAT OPERATION	
	1 Press the UNLOCK button on remote transmitter two. • **Does the seat move to the memory seat position two?** → **Yes** System is OK. → **No** GO to E4 .
E4 CHECK THE RAP SEAT MEMORY TWO OUTPUT USING THE SCAN TOOL	
1 	1 **NOTE:** Memory one must be OFF. Trigger the RAP active command MEMORY 2 to ON. • **Does the seat move to memory seat position two?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E5 .
E5 CHECK THE RAP MODULE OUTPUT FOR MEMORY SEAT POSITION TWO FOR VOLTAGE — CIRCUIT 268 (BK/O)	
1 DSM C337 2	2 Measure the voltage between DSM C337-15, circuit 268 (BK/O), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the DSM; REFER to Section 501-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to E6 .

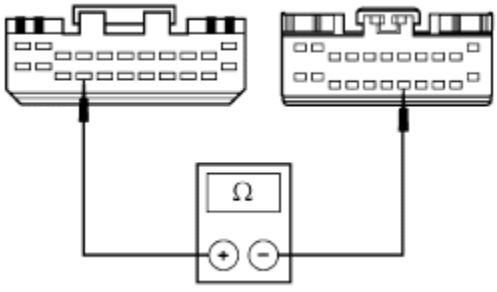
E6 CHECK CIRCUIT 268 (BK/O) FOR OPEN

1

2

RAP Module C338

3

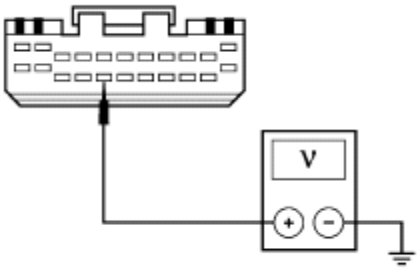


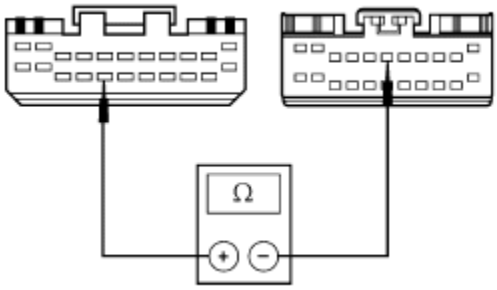
1 Trigger the RAP active command MEMORY 2 to OFF.

3 Measure the resistance between RAP module C338-18, circuit 268 (BK/O), and DSM C337-15, circuit 268 (BK/O).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

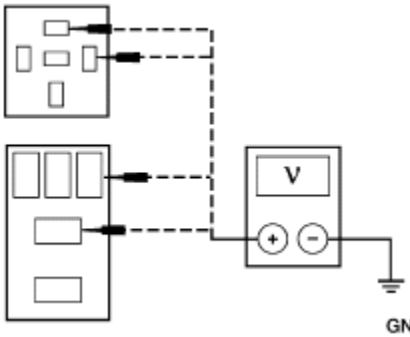
	→ **No** REPAIR circuit 268 (BK/O). CLEAR the DTCs. TEST the system for normal operation.
E7 CHECK THE RAP SEAT MEMORY ONE OUTPUT USING THE SCAN TOOL	
1 	1 **NOTE:** Memory one must be OFF. Trigger RAP active command MEMORY 1 to ON. • **Does the memory seat move to memory seat position one?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E8 .
E8 CHECK THE RAP MODULE OUTPUT FOR MEMORY SEAT POSITION ONE FOR VOLTAGE — CIRCUIT 267 (BR/LG)	
1 DSM C337 2  GN2225-A	2 Measure the voltage between DSM C337-16, circuit 267 (BR/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the DSM; REFER to Section 501-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E9 .
E9 CHECK CIRCUIT 267 (BR/LG) FOR OPEN	

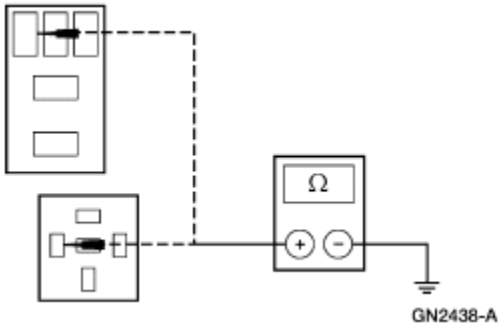
1 2 RAP Module C338 3  GN2224-A	1 Trigger the RAP active command MEMORY 1 to OFF. 3 Measure the resistance between RAP module C338-6, circuit 267 (BR/LG), and DSM C337-16, circuit 267 (BR/LG). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the RAP module; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 267 (BR/LG). CLEAR the DTCs. TEST the system for normal operation.

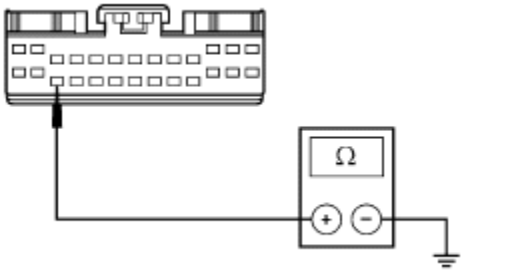
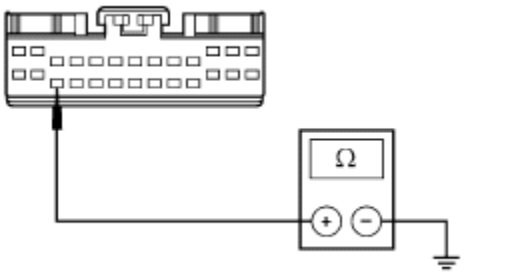
PINPOINT TEST F: ALL DOOR LOCKS ARE INOPERATIVE — TWO STEP UNLOCK DOES NOT OPERATE PROPERLY (IF EQUIPPED)

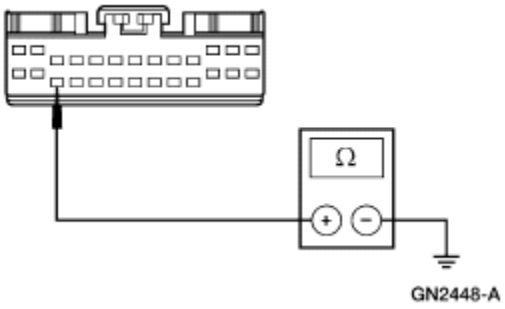
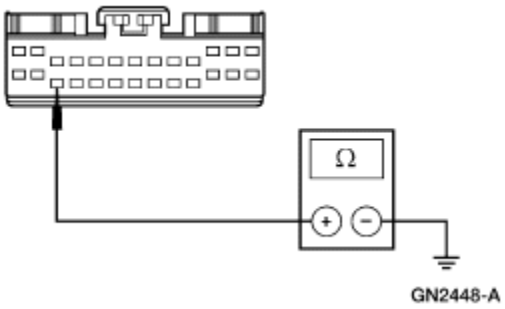
CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK IGNITION STATES — MONITORING THE PID GEM PID IGN_GEM	
1 2 Scan Tool 3	3 Monitor the GEM PID IGN_GEM while cycling

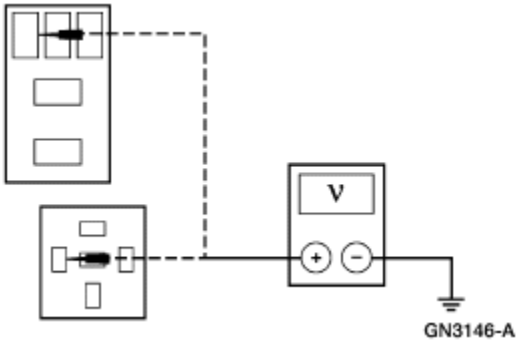
	the ignition switch through the RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to F2 . → **No** REFER to Section 417-02 .
F2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM On-Demand Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1833, GO to F13 . If DTC B1834, GO to F3 . If DTC B1836, GO to F3 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . TEST the system for normal operation. → **No** GO to F3 .
F3 CHECK THE TWO STEP UNLOCK CIRCUIT — MONITOR THE GEM PID DR_UNLK	
1 	1 Monitor the GEM PID DR_UNLK while triggering the GEM active command mode DD UNLOCK ON and OFF.

	• **Does the GEM PID DR_UNLK agree with the active command mode?** → **Yes** GO to F13 . → **No** If the PID DR_UNLK displays OFFO-G, GO to F4 . If the PID DR_UNLK displays ON-B-, GO to F11 .
F4 CHECK THE VOLTAGE TO DOOR UNLOCK RELAY — CIRCUIT 171 (BK/W)	
1 2 Door Unlock Relay 3  	3 Measure the voltage between door unlock relay connector pin 1 or 86, circuit 171 (BK/W), and ground; and between door unlock relay connector pin 5 or 87, circuit 171 (BK/W), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to F5 . → **No** CHECK fuse junction box fuse 18 (10A). If OK repair circuit 171 (BK/W). CLEAR the DTCs. TEST the system for normal operation.
F5 CHECK THE DOOR UNLOCK RELAY	
	1 Check the door unlock relay; refer to Wiring Diagrams cell 149. • **Is the door unlock relay OK?**

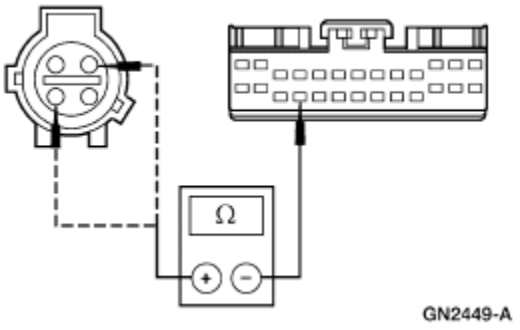
	→ **Yes** GO to F6 . → **No** REPLACE the door unlock relay. CLEAR the DTCs. TEST the system for normal operation.
F6 CHECK CIRCUIT 120 (PK/LG) FOR OPEN	
1 GEM C280 2 	2 Measure the resistance between door unlock relay pin 85 or pin 2, circuit 120 (PK/LG), and GEM C280-16, circuit 120 (PK/LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to F7 . → **No** REPAIR circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation.
F7 CHECK CIRCUIT 120 (PK/LG) FOR SHORT TO GROUND	
1 RAP Module C338 2 Passenger Power Door Lock Switch C614 3 	

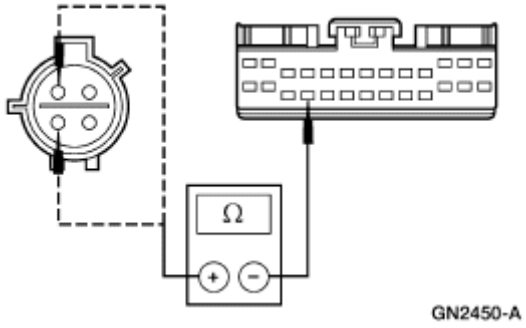
Liftgate Lock Switch C404 4 Master Window/Door Lock Switch C501 5  GN2448-A	5 Measure the resistance between GEM C280-16, circuit 120 (PK/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to F8 . → **No** REPAIR circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation.
F8 CHECK THE RIGHT FRONT POWER DOOR LOCK SWITCH FOR SHORT TO GROUND	
1 Passenger Power Door Lock Switch C414 2  GN2448-A	2 Measure the resistance between GEM C280-16, circuit 120 (PK/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes**

	GO to F9 . → **No** REPLACE RF power door lock switch. CLEAR the DTCs. TEST the system for normal operation.
F9 CHECK THE LIFTGATE LOCK SWITCH FOR SHORT TO GROUND	
1 Liftgate Lock Switch C404 2  GN2448-A	2 Measure the resistance between GEM C280-16, circuit 120 (PK/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to F10 . → **No** REPLACE liftgate lock switch. CLEAR the DTCs. TEST the system for normal operation.
F10 CHECK THE MASTER WINDOW DOOR/LOCK SWITCH FOR SHORT TO GROUND	
1  GN2448-A	1 Measure the resistance between GEM C280-16, circuit 120 (PK/LG), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes**

	REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the master window/door lock switch. CLEAR the DTCs. TEST the system for normal operation.
F11 CHECK CIRCUIT 120 (PK/LG) FOR SHORT TO POWER	
1 2 Door Unlock Relay 3 4  	4 Measure the voltage between door unlock relay connector pin 85 or pin 2, circuit 120 (PK/LG), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 120 (PK/LG). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to F12 .
F12 CHECK THE DOOR UNLOCK RELAY	
	1 Check the door unlock relay; refer to Wiring Diagrams cell 149. • **Is the relay OK?**

	→ **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the door unlock relay. CLEAR the DTCs. TEST the system for normal operation.
F13 CHECK THE DOOR DISARM INPUT CIRCUIT — MONITOR THE GEM PID DR_DSRM	
1 	1 Monitor the GEM PID DR_DSRM while unlocking the LF door, RF door and liftgate with the key. • **Does the PID indicate L_Door when in the unlock position and OFF when in the unlock position for each door?** → **Yes** REPLACE the GEM. CLEAR the DTCs. TEST the system for normal operation. → **No** If the GEM PID DR_DSRM indicates L_Door only, GO to F14 . If the GEM PID DR_DSRM indicates R_Door only, GO to F15 . If the GEM PID DR_DSRM indicates LIFT_G only, GO to F16 . If the GEM PID DR_DSRM indicates L_Door for all locks, GO to F17 .
F14 CHECK THE DRIVER DOOR DISARM SWITCH CIRCUIT 25 (DG/P) AND CIRCUIT 57 (BK) FOR OPEN	
1 2 Driver Door Disarm Switch C510 3 GEM C280	

4  GN2449-A	4 Measure the resistance between driver door disarm switch C510F, circuit 25 (DG/P), C510F and GEM C280-17, circuit 25 (DG/P); and between driver door disarm switch C510F, circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REPLACE the driver door disarm switch. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 25 (DG/P) or circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
F15 CHECK THE PASSENGER DOOR DISARM SWITCH CIRCUIT 25 (DG/P) AND CIRCUIT 57 (BK) FOR OPEN	
1 2 Passenger Door Disarm Switch C607 3 GEM C280 4	4 Measure the resistance between passenger door disarm switch C607F, circuit 25 (DG/P), and GEM C280-17, circuit 25 (DG/P); and between passenger door disarm switch C607F, circuit 57 (BK), and ground.



- **Are the resistances less than 5 ohms?**

→ **Yes**
REPLACE the passenger door disarm switch. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 25 (DG/P) or circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

F16 CHECK THE LIFTGATE DISARM SWITCH CIRCUIT 25 (DG/P) AND CIRCUIT 57 (BK) FOR OPEN

1

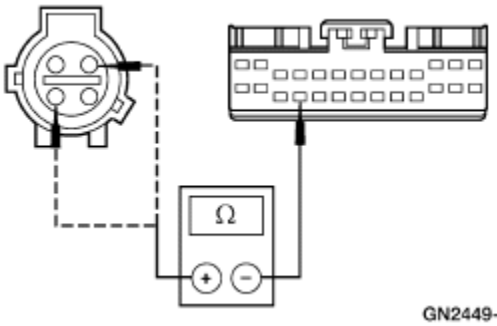
2

Liftgate Disarm Switch C426

3

GEM C280

4

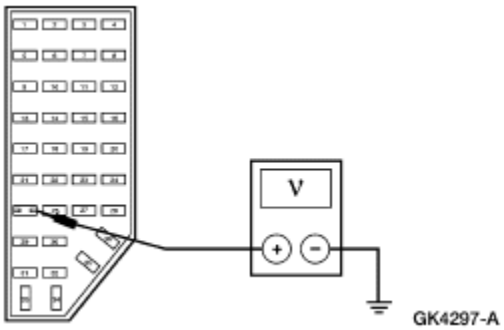


4 Measure the resistance between liftgate disarm switch C426F, circuit 25 (DG/P), and GEM C280-17, circuit 25 (DG/P); and between liftgate disarm switch C426F, circuit 57 (BK), and ground.

	• **Are the resistances less than 5 ohms?** → **Yes** REPLACE the liftgate disarm switch. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 25 (DG/P) or circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
F17 CHECK CIRCUIT 25 (DG/P) FOR SHORT TO GROUND — MONITOR THE GEM PID DR_DSRM	
1 	1 Monitor the GEM PID DR_DSRM while disconnecting each disarm switch. • **Does PID indicate OFF when any of the disarm switches is disconnected?** → **Yes** REPLACE the disarm switch that changed PID value when disconnected. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 25 (DG/P). CLEAR the DTCs. TEST the system for normal operation.

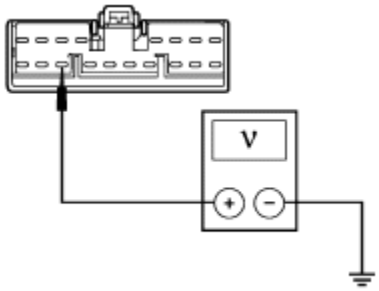
PINPOINT TEST G: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE/CENTRAL TIMER MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK BATTERY JUNCTION BOX MAXI-FUSE 1 (50A)	
1 Maxi-Fuse 1 (60A)	• **Is the fuse OK?** → **Yes** GO to G2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST

	the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
G2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1 Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to G3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.
G3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE	
1  GK4297-A	1 Measure the voltage between fuse junction panel fuse 25 (7.5A) pin 2, circuit 1052 (T/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to G4 . → **No** REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.
G4 CHECK THE VOLTAGE TO THE GEM — CIRCUIT 1001 (W/Y)	
1 2	

GEM C283

3



GK6043-A

3 Measure the voltage between GEM C283-11, circuit 1001 (W/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to G5 .

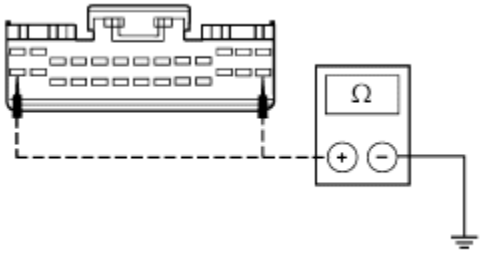
→ **No**
REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.

G5 CHECK CIRCUIT 570 (BK/W) FOR OPEN

1

GEM C280

2



GC1770-A

2 Measure the resistance between GEM C280-14, circuit 570 (BK/W), and ground; and between GEM C280-26, circuit 570 (BK/W), and ground.

- **Are the resistances less than 5 ohms?**

→ **Yes**
REFER to Section 418-00 .

→ **No**
REPAIR circuit 570 (BK/W). CLEAR the DTCs.

	TEST the system for normal operation.

Programming

NOTE: All keyless entry remote transmitters (15K601) are programmable and must be set at the same time.

NOTE: To program (or reprogram) the keyless entry remote transmitters into the RAP module, perform the following steps:

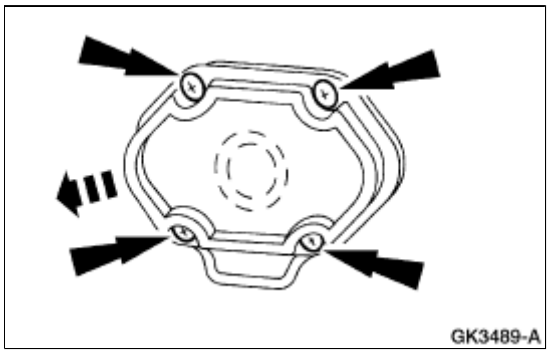
1. Make sure that the anti-theft system is not armed or triggered.
2. Turn the ignition switch (11572) from OFF to RUN eight times within ten seconds, ending in RUN. If the RAP module has successfully entered program mode, it will lock and then unlock all doors.
3. Press any button on a keyless entry remote transmitter, and the doors will lock and then unlock to confirm that each keyless entry remote transmitter has been programmed.
4. If the door locks do not respond for any keyless entry remote transmitter, wait several seconds and press the button again. If the door locks still fail to respond, refer to Diagnosis and Testing.
5. Turn the ignition switch to the OFF position, or wait up to 20 seconds after step 2, to exit program mode. If a keyless entry remote transmitter has been programmed (or reprogrammed), the RAP module will lock and unlock all doors one last time to confirm.

Keypad —Keyless Entry

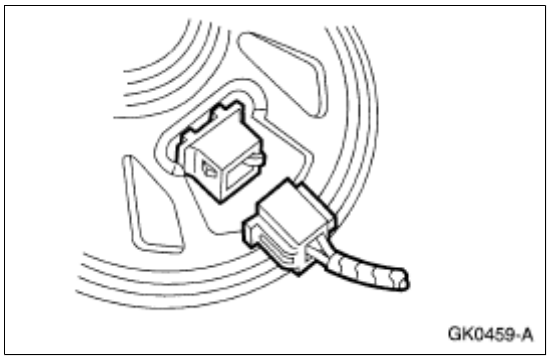
Removal

1. Disconnect the battery ground cable.
2. **CAUTION: Do not operate the radio chassis with a radio speaker disconnected.**

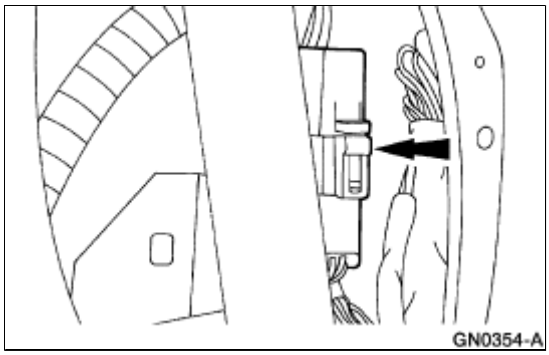
   Remove the front door trim panel. For additional information, refer to Section 501-05 .
3. Remove the screws and lift the radio speaker out to gain access to the electrical connector.



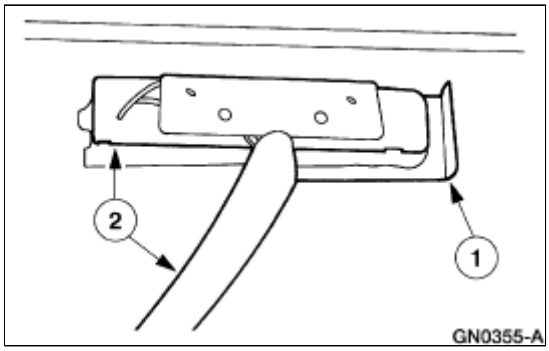
4. Disconnect the speaker wiring connector.



5. Disconnect the electrical connector.
   - Release harness pin-type retainers.



6. Remove the keyless entry keypad and harness.
    1. Remove the clip.
    2. Remove the keyless entry keypad and harness.



Installation

1. **NOTE:** When the is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

    To install, reverse the removal procedure.

Module —Remote Anti-Theft Personality (RAP)

Removal and Installation

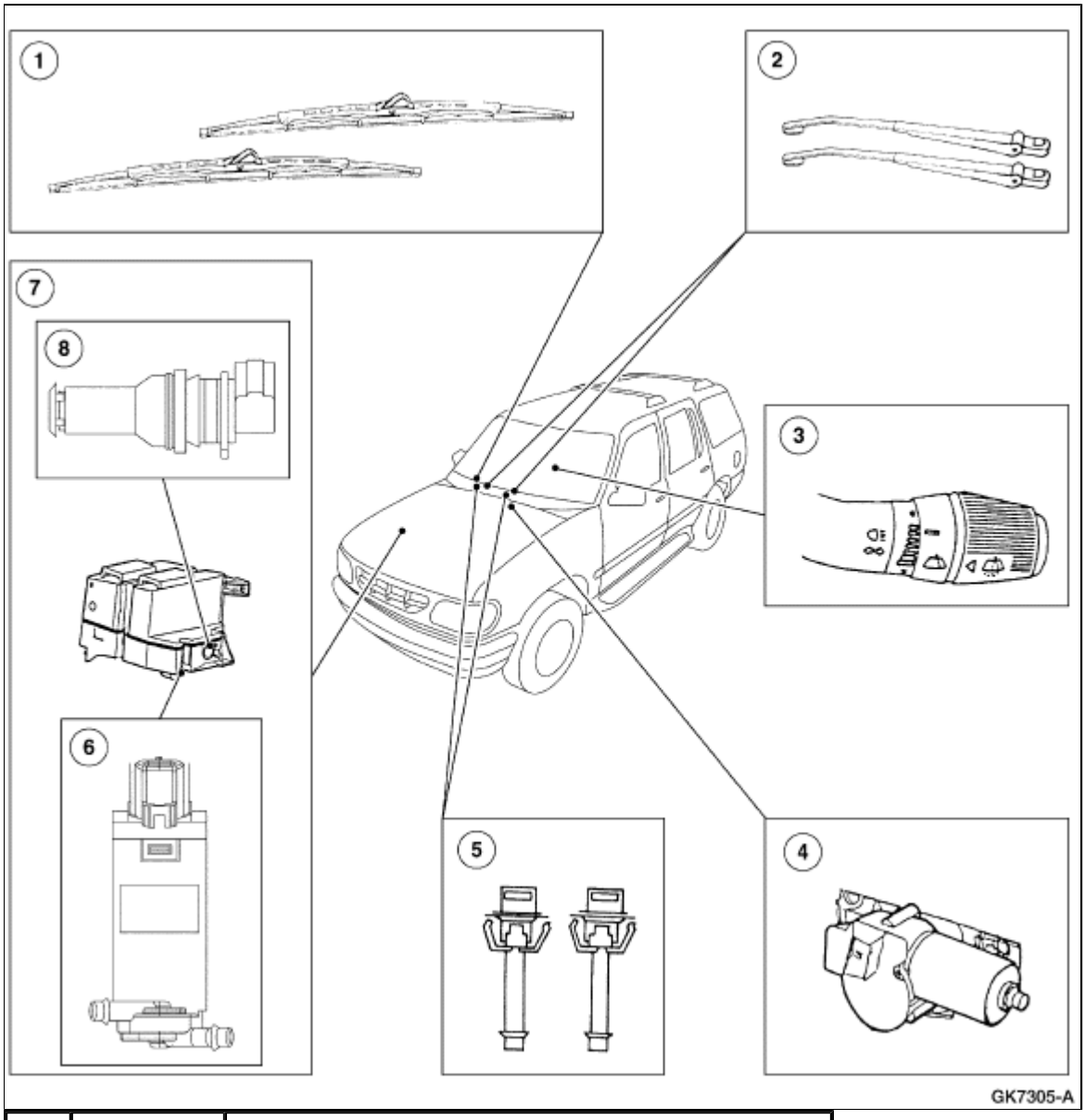
For additional information, refer to Section 419-10 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Instrument Panel Finish Panel Screws	2-3	—	18-26
Ground Strap Nut	7-9	—	61-82
Windshield Wiper Washer Switch	2-3	—	18-26
Windshield Wiper Pivot Shaft Nut	10-13	—	89-115
Windshield Wiper Motor Bolts	7.0-9.0	—	61-82
Windshield Wiper/Washer Reservoir Screw and Nut	5-6	—	44-53
Pivot Arm — Rear Nut	13-17	—	113-154
Rear Wiper Motor Bolts	9-12	—	79-108

Wipers and Washers

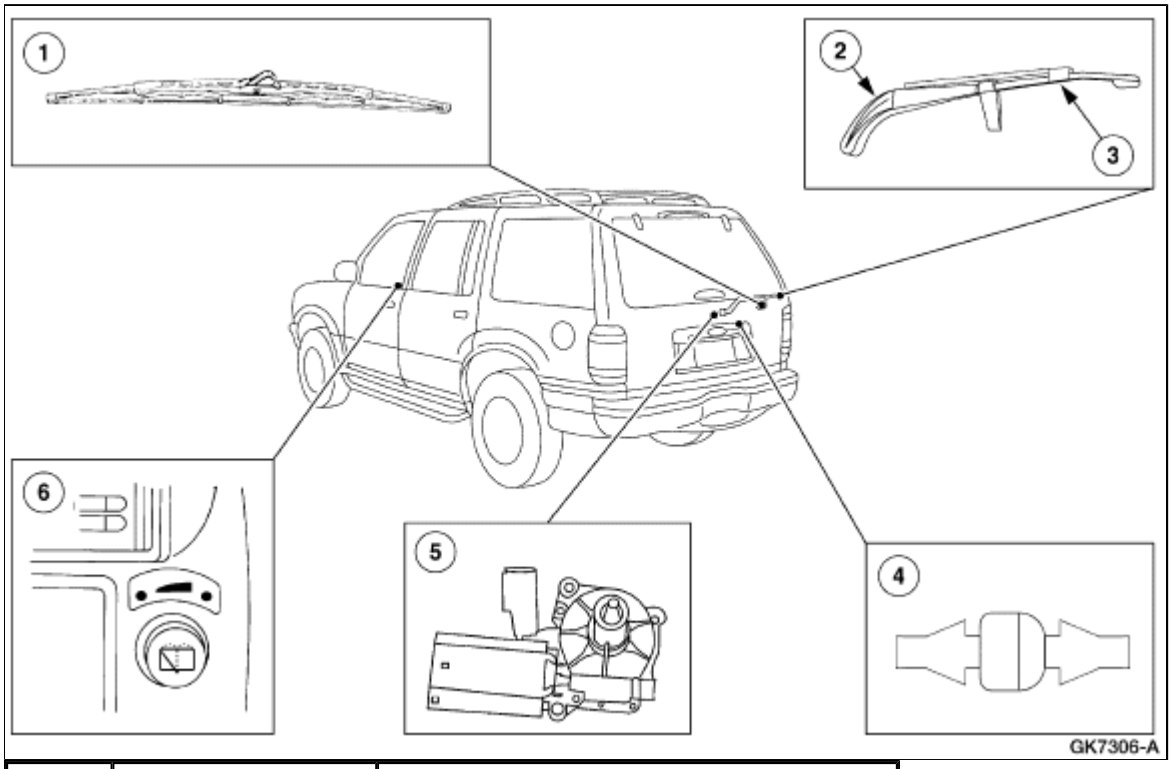
Wiper and Washer Systems



Item	Part Number	Description
1	17528	Windshield Wiper Blade
2	—	Windshield Wiper Pivot Arm
3	13K359	Multi-Function Switch
4	17504	Windshield Wiper Motor
5	17603	Windshield Washer Nozzle Jet and Bracket

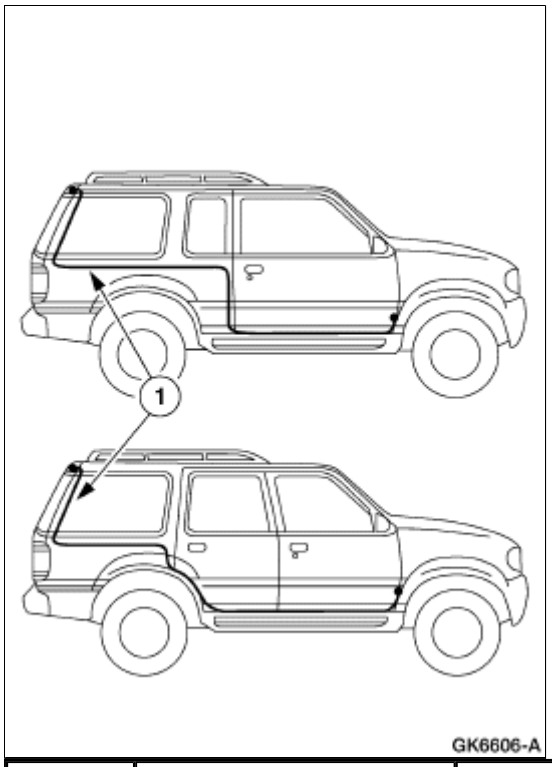
6	17664	Windshield Washer Pump
7	17618	Windshield Washer Reservoir
8	17B649	Windshield Washer Reservoir Fluid Level Sensor (If Equipped)

Rear Wiper and Washer System



Item	Part Number	Description
1	17528	Windshield Wiper Blade
2	17526	Windshield Wiper Pivot Arm
3	—	Rear Washer Nozzle
4	—	Check Valve
5	17508	Rear Wiper Motor
6	17A553	Rear Wiper Switch

Rear Washer Hose Location and Routing



Item	Part Number	Description
1	—	Rear Washer Hose

Wipers and Washers —Front

The wiper system has four different operating modes: off mode, low speed mode, high speed mode, and interval mode.

In the off mode, there is no windshield wiper motor activity, and the windshield wiper motor is in the PARK position.

In the low speed mode, the windshield wiper motor is set to a low speed setting. The windshield wiper hi/lo relay is deactivated, while the windshield wiper run/park relay is activated.

In the high speed mode, the windshield wiper motor is set to a high speed setting. The windshield wiper hi/lo relay and the windshield wiper run/park relay are both activated.

In the interval mode, the windshield wiper motor is set to a low speed setting with the windshield wiper hi/lo relay deactivated. The windshield wiper run/park relay is activated at the beginning of each wipe and deactivated when the windshield wiper motor park switch reaches the RUN position.

The permanent magnet three-brush windshield wiper motor allows selection of either low or high speed, when selected the steering column mounted multi-function switch (13K359). When the multi-function switch is in the LOW position, the common brush and low speed brush are used. When the multi-function switch is in the HIGH position, current bypasses part of the armature winding to the high speed brush. When the multi-function switch is moved to the off position, the windshield wiper motor will continue to run at low speed until the windshield wipers (17500) park.

When the multi-function switch is in the interval (INT) position, the windshield wipers will make a single sweep followed by a pause. The control knob on the end of the multi-function switch adjusts the pause from approximately 1-20 seconds.

Vehicles equipped with a generic electronic module (GEM) are available with the speed-dependant interval wiper feature. During the interval mode, the delay between successive wipes will decrease with higher vehicle speed to compensate for increased water on the windshield glass. This feature will relieve the operator from constantly switching between interval settings.

Dwell Intervals for Each Switch State

	Dwell Interval	
Delay/Wash Switch State	**0-10 MPH**	**65 MPH and Above**
1 (Long)	18	18
2	16	5
3	13	4
4	10	3
5	7	2
6	4	1
7 (Short)	1	0

If the washer switch is pressed between 100 ms and 300 ms, with the mode switch in the OFF position, the wiper system will provide one low speed wipe with no wash.

To engage the windshield washer, push the knob of the multi-function switch toward the steering column (3C529). When the multi-function switch is in the OFF or INT position, the windshield wipers will run as long as the knob is depressed up to 10 seconds. When the knob is released, the washer will stop immediately, but the windshield wipers will continue to run for two to three sweeps, then return to their previous set operation. Washer engagement does not affect windshield wiper operation when the multi-function switch is in the LOW or HIGH position, but the washer will be deactivated if the knob is held greater than 10 seconds.

Feature inputs:

- Ignition switch RUN position: (battery potential on both RUN and RUN/ACC inputs).
- Ignition switch ACC position: (battery potential on RUN/ACC input only).
- Wiper switch position: (different resistance for each mode; see Wiper Switch Resistance Values table).
- Interval Delay/Wash switch position: (different resistance for each mode; See Interval Delay/Wash Switch Resistance Values table).
- Windshield wiper motor park switch: (ground for PARK position and battery potential for RUN position).

Feature outputs:

- Windshield wiper hi/lo relay control: (ground to activate and open circuit to deactivate.)
- Windshield wiper run/park relay control: (ground to activate and open circuit to deactivate.)
- Washer pump relay control: (ground to activate and open circuit to deactivate.)

Wipers and Washers —Rear

The generic electronic module (GEM) allows operation of the rear wiper functions when the ignition switch is in the RUN or ACC position only. When the liftgate or liftgate glass is ajar (ground potential is present at the liftgate and/or liftgate glass ajar switch), the rear wiper is moved to the PARK position (if not in this position) and deactivated. The GEM controls the cycling of the rear wiper motor through two external relays (rear wiper up relay and rear wiper down relay).

There are four modes of operation: off mode, interval mode, low mode and wash mode.

In the off mode, there is no liftgate wiper motor activity and the liftgate wiper motor will be in the PARK position.

In the interval mode, there are two interval wiper settings to provide the following rear wiper dwell times:

Setting	Dwell
Interval 1	12 seconds
Interval 2	6 seconds

When the rear wiper mode/wash switch is placed in one of the intervals in the table, the GEM will activate one rear wipe cycle of the rear wiper motor. Once the wiper cycle has reached the LO position, after the initial wipe, the GEM will start a cyclical timing function with the dwell times specified in the table.

In the low mode, the liftgate wiper motor will cycle the rear motor continuously at a low speed setting.

In the wash mode, when the rear wiper wash switch is pressed and held for a time greater than 100 ms, the GEM will cycle the rear wiper motor three times.

NOTE: The GEM does not control the rear washer, only the wiper.

In the mist mode, the washer switch is pressed between 100 ms and 300 ms with the mode switch in the OFF position, the wiper system will provide one low speed wipe with no wash.

Wipers and Washers —Rear Washer Hose

Fluid for the rear washer is supplied by a two-way washer pump located in the windshield washer fluid reservoir in the engine compartment.

The rear washer hose contains a check valve, which is located in the hose that passes through the liftgate in the rear of the vehicle. This check valve holds the entire line full of washer fluid between washer operation. There is also a stand pipe located along the right hand D-pillar of the vehicle. This stand pipe prevents the unintentional release of washer fluid from the rear washer nozzle. If the hose is cut or disconnected after the line was initially primed with fluid, and the washer system is turned on, the stand pipe may fill with fluid. To resolve this, once the hose is repaired, temporarily disconnect the check valve to allow fluid in stand pipe to drain to lowest point in the hose; then reinstall the check valve.

Wipers and Washers

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell 81 , Interval Wiper/Washer for schematic and connector information.

Refer to Wiring Diagrams Cell 82 , Liftgate Wiper/Washer for schematic and connector information.

Special Tool(s)

ST1137-A	73 Digital Multimeter or equivalent 105-R0051
ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
ST1453-A	Alternator, Regulator, Battery and Starter Tester (ARBST) or equivalent 010-00725

Inspection and Verification

1. **NOTE:** The CTM must be reconfigured upon replacement. Refer to the scan tool help screen on the configuration card to program the tire size and axle ratio.

   The wiper washer system is a generic electronic module (GEM)/central timer module (CTM) controlled system.

2. Verify the customer concern by operating the system in question.

3. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Switch(es)
• Wiper arms
• Wiper mechanism
	• BJB Fuses:
	  ▪ 1 (60A)
	  ▪ 8 (15A)
	• CJB Fuses:
	  ▪ 12 (7.5A)
	  ▪ 16 (30A)
	  ▪ 25 (7.5A)
	• Damaged wiring harness
	• Loose or corroded connections
	• Lamps
	• Circuitry

4. If the concern remains after the inspection, connect scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is properly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

6. Perform the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESPONSE/NOT EQUIPPED for GEM/CTM, go to Pinpoint Test M.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform front and rear wiper self-test diagnostics for the GEM/CTM.

7. If the DTCs retrieved are related to the concern, go to GEM/CTM Diagnostic Trouble Code (DTC) Reference Chart to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	GO to Pinpoint Test F .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .

B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar Driver Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 . TEST the system for normal operation.
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window Driver One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window Driver One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window Driver Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .

B1410	Power Window Driver Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	GO to Symptom Chart.
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	GO to Pinpoint Test A .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	GO to Symptom Chart.
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	GO to Pinpoint Test C .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	GO to Symptom Chart.
B1441	Wiper Mode Select Switch Input Short to Ground	GEM/CTM	GO to Symptom Chart.
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	GO to Pinpoint Test D .
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM	GO to Symptom Chart.
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM	GO to Symptom Chart.
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	GO to Pinpoint Test E .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	GO to Pinpoint Test E .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	GO to Symptom Chart.
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	GO to Symptom Chart.
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	GO to Symptom Chart.
B1475	Accessory Delayed Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	GO to Symptom Chart.

B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	GO to Symptom Chart.
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	GO to Symptom Chart.
B1814	Wiper Rear Motor Down Relay Circuit Failure	GEM	GO to Pinpoint Test K .
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	GO to Pinpoint Test K .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	GO to Symptom Chart.
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	GO to Pinpoint Test K .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Motor Circuit Failure	GEM	GO to Pinpoint Test K .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	GO to Pinpoint Test A .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	GO to Pinpoint Test K .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .

B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size ratio. TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral InTow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral InTow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD LOW Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A"	GEM	REFER to Section 308-07A .

	Circuit Failure		
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .
P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Driver Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_Door, R_Door, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G

CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, OFFO-G, ON-B-
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED
BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	Driver Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	Driver Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds

WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage Low	GEM/CTM
B1322	Driver Door Ajar Circuit Short to Ground	GEM/CTM
B1330	Passenger Door Ajar Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Driver Power Window Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM
B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Park Lamp Input Circuit Short to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM/CTM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Wipers Are Inoperative	• CJB Fuse 16 (30A). • Circuitry. • GEM/CTM. • Multi-function switch (13K359). • Wiper run/park relay. • Wiper HI/LO relay. • Wiper motor. • DTC B1431. • DTC B1432. • DTC B1438. • DTC B1450. • DTC B1840.	• GO to Pinpoint Test A .
• The Wipers Stay On Continuously	• Circuitry. • GEM/CTM. • Multi-function	• GO to Pinpoint Test B .

	switch. • Wiper run/park relay. • Wiper HI/LO relay. • Wiper motor. • DTC B1431. • DTC B1441. • DTC B1453. • DTC B1473. • DTC B1476.	
• The High/Low Wiper Speeds Do Not Operate Properly	• Circuitry. • GEM/CTM. • Multi-function switch. • Wiper HI/LO relay. • Wiper motor. • DTC B1434. • DTC B1436. • DTC B1438. • DTC B1441. • DTC B1450. • DTC B1466. • DTC B1473. • DTC B1476.	• GO to Pinpoint Test C .
• The Intermittent Wiper Mode Does Not Operate Properly	• Circuitry. • GEM/CTM. • Multi-function switch. • Wiper motor. • DTC B1438. • DTC B1446. • DTC B1450. • DTC B1453.	• GO to Pinpoint Test D .
• The Windshield Washer Pump Is Inoperative	• Circuitry. • GEM/CTM. • Multi-function switch. • Washer pump relay. • Washer pump. • DTC B1450. • DTC B1453. • DTC B1458. • DTC B1460.	• GO to Pinpoint Test E .
• The Speed Dependent Interval Mode Does Not Operate Properly	• Circuitry. • GEM. • 4WABS control module. • DTC P0500.	• GO to Pinpoint Test F .
• The Wipers Do Not Operate Properly — High Speed Wipers Only Operate	• Circuitry. • Multi-function switch. • Wiper HI/LO relay.	• GO to Pinpoint Test G .

	• Wiper motor. • GEM/CTM. • DTC B1473. • DTC B1434. • DTC B1436. • DTC B1466. • DTC B1467.	
• The Wipers Stay On Continuously — Rear Wiper	• Circuitry. • GEM. • Rear wiper/washer switch. • DTC B1614.	• GO to Pinpoint Test H .
• The Washer Pump Is Inoperative — Rear Washer Pump	• Circuitry. • GEM. • Rear wiper/washer switch. • Washer pump.	• GO to Pinpoint Test J .
• The Wipers Are Inoperative — Rear Wiper	• Circuitry. • GEM. • Rear wiper down relay. • Rear wiper up relay. • Rear wiper motor. • Liftgate door ajar switch(es). • Liftgate wiper disable switch. • DTC B1334. • DTC B1611. • DTC B1814. • DTC B1816. • DTC B1820. • DTC B1839. • DTC B1894.	• GO to Pinpoint Test K .
• The Wipers Do Not Operate Properly — Rear Wiper	• Circuitry. • GEM. • Rear wiper/washer switch. • DTC B1611. • DTC B1614.	• GO to Pinpoint Test L .
• No Communication With the Module — GENERIC ELECTRONIC MODULE/CENTRAL TIMER MODULE	• BJB Fuse 1 (50A) • CJB Fuse 25 (7.5A) • Circuitry. • GEM/CTM.	• GO to Pinpoint Test M .

Pinpoint Tests

CAUTION: Before removing and installing the GEM/CTM or its connectors, disconnect the

battery. Failure to follow this caution will result in GEM/CTM storing many erroneous DTCs and it may exhibit erratic operation after installation.

CAUTION: Be careful when probing the battery junction box (BJB), central junction box (CJB) or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when performing the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: Complete the entire pinpoint test related to the symptom before replacing the GEM/CTM.

PINPOINT TEST A: THE WIPERS ARE INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to A2 . → **No** REFER to Section 417-02 .
A2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1	1 Retrieve and document continuous DTCs.

2

Clear Continuous DTCs

3

GEM/CTM Wiper/Washer Self Test

- **Are any DTCs recorded?**

→ **Yes**
If DTC B1431, GO to A4 .

If DTC B1432, GO to A4 .

If DTC B1438, GO to A11 .

If DTC B1450, GO to A11 .

If DTC B1840, GO to A11 .

If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to A3 .

A3 CHECK CJB FUSE 16 (30A)

1

2

CJB Fuse 16 (30A)

- **Is the fuse OK?**

→ **Yes**
GO to A4 .

	→ **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
A4 CHECK THE WIPER RUN RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID WPRUN	
1 2 	2 Monitor the GEM/CTM PID WPRUN while triggering the GEM/CTM active command WIPER RLY. • **Does the GEM/CTM PID WPRUN value agree with the command mode?** → **Yes** If the GEM/CTM PID WPRUN displays ON--- and OFF---, GO to A11 . → **No** If the GEM/CTM PID WPRUN displays OFFO-G, GO to A7 . If the GEM/CTM PID WPRUN displays ON-B-, GO to A5 .
A5 CHECK THE WIPER RUN RELAY	
1 	2 Check the wiper run relay; refer to Wiring Diagrams cell 149 . • **Is the wiper run relay OK?** → **Yes** GO to A6 . → **No** REPLACE the wiper run relay. CLEAR the DTCs. TEST the system for normal operation.
A6 CHECK CIRCUIT 646 (Y/W) FOR SHORT TO POWER	
1	

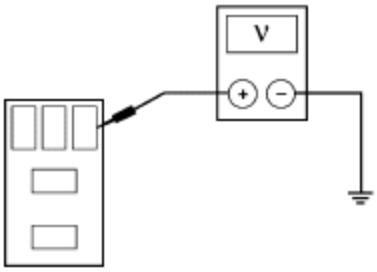
GEM/CTM C280

2

Wiper Run Relay

3

4



GN0110-A

4 Measure the voltage between wiper run relay connector pin 1, circuit 646 (Y/W), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 646 (Y/W). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

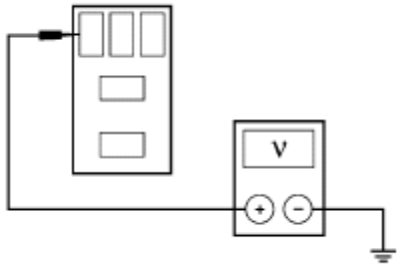
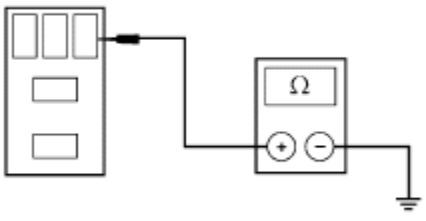
A7 CHECK THE VOLTAGE TO THE WIPER RUN RELAY — CIRCUIT 63 (R)

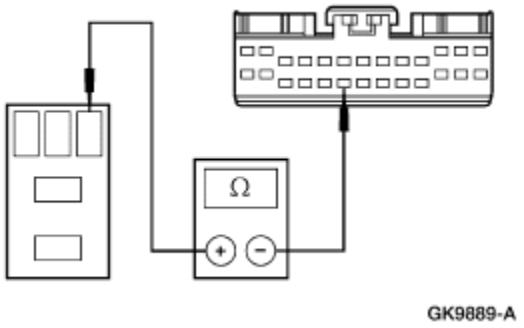
1

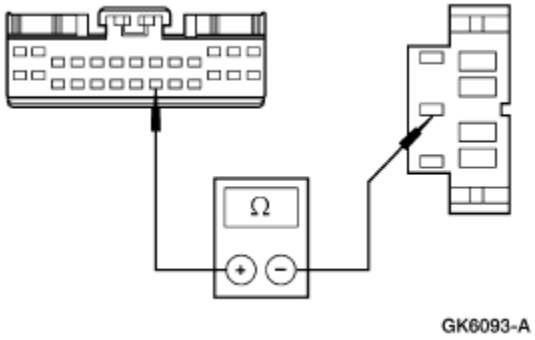
2

Wiper Run Relay

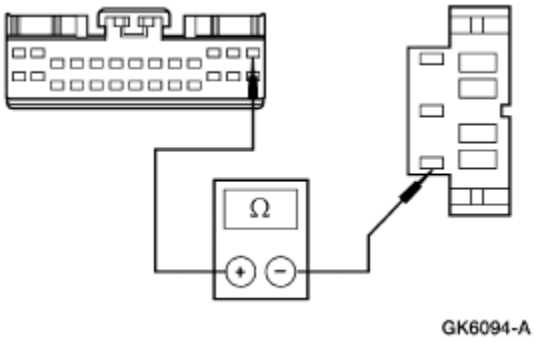
3

 4  GN0104-A	4 Measure the voltage between wiper run relay connector pin 2, circuit 63 (R), and ground. • **Is the voltage greater than 10 volts?** → **Yes** RECONNECT the wiper run relay, GO to A8 . → **No** REPAIR circuit 63 (R). CLEAR the DTCs. TEST the system for normal operation.
A8 CHECK CIRCUIT 646 (Y/W) FOR SHORT TO GROUND	
1 2 GEM C280 3  GN1453-A	3 Measure the resistance between wiper run relay connector pin 1, circuit 646 (Y/W), and ground. • **Is the resistance greater than 10,000 ohms?**

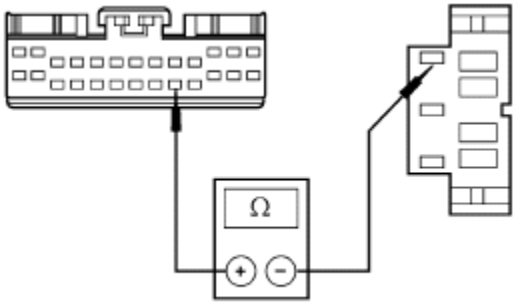
	→ **Yes** GO to A9 . → **No** REPAIR circuit 646 (Y/W). CLEAR the DTCs. TEST the system for normal operation.
A9 CHECK THE WIPER RUN RELAY	
	1 Check the wiper run relay; refer to Wiring Diagrams cell 149. • **Is the wiper run relay OK?** → **Yes** GO to A10 . → **No** REPLACE the wiper run relay. CLEAR the DTCs. TEST the system for normal operation.
A10 CHECK CIRCUIT 646 (Y/W) FOR OPEN	
1  	1 Measure the resistance between wiper run relay connector pin 1, circuit 646 (Y/W), and GEM/CTM C280-19, circuit 646 (Y/W). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 646 (Y/W). CLEAR the DTCs. TEST the system for normal operation.
A11 CHECK THE WIPER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE	
1 	1 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all the switch positions. • **Do the GEM/CTM PID WPMODE values agree with the wiper switch position?**

	→ **Yes** GO to A16 . → **No** GO to A12 .
A12 CHECK THE MULTI-FUNCTION SWITCH	
1 	2 Check the multi-function switch; refer toWiring Diagrams cell 149. • **Is the multi-function switch OK?** → **Yes** GO to A13 . → **No** REPLACE the multi-function switch; REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
A13 CHECK CIRCUIT 359 (GY/R) FOR OPEN	
1 GEM/CTM C280 2  GK6093-A	2 Measure the resistance between multi-function switch C210-993, circuit 359 (GY/R), and GEM/CTM C280-21, circuit 359 (GY/R). • **Is the resistance less than 5 ohms?** → **Yes** GO to A14 . → **No** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.

A14 CHECK CIRCUIT 680 (LB/O) FOR OPEN

1  GK6094-A	1 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and GEM/CTM C280-13, circuit 680 (LB/O). • **Is the resistance less than 5 ohms?** → **Yes** GO to A15 . → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.

A15 CHECK CIRCUIT 684 (PK/Y) FOR OPEN

1  GK6095-A	1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and GEM/CTM C280-22, circuit 684 (PK/Y). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

A16 CHECK THE VOLTAGE TO THE SWITCH SIDE OF THE WIPER RUN RELAY — CIRCUIT 63 (R)

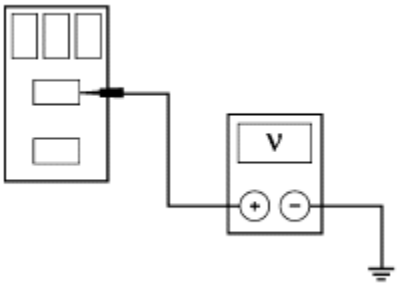
1	

2

Wiper Run Relay

3

4



4 Measure the voltage between wiper run relay connector pin 5, circuit 63 (R), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
RECONNECT the wiper run relay; GO to A17 .

→ **No**
REPAIR circuit 63 (R). CLEAR the DTCs.
TEST the system for normal operation.

A17 CHECK THE WIPER HI/LO RELAY SWITCH

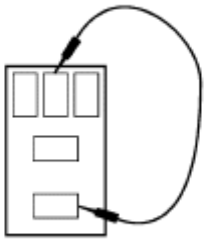
1

2

Wiper HI/LO Relay

3

4



GK4344-A

4 Connect a jumper wire between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and wiper HI/LO relay connector pin 4, circuit 58 (W), while turning the wiper switch through all switch positions.

- **Do the wipers operate?**

→ **Yes**
REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to A18 .

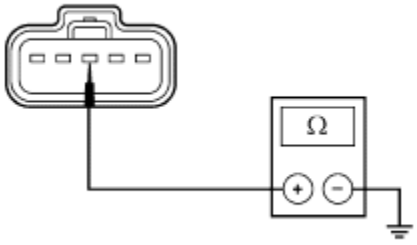
A18 CHECK THE GROUND TO THE WIPER MOTOR — CIRCUIT 57 (BK)

1

2

Wiper Motor C145

3



GK7068-A

3 Measure the resistance between wiper motor C145-3, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to A19 .

→ **No**
REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

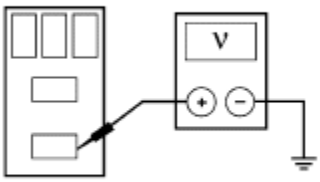
A19 CHECK THE WIPER RUN RELAY SWITCH CIRCUIT

1

2

3

4



GK0902-A

3 Trigger the GEM/CTM active command WIPER RLY to ON.

4 Measure the voltage between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to A20 .

→ **No**
REPAIR circuit 28 (BK/PK). CLEAR the DTCs. TEST the system for normal operation.

A20 CHECK THE WIPER MECHANISM

1 Remove the linkage from the wiper motor.

- **Are the wipers free?**

→ **Yes**
CHECK the wiper motor by performing the Wiper Motor Current Draw Test; REFER to Component Test. If the wiper motor does not pass the test, REPLACE the wiper motor; REFER to Motor—Windshield Wiper . CLEAR the DTCs. TEST the system for normal operation.

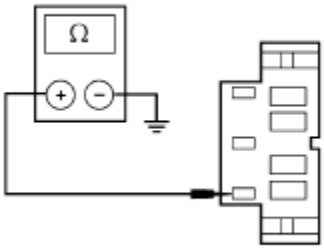
→ **No**

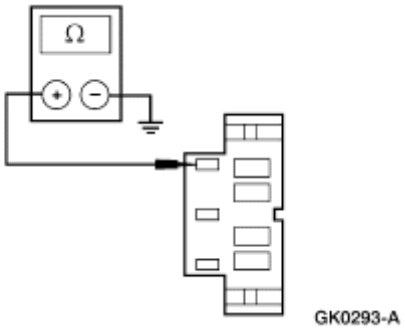
	REPAIR the wiper mechanism. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST B: THE WIPERS STAY ON CONTINUOUSLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to B2 . → **No** REFER to Section 417-02 .
B2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Clear Continuous DTCs 3	1 Retrieve and document continuous DTCs.

GEM/CTM Wiper/Washer Self Test	• **Are any DTCs recorded?** → **Yes** If DTC B1431, GO to B7 . If DTC B1441, GO to B3 . If DTC B1453, GO to B3 . If DTC B1473, GO to B10 . If DTC B1476, GO to B10 . If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B3 .
B3 CHECK THE WIPER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE	
1 2 	2 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all the switch positions. • **Does the GEM/CTM PID WPMODE agree with the wiper switch positions?** → **Yes** GO to B7 . → **No** GO to B4 .
B4 CHECK THE WIPER SWITCH	
1 2 Multi-Function Switch C210	

	3 Check the multi-function switch; refer to Wiring Diagrams cell 149. • **Is the wiper switch OK?** → **Yes** GO to B5 . → **No** REPLACE the multi-function switch; REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
B5 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO GROUND	
1 GEM/CTM C280 2  GK0913-A	2 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B6 . → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.
B6 CHECK CIRCUIT 684 (PK/Y) FOR SHORT TO GROUND	
1	1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and ground.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

B7 CHECK THE WIPER RUN RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID WPRUN

1

2

2 Monitor the GEM/CTM PID WPRUN while triggering the GEM/CTM active command WIPER RLY.

- **Does the GEM/CTM PID WPRUN agree with the active command mode?**

→ **Yes**
If the GEM/CTM PID WPRUN displays ON--- and OFF---, GO to B10 .

→ **No**
If the GEM/CTM PID WPRUN displays OFFO-G, GO to B8 .

B8 CHECK THE WIPER RUN RELAY

1

2

Wiper Run Relay

3 Check the wiper run relay; refer to Wiring Diagrams cell 149.

- **Is the wiper run relay OK?**

→ **Yes**
GO to B9 .

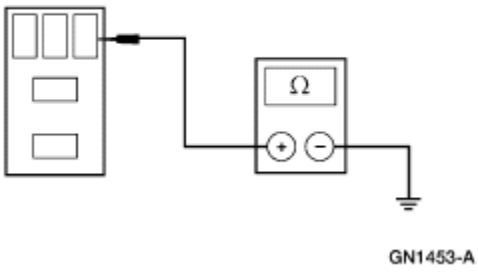
→ **No**
REPLACE wiper run relay. CLEAR the DTCs. TEST the system for normal operation.

B9 CHECK CIRCUIT 646 (Y/W) FOR SHORT TO GROUND

1

GEM/CTM C280

2



GN1453-A

2 Measure the resistance between wiper run relay connector pin 1, circuit 646 (Y/W), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 646 (Y/W). CLEAR the DTCs. TEST the system for normal operation.

B10 CHECK THE WINDSHIELD WIPER RUN RELAY SWITCH CIRCUIT

1

2

Wiper Run Relay

- **Do the wipers stop operating?**

→ **Yes**
REPLACE the wiper run relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to B11 .

B11 CHECK CIRCUIT 56 (DB/O) FOR SHORT TO POWER

1

2

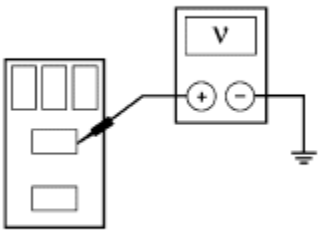
Wiper HI/LO Relay

3

Wiper Motor C145

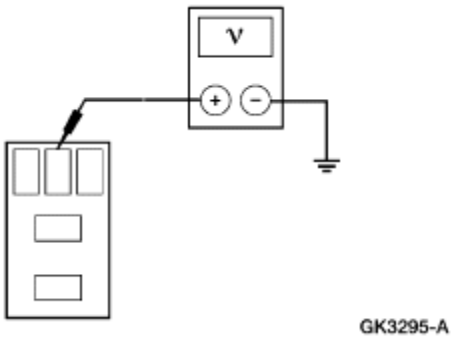
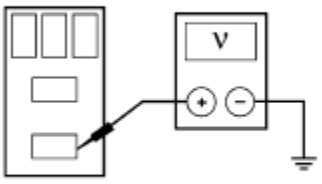
4

5



GK0903-A

5 Measure the voltage between wiper HI/LO relay connector pin 5, circuit 56 (DB/O), and ground.

	• **Is any voltage indicated?** → **Yes** REPAIR circuit 56 (DB/O). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B12 .
B12 CHECK CIRCUIT 58 (W) FOR SHORT TO POWER	
1  GK3295-A	1 Measure the voltage between wiper HI/LO relay connector pin 4, circuit 58 (W), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 58 (W). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to B13 .
B13 CHECK CIRCUIT 28 (BK/PK) FOR SHORT TO POWER	
1  GK0902-A	1 Measure the voltage between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 28 (BK/PK). CLEAR the DTCs. TEST the system for normal operation. → **No**

	REPLACE the wiper motor; REFER to Motor—Windshield Wiper . CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST C: THE HIGH/LOW WIPER SPEEDS DO NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to C2 . → **No** REFER to Section 417-02 .
C2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3	1 Retrieve and document continuous DTCs.

GEM/CTM Wiper/Washer Self-Test

- **Are any DTCs recorded?**

→ **Yes**
If DTC B1434, GO to C9.

If DTC B1436, GO to C9.

If DTC B1438, GO to C3.

If DTC B1441, GO to C3.

If DTC B1450, GO to C3.

If DTC B1466, GO to C3.

If DTC B1473, GO to C3.

If DTC B1476, GO to C3.

If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to C3.

C3 CHECK THE WIPER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE

1

1 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all switch positions.

- **Does the GEM/CTM PID WPMODE value agree with the wiper switch position?**

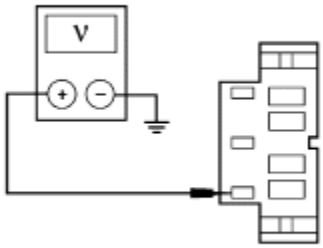
→ **Yes**
GO to C9.

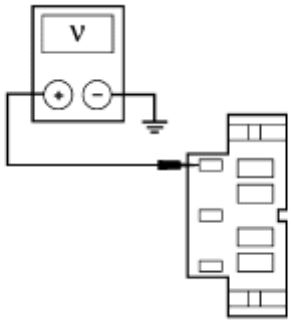
→ **No**
GO to C4.

C4 CHECK THE WIPER SWITCH

1

Multi-Function Switch

	2 Check the multi-function switch; refer to Wiring Diagrams cell 149. • **Is the multi-function switch OK?** → **Yes** GO to C5 . → **No** REPLACE the multi-function switch; REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
C5 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO POWER	
1 GEM/CTM C280 2 3  GK0314-A	3 Measure the voltage between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C6 .
C6 CHECK CIRCUIT 684 (PK/Y) FOR SHORT TO POWER	
1	1 Measure the voltage between multi-function switch C210-685, circuit 684 (PK/Y), and ground.



- **Is any voltage indicated?**

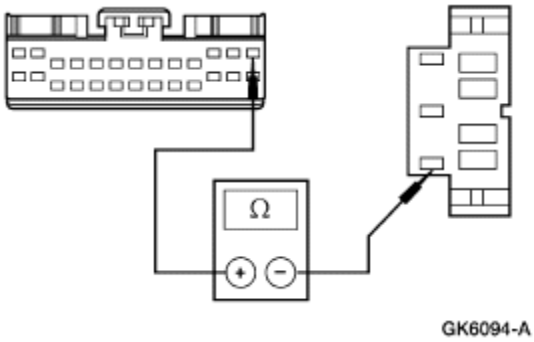
→ **Yes**
REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to C7 .

C7 CHECK CIRCUIT 680 (LB/O) FOR OPEN

1

2



2 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and GEM C280-13, circuit 680 (LB/O).

- **Is the resistance less than 5 ohms?**

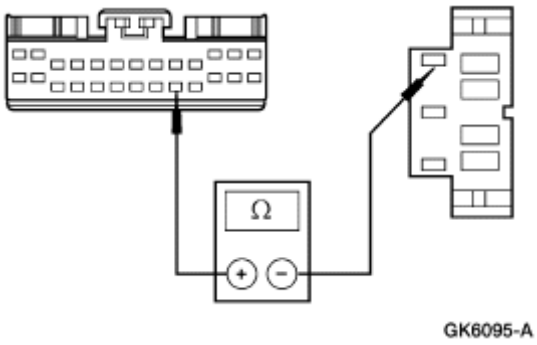
→ **Yes**
GO to C8 .

→ **No**
REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.

C8 CHECK CIRCUIT 684 (PK/Y) FOR OPEN

1

1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and GEM C280-22, circuit 684 (PK/Y).



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.

C9 CHECK THE WIPER HI/LO RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID WPHISP

1

1 Monitor the GEM/CTM PID WPHISP while triggering the GEM/CTM active command SPEED RLY.

- **Does the GEM/CTM PID WPHISP value agree with the active command?**

→ **Yes**
If the GEM/CTM PID WPHISP displays ON--- and OFF---, GO to C16 .

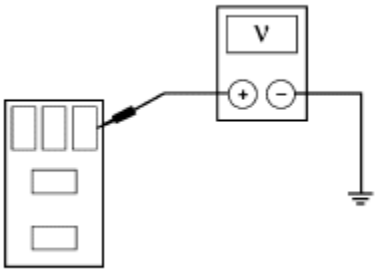
→ **No**
If the GEM/CTM PID WPHISP displays OFFO-G, GO to C12 .

If the GEM/CTM PID WPHISP displays ON-B-, GO to C10 .

C10 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO POWER

1

2

Wiper HI/LO Relay 3 GEM/CTM C280 4 5  GN0110-A	5 Measure the voltage between wiper HI/LO relay connector pin 1, circuit 647 (GY/LB), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 647 (GY/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to C11 .
C11 CHECK THE WIPER HI/LO RELAY	
1 	2 Check the wiper HI/LO relay; refer to Wiring Diagrams cell 149. • **Is the wiper HI/LO relay OK?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.

C12 CHECK THE VOLTAGE TO THE WIPER HI/LO RELAY — CIRCUIT 63 (R)

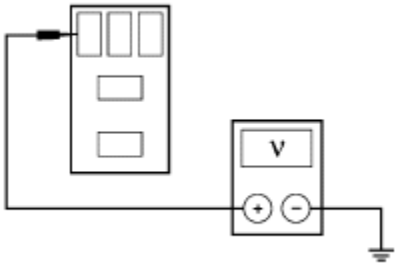
1

2

Wiper HI/LO Relay

3

4



GN0104-A

4 Measure the voltage between wiper HI/LO relay connector pin 2, circuit 63 (R), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to C13 .

→ **No**
REPAIR circuit 63 (R). CLEAR the DTCs. TEST the system for normal operation.

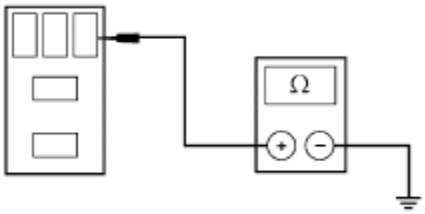
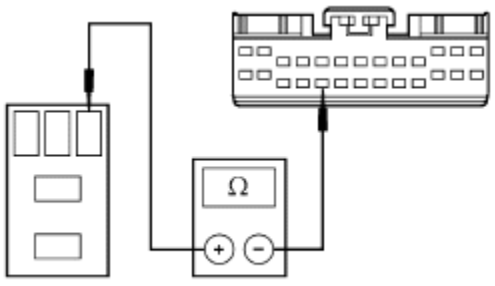
C13 CHECK THE WIPER HI/LO RELAY

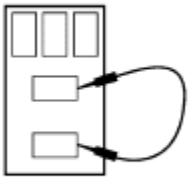
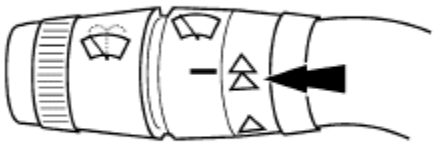
1

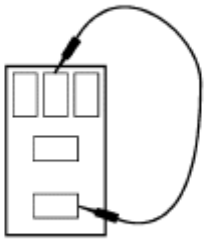
2 Check the wiper HI/LO relay; refer to Wiring Diagrams cell 149.

- **Is the wiper HI/LO relay OK?**

→ **Yes**
GO to C14 .

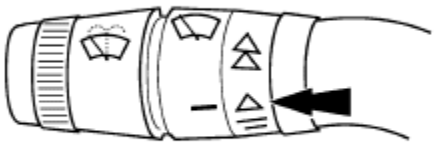
	→ **No** REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.
C14 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO GROUND	
1 GEM/CTM C280 2  GN1453-A	2 Measure the resistance between wiper HI/LO relay connector pin 1, circuit 647 (GY/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C15 . → **No** REPAIR circuit 647 (GY/LB). CLEAR the DTCs. TEST the system for normal operation.
C15 CHECK CIRCUIT 647 (GY/LB) FOR OPEN	
1  GK9890-A	1 Measure the resistance between GEM/CTM C280-18, circuit 647 (GY/LB), and wiper HI/LO relay connector pin 1, circuit 647 (GY/LB). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** REPAIR circuit 647 (GY/LB). CLEAR the DTCs. TEST the system for normal operation.
C16 CHECK THE WIPER HI/LO RELAY SWITCH CIRCUIT	
1 	
2 Wiper HI/LO Relay	
3 	
4  GK0919-A	4 Connect a jumper wire between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and wiper HI/LO relay connector pin 5, circuit 56 (DB/O).
5  GK0918-A	5 Turn the wiper switch to the high position.
	6 Remove the jumper wire.
7	7 Connect a jumper wire between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and wiper HI/LO relay connector pin 4, circuit 58 (W).



GK4344-A

8



GK0920-A

8 Turn the wiper switch to the low position.

- **Do the wipers operate at the correct speeds?**

→ **Yes**
REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REMOVE the jumper wire, GO to C17 .

If the wipers do not operate at high speed and DTC B1476 is indicated, GO to C17 .

C17 CHECK CIRCUIT 56 (DB/O) FOR OPEN

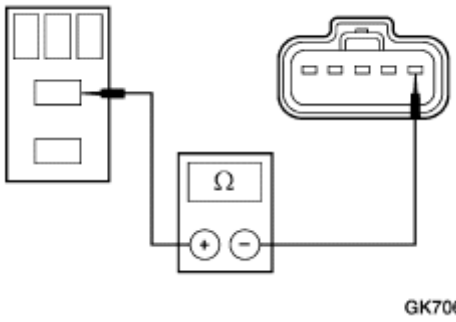
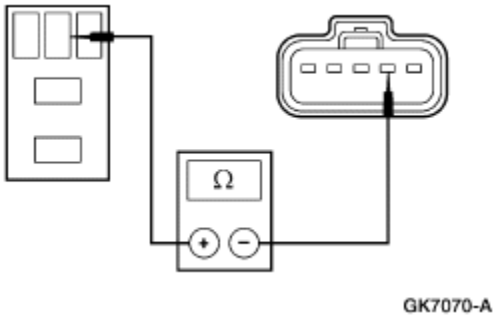
1

2

Wiper Motor C145

3

3 Measure the resistance between wiper HI/LO relay connector pin 5, circuit 56 (DB/O), and wiper motor C145-5, circuit 56 (DB/O).

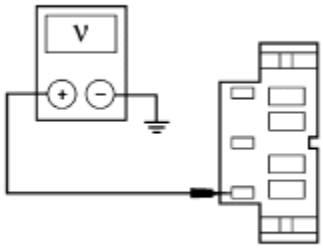
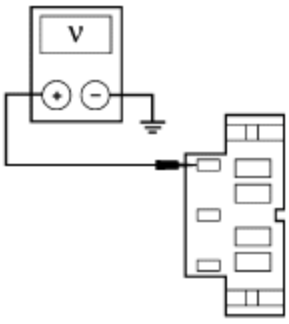
	• **Is the resistance less than 5 ohms?** → **Yes** GO to C18 . → **No** REPAIR circuit 56 (DB/O). CLEAR the DTCs. TEST the system for normal operation.
C18 CHECK CIRCUIT 58 (W) FOR OPEN	
1 	1 Measure the resistance between wiper HI/LO relay connector pin 4, circuit 58 (W), and wiper motor C145-4, circuit 58 (W). • **Is the resistance less than 5 ohms?** → **Yes** CHECK the wiper motor. REFER to Component Test. REPLACE the wiper motor if it does not pass the test; REFER to Motor—Windshield Wiper . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 58 (W). CLEAR the DTCs. TEST the system for normal operation.

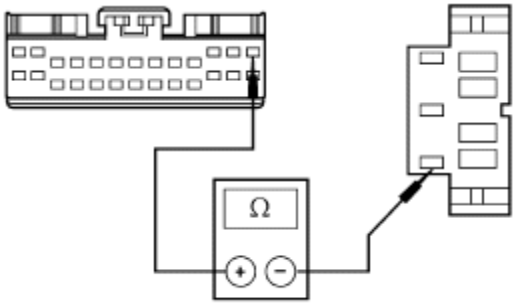
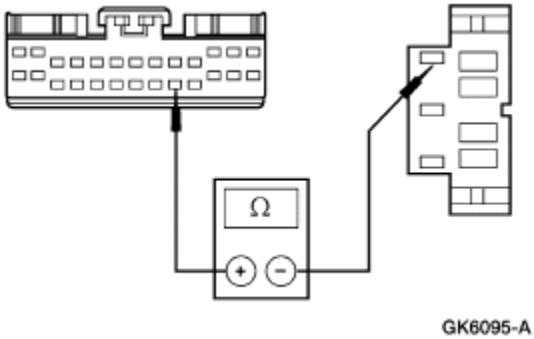
PINPOINT TEST D: THE INTERMITTENT WIPER SPEED DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	

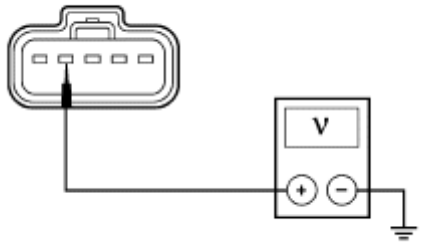
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to D2 . → **No** REFER to Section 417-02 .
D2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM Wiper/Washer Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1438, GO to D3 . If DTC B1446, GO to D9 .

	If DTC B1450, GO to D3. If DTC B1453, GO to D3. If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D3.
D3 CHECK THE WIPER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE	
1 2 	2 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all the switch positions. • **Does the GEM/CTM PID WPMODE agree with all the wiper switch positions?** → **Yes** GO to D9. → **No** GO to D4.
D4 CHECK THE WIPER SWITCH	
1 2 Multi-Function Switch	3 Check the multi-function switch; REFER to Section 211-05. • **Is the multi-function switch OK?** → **Yes** GO to D5. → **No** REPLACE the multi-function switch; REFER to

	Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
D5 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO POWER	
1 GEM C280 2 3  GK0314-A	3 Measure the voltage between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D6 .
D6 CHECK CIRCUIT 684 (PK/Y) FOR SHORT TO POWER	
1  GK0916-A	1 Measure the voltage between multi-function switch C210-685, circuit 684 (PK/Y), and ground. • **Is any voltage indicated?** → **Yes**

	REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D7 .
D7 CHECK CIRCUIT 680 (LB/O) FOR OPEN	
1 GEM/CTM C280 2  GK6094-A	2 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and GEM/CTM C280-13, circuit 680 (LB/O). • **Is the resistance less than 5 ohms?** → **Yes** GO to D8 . → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.
D8 CHECK CIRCUIT 684 (PK/Y) FOR OPEN	
1  GK6095-A	1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and GEM/CTM C280-22, circuit 684 (PK/Y). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system

	for normal operation. → **No** REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.
D9 CHECK THE WIPER MOTOR PARK SWITCH STATUS — MONITOR THE GEM/CTM PID WPPRKSW	
1 2 	2 Monitor the GEM/CTM PID WPPRKSW while the wipers are operating. • **Does the GEM/CTM PID WPPRKSW agree with the status of the wipers?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to D10 .
D10 CHECK THE VOLTAGE TO THE WIPER MOTOR PARK SENSE SWITCH — CIRCUIT 63 (R)	
1 2 Wiper Motor C145 3 4	4 Measure the voltage between wiper motor C145-2, circuit 63 (R), and ground.



- **Is the voltage greater than 10 volts?**

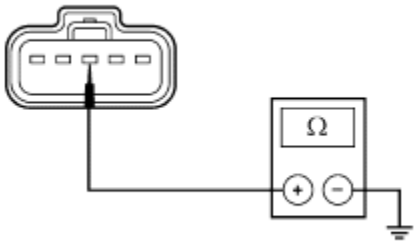
→ **Yes**
GO to D11 .

→ **No**
REPAIR circuit 63 (R). CLEAR the DTCs.
TEST the system for normal operation.

D11 CHECK THE GROUNDS TO THE WIPER MOTOR — CIRCUITS 57 (BK)

1

2



2 Measure the resistance between wiper motor C145-3, circuit 57 (BK), and ground.

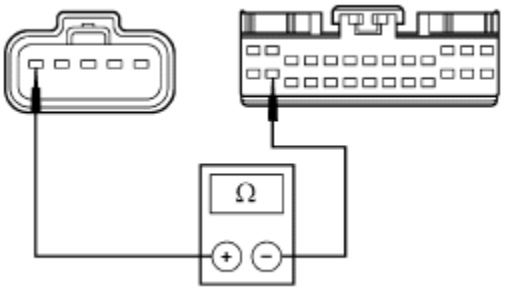
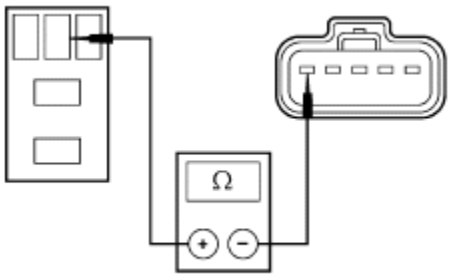
- **Is the resistance less than 5 ohms?**

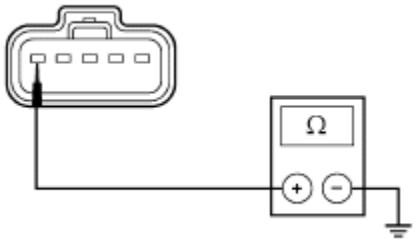
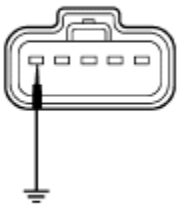
→ **Yes**
GO to D12 .

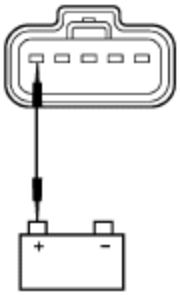
→ **No**
REPAIR circuit 57 (BK). CLEAR the DTCs.
TEST the system for normal operation.

D12 CHECK CIRCUIT 671 (BK) FOR OPEN BETWEEN THE WIPER MOTOR AND THE GEM/CTM

1

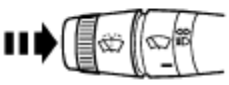
2 GEM/CTM C280 3 Wiper Run Relay 4  GK7072-A	4 Measure the resistance between GEM/CTM C280-15, circuit 671 (BK), and wiper motor C145-1, circuit 671 (BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to D13 . → **No** REPAIR circuit 671 (BK). CLEAR the DTCs. TEST the system for normal operation.
D13 CHECK CIRCUIT 671 (BK) FOR OPEN BETWEEN THE WIPER RUN RELAY AND THE WIPER MOTOR	
1  GK7073-A	1 Measure the resistance between wiper run relay connector pin 4, circuit 671 (BK), and wiper motor C145-1, circuit 671 (BK). • **Is the resistance less than 5 ohms?** → **Yes** GO to D14 .

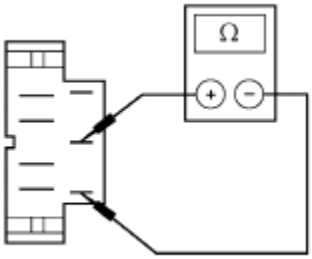
	→ **No** REPAIR circuit 671 (BK). CLEAR the DTCs. TEST the system for normal operation.
D14 CHECK CIRCUIT 671 (BK) FOR SHORT TO GROUND	
1  GK7085-A	1 Measure the resistance between wiper motor C145-1, circuit 671 (BK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** RECONNECT GEM/CTM C280; GO to D15 . → **No** REPAIR circuit 671 (BK). CLEAR the DTCs. TEST the system for normal operation.
D15 CHECK THE PARKED FUNCTION OF THE WIPER MOTOR — MONITOR THE GEM/CTM PID WPPRKSW	
1  GK7075-A	1 Connect a jumper wire between wiper motor C145-1 circuit 671 (BK), and ground.
2 	
3 	3 Monitor the GEM/CTM PID WPPRKSW. • **Does the GEM/CTM PID WPPRKSW indicate PARKED?**

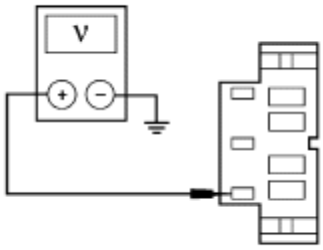
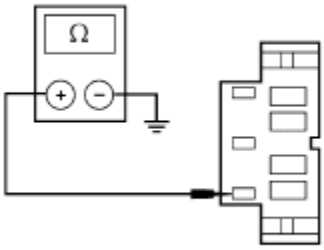
	→ **Yes** REMOVE the jumper wire; GO to D16 . → **No** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.
D16 CHECK THE NOT PARKED FUNCTION OF THE WIPER MOTOR — MONITOR THE GEM/CTM PID WPPRKSW	
1 2 3  GK7076-A 4 	2 Monitor the GEM/CTM PID WPPRKSW. 3 Connect a jumper wire between wiper motor C145-1, circuit 671 (BK), and the positive battery terminal. • **Does the GEM/CTM PID WPPRKSW indicate notPRK?** → **Yes** REPLACE the wiper motor; REFER to Motor—Windshield Wiper . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

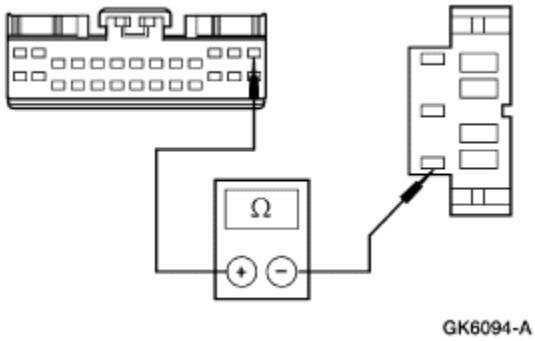
PINPOINT TEST E: THE WASHER PUMP IS INOPERATIVE

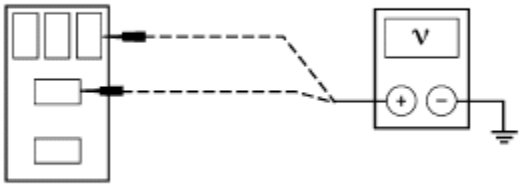
CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to E2 . → **No** REFER to Section 417-02 .
E2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM Wiper/Washer Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1450, GO to E3 .

	If DTC B1453, GO to E3. If DTC B1458, GO to E9. If DTC B1460, GO to E9. If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10. CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E3.
E3 CHECK THE WASHER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE	
1 2 	2 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all the switch positions. • **Does the GEM/CTM PID WPMODE agree with all the wiper switch positions?** → **Yes** GO to E4. → **No** GO to E6.
E4 CHECK THE WASHER SWITCH — MONITOR THE GEM/CTM PID WASH_SW	
1 2  GK4346-A	1 Monitor the GEM/CTM PID WASH_SW. 2 Press the washer switch. • **Does the GEM/CTM PID WASH_SW**

	indicate ON when depressed and OFF when released? → **Yes** GO to E9 . → **No** GO to E5 .
E5 CHECK THE MULTI-FUNCTION WASHER SWITCH	
1 2 Multi-Function Switch C210 3  GK0935-A	3 Measure the resistance between multi-function switch terminals 590 and 993 while depressing and releasing the washer switch. • **Is the resistance less than 5 ohms with the washer switch depressed and approximately 2670 ohms with the washer switch released?** → **Yes** GO to E6 . → **No** REPLACE the multi-function switch; REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
E6 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO POWER	
1 GEM C280	

2 3  GK0314-A	3 Measure the voltage between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E7.
E7 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO GROUND	
1 2  GK0913-A	2 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to E8. → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs.

	TEST the system for normal operation.
E8 CHECK CIRCUIT 680 (LB/O) FOR OPEN	
1  	1 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and GEM/CTM C280-13, circuit 680 (LB/O). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.
E9 CHECK THE FRONT WASHER PUMP RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID WASHRLY	
1 	1 Monitor the GEM/CTM PID WASHRLY while triggering the active command WASH RLY ON and OFF. • **Does the GEM/CTM PID WASHRLY agree with the active command WASH RLY?** → **Yes** If the GEM/CTM PID WASHRLY displays ON---- and OFF---, GO to E17 . → **No** If the GEM/CTM PID WASHRLY displays OFFO-G, GO to E10 . If the GEM/CTM PID WASHRLY displays ON-B-, GO to E15 .
E10 CHECK CJB FUSE 12 (7.5A)	
1 	

2 CJB Fuse 12 (7.5A)	• **Is the fuse OK?** → **Yes** GO to E11 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.
E11 CHECK THE VOLTAGE TO THE WASHER PUMP RELAY — CIRCUIT 950 (W/BK)	
1 2 Front Washer Pump Relay 3  GK3291-A	3 Measure the voltage between front washer pump relay connector pin 1, circuit 950 (W/BK), and ground; and between washer pump relay connector pin 5, circuit 950 (W/BK), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to E12 . → **No** REPAIR circuit 950 (W/BK). CLEAR the DTCs. TEST the system for normal operation.
E12 CHECK THE FRONT WASHER PUMP RELAY	
1	

2 Check the front washer pump relay; refer to Wiring Diagrams cell 149.

- **Is the washer pump relay OK?**

→ **Yes**
GO to E13 .

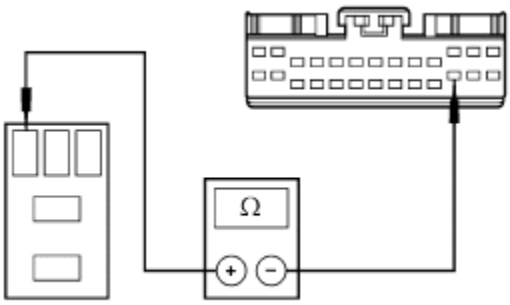
→ **No**
REPLACE the front washer pump relay. CLEAR the DTCs. TEST the system for normal operation.

E13 CHECK CIRCUIT 686 (T/R) FOR OPEN

1

GEM/CTM C280

2



GK6109-A

2 Measure the resistance between front washer pump relay connector pin 2, circuit 686 (T/R), and GEM/CTM C280-24, circuit 686 (T/R).

- **Is the resistance less than 5 ohms?**

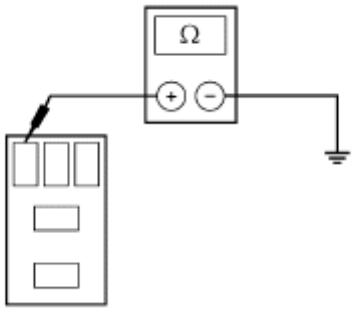
→ **Yes**
GO to E14 .

→ **No**
REPAIR circuit 686 (T/R). CLEAR the DTCs. TEST the system for normal operation.

E14 CHECK CIRCUIT 686 (T/R) FOR SHORT TO GROUND

1

1 Measure the resistance between front washer pump relay connector pin 2, circuit 686 (T/R), and ground.



GK0914-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 686 (T/R). CLEAR the DTCs. TEST the system for normal operation.

E15 CHECK THE FRONT WASHER PUMP RELAY

1

2 Check the front washer pump relay; refer to Wiring Diagrams cell 149.

- **Is the washer pump relay OK?**

→ **Yes**
GO to E16 .

→ **No**
REPLACE the front washer pump relay. CLEAR the DTCs. TEST the system for normal operation.

E16 CHECK CIRCUIT 686 (T/R) FOR SHORT TO POWER

1

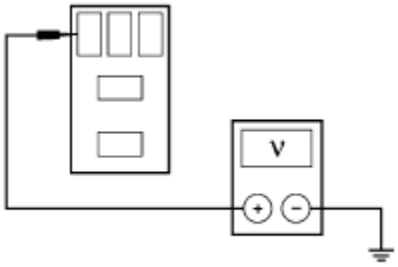
GEM/CTM C280

2

Front Washer Pump Relay

3

4



GN0104-A

4 Measure the voltage between front washer pump relay connector pin 2, circuit 686 (T/R), and ground.

- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 686 (T/R). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

E17 CHECK THE WASHER PUMP RELAY SWITCH

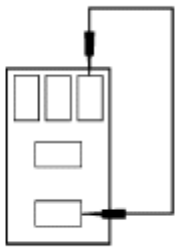
1

2

Front Washer Pump Relay

3

3 Connect a jumper wire between front washer pump relay connector pin 1, circuit 950 (W/BK), and front washer pump relay connector pin 3, circuit 941 (BK/W).



GK3296-A

4

- **Does the washer pump motor operate?**

→ **Yes**
REPLACE the front washer pump relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to E18 .

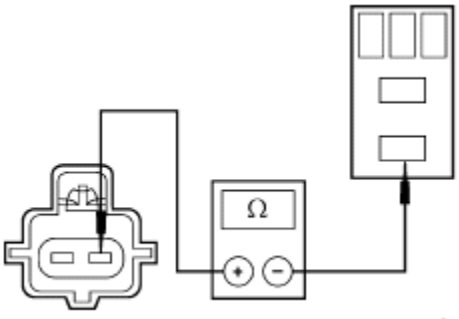
E18 CHECK CIRCUIT 941 (BK/W) FOR OPEN

1

2

Washer Pump Motor C139

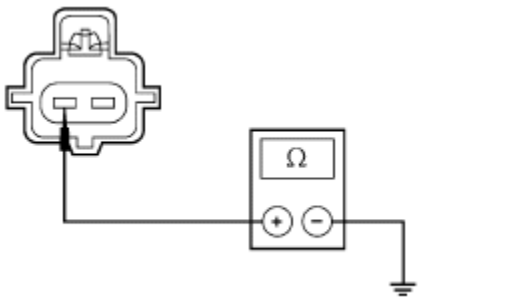
3

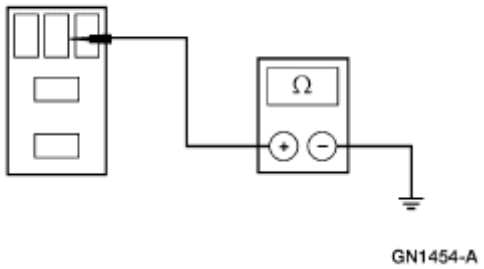


GK6110-B

3 Measure the resistance between washer pump relay connector pin 3, circuit 941 (BK/W), and washer pump motor C139, circuit 941 (BK/W).

- **Is the resistance less than 5 ohms?**

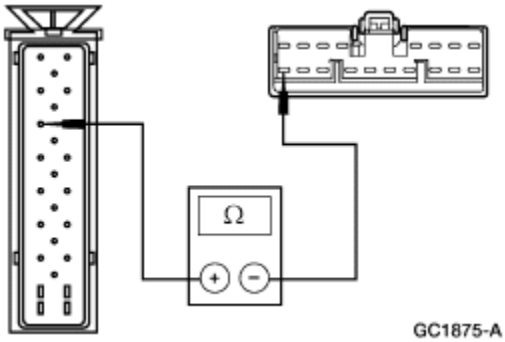
	→ **Yes** GO to E19 . → **No** REPAIR circuit 941 (BK/W). CLEAR the DTCs. TEST the system for normal operation.
E19 CHECK CIRCUIT 488 (DG) FOR OPEN	
1  	1 Measure the resistance between washer pump motor C139, circuit 488 (DG), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the washer pump motor; REFER to Washer Pump and Reservoir—Front . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to E20 .
E20 CHECK THE REAR WASHER RELAY CONTROL	
1 Rear Washer Relay	2 Check the rear washer relay; refer to Wiring Diagrams cell 149. • **Is the rear washer relay OK?** → **Yes** GO to E21 . → **No** REPLACE the rear washer relay. CLEAR the DTCs. TEST the system for normal operation.
E21 CHECK THE FRONT WASHER MOTOR GROUND — CIRCUIT 57 (BK)	
1	1 Measure the resistance between rear washer pump relay connector pin 4, circuit 57 (BK),

 GN1454-A	and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 488 (DG). CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST F: THE SPEED DEPENDENT INTERVAL MODE DOES NOT OPERATE PROPERLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to F2 .

	→ **No** REFER to Section 417-02 .
F2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM Wiper/Washer Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC P0500, GO to F3 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to F3 .
F3 CHECK THE VEHICLE SPEED SIGNAL — MONITOR THE GEM PID VSS_GEM	
1 2 	1 Trigger the GEM active command SPEED RLY to ON. 2 Monitor the GEM PID VSS_GEM while driving the vehicle 0 to 55 mph. • **Is the GEM PID VSS_GEM value and speedometer reading greater than 0.0 mph (k/ph)?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

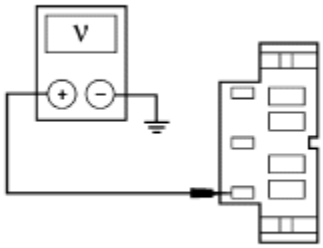
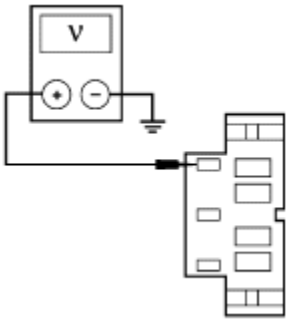
	→ **No** GO to F4 .
F4 CHECK CIRCUIT 679 (GY/BK) FOR OPEN	
1 2 GEM C283 3 4WABS Control Module C186 4  	4 Measure the resistance between 4WABS control module C186-19. circuit 679 (GY/BK), and GEM C283-9, circuit 679 (GY/BK). • **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 206-09 . → **No** REPAIR circuit 679 (GY/BK). CLEAR the DTCs. TEST the system for normal operation.

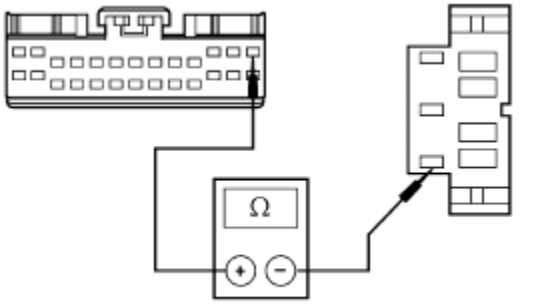
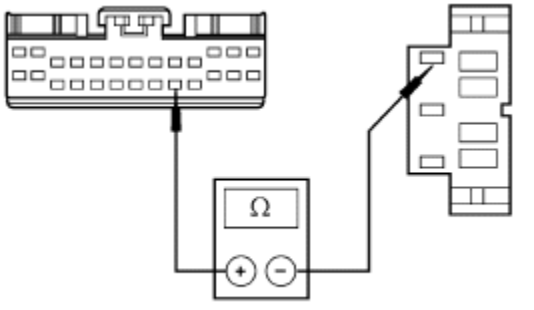
PINPOINT TEST G: THE WIPERS DO NOT OPERATE PROPERLY — HIGH SPEED WIPERS ONLY OPERATE

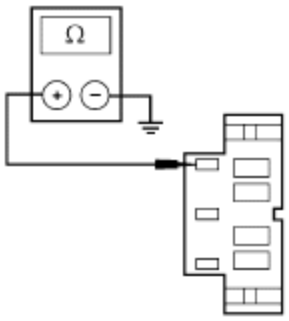
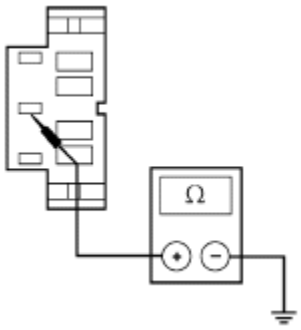
CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1	

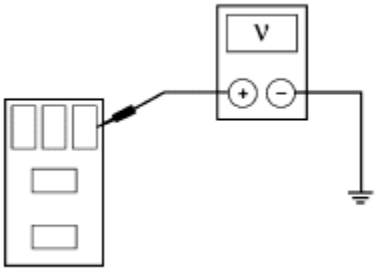
 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to G2 . → **No** REFER to Section 417-02 .
G2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM Wiper/Washer Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1434, GO to G11 . If DTC B1436, GO to G11 . If DTC B1466, GO to G11 .

	If DTC B1467, GO to G11 . If DTC B1473, GO to G3 . If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** GO to G3 .
G3 CHECK THE WIPER SWITCH OUTPUTS — MONITOR THE GEM/CTM PID WPMODE	
1 	1 Monitor the GEM/CTM PID WPMODE while turning the wiper switch through all the switch positions. • **Does the GEM/CTM PID WPMODE agree with all of the wiper switch positions?** → **Yes** GO to G11 . → **No** GO to G4 .
G4 CHECK THE WIPER SWITCH	
1 2 Multi-Function Switch	3 Check the multi-function switch; refer to Wiring Diagrams cell 149. • **Is the multi-function switch OK?** → **Yes** GO to G5 . → **No** REPLACE the multi-function switch; REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.
G5 CHECK CIRCUIT 680 (LB/O) FOR SHORT TO POWER	

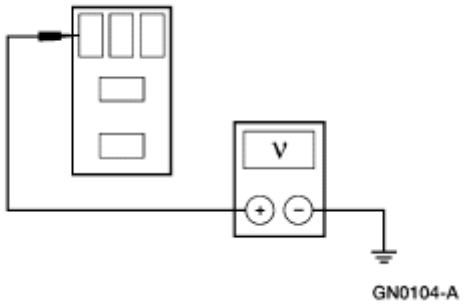
1 GEM/CTM C280 2 3  GK0314-A	3 Measure the voltage between multi-function switch C210-590, circuit 680 (LB/O), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to G6 .
G6 CHECK CIRCUIT 684 (PK/Y) FOR SHORT TO POWER	
1  GK0916-A	1 Measure the voltage between multi-function switch C210-685, circuit 684 (PK/Y), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation. → **No**

	GO to G7 .
G7 CHECK CIRCUIT 680 (LB/O) FOR OPEN	
1 2  GK6094-A	2 Measure the resistance between multi-function switch C210-590, circuit 680 (LB/O), and GEM/CTM C280-13, circuit 680 (LB/O). • **Is the resistance less than 5 ohms?** → **Yes** GO to G8 . → **No** REPAIR circuit 680 (LB/O). CLEAR the DTCs. TEST the system for normal operation.
G8 CHECK CIRCUIT 684 (PK/Y) FOR OPEN	
1  GK6095-A	1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and GEM/CTM C280-22, circuit 684 (PK/Y). • **Is the resistance less than 5 ohms?** → **Yes** GO to G9 . → **No** REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.
G9 CHECK CIRCUIT 684 (PK/Y) FOR SHORT TO GROUND	

1  GK0293-A	1 Measure the resistance between multi-function switch C210-685, circuit 684 (PK/Y), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to G10 . → **No** REPAIR circuit 684 (PK/Y). CLEAR the DTCs. TEST the system for normal operation.
G10 CHECK CIRCUIT 359 (GY/R) FOR SHORT TO GROUND	
1  GK4391-A	1 Measure the resistance between multi-function switch C210-993, circuit 359 (GY/R), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.
G11 CHECK THE WIPER HI/LO RELAY COIL CIRCUIT — MONITOR THE GEM/CTM PID WPHISP	
1 	1 Monitor the GEM/CTM PID WPHISP while toggling the active command SPEED RLY ON and OFF.

	• **Does the GEM/CTM PID WPHISP value agree with the active command SPEED RLY?** → **Yes** If the GEM/CTM PID WPHISP indicates ON--- and OFF---, GO to G17 . → **No** If the GEM/CTM PID WPHISP indicates OFFO-G, GO to G14 . If the GEM/CTM PID WPHISP indicates ON-B-, GO to G12 .
G12 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO POWER	
1 2 Wiper HI/LO Relay 3 GEM/CTM C280 4 5  GN0110-A	5 Measure the voltage between wiper HI/LO relay connector pin 1, circuit 647 (GY/LB), and ground. • **Is any voltage indicated?**

	→ **Yes** REPAIR circuit 647 (GY/LB). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to G13 .
G13 CHECK THE WIPER HI/LO RELAY	
1 	2 Check the wiper HI/LO relay; refer to Wiring Diagrams cell 149. • **Is the wiper HI/LO relay OK?** → **Yes** REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.
G14 CHECK CIRCUIT 63 (R) FOR VOLTAGE	
1 2 Wiper HI/LO Relay 3 4	4 Measure the voltage between wiper HI/LO relay connector pin 2, circuit 63 (R), and ground.



- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to G15.

→ **No**
REPAIR circuit 63 (R). CLEAR the DTCs. TEST the system for normal operation.

G15 CHECK THE WIPER HI/LO RELAY

1

2 Check the wiper HI/LO relay; refer to Wiring Diagrams cell 149.

- **Is the wiper HI/LO relay OK?**

→ **Yes**
GO to G16.

→ **No**
REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.

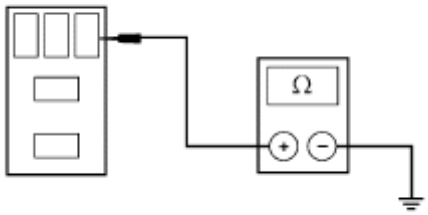
G16 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO GROUND

1

GEM/CTM C280

2

2 Measure the resistance between wiper HI/LO relay connector pin 1, circuit 647 (GY/LB), and ground.



GN1453-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 647 (GY/LB). CLEAR the DTCs. TEST the system for normal operation.

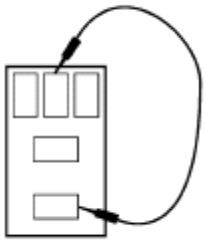
G17 CHECK THE WIPER HI/LO RELAY SWITCH CIRCUIT

1

2

Wiper HI/LO Relay

3

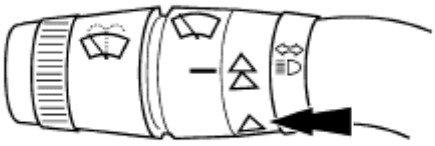


GK4344-A

4

3 Connect a jumper wire between wiper HI/LO relay connector pin 3, circuit 28 (BK/PK), and wiper HI/LO relay connector pin 4, circuit 58 (W).

4 Turn the wiper switch to the LO position.



GK4347-A

5

- **Do the wipers operate at LO speed?**

→ **Yes**
REPLACE the wiper HI/LO relay. CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REMOVE the jumper wire; GO to G18 .

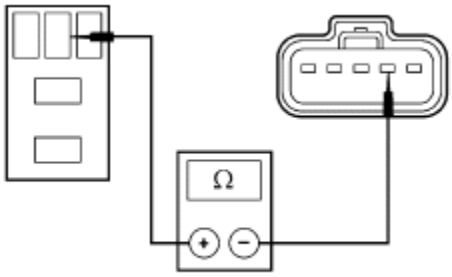
G18 CHECK CIRCUIT 58 (W) FOR OPEN

1

2

Wiper Motor C145

3



GK7070-A

3 Measure the resistance between wiper motor C145-4, circuit 58 (W), and wiper HI/LO relay connector pin 4, circuit 58 (W).

- **Is the resistance less than 5 ohms?**

→ **Yes**

	CHECK the wiper motor; REFER to Component Test. REPLACE the wiper motor if it does not pass the test; REFER to Motor—Windshield Wiper . CLEAR the DTC. TEST the system for normal operation. → **No** REPAIR circuit 58 (W). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST H: THE WIPERS STAY ON CONTINUOUSLY — REAR WIPER

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions. • **Do the PID values agree with the ignition switch positions?** → **Yes** GO to H2 . → **No** REFER to Section 417-02 .
H2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2	1 Retrieve and document continuous DTCs.

Clear Continuous DTCs

3

GEM/CTM Wiper/Washer Self Test

- **Are any DTCs recorded?**

→ **Yes**
If DTC B1614, GO to H3 .

If DTC B1342, REPLACE the GEM/CTM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to H3 .

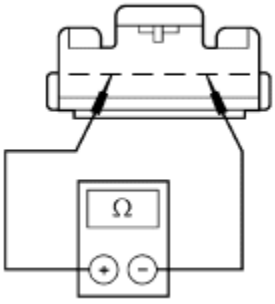
H3 CHECK THE REAR WIPER SWITCH

1

2

Rear Wiper Switch C249

3



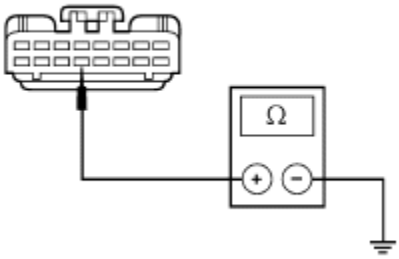
GK0944-A

3 Measure the resistance between the following rear wiper switch terminals 2 and 5.

Switch Position	Resistance (Ohms)
OFF	4200-9100
First Interval Delay	1000-2420
Second Interval Delay	220-900
HI	50-230

- **Are the resistances as indicated?**

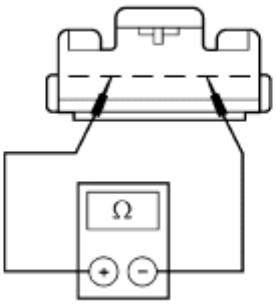
→ **Yes**
GO to H4 .

	→ **No** REPLACE the rear wiper switch; REFER to Switch—Rear Wiper/Washer . CLEAR the DTCs. TEST the system for normal operation.
H4 CHECK CIRCUIT 485 (PK/LB) FOR SHORT TO GROUND	
1 GEM C281 2  GK6113-A	2 Measure the resistance between GEM C281-12, circuit 485 (PK/LB), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 485 (PK/LB). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST J: THE WASHER PUMP IS INOPERATIVE — REAR WASHER PUMP

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK THE FRONT WASHER OPERATION	
1 	2 Verify the front washer operates properly by pressing the front washer switch. • **Does the front washer operate properly?**

	→ **Yes** GO to J2 . → **No** GO to E18 .
J2 CHECK THE REAR WASHER SWITCH OUTPUT — MONITOR THE GEM/CTM PID R_WP_MD	
1 2 Scan Tool 3 	3 Monitor the GEM/CTM PID R_WP_MD while pressing the rear washer switch. • **Does the GEM/CTM PID R_WP_MD indicate WASH?** → **Yes** GO to J4 . → **No** GO to J3 .
J3 CHECK THE REAR WIPER/WASHER SWITCH — INPUT TO THE GEM	
1 2 Rear Wiper/Washer Switch C249 3	3 Measure the resistance between rear wiper/washer switch terminals 2 and 5 while pressing the rear washer switch.



- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the rear wiper/washer switch; REFER to Switch—Rear Wiper/Washer . CLEAR the DTCs. TEST the system for normal operation.

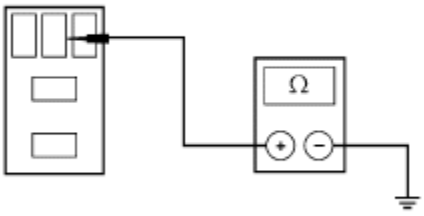
J4 CHECK THE REAR WASHER PUMP MOTOR GROUND — CIRCUIT 57 (BK)

1

2

Front Washer Pump Relay

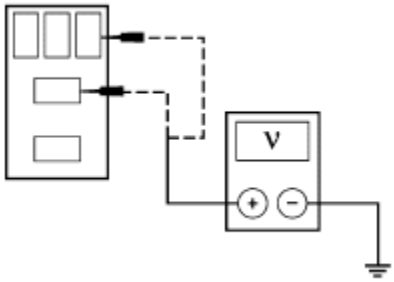
3

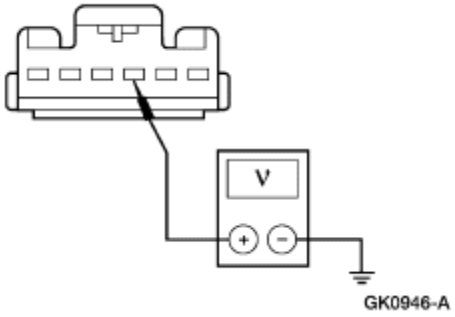
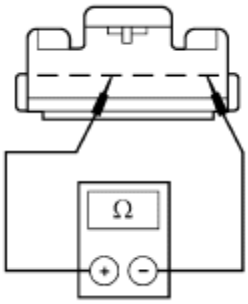


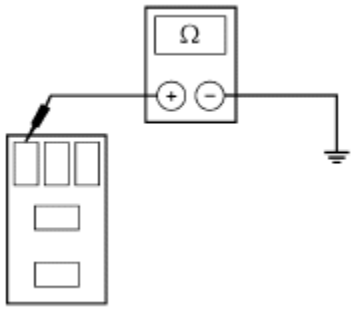
3 Measure the resistance between front washer pump relay connector pin 4, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to J5 .

	→ **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
J5 CHECK THE VOLTAGE TO THE REAR WASHER RELAY — CIRCUIT 946 (P/LG)	
1 Rear Washer Relay 2 3  GK7264-A	3 Measure the voltage between rear washer relay connector pin 5, circuit 946 (P/LG), and ground, while pressing the rear washer switch; and between rear washer relay connector pin 1, circuit 946 (P/LG), and ground while pressing the rear washer switch. • **Are the voltages greater than 10 volts?** → **Yes** GO to J8 . → **No** GO to J6 .
J6 CHECK THE VOLTAGE TO THE REAR WIPER/WASHER SWITCH — CIRCUIT 950 (W/BK)	
1 2 Wiper/Washer Switch C249 3 	

4  	4 Measure the voltage between rear wiper/washer switch C249-4, circuit 950 (W/BK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to J7 . → **No** REPAIR circuit 950 (W/BK). CLEAR the DTCs. TEST the system for normal operation.
J7 CHECK THE REAR WIPER/WASHER SWITCH FOR OPEN TO THE WASHER PUMP	
1 2  	2 Measure the resistance between rear wiper/washer switch terminals 1 and 4 while pressing the rear washer switch. • **Is the resistance less than 5 ohms?** → **Yes** REPAIR circuit 946 (P/LG). CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the rear wiper/washer switch; REFER to Switch—Rear Wiper/Washer . CLEAR the DTCs. TEST the system for normal operation.
J8 CHECK THE REAR WASHER RELAY SOLENOID GROUND — CIRCUIT 57 (BK)	

1 2  GK0914-A	2 Measure the resistance between rear washer relay connector pin 2, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the rear washer relay. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST K: THE WIPERS ARE INOPERATIVE — REAR WIPER

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK THE IGNITION STATES — MONITOR THE GEM/CTM PID IGN_GEM	
1 2 Scan Tool 3 	3 **NOTE:** If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to start. Monitor the GEM/CTM PID IGN_GEM while turning the ignition switch through the START, RUN, OFF and ACC positions.

	• **Do the PID values agree with the ignition switch positions?** → **Yes** GO to K2 . → **No** REFER to Section 417-02 .
K2 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
1 2 Clear Continuous DTCs 3 GEM/CTM Wiper/Washer Self Test 4 GEM Rear Wiper Self-Test	1 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1334, GO to K3 . If DTC B1611, GO to K9 . If DTC B1814, GO to K24 . If DTC B1816, GO to K27 . If DTC B1818, GO to K16 . If DTC B1820, GO to K13 . If DTC B1839, GO to K8 . If DTC B1894, GO to K9 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** GO to K9 .
K3 CHECK THE LIFTGATE AJAR GEM PID LGATESW	
2 	1 Verify that the liftgate and liftgate glass are closed. 2 Monitor the GEM PID LGATESW. • **Does the GEM PID LGATESW indicate AJAR?** → **Yes** GO to K4 . → **No** GO to K8 .
K4 CHECK THE WIPER DISABLE SWITCH — MONITOR THE GEM PID LGATESW	
1 2 Liftgate Wiper Disable Switch C419 4 5 	3 Close the liftgate and liftgate glass. 5 Monitor the GEM PID LGATESW. • **Does the GEM PID LGATESW indicate AJAR?** → **Yes** GO to K5 . → **No**

	REPLACE the liftgate wiper disable switch. CLEAR the DTCs. TEST the system for normal operation.
K5 CHECK THE RH LIFTGATE AJAR SWITCH — MONITOR THE GEM PID LGATESW	
1 2 RH Liftgate Ajar Switch C439 4 5 	3 Close the liftgate and liftgate glass. 5 Monitor the GEM PID LGATESW. • **Does the GEM PID LGATESW indicate AJAR?** → **Yes** GO to K6 . → **No** REPLACE the RH liftgate ajar switch. CLEAR the DTCs. TEST the system for normal operation.
K6 CHECK THE LH LIFTGATE AJAR SWITCH — MONITOR THE GEM PID LGATESW	
1 2 LH Liftgate Ajar Switch C438 4	3 Close the liftgate and liftgate glass.

5

5 Monitor the GEM PID LGATESW.

- **Does the GEM PID LGATESW indicate AJAR?**

→ **Yes**
GO to K7 .

→ **No**
REPLACE the LH liftgate ajar switch. CLEAR the DTCs. TEST the system for normal operation.

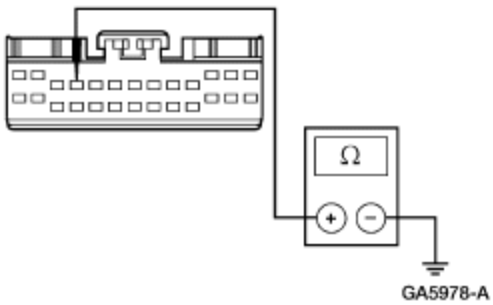
K7 CHECK CIRCUIT 700 (W/P) FOR SHORT TO GROUND

1

2

GEM C280

3

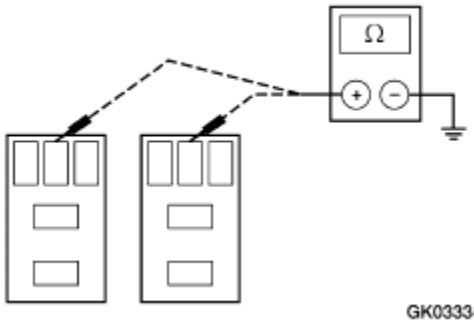


3 Measure the resistance between GEM C280-4, circuit 700 (W/P), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**

	REPAIR circuit 700 (W/P). CLEAR the DTCs. TEST the system for normal operation.
K8 CHECK THE GROUND TO THE REAR WIPER SYSTEM RELAYS — CIRCUIT 57 (BK)	
1 2 Rear Wiper Down Relay 3 Rear Wiper Up Relay 4  GK0333-A	4 Measure the resistance between rear wiper up relay connector pin 4, circuit 57 (BK) and ground; and between rear wiper down relay connector pin 4, circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** RECONNECT the rear wiper up and rear wiper down relays; GO to K26 . → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.
K9 CHECK THE REAR WIPER SWITCH OUTPUTS — MONITOR THE GEM PID R_WP_MD	
1 2 	2 **NOTE:** The GEM PID R_WP_MD should indicate LO when the rear wiper/washer switch is in the HI position.

Monitor the GEM PID R_WP_MD while turning the rear wiper/washer switch through all the positions.

- **Does the GEM PID R_WP_MD value agree with the switch position?**

→ **Yes**
GO to K13.

→ **No**
GO to K10.

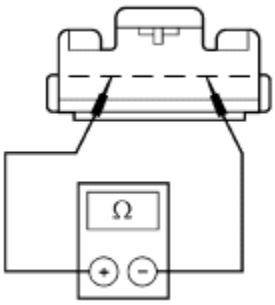
K10 CHECK THE REAR WIPER/WASHER SWITCH

1

2

Rear Wiper/Washer Switch C249

3



3 Measure the resistance between the following rear wiper/washer switch terminals 2 and 5.

Switch Position	Resistance (Ohms)
OFF	4200-9100
First Interval Delay	1000-2420
Second Interval Delay	220-950
HI	50-230

- **Are the resistances as indicated?**

→ **Yes**
GO to K11.

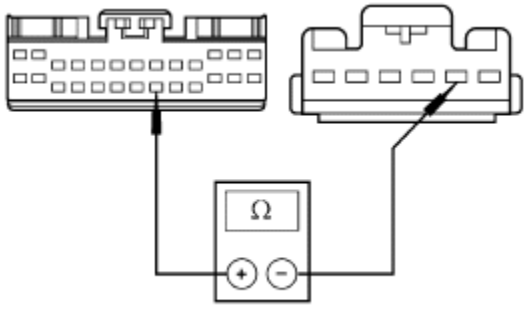
→ **No**
REPLACE the rear wiper/washer switch; REFER to Switch—Rear Wiper/Washer. CLEAR the DTCs. TEST the system for normal operation.

K11 CHECK CIRCUIT 359 (GY/R) FOR OPEN

1

GEM C280

2



2 Measure the resistance between GEM C280-21, circuit 359 (GY/R), and rear wiper/washer switch C249-5, circuit 359 (GY/R).

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to K12 .

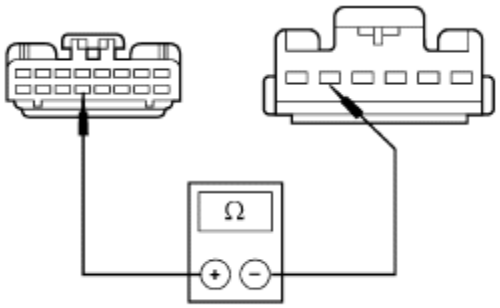
→ **No**
REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.

K12 CHECK CIRCUIT 485 (PK/BK) FOR OPEN

1

GEM C281

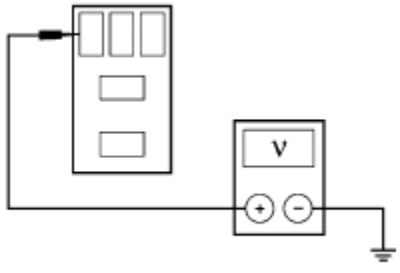
2

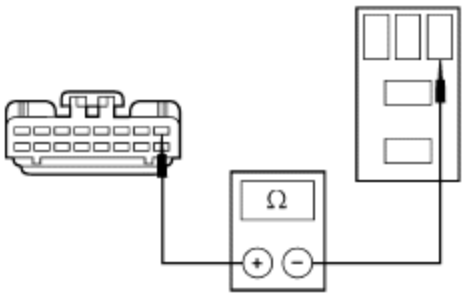


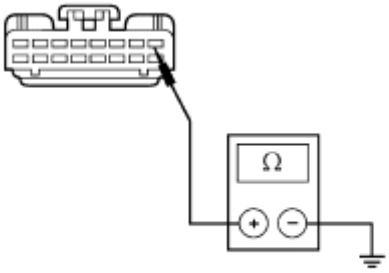
2 Measure the resistance between GEM C281-12, circuit 485 (PK/BK), and rear wiper/washer switch C249-2, circuit 485 (PK/BK).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** REPAIR circuit 485 (PK/BK). CLEAR the DTCs. TEST the system for normal operation.
K13 CHECK THE REAR WIPER UP RELAY COIL CIRCUIT — MONITOR THE GEM PID UP RELAY	
1 2 	1 Trigger the GEM rear wiper active command UP RELAY ON and OFF. 2 Monitor the GEM PID R_WP_UP. • **Does the GEM PID R_WP_UP agree with the active command?** → **Yes** If the GEM PID R_WP_UP indicates ON--- and OFF---, GO to K20 . → **No** If the GEM PID R_WP_UP indicates OFFO-G, GO to K14 . If the GEM PID R_WP_UP indicates ON-B-, GO to K18 .
K14 CHECK THE VOLTAGE TO THE REAR WIPER UP RELAY COIL — CIRCUIT 326 (W/P)	
1 2 Rear Wiper Up Relay 3  GN0104-A	3 Measure the voltage between rear wiper up relay connector pin 2, circuit 326 (W/P), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** GO to K15 . → **No** REPAIR circuit 326 (W/P). CLEAR the DTCs. TEST the system for normal operation.
K15 CHECK THE REAR WIPER UP RELAY	
	1 Check the rear wiper up relay; refer to Wiring Diagrams cell 149. • **Is the rear wiper up relay OK?** → **Yes** GO to K16 . → **No** REPLACE the rear wiper up relay. CLEAR the DTCs. TEST the system for normal operation.
K16 CHECK CIRCUIT 591 (LG) FOR OPEN	
1 GEM C281 2  GK6116-A	2 Measure the resistance between GEM C281-8, circuit 591 (LG), and rear wiper up relay connector pin 1, circuit 591 (LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to K17 . → **No** REPAIR circuit 591 (LG). CLEAR the DTCs. TEST the system for normal operation.
K17 CHECK CIRCUIT 591 (LG) FOR A SHORT TO GROUND	
1	



GK4368-A

1 Measure the resistance between GEM C281-8, circuit 591 (LG), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPAIR circuit 591 (LG). CLEAR the DTCs. TEST the system for normal operation.

K18 CHECK CIRCUIT 591 (LG) FOR SHORT TO POWER

1

2

GEM C281

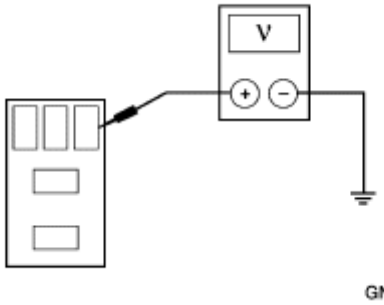
3

Rear Wiper Up Relay

4

5

5 Measure the voltage between rear wiper up relay connector pin 1, circuit 591 (LG), and ground.



- **Is any voltage indicated?**

→ **Yes**
REPAIR circuit 591 (LG). CLEAR the DTCs. TEST the system for normal operation.

→ **No**
GO to K19 .

K19 CHECK THE REAR WIPER UP RELAY

1 Check the rear wiper up relay; refer to Wiring Diagrams cell 149.

- **Is the rear wiper up relay OK?**

→ **Yes**
REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

→ **No**
REPLACE the rear wiper up relay. CLEAR the DTCs. TEST the system for normal operation.

K20 CHECK BJB FUSE 8 (15A)

1

BJB Fuse 8 (15A)

- **Is the fuse OK?**

→ **Yes**
GO to K21 .

→ **No**
REPLACE BJB Fuse 8 (15A). CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.

K21 CHECK THE VOLTAGE TO THE REAR WIPER MOTOR CIRCUIT 410 (W/O)

1

2

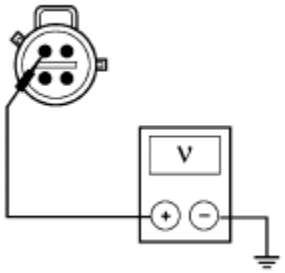
Rear Wiper Motor C417

3

4

4 Trigger the GEM active command UP RELAY to ON.

5



GK4350-A

5 Measure the voltage between rear wiper motor C417-1, circuit 410 (W/O), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to K24 .

→ **No**
GO to K22 .

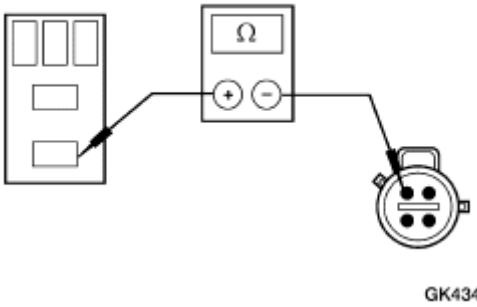
K22 CHECK CIRCUIT 410 (W/O) FOR OPEN

1

Rear Wiper Up Relay

2

2 Measure the resistance between rear wiper motor C417-1, circuit 410 (W/O), and rear up relay connector pin 3, circuit 410 (W/O).



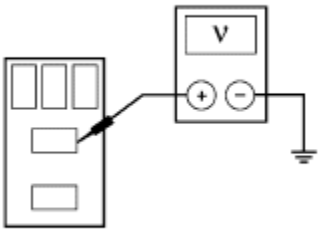
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to K23 .

→ **No**
REPAIR circuit 410 (W/O). CLEAR the DTCs. TEST the system for normal operation.

K23 CHECK THE VOLTAGE TO THE REAR WIPER UP RELAY — CIRCUIT 326 (W/P)

1



1 Measure the voltage between rear wiper up relay connector pin 5, circuit 326 (W/P), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
REPLACE the rear wiper up relay. CLEAR the DTCs. TEST the system for normal operation.

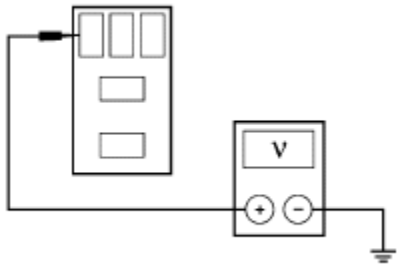
→ **No**
REPAIR circuit 326 (W/P). CLEAR the DTCs. TEST the system for normal operation.

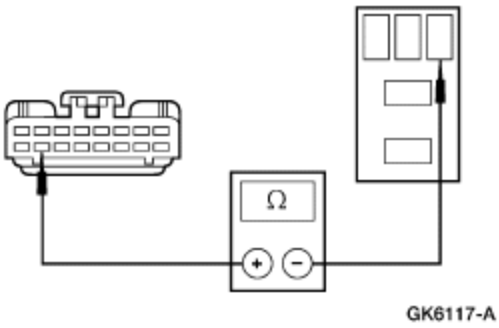
K24 CHECK THE REAR WIPER DOWN RELAY COIL CIRCUIT — MONITOR THE GEM PID R_WP_DN

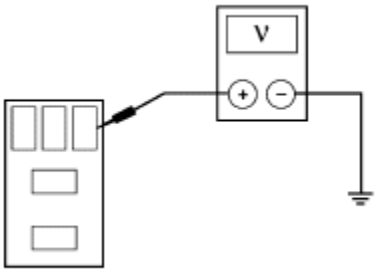
1

1 Monitor the GEM PID R_WP_DN while toggling the rear wiper active command DWN RELAY ON and OFF.

- **Does the GEM PID R_WP_DN agree with**

	the active command? → **Yes** If the GEM PID R_WP_DN indicates ON--- and OFF---, GO to K30 . → **No** If the GEM PID R_WP_DN indicates OFFO-G, GO to K25 . If the GEM PID R_WP_DN indicates ON-B-, GO to K28 .
K25 CHECK THE VOLTAGE TO THE REAR WIPER DOWN RELAY COIL	
1 2 Rear Wiper Down Relay 3 4  GN0104-A	4 Measure the voltage between rear wiper down relay connector pin 2, circuit 326 (W/P) and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to K26 . → **No** REPAIR circuit 326 (W/P). CLEAR the DTCs. TEST the system for normal operation.
K26 CHECK THE REAR WIPER DOWN RELAY	
	1 Check the rear wiper down relay; refer to

	Wiring Diagrams cell 149. • **Is the rear wiper down relay OK?** → **Yes** GO to K27 . → **No** REPLACE the rear wiper down relay. CLEAR the DTCs. TEST the system for normal operation.
K27 CHECK CIRCUIT 592 (T) FOR OPEN	
1 GEM C281 2  GK6117-A	2 Measure the resistance between GEM C281-10, circuit 592 (T), and rear wiper down relay connector pin 1, circuit 592 (T). • **Is the resistance less than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 592 (T). CLEAR the DTCs. TEST the system for normal operation.
K28 CHECK CIRCUIT 592 (T) FOR SHORT TO POWER	
1 2 GEM C281	

3 Rear Wiper Down Relay 4 5  GN0110-A	5 Measure the voltage between rear wiper down relay connector pin 1, circuit 592 (T), and ground. • **Is any voltage indicated?** → **Yes** REPAIR circuit 592 (T). CLEAR the DTCs. TEST the system for normal operation. → **No** GO to K29 .
K29 CHECK THE REAR WIPER DOWN RELAY	
	1 Check the rear wiper down relay; refer to Wiring Diagrams cell 149. • **Is the rear wiper down relay OK?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the rear wiper down relay. CLEAR the DTCs. TEST the system for normal operation.
K30 CHECK BJB FUSE 8 (15A)	
1	

BJB Fuse 8 (15A)

- **Is the fuse OK?**

→ **Yes**
GO to K31 .

→ **No**
REPLACE BJB Fuse 8 (15A). CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK for a short to ground. REPAIR as necessary.

K31 CHECK CIRCUIT 411 (BK/LB) FOR VOLTAGE

1

2

Rear Wiper Motor C417

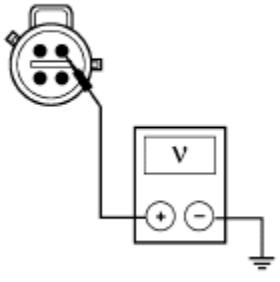
3

4

4 Trigger the GEM rear wiper active command DWN RELAY to ON.

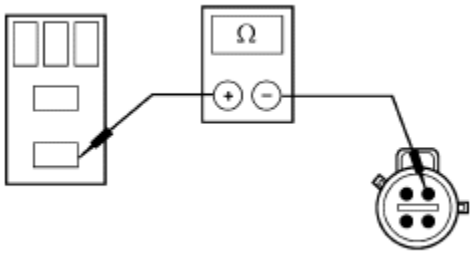
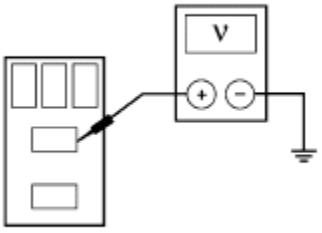
5

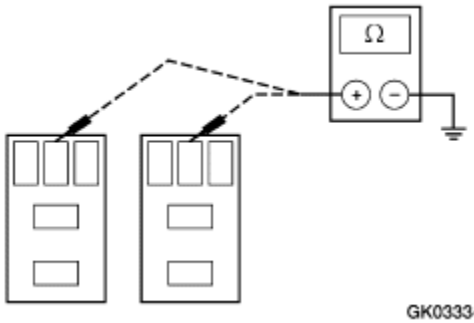
5 Measure the voltage between rear wiper motor C417-2, circuit 411 (BK/LB), and ground.



GK4351-A

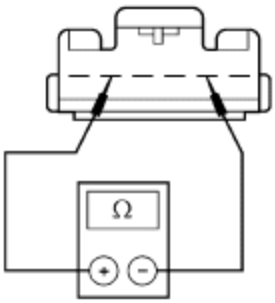
- **Is the voltage greater than 10 volts?**

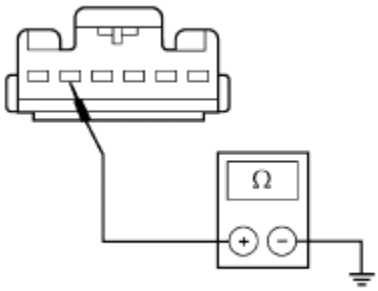
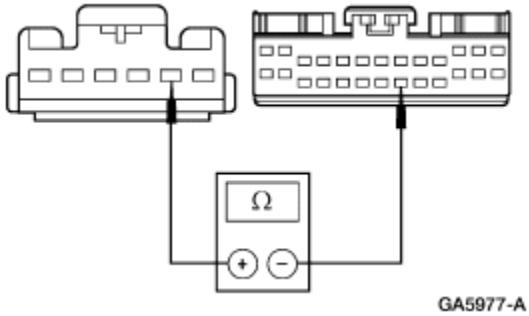
	→ **Yes** GO to K34 . → **No** GO to K32 .
K32 CHECK CIRCUIT 411 (BK/LB) FOR OPEN	
1 2 Rear Wiper Down Relay 3  GK4352-A	3 Measure the resistance between rear wiper motor C417-2, circuit 411 (BK/LB), and rear wiper down relay connector pin 3, circuit 411 (BK/LB). • **Is the resistance less than 5 ohms?** → **Yes** GO to K33 . → **No** REPAIR circuit 411 (BK/LB). CLEAR the DTCs. TEST the system for normal operation.
K33 CHECK THE VOLTAGE TO THE REAR WIPER DOWN RELAY — CIRCUIT 326 (W/P)	
1  GK0903-A	1 Measure the voltage between rear wiper down relay connector pin 5, circuit 326 (W/P), and ground.

	• **Is the voltage greater than 10 volts?** → **Yes** REPLACE the rear wiper down relay. CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 326 (W/P). CLEAR the DTCs. TEST the system for normal operation.
K34 CHECK THE GROUND TO THE REAR WIPER SYSTEM RELAYS — CIRCUIT 57 (BK)	
1 2 Rear Wiper Up Relay 3 Rear Wiper Down Relay 4  GK0333-A	4 Measure the resistance between rear wiper down relay connector pin 4, circuit 57 (BK), and ground; and between rear wiper up relay connector pin 4, circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** REPLACE the rear wiper motor; REFER to Motor—Rear Wiper . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

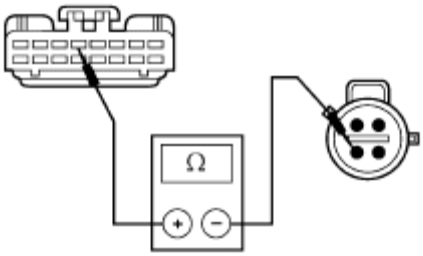
PINPOINT TEST L: THE REAR WIPERS DO NOT OPERATE PROPERLY — REAR WIPER

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCs)	
1 2 Scan Tool 3 4 Clear Continuous DTCs 5 GEM Wiper/Washer Self Test 6 GEM Rear Wiper Self-Test	3 Retrieve and document continuous DTCs. • **Are any DTCs recorded?** → **Yes** If DTC B1611, GO to L2 . If DTC B1614, GO to L2 . If DTC B1839, GO to L6 . If DTC B1894, GO to L6 . If DTC B1342, REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** GO to L2 .
L2 CHECK THE REAR WIPER/WASHER SWITCH — MONITOR THE GEM PID R_WP_MD	
1 	1 Monitor the GEM PID R_WP_MD. 2 Turn the rear wiper/washer switch through all positions. • **Does the GEM PID R_WP_MD agree with the positions of the rear wiper/washer switch?** → **Yes** GO to L6 . → **No** GO to L3 .
L3 CHECK THE REAR WIPER/WASHER SWITCH	
1 2 Rear Wiper/Washer Switch C249 3  GK0944-A	3 Measure the resistance between the following rear wiper/washer switch terminals 2 and 5. **Switch Position** / **Resistance (Ohms)** OFF — 4200-9100 First Interval Delay — 1000-2420 Second Interval Delay — 220-950 HI — 50-230 • **Are the resistances as indicated?** → **Yes** GO to L4 . → **No**

	REPLACE the rear wiper/washer switch; REFER to Switch—Rear Wiper/Washer . CLEAR the DTCs. TEST the system for normal operation.
L4 CHECK CIRCUIT 485 (PK/BK) FOR SHORT TO GROUND	
1 GEM C281 2  GK4353-A	2 Measure the resistance between rear wiper/washer switch C249-2, circuit 485 (PK/BK), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to L5 . → **No** REPAIR circuit 485 (PK/BK). CLEAR the DTCs. TEST the system for normal operation.
L5 CHECK CIRCUIT 359 (GY/R) FOR OPEN	
1  GA5977-A	1 Measure the resistance between rear wiper/washer switch C249-5, circuit 359 (GY/R), and GEM C280-21, circuit 359 (GY/R). • **Is the resistance greater than 5 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation.

	→ **No** REPAIR circuit 359 (GY/R). CLEAR the DTCs. TEST the system for normal operation.
L6 CHECK THE REAR WIPER MOTOR STATUS — MONITOR THE GEM PID R_WP_PK	
1 	1 Monitor the GEM PID R_WP_PK. 2 Move the rear wiper arm to the center of the glass by triggering the GEM active commands REAR WIPER UP RELAY and REAR WIPER DOWN RELAY ON and OFF. • **Does the GEM PID R_WP_PK indicate PARKED when the rear wiper is parked and notPRK when the rear wiper is in the center of the glass?** → **Yes** GO to L12 . → **No** GO to L7 .
L7 CHECK CIRCUIT 587 (P/Y) FOR OPEN	
1 2 Rear Wiper Motor C417 3 GEM C281 4	4 Measure the resistance between GEM C281-4, circuit 587 (P/Y), and rear wiper motor C417-3, circuit 587 (P/Y).



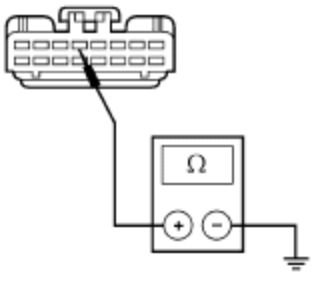
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to L8 .

→ **No**
REPAIR circuit 587 (P/Y). CLEAR the DTCs. TEST the system for normal operation.

L8 CHECK CIRCUIT 587 (P/Y) FOR SHORT TO GROUND

1



1 Measure the resistance between GEM C281-4, circuit 587 (P/Y), and ground.

- **Is the resistance greater than 10,000 ohms?**

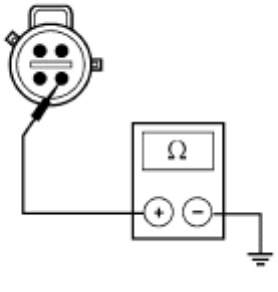
→ **Yes**
GO to L9 .

→ **No**
REPAIR circuit 587 (P/Y). CLEAR the DTCs. TEST the system for normal operation.

L9 CHECK THE GROUND TO THE REAR WIPER MOTOR STATUS — CIRCUIT 57 (BK)

1

1 Measure the resistance between rear wiper motor C417-4, circuit 57 (BK), and ground.



- **Is the resistance less than 5 ohms?**

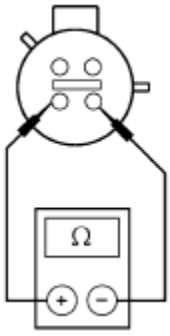
→ **Yes**
GO to L10 .

→ **No**
REPAIR circuit 57 (BK). CLEAR the DTCs. TEST the system for normal operation.

L10 CHECK THE WIPER PARK INDICATOR SWITCH — PARKED POSITION

1 Place the rear wiper arm in the PARKED position.

2 Measure the resistance between rear wiper motor terminals 3 and 4.



- **Is the resistance less than 5 ohms?**

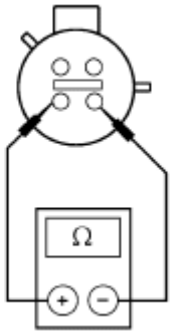
→ **Yes**
GO to L11 .

→ **No**
REPLACE the rear wiper motor; REFER to Motor—Rear Wiper . CLEAR the DTCs. TEST the system for normal operation.

L11 CHECK THE WIPER PARK INDICATOR SWITCH — NOT-PARKED POSITION

1 Place the rear wiper arm in the middle of the glass.

2 Measure the resistance between rear wiper motor terminals 3 and 4.

 GK6120-A	• **Is the resistance greater than 10,000 ohms?** → **Yes** REPLACE the GEM; REFER to Section 419-10 . CLEAR the DTCs. TEST the system for normal operation. → **No** REPLACE the rear wiper motor; REFER to Motor—Rear Wiper . CLEAR the DTCs. TEST the system for normal operation.
L12 CHECK THE WIPER MECHANISM	
	1 Remove the linkage from the wiper motor. • **Are the wipers free?** → **Yes** CHECK the wiper motor by performing the Wiper Motor Current Draw Test; REFER to Component Testing. If the wiper motor does not pass the test, REPLACE the rear wiper motor; REFER to Motor—Rear Wiper . CLEAR the DTCs. TEST the system for normal operation. → **No** REPAIR the wiper mechanism. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST M: NO COMMUNICATION WITH THE MODULE — GENERIC ELECTRONIC MODULE/CENTRAL TIMER MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK BJB FUSE 1 (60A)	
1	

BJB Fuse 1 (60A)

- **Is the fuse OK?**

→ **Yes**
GO to M2 .

→ **No**
REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.

M2 CHECK CJB FUSE 25 (7.5A)

1

CJB Fuse 25 (7.5A)

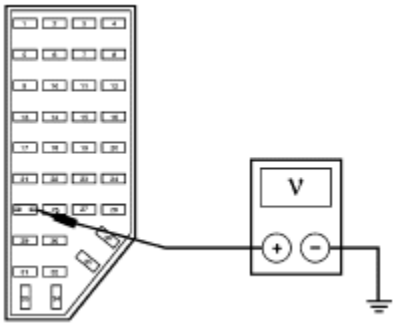
- **Is the fuse OK?**

→ **Yes**
GO to M3 .

→ **No**
REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.

M3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE

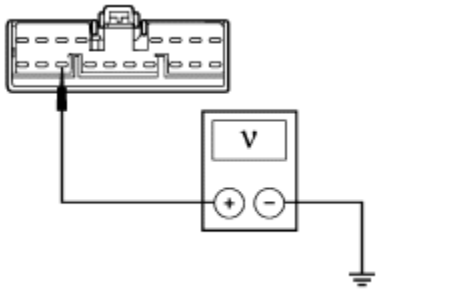
1

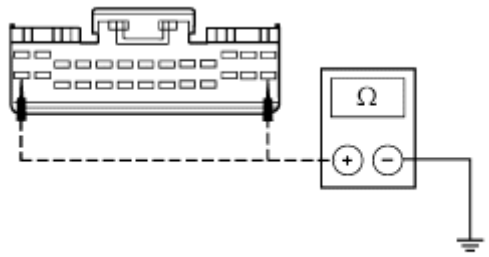


1 Measure the voltage between CJB Fuse 25 (7.5A) pin 2, circuit 1052 (T/BK), and ground.

- **Is voltage greater than 10 volts?**

→ **Yes**
GO to M4 .

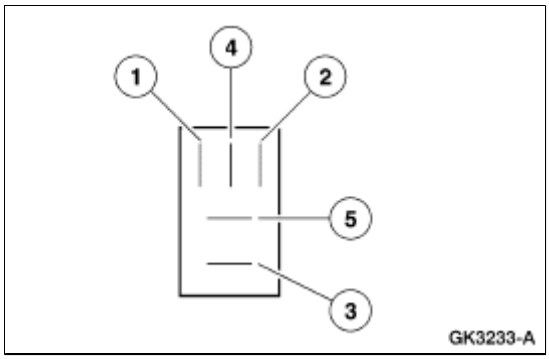
	→ **No** REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.
M4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (W/Y)	
1 2 GEM/CTM C283 3  GK6043-A	3 Measure the voltage between GEM/CTM C283-11, circuit 1001 (W/Y), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to M5 . → **No** REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.
M5 CHECK CIRCUIT 570 (BK/W) FOR OPEN	
1 GEM/CTM C280 2	2 Measure the resistance between GEM/CTM C280-14 circuit 570 (BK/W), and ground; and between GEM/CTM C280-26 circuit 570 (BK/W), and ground.

 GC1770-A	• **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.

Component Test

Relay — Micro ISO

Use the multimeter to check for the continuity between terminal 2 and all other terminals. If the resistance is 5 ohms or less between terminal 2 and any other terminal, replace the relay. If resistance is greater than 5 ohms, continue with the test. Use two jumper wires to connect relay terminals 1 and 3 directly to the positive battery terminal. Use the multimeter set in the volts position to check for voltage at terminal 4. If battery voltage is not indicated, replace the relay. If battery voltage is indicated, connect a third jumper wire to terminal 2 and ground the jumper wire to a known good ground. Check for voltage at terminal 5. If battery voltage is not indicated, replace the relay.



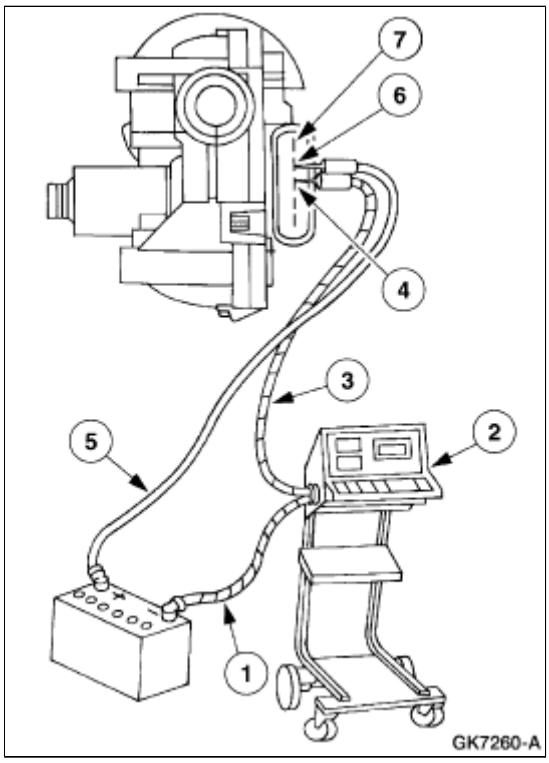
GK3233-A

Windshield Wiper Motor

CAUTION: Do not handle the wiper motor abusively when diagnosing the wiper operations. Failure to follow this caution may result in damage to the motor magnets and will make the wiper motor inoperative. Rough handling of new replacement wiper motors may also damage the motor

magnets.

Use Alternator, Regulator, Battery and Starter Tester (ARBST) to test the wiper motor on the vehicle.



To test the wiper motor, disconnect the windshield wiper mounting arm and pivot shaft from the windshield wiper motor; refer to Pivot Arm—Front or refer to Pivot Arm—Rear .

Disconnect the wiper motor. Connect the (1) green lead from (2) Alternator, Regulator, Battery and Starter Tester (ARBST) to the battery negative (-) post. Connect the (3) red lead from ARBST to the wiper motor (4) common brush terminal (terminal 3).

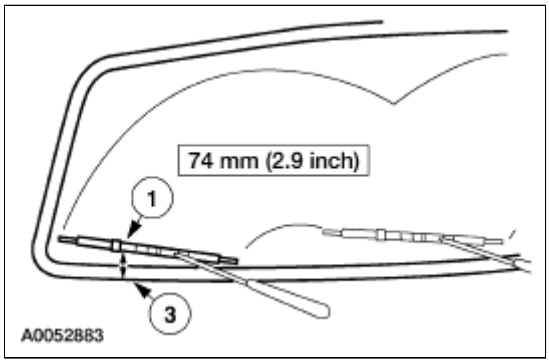
Test the low speed mode by connecting a (5) cable from the battery positive (+) post to the (6) low speed brush terminal (terminal 4) and measure the current draw. If the current draw is greater than 3.5 amperes, replace the windshield wiper motor.

Test the high speed mode by connecting a cable from the battery positive (+) post to the (7) high speed brush terminal (terminal 5) and measure the current draw. If the current draw is greater than 5.5 amperes, replace the wiper motor.

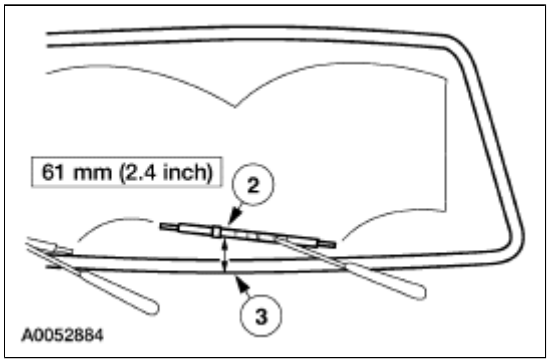
Windshield Wiper Blade and Pivot Arm Adjustment

1. Cycle and park the windshield wipers.

2. Verify the distance between the center of the (1) RH windshield wiper blade and the (3) bottom of the windshield glass is within specification.



3. Verify the distance between the center of the (2) LH windshield wiper blade and the (3) bottom of the windshield glass is within specification.



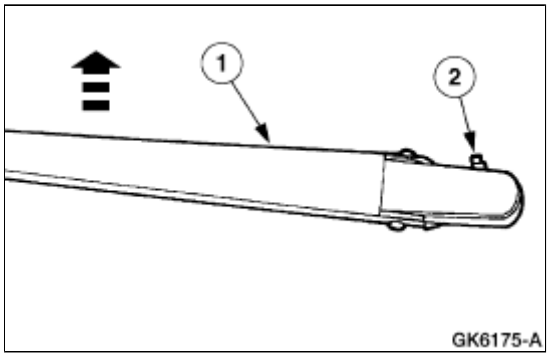
4. If the distance is not within specification, remove the windshield wiper pivot arm and reposition to specification. For additional information, refer to Pivot Arm—Front .

Pivot Arm —Front

Removal

1. **NOTE:** The windshield wiper pivot arms are replaced as an assembly.

   Remove the pivot arm.
   1. Pull up on the pivot arm.
   2. Pull out on the retainer tab and remove the pivot arm.



Installation

1. **NOTE:** The wiper motor must be cycled to make sure that it is in the park position. If necessary, adjust the wiper pivot arms. For additional information, refer to Windshield Wiper Blade and Pivot Arm Adjustment in this section.

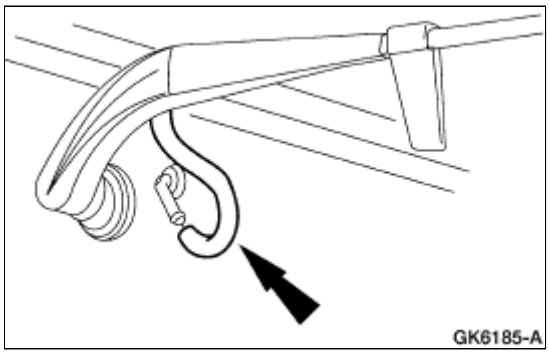
   To install, reverse the removal procedure.

Pivot Arm —Rear

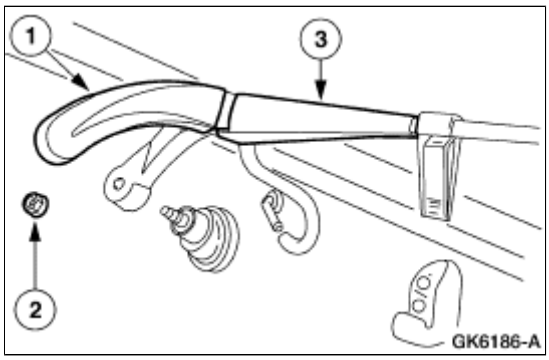
Removal

CAUTION: Use a shop towel or similar device to protect the vehicle finish when performing the procedure.

1. Disconnect the rear washer hose.

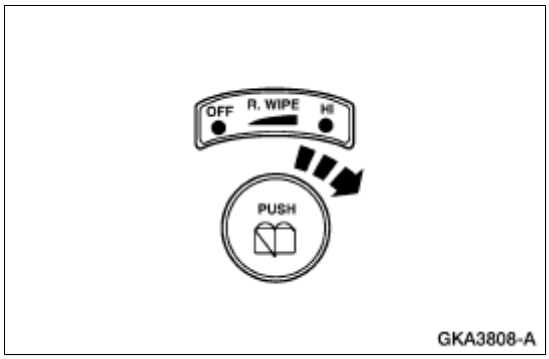


2. Remove rear pivot arm.
    1. Lift the pivot arm nut cover.
    2. Remove the nut.
    3. Remove the pivot arm.



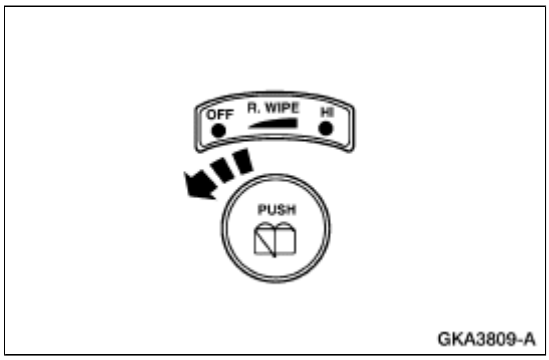
Installation

1. Turn the rear wiper switch on and allow the motor to operate for at least one cycle.

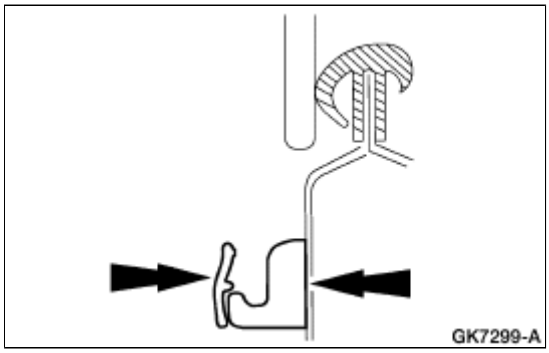


2. **NOTE:** This step ensures that the wiper motor is in the park position.

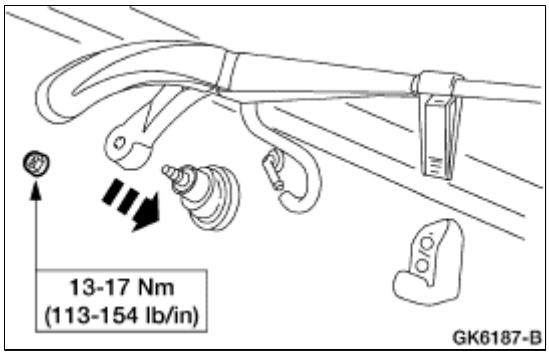
   Turn the rear wiper switch OFF.



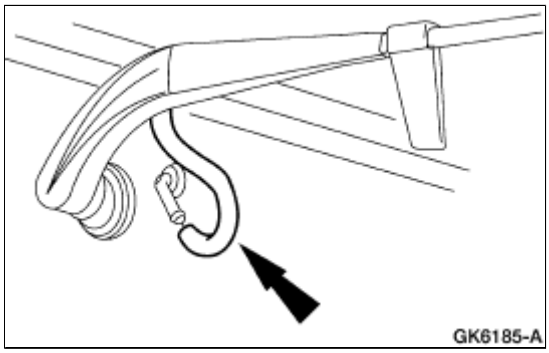
3. Position the wiper blade outside the wiper arm stop.



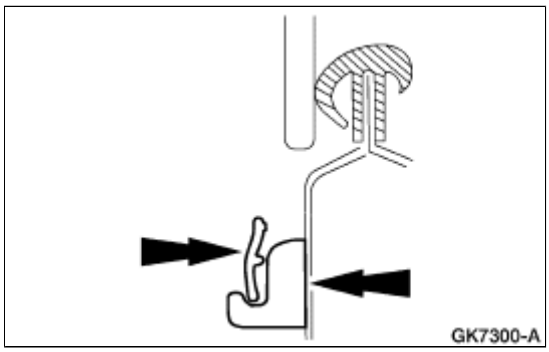
4. Install the wiper pivot arm onto the wiper motor.
   - Tighten retaining nut.



5. Connect the washer hose.



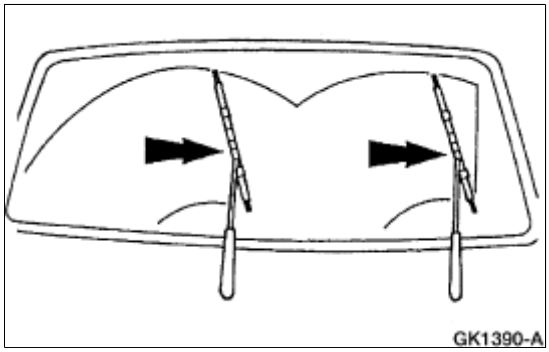
6. Cycle the wiper motor one time to allow the wiper arm to park on the wiper arm stop.



Mounting Arm and Pivot Shaft

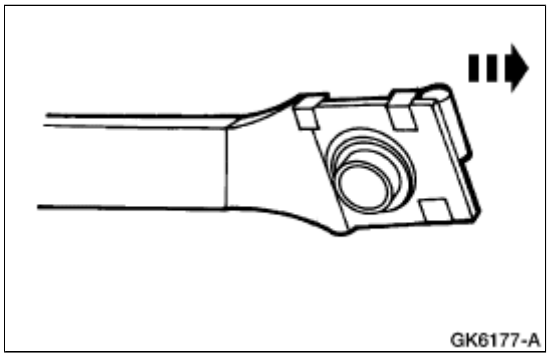
Removal

1. Cycle the windshield wiper blades (17528) to the verticle position.

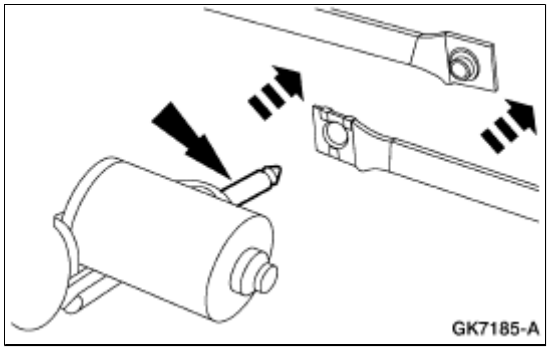


2. Remove the cowl top vent panels; refer to Section 501-02 .

3. Unsnap the wiper motor clip from the RH mounting arm and pivot shaft.

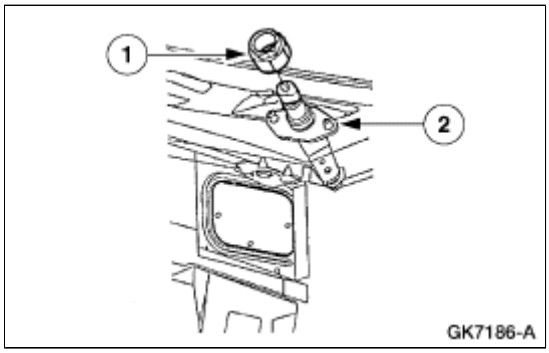


4. Disconnect the RH windshield wiper mounting arm and pivot shaft (17566) from the LH windshield wiper mounting arm and pivot shaft (17567) and move both away from the windshield wiper motor (17504).



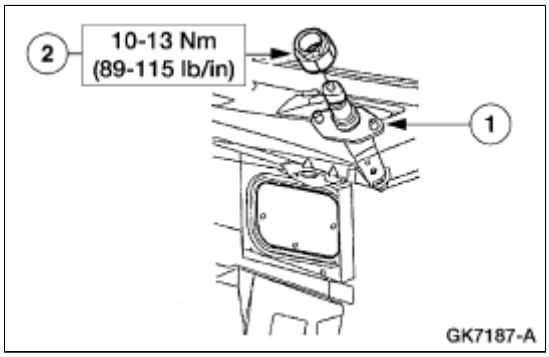
5. Remove the RH and LH mounting arm and pivot shafts.

1. Remove the two nuts.
2. Remove the mounting arm and pivot shafts.



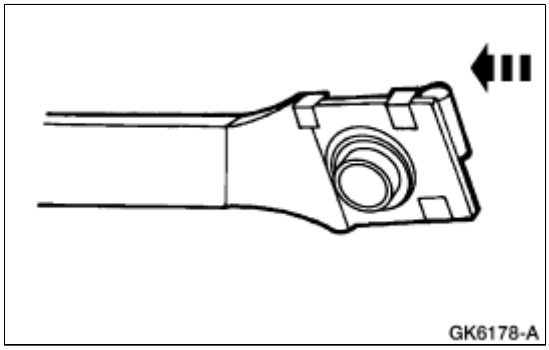
Installation

1. Install the RH and LH mounting arms and pivot shafts.
    1. Position the mounting arm and pivot shafts into place.
    2. Install the two nuts.

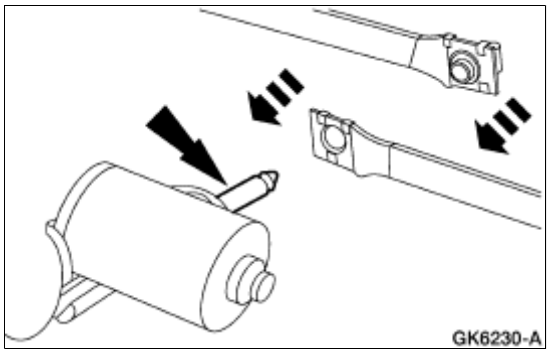


2. **CAUTION: To avoid possible damage to the windshield wiper adapter and connecting arm clip (17531), be sure the clip is fully seated before installing the adapter and connecting arm clip on the windshield wiper motor crank pin.**

    Install the clip onto the RH mounting arm and pivot shaft.



3. Install the LH windshield wiper mounting arm and pivot shaft onto the windshield wiper motor crank pin, and install the RH windshield wiper mounting arm and pivot shaft onto the wiper motor crank pin.



4. Install the cowl top vent panels; refer to Section 501-02 .

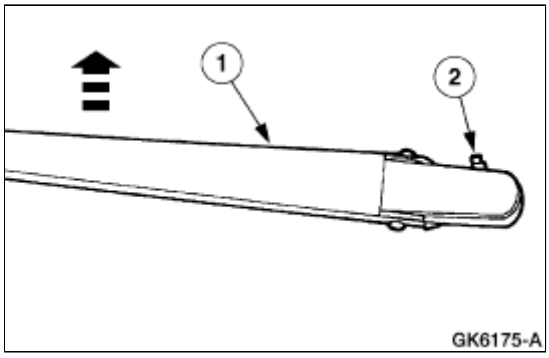
Motor —Windshield Wiper

Removal

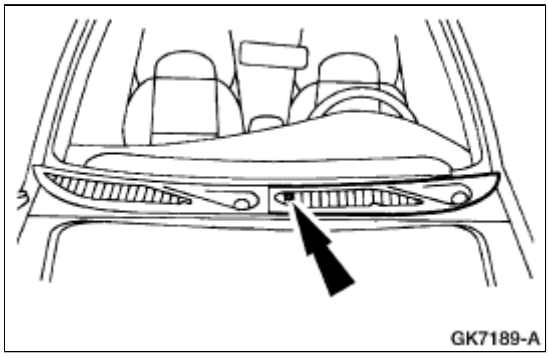
CAUTION: The internal permanent magnets used in the windshield wiper motor (17504) are made of a glass-like material. To avoid damaging the magnets, do not strike the motor with a hammer or any other object.

NOTE: The windshield wiper motor is not a repairable item. If worn or damaged, the motor must be replaced.

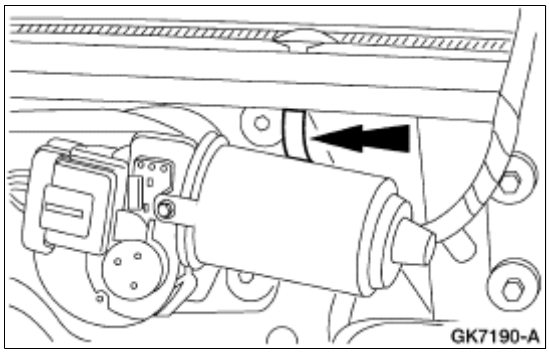
1. Remove the LH pivot arm.
    1. Pull up on the pivot arm.
    2. Pull out on the retainer tab and remove the pivot arm.



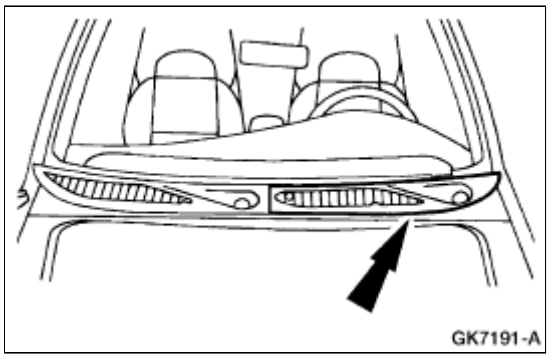
2. Remove the LH cowl top vent panel screw.



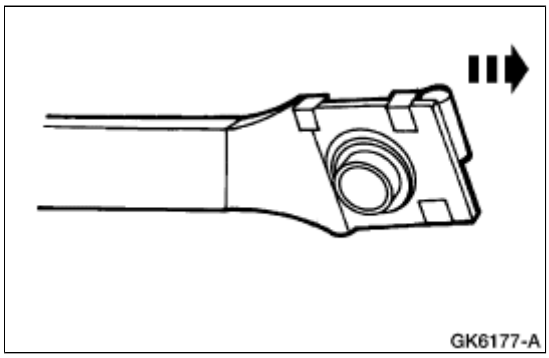
3. Disconnect the washer hose from the LH washer jet nozzle.



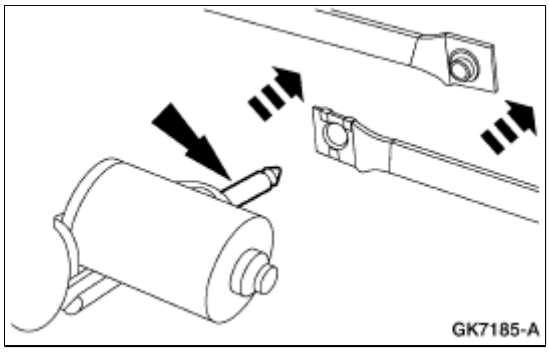
4. Remove the LH cowl top vent panel.
    - Release the seven spring retainers.



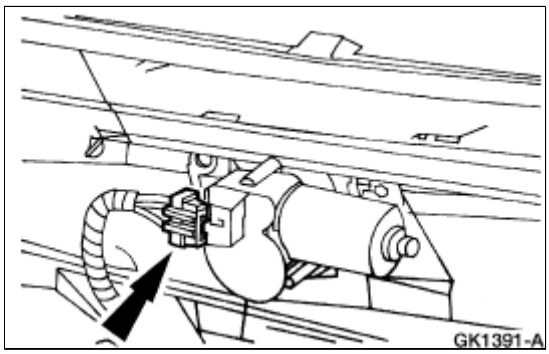
5. Unsnap the wiper motor clip from the RH mounting arm and pivot shaft.



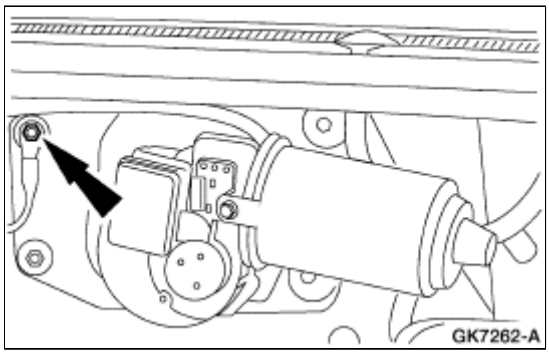
6. Disconnect the RH windshield wiper mounting arm and pivot shaft (17566) from the LH windshield wiper mounting arm and pivot shaft (17567) and move both away from the windshield wiper motor.



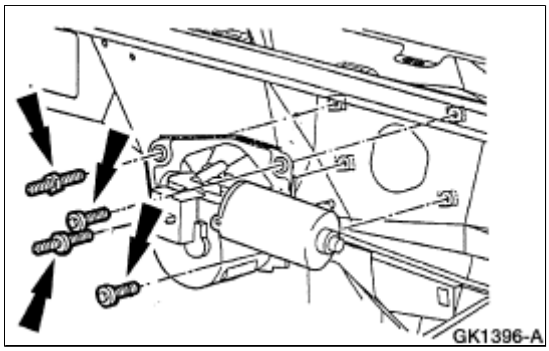
7. Disconnect the electrical connector.



8. Remove the ground strap nut and position the strap aside.



9. Remove the windshield wiper motor.
   - Remove the stud bolts.
   - Remove the bolts.



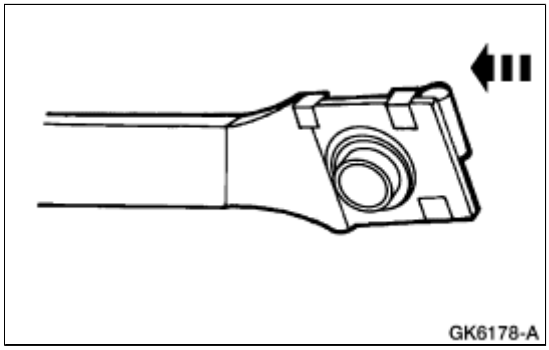
Installation

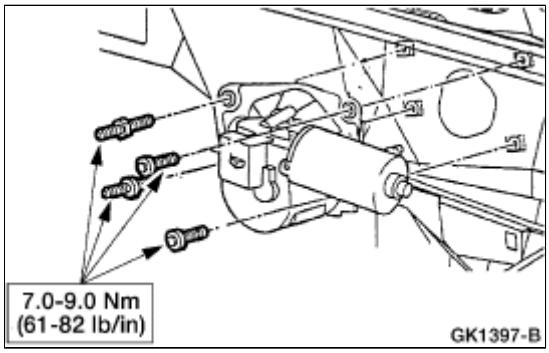
1. **CAUTION: To avoid possible damage to the mounting arm and pivot shaft retainer clip, be sure the clip is fully seated before installing on the motor crank pin.**

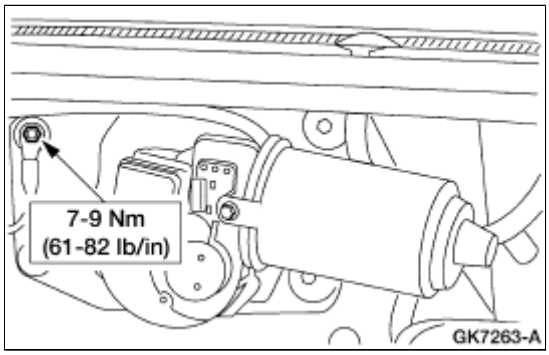
   NOTE: Install the LH mounting arm and pivot shaft to the motor before installing the RH mounting arm and pivot shaft.

   NOTE: Install the retainer clip on the RH mounting arm and pivot shaft prior to installing the motor.

To install, reverse the removal procedure.







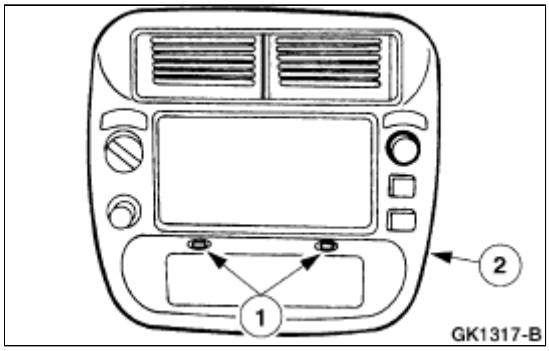
Module —Generic Electronic Module (GEM)

For additional information, refer to Section 419-10 .

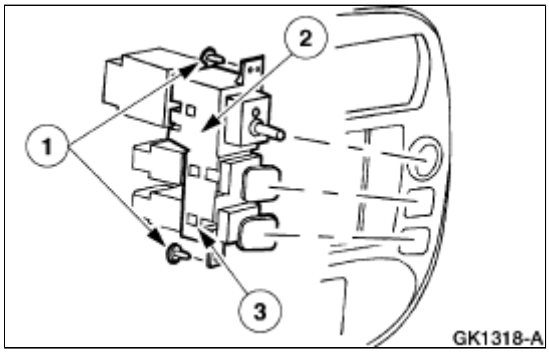
Switch —Rear Wiper/Washer

Removal

1. Remove the instrument panel finish panel.
    1. Remove the two screws.
    2. Remove the center instrument panel finish panel.
        - Disconnect the electrical connectors.

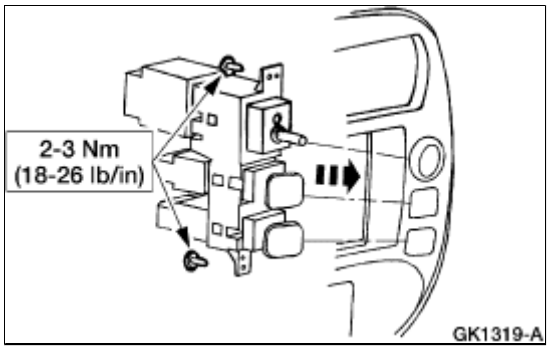


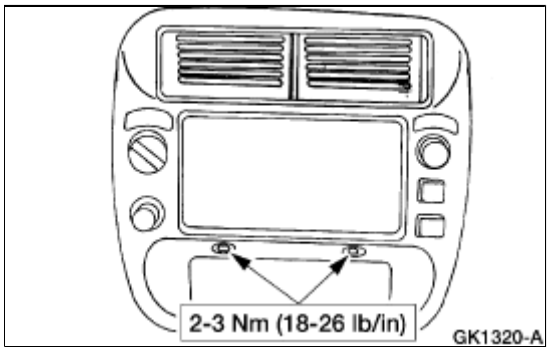
2. Remove the rear wiper/washer switch.
    1. Remove the screws.
    2. Remove the mounting bezel.
    3. Release the two tabs and remove the rear wiper/washer switch.



Installation

1. To install, reverse the removal procedure.

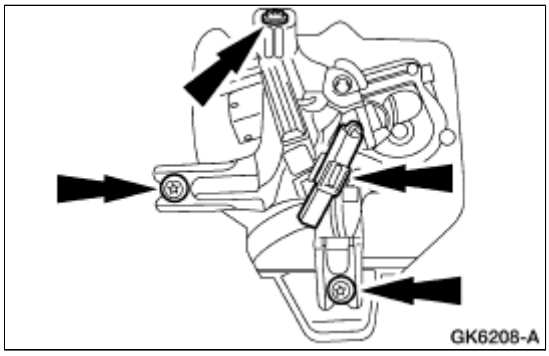

2-3 Nm
(18-26 lb/in)
GK1319-A


2-3 Nm (18-26 lb/in)
GK1320-A

Motor —Rear Wiper

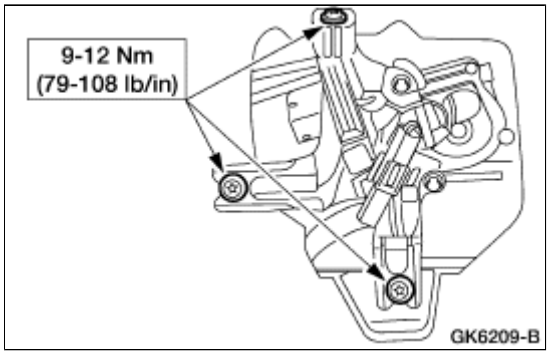
Removal

1. Remove the rear pivot arm; refer to Pivot Arm—Rear .
2. Remove the liftgate door trim panel; refer to Section 501-05 .
3. Position the watershield aside to gain access to the rear wiper motor.
4. Remove rear wiper motor.
   - Disconnect electrical connector.
   - Remove three retaining bolts.
   - Remove rear wiper motor.



Installation

1. To install, reverse the removal procedure.



Washer Pump and Reservoir —Front

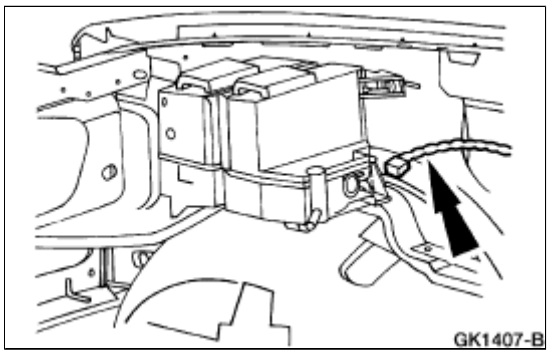
Removal

1. **NOTE:** To prevent spilling windshield washer fluid, drain the windshield washer reservoir (17618) before removal.

   Disconnect the windshield washer hose from the windshield washer pump.

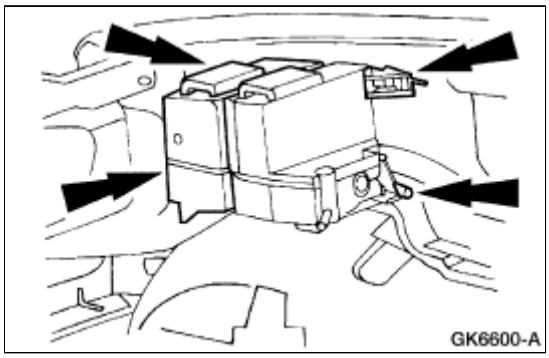
2. Disconnect the coolant overflow hose from the engine coolant overflow reservoir and plug the outlet of the reservoir.

3. Disconnect the windshield washer reservoir pump electrical connector and low level washer fluid electronic sensor connector, if equipped.



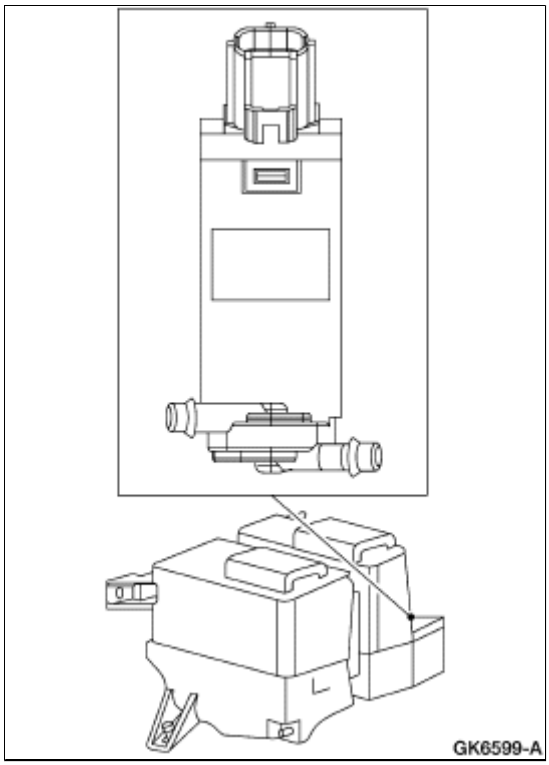
4. Remove the engine air cleaner; refer to Section 303-12 .

5. Remove the two screws and two nuts and remove the windshield washer reservoir.



6. **NOTE:** Make sure not to tear the rubber grommet during disassembly.

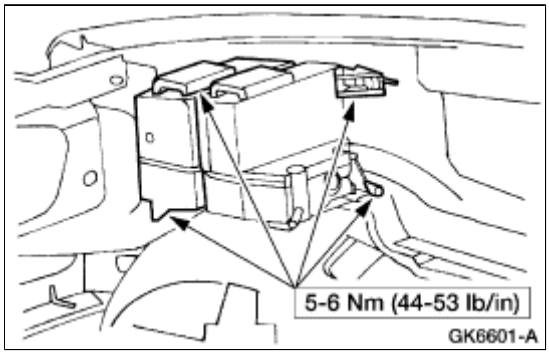
   Remove the windshield washer pump.



Installation

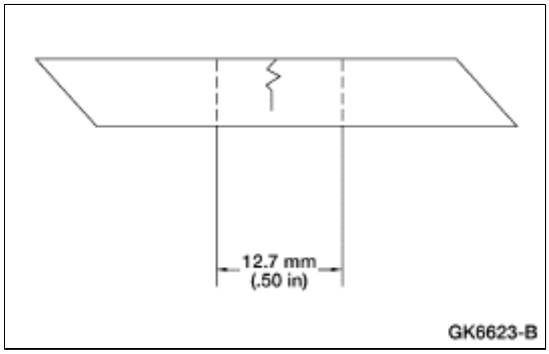
1. **NOTE:** The windshield washer reservoir, windshield washer pump (17664) and the windshield washer reservoir fluid level sensor (17B649) are replaced separately.

   To install, reverse the removal procedure.



Washer Pump and Reservoir —Washer Hose Repair

1. Locate and verify the leaking washer hose.
2. Cut the hose cleanly and remove the damaged portion of the washer hose.



3. Install a windshield washer hose adapter (17A612) between the cut ends of the hose.
4. **NOTE:** In difficult cases, clamping may be required.

   Install a segment of 6.4 mm (0.25 in) i.d. black rubber hose N809610-S or equivalent over th e ends of the washer hose, and clamp both ends of the rubber hose using spring clamps 389252-S101 or equivalent.

General Specifications

Item	Specification
Roof Opening Panel	
Rear edge of roof panel to roof opening panel	0 - 1.5 mm (0.059)
Front edge of roof panel to roof opening panel	0 - 1.5 mm (0.059)

Torque Specifications

Description	Nm	lb-in
Roof opening panel assembly screws	10	89
Roof opening panel lifter arm bolts	4	35
Roof opening panel motor bolts	5	50

Roof Opening Panel

The roof opening panel consists of the following:

- air deflector
- overhead console
- roof opening panel motor
- roof opening panel module located above the headliner
- roof opening panel
- roof opening panel shield
- roof opening panel switch
- roof opening panel drain hose

The roof opening panel is an electronically operated panel that can be opened or closed by depressing a switch located inside the vehicle on the overhead console. It also has a one-touch open feature.

When the roof opening panel switch is rocked rearward, the roof opening panel moves back into the storage space between the headliner and the roof panel (50202).

The roof opening panel can be moved to the fully closed position by rocking the switch forward and holding it until the roof opening panel is fully closed.

When the roof opening panel is in the fully closed position, the rear portion can be raised to the vent position to provide ventilation by rocking the switch forward. The roof opening panel can be closed by rocking the switch rearward.

Roof Opening Panel

Special Tool(s)

ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the roof opening panel.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Roof opening panel • Opening shield • Roof panel frame • Opening shield guide feet	• Central junction box Fuse 26 (10A) • Battery junction box Fuse 4 (30A) maxi-fuse • Relays • Roof opening panel switch • Wiring harness • Roof opening panel motor

3. If the concern is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The roof opening panel has excessive wind noise	• Incorrect adjustment. • Roof opening panel seals.	• GO to Pinpoint Test A .
• The roof opening panel leaks	• Improper adjustment. • Roof opening panel frame drain hose. • Roof opening panel seals. • Roof opening panel frame.	• GO to Pinpoint Test B .
• The roof opening panel rattles	• Roof opening panel.	• GO to Pinpoint

	• Roof opening panel rail or guide. • Rear lifter assemblies. • Front guides. • Roof opening panel headlining.	Test C .
• The roof opening panel is noisy during operation	• Sliding roof outer glass panel. • Roof opening panel rail and guide or troughs. • Rear guide pin. • Rear lifter assemblies. • Roof opening panel motor.	• GO to Pinpoint Test D .
• The roof opening panel does not open or close	• Central junction box Fuse 26 (10A). • Battery junction box Fuse 4 (30A). • Circuitry. • Switch. • Roof opening panel motor.	• GO to Pinpoint Test E .
• The roof opening panel does not seat in flush position from any position	• Incorrect adjustment.	• REFER to General Procedures.

Pinpoint Tests

PINPOINT TEST A: THE ROOF OPENING PANEL HAS EXCESSIVE WIND NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE ROOF OPENING PANEL SEALS	
	1 **NOTE:** Make sure the seals are not loose, cracked, pinched, or obstructed. Check the roof opening panel seals. • **Are the seals OK?** → **Yes** GO to A2 . → **No** REPAIR as necessary. TEST the system for normal operation.
A2 CHECK THE ROOF OPENING PANEL ADJUSTMENT	
1	

	2 Open and close the roof opening panel. 3 Check the adjustment when the roof opening panel closes. • **Is the adjustment OK?** → **Yes** Check for correct installation of the roof opening panel motor. Refer to Motor—Roof Opening Panel . TEST the system for normal operation. → **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment or Roof Opening Panel Horizontal Adjustment . TEST the system for normal operation.

PINPOINT TEST B: THE ROOF OPENING PANEL LEAKS

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE ADJUSTMENT OF THE ROOF OPENING PANEL	
	1 **NOTE:** Make sure the roof opening panel seals are not cracked or loose. Check the roof opening panel seals. • **Does the roof opening panel seal correctly?** → **Yes** GO to B2 . → **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment or Roof Opening Panel Horizontal Adjustment . TEST the system for normal operation.
B2 CHECK THE DRAIN HOSES	
	1 **NOTE:** Make sure the drain hoses are not cracked, slit, pinched, or obstructed. Check the four drain hoses for correct operation. • **Are the drain hoses OK?** → **Yes** GO to B3 . → **No** REPAIR or INSTALL a new drain hose(s). Refer to Roof Opening Panel Drain Hose . TEST the system for normal operation.
B3 CHECK THE DRAIN HOSE ATTACHMENT POINTS	
	1 **NOTE:** Make sure the drain hose attachment points are not damaged or obstructed. Check the drainage points for proper attachment.

	• **Are the attachment points OK?** → **Yes** GO to B4 . → **No** REPAIR the roof opening panel as necessary. TEST the system for normal operation.
B4 CHECK THE WATER TROUGH CONDITION	
	1 Check the water trough for damage. • **Is the water trough OK?** → **Yes** GO to B5 . → **No** REPAIR the water trough. TEST the system for normal operation.
B5 CHECK THE CONDITION OF THE ROOF OPENING PANEL	
	1 Check the roof opening panel frame for damage that may cause the roof opening panel seal to seat incorrectly. • **Is the roof opening panel frame OK?** → **Yes** INSTALL a new roof opening panel; REFER to Roof Opening Panel . TEST the system for normal operation. → **No** REPAIR roof opening panel frame as necessary. TEST the system for normal operation.

PINPOINT TEST C: THE ROOF OPENING PANEL RATTLES

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ROOF OPENING PANEL OPERATION	
	1 Check the roof opening panel during operation. • **Is the roof opening panel loose?** → **Yes** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment or Roof Opening Panel Horizontal Adjustment . TEST the system for normal operation. → **No** GO to C2 .

C2 CHECK THE ROOF OPENING PANEL TRACKS	
	1 Open the roof opening panel. 2 Check the tracks for obstructions and damage. • **Are the tracks OK?** → **Yes** GO to C3 . → **No** REMOVE all the track obstructions and REPAIR the roof opening panel tracks. TEST the system for normal operation.
C3 CHECK THE WATER TROUGH AND TROUGH GUIDES	
	1 Check the water trough and trough guides for any loose fasteners or obstructions. • **Are the trough and trough guides installed securely and free from foreign material?** → **Yes** GO to C4 . → **No** REMOVE all foreign material from the trough and install securely. SECURE the trough guides or REPAIR as necessary. TEST the system for normal operation.
C4 CHECK THE OPENING SHIELD	
	1 Check the opening shield for correct installation. • **Is the opening shield installed correctly?** → **Yes** GO to C5 . → **No** INSTALL the opening shield correctly. Refer to Roof Opening Panel Shield . TEST the system for normal operation.
C5 CHECK THE AIR DEFLECTOR ASSEMBLY	
	1 Check the air deflector for obstructions and damage. • **Is the air deflector OK?** → **Yes** GO to C6 . → **No** REMOVE all obstructions and REPAIR or INSTALL a new the air deflector assembly. REFER to Air Deflector . TEST the system for normal operation.
C6 CHECK ROOF OPENING PANEL	

	1 Verify the roof opening panel is free from obstruction, damage, and is securely fastened. • **Is the roof opening panel OK?** → **Yes** INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame . → **No** REPAIR the roof opening panel as necessary. REFER to Roof Opening Panel . TEST the system for normal operation.

PINPOINT TEST D: THE ROOF OPENING PANEL IS NOISY DURING OPERATION

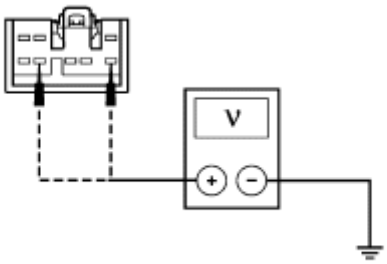
CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE ROOF OPENING PANEL FOR OBSTRUCTIONS OR DAMAGE	
	1 Check the roof opening panel for any obstructions and damage. • **Are there any obstructions and damage?** → **Yes** REMOVE all obstructions. REPAIR the roof opening panel as necessary. TEST the system for normal operation. → **No** GO to D2 .
D2 CHECK THE ROOF OPENING PANEL OPERATION	
	1 Check the roof opening panel during operation. • **Is the roof opening panel loose or not correctly adjusted?** → **Yes** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment or Roof Opening Panel Horizontal Adjustment . It may be necessary to adjust the roof opening panel forward. TEST the system for normal operation. → **No** GO to D3 .
D3 CHECK THE ROOF OPENING PANEL TRACKS	
	1 Open the roof. 2 Check the tracks for obstructions and damage. • **Are the tracks OK?** → **Yes** GO to D4 .

	→ **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D4 CHECK THE OPENING SHIELD	
	1 Check the opening shield for proper movement. • **Is the opening shield moving correctly?** → **Yes** GO to D5 . → **No** REMOVE and REINSTALL the opening shield. REFER to Roof Opening Panel Shield . TEST the system for normal operation.
D5 CHECK THE LIFTER ARMS	
	1 Check the lifter arms for obstructions and damage. • **Are the lifter assemblies OK?** → **Yes** GO to D6 . → **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D6 CHECK THE ROOF OPENING PANEL MOTOR	
	1 Gain access to the roof opening panel motor. 2 Open the roof opening panel. • **Does the motor make excessive noise?** → **Yes** INSTALL a new roof opening panel motor. REFER to Motor—Roof Opening Panel . TEST the system for normal operation. → **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment or Roof Opening Panel Horizontal Adjustment . TEST the system for normal operation.

PINPOINT TEST E: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE POWER DOOR LOCKS	
	1 Verify the power door locks operate.

	• **Do the power door locks operate?** → **Yes** GO to E2 . → **No** REFER to Section 501-14A .
E2 CHECK THE POWER WINDOWS	
1 	2 Verify the power windows operate. • **Do the power windows operate?** → **Yes** GO to E3 . → **No** REFER to Section 501-11 .
E3 CHECK VOLTAGE TO THE ROOF OPENING PANEL MOTOR — CIRCUITS 400 (LB/BK) AND 170 (RD/LB)	
1 2 Roof Opening Panel Motor C901 3 4	4 **NOTE:** The battery saver must be activated for this check. Measure the voltage between roof opening panel motor C901 pin 8, circuit 400 (LB/BK), and ground; and between roof opening panel motor C901 pin 5, circuit 170 (RD/LB), and ground.



GR3296-A

- **Are the voltages greater than 10 volts?**

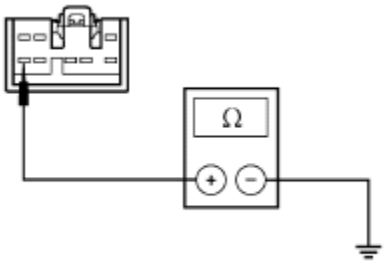
→ **Yes**
GO to E4 .

→ **No**
REPAIR circuit 400 (LB/BK) or circuit 170 (RD/LB). TEST the system for normal operation.

E4 CHECK THE ROOF OPENING PANEL GROUND — CIRCUIT 57 (BK)

1

2



GR3297-A

2 Measure the resistance between roof opening panel motor C901 pin 4, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to E5 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

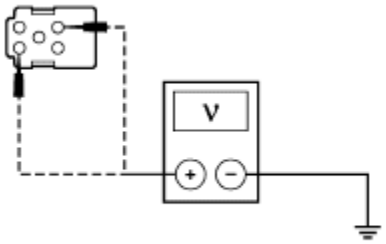
E5 CHECK THE VOLTAGE TO ROOF OPENING PANEL SWITCH

1

Roof Opening Panel Switch C900

2

3



GR3298-A

3 Measure the voltage between roof opening panel switch C900 pin 2, circuit 691 (DB), and ground; and between roof opening panel switch C900 pin 4, circuit 692 (RD), and ground.

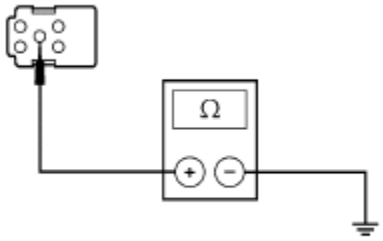
- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to E6 .

→ **No**
GO to E7 .

E6 CHECK ROOF OPENING PANEL SWITCH GROUNDS — CIRCUIT 57 (BK)

1



GR3299-A

1 Measure the resistance between roof opening panel switch C900 pin 3, circuit 57 (BK), and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new roof opening panel switch. TEST the system for normal operation.

→ **No**
REPAIR the circuit. TEST the system for normal operation.

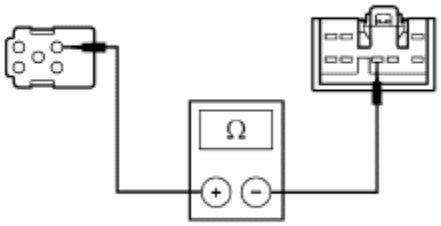
E7 CHECK CIRCUIT 691 (DB) FOR OPEN

1

2

Roof Opening Panel Motor C901

3



GR3300-A

3 Measure the resistance between the roof opening panel switch C900 pin 2, circuit 691 (DB), and roof opening panel motor C901 pin 6, circuit 691 (DB).

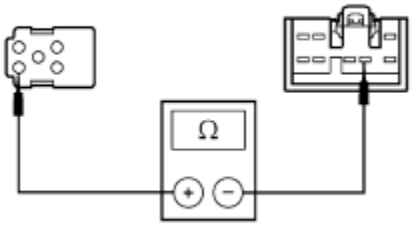
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to E8 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

E8 CHECK CIRCUIT 692 (RD) FOR OPEN

1



GR3301-A

1 Measure the resistance between the roof opening panel switch C900 pin 4, circuit 692 (RD), and roof opening panel motor C901 pin 7, circuit 692 (RD).

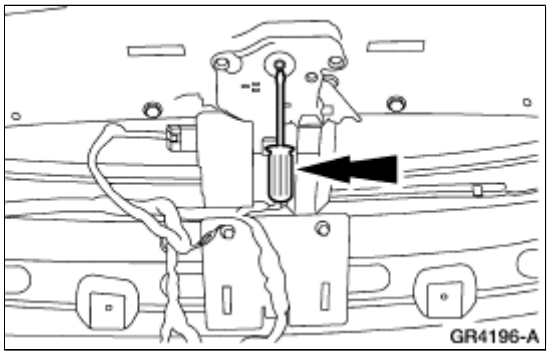
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new roof opening panel motor. REFER to Motor—Roof Opening Panel . TEST the system for normal operation.

	→ **No** REPAIR the circuit. TEST the system for normal operation.

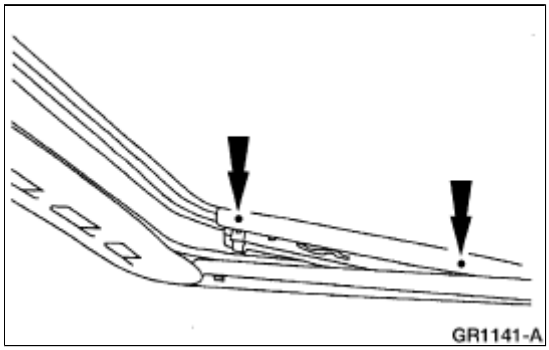
Manual Operation

1. Remove the overhead console. For additional information, refer to Section 501-12 .
2. Insert a flat head screwdriver in the center of the manual drive slot to depress the release pin. Rotate the screwdriver clockwise until the roof opening panel is closed.



Roof Opening Panel Alignment

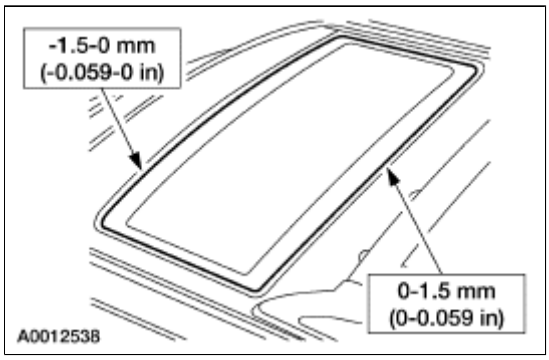
1. Loosen the four roof opening panel bolts.



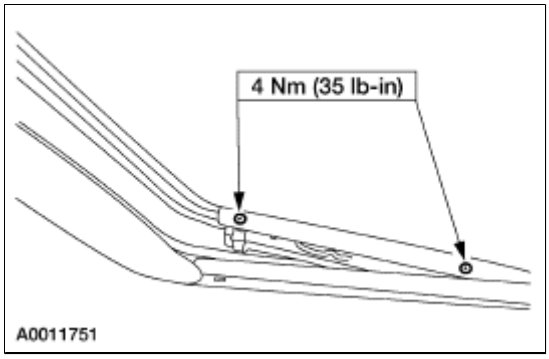
2. Close the roof opening panel.

3. **NOTE:** The correct position of the roof opening panel to the roof panel should be 0 to 1.5 mm (0.059 in) above the roof panel at the rear edge and 0 to 1.5 mm (0.059 in) below the roof panel at the front edge of the panel.

   Adjust the roof opening panel.

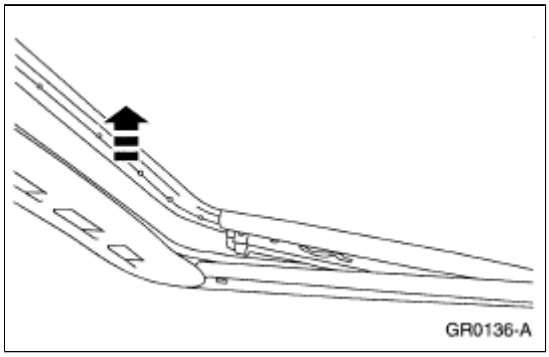


4. Tighten the roof opening panel bolts.

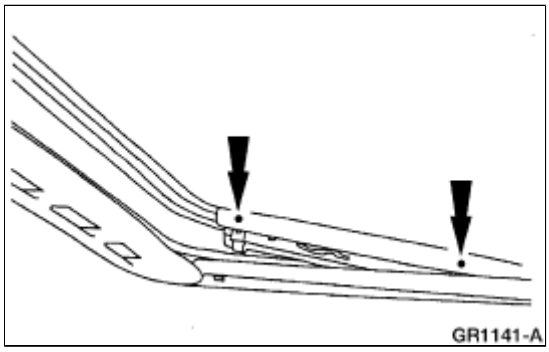


Roof Opening Panel Horizontal Adjustment

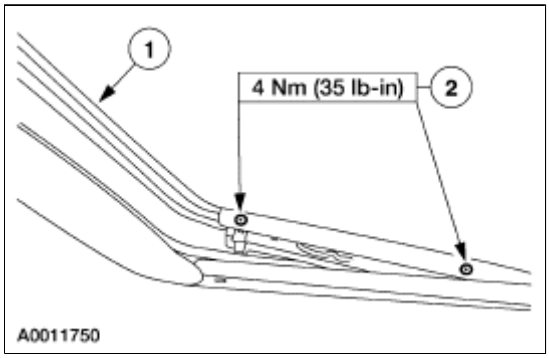
1. Open the roof opening panel to the vent position.



2. Loosen the roof opening panel.
   - Loosen the four lifter arm bolts.



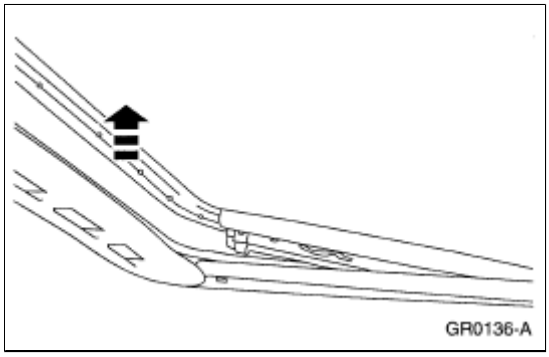
3. Adjust the roof opening panel.
   1. Reposition the roof opening panel.
   2. Tighten the four lifter arm bolts.



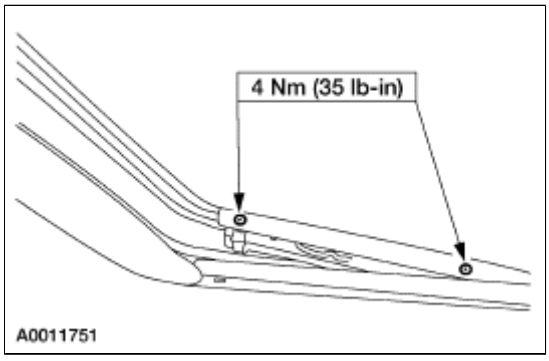
Roof Opening Panel

Removal and Installation

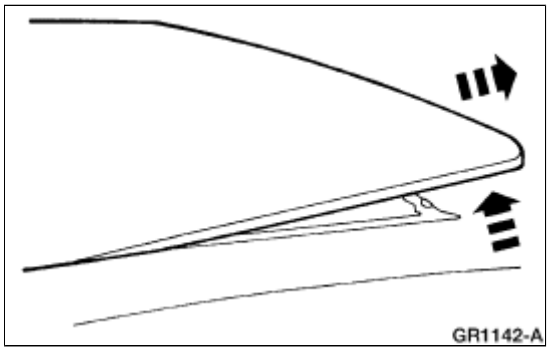
1. Open the roof opening panel to the vent position.



2. Remove the four lifter arm bolts.



3. From outside the vehicle, remove the roof opening panel.



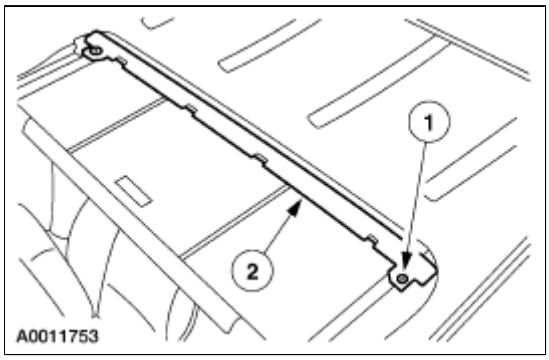
4. To install, reverse the removal procedure.
   - Check for correct alignment of the panel. For additional information, refer to Roof Opening Panel Alignment and Roof Opening Panel Horizontal Adjustment in this section.

Roof Opening Panel Shield

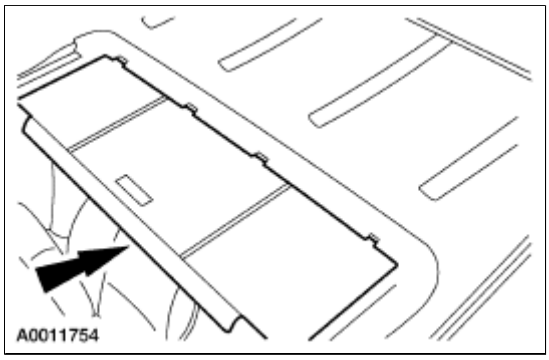
Removal and Installation

1. Remove the roof opening panel. For additional information, refer to Roof Opening Panel in this section.

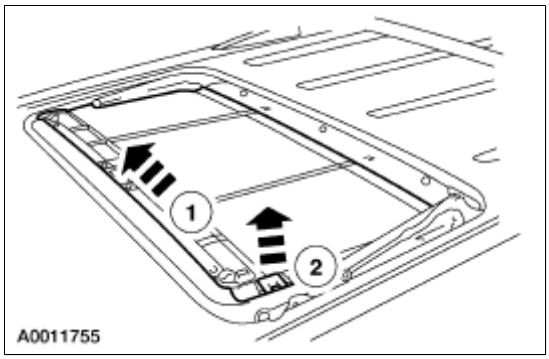
2. Remove the water channel.
    1. Remove the screws.
    2. Remove the water channel.



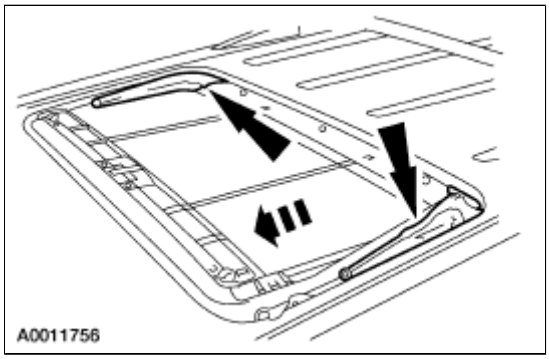
3. Slide the roof opening panel shield forward halfway.



4. Disengage the roof opening panel shield spring-loaded guide feet.
    1. Push the roof opening panel shield toward one side of the vehicle.
    2. Lift the front portion of the roof opening panel shield upward to disengage the spring-loaded guide feet.



5. Slide the roof opening panel shield forward and release the rear guide feet.



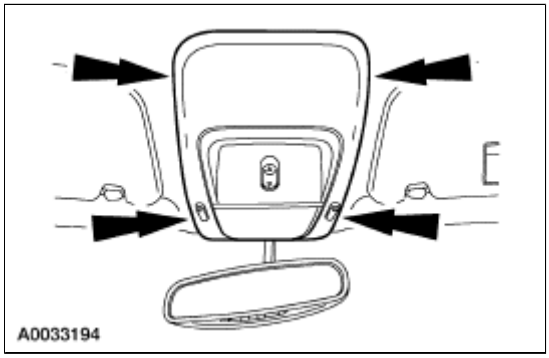
6. **NOTE:** When installing the water channel, make sure that the water channel is seated on the locking clips. The LH water channel screw must be installed first.

   To install, reverse the removal procedure.

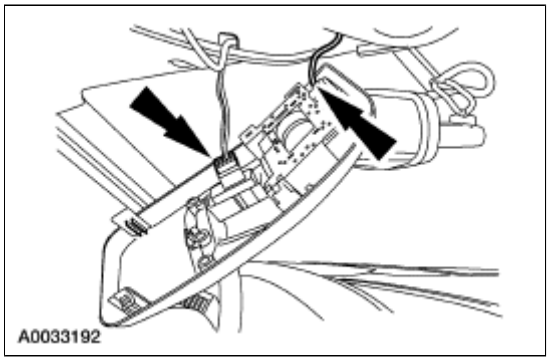
Motor —Roof Opening Panel

Removal

1. Remove the overhead console.
   - Disengage the retaining clips and partially remove the overhead console.



2. Disconnect the electrical connectors.



3. **NOTE:** Make sure that the roof opening panel motor is in the closed position before removal.

   Remove the motor.
   1. Remove the bolts.
   2. Disconnect the electrical connector.

Installation

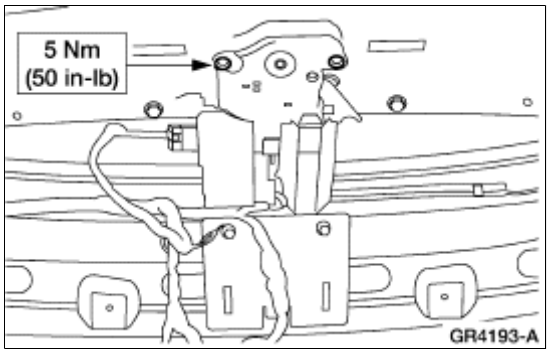
1. **NOTE:** The roof opening panel should be in the closed position.

   Connect the roof opening panel motor electrical connector.

2. Position the overhead console and connect the electrical connectors.

3. With the motor still removed, bump the switch one time only towards the close or vent open position.

4. Position the roof opening panel motor and install the bolts.

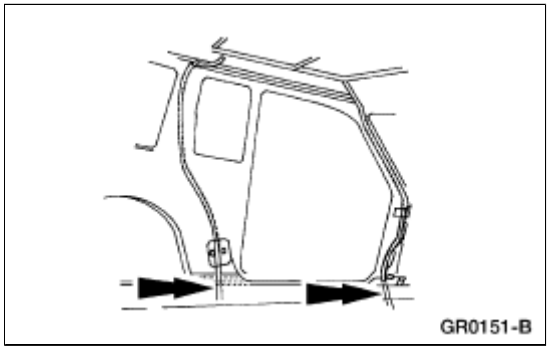


5. Install the overhead console.

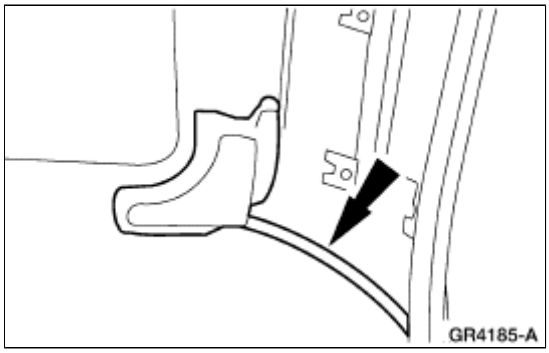
Roof Opening Panel Drain Hose

Removal and Installation

1. Remove the headliner. For additional information, refer to Section 501-05 .
2. From underneath the vehicle, securely attach a new drain hose to the lower end of the old drain hose.

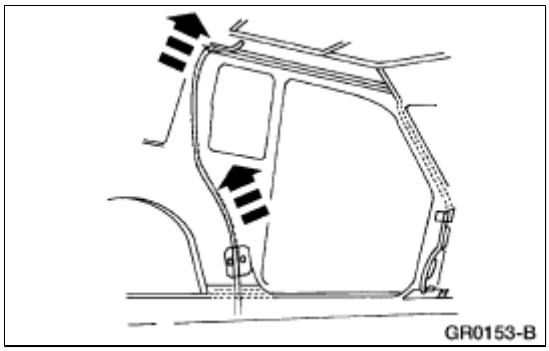


3. Disconnect the drain hose from the roof opening panel assembly.



4. **NOTE:** Make sure that the hoses are not kinked.

   Pull the old drain hose through the body of the vehicle and connect the new hose to the roof opening panel.

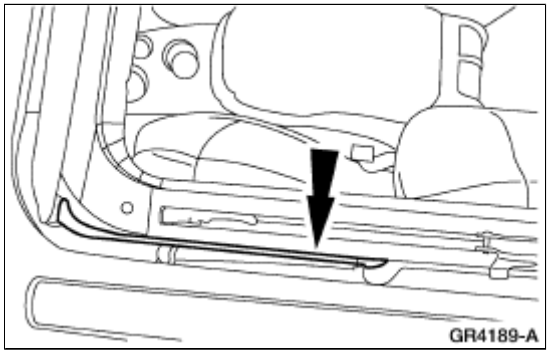


5. Install the headliner. For additional information, refer to Section 501-05 .

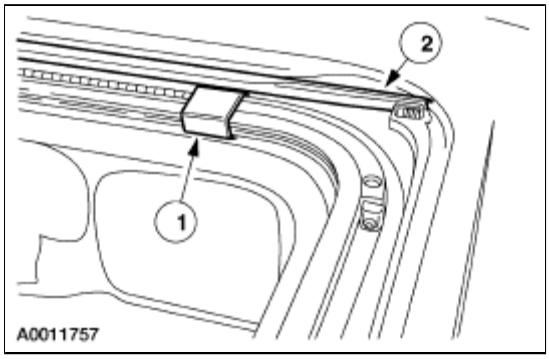
Air Deflector

Removal and Installation

1. Open the roof opening panel to the fully retracted position.
2. Release the two air deflector arms.



3. Remove the air deflector.
    1. Detach the two air deflector retainer clips from the U-frame.
    2. Remove the air deflector.

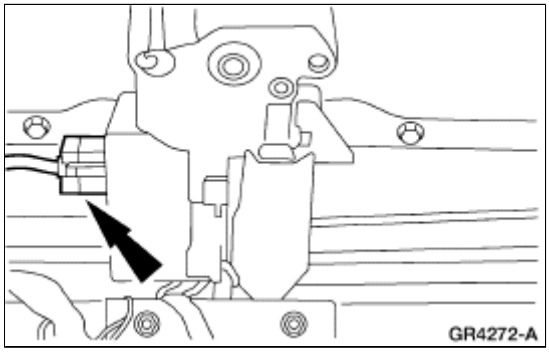


4. To install, reverse the removal procedure.

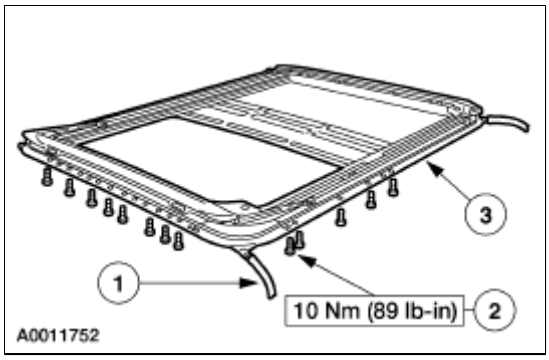
Roof Opening Panel Frame

Removal and Installation

1. Remove the headliner. For additional information, refer to Section 501-05 .
2. Disconnect the roof opening panel motor electrical connector.



3. Remove the roof opening panel frame.
    1. Disconnect the four drain hoses.
    2. Remove the fourteen screws.
    3. Remove the roof opening panel frame.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft
Front bumper cover strut bolts (Mountaineer)	12	9
Front bumper nuts	70	52
Front bumper fog lamp bracket bolts (Explorer)	30	22
Front bumper fog lamp bracket bolts (Mountaineer)	12	9
Rear bumper isolator and bracket bolts	98-132	72-97
Rear bumper to frame nuts	98-132	72-97

Bumpers

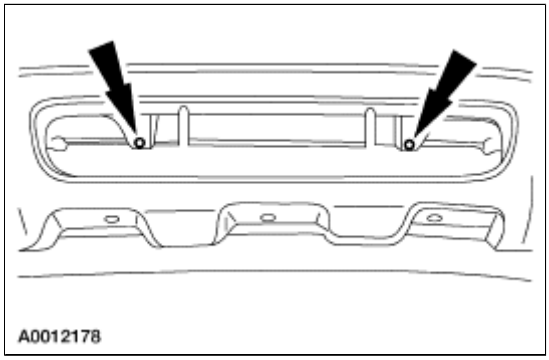
The bumper system consists of the following components:

- air deflector
- fog lamps
- front license plate mounting bracket
- front bumper reinforcement
- front bumper cover
- front bumper cover corner mouldings (Explorer)
- rear bumper spacers
- rear bumper stone deflector
- rear bumper

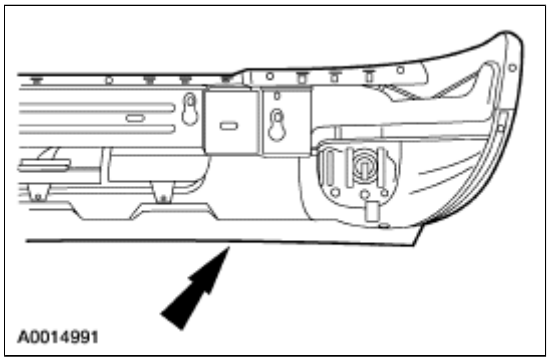
Bumper Cover —Explorer

Removal

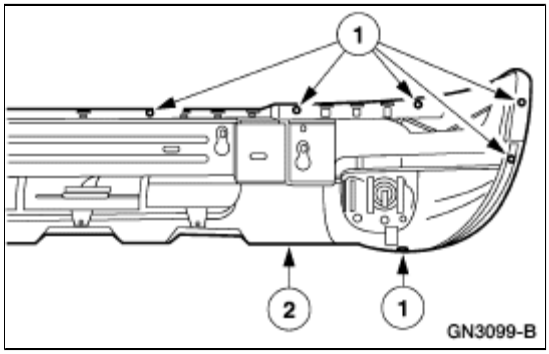
1. Remove the front bumper. For additional information, refer to Bumper—Front in this section.
2. Remove the bumper cover pin-type retainers.



3. Remove the six fasteners, one pin-type retainer and the air deflector.



4. Remove the bumper cover.
    1. Remove the 12 screws.
    2. Remove the bumper cover.



Installation

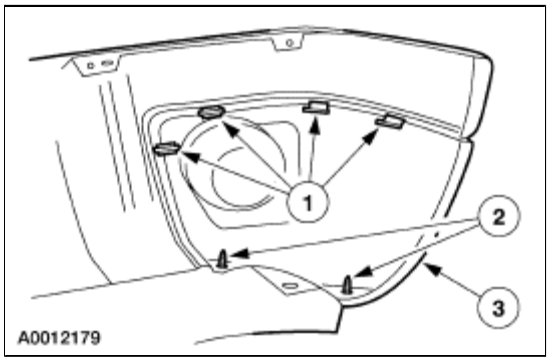
1. To install, reverse the removal procedure.

Bumper Cover —Corner Molding, Explorer

Removal

1. Remove the front bumper cover. For additional information, refer to Bumper Cover—Explorer in this section.

2. Remove the bumper cover corner moulding.
    1. Remove the clips.
    2. Remove the screws.
    3. Remove the bumper cover corner moulding.



Installation

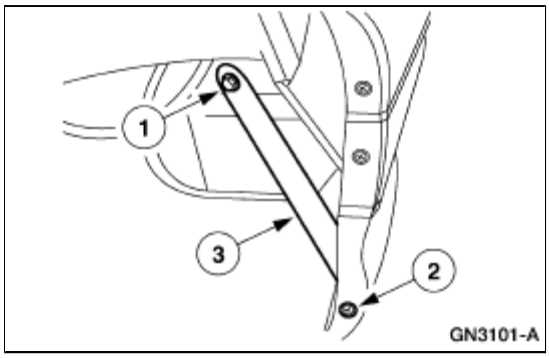
1. To install, reverse the removal procedure.

Bumper Cover —Mountaineer

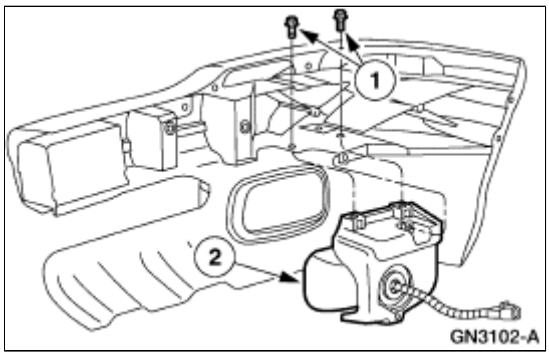
Removal

1. Remove the front bumper. For additional information, refer to Bumper—Front in this section.

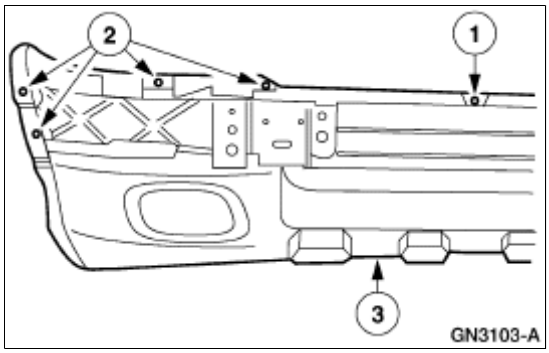
2. Remove the two bumper cover struts.
    1. Remove the two bolts.
    2. Remove the two screws.
    3. Remove the two bumper cover struts.



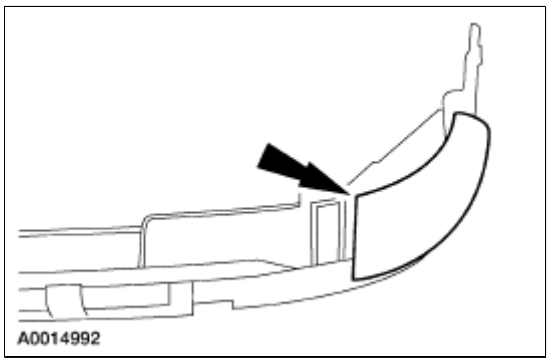
3. Remove the two fog lamp assemblies.
    1. Remove the four bolts.
    2. Remove the two fog lamp assemblies.



4. Remove the bumper cover.
    1. Remove the rivet.
    2. Remove the eight screws.
    3. Remove the bumper cover.

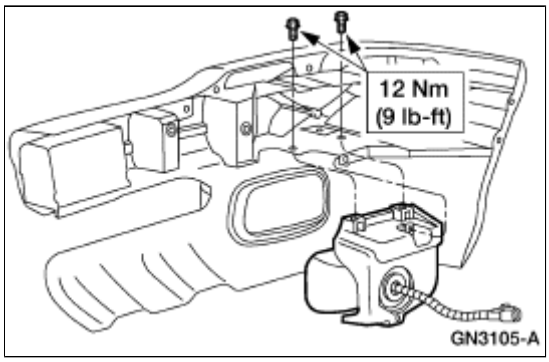


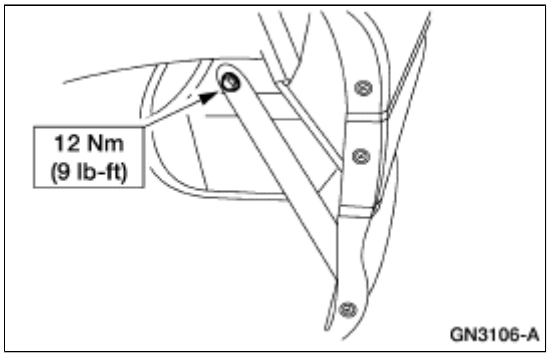
5. Remove the two bumper insulators.



Installation

1. To install, reverse the removal procedure.



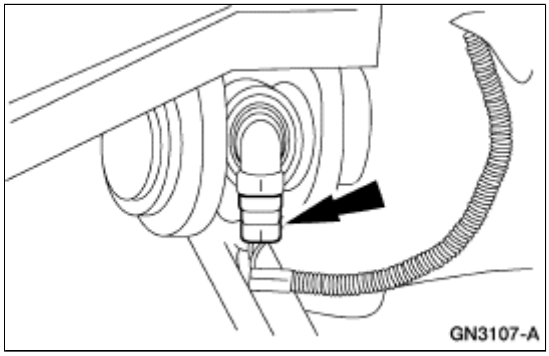


Bumper —Front

Removal

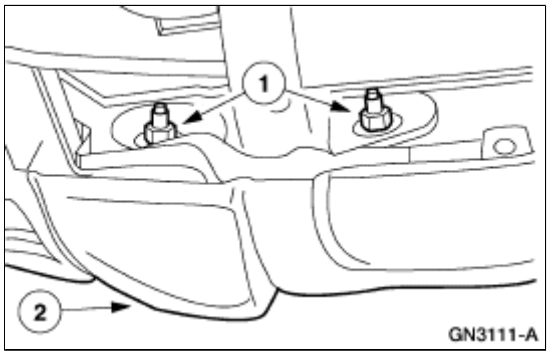
NOTE: Explorer shown, Mountaineer similar.

1. If equipped, disconnect the fog lamp electrical connector.



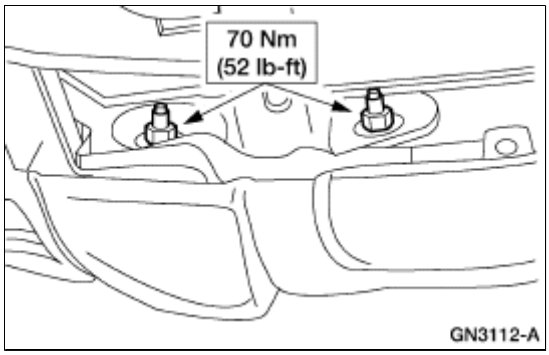
2. **WARNING: To avoid possible injury, support the front bumper before removing the nuts.**

   Remove the front bumper.
   1. Remove the four nuts (two each side).
   2. Remove the front bumper.



Installation

1. To install, reverse the removal procedure.


70 Nm
(52 lb-ft)
GN3112-A

Bumper —Rear

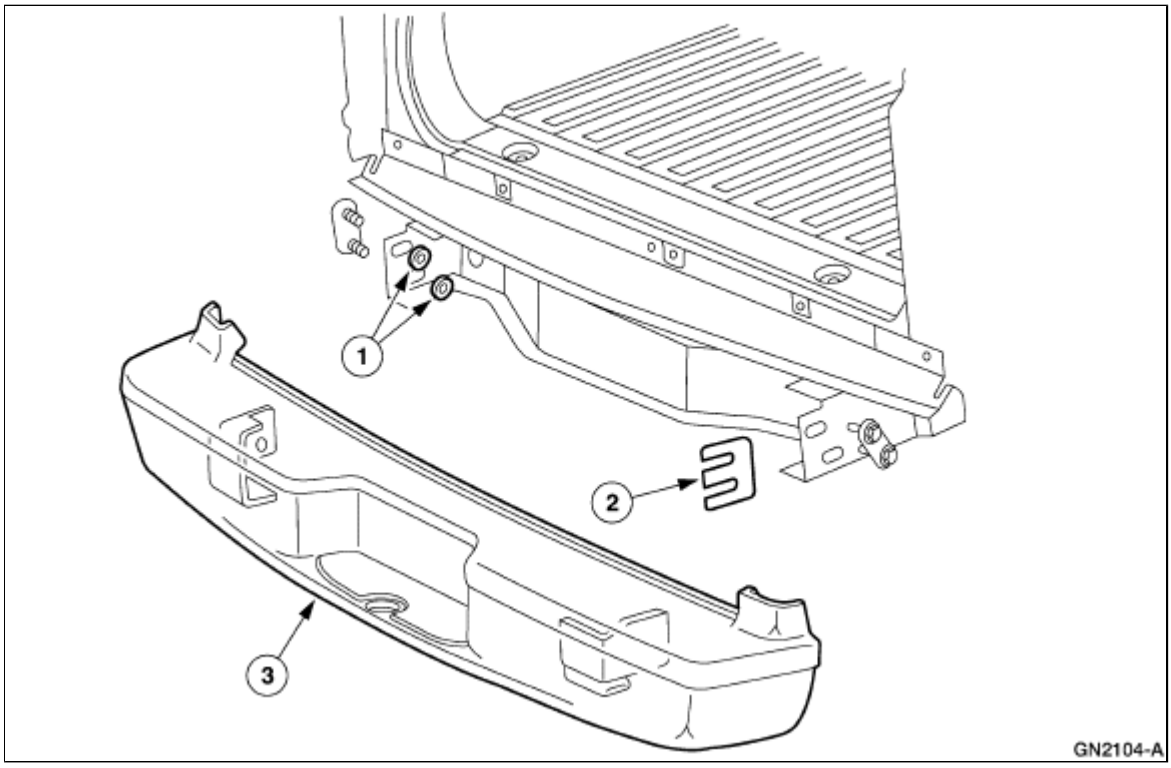
Removal

1. If equipped, disconnect the parking aid wiring harness electrical connector.

2. **WARNING: To avoid possible injury, support the rear bumper before removing the nuts.**

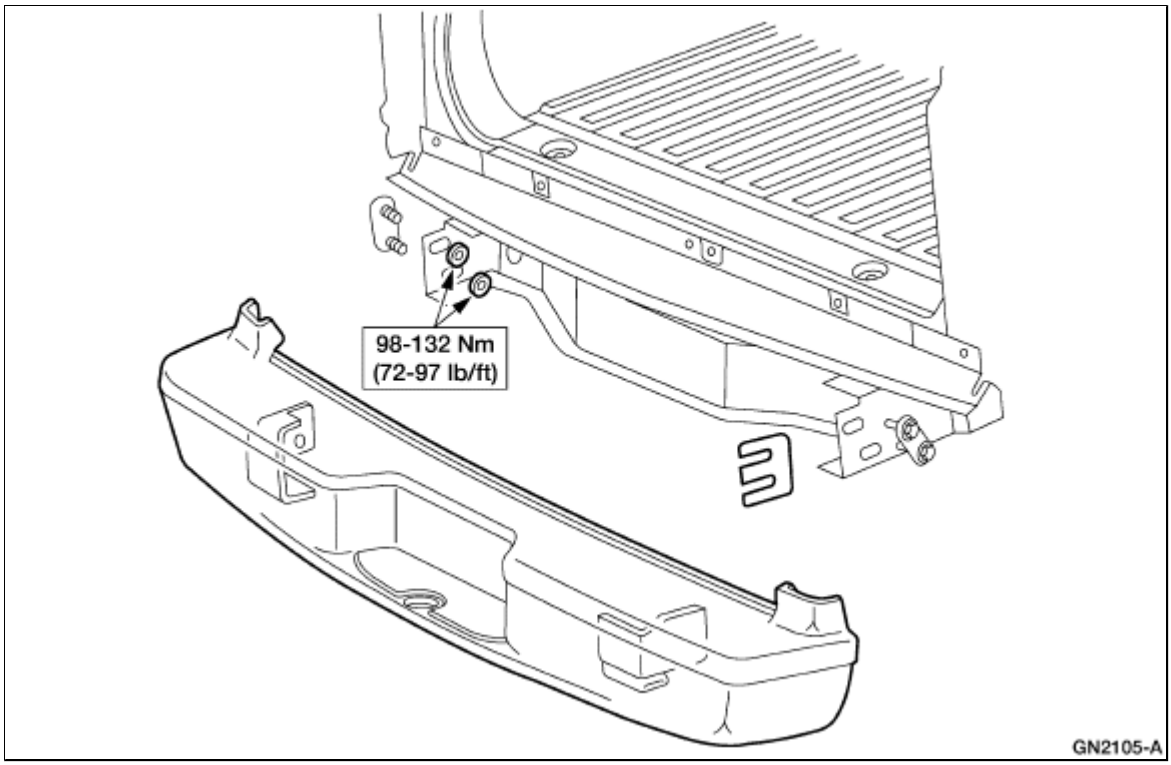
   NOTE: The rear bumper spacer is required for repair only.

   Remove the rear bumper (17906).
   1. Support the bumper and remove the four nuts (two each side).
   2. If equipped, remove the spacer.
   3. Remove the rear bumper.



Installation

1. To install, reverse the removal procedure.

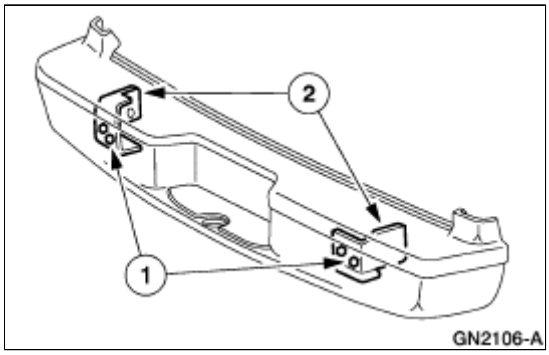

98-132 Nm
(72-97 lb/ft)
GN2105-A

Bumper Bracket —Rear

Removal

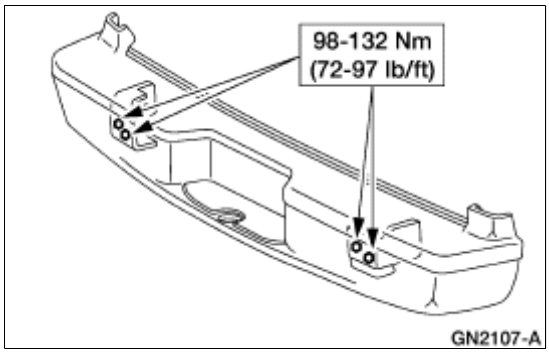
1. Remove the rear bumper (17906); refer to Bumper—Rear in this section.

2. Remove the rear bumper isolator and bracket (17787).
    1. Remove the nuts and bolts.
    2. Remove the isolators and brackets.



Installation

1. To install, reverse the removal procedure.



Parking Aid Sensor

Removal and Installation

For additional information, refer to Section 413-13 .

General Specifications

Item	Specification
Ford Threadlock 262 (E2FZ-19554-B)	WSK-M2G351-A6

Torque Specifications

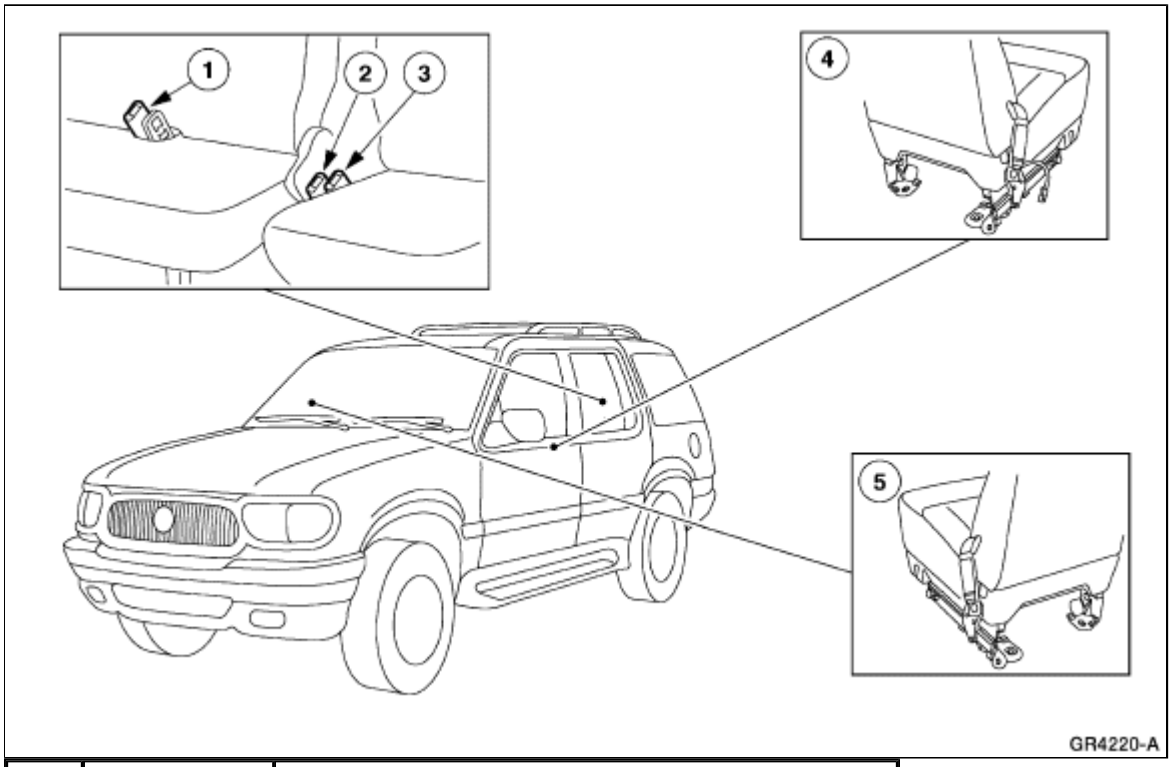
Description	Nm	lb-ft	lb-in
Driver seat safety belt buckle nut	40	30	—
Front seat safety belt buckle bolts	40	30	—
Rear seat center occupant safety belt and retractor bolt	40	30	—
Rear seat safety belt buckle front nuts	40	30	—
Rear seat safety belt buckle assembly rear nuts	48	35	—
Safety belt anchor bolts	40	30	—
Safety belt guide to floor bolt	40	30	—
Safety belt guide to seat track bolt	9	—	80
Safety belt guide to seat track nut	9	—	80
Safety belt retractor bolts	40	30	—
Shoulder safety belt height adjuster bolts	40	30	—

Occupant Restraint System

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds that the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

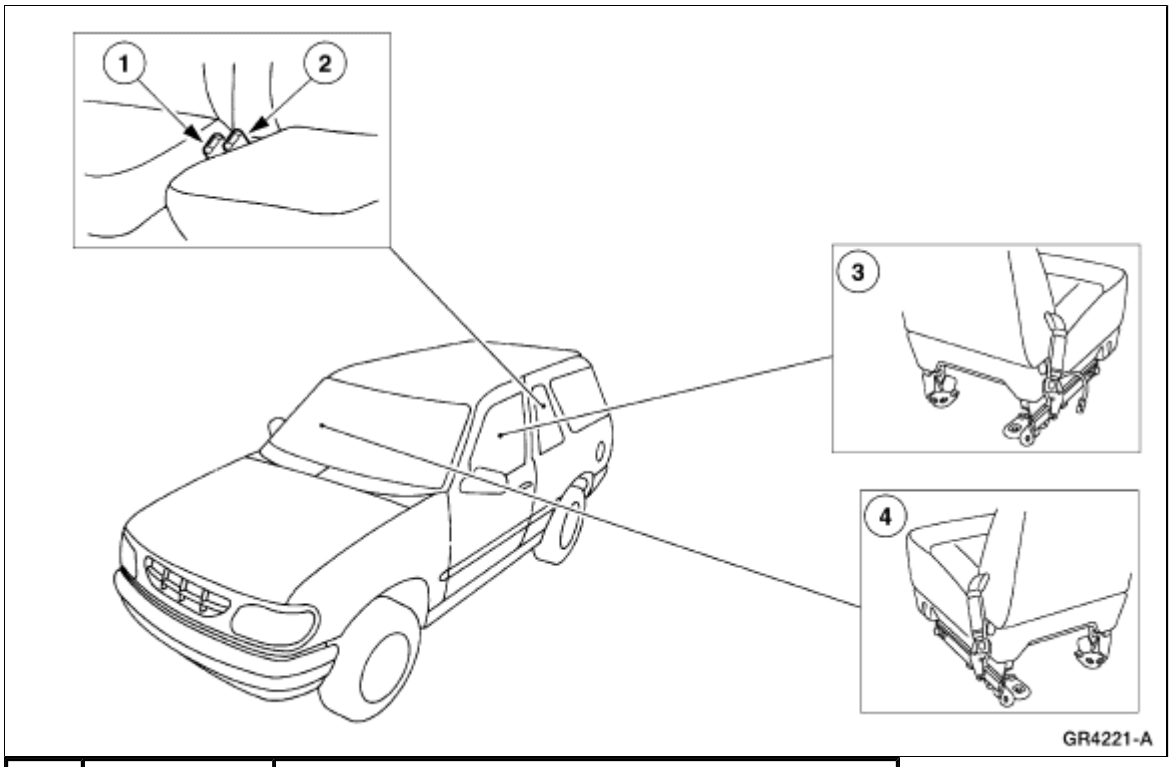
When replacing safety belt buckle or retractor assemblies, use only the replacement parts specified in the Ford Customer Service Division Master Parts Catalog.

Occupant Restraint System Component Locations — Buckles, Four-Door



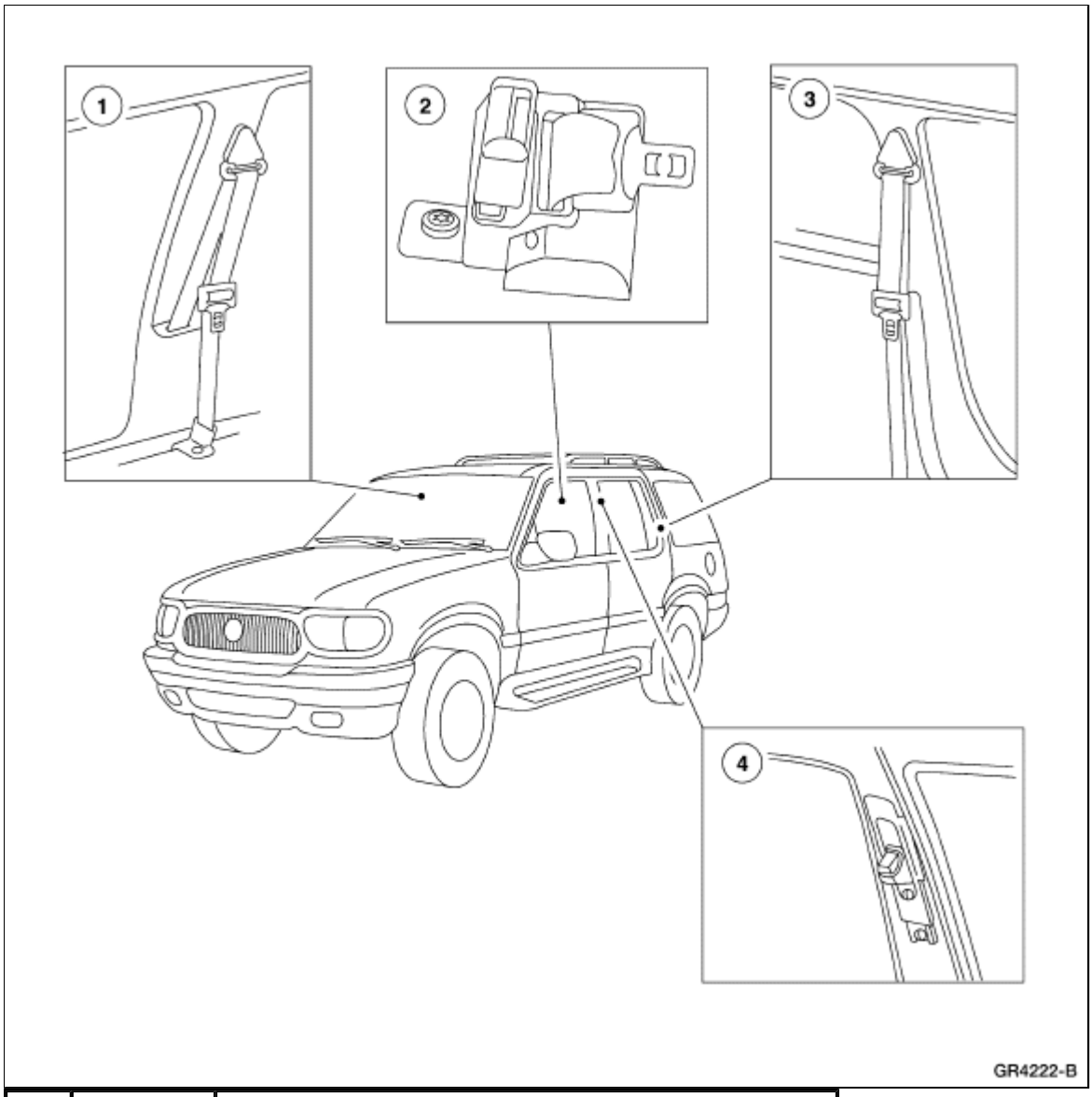
Item	Part Number	Description
1	—	Passenger side rear safety belt buckle
2	—	Center rear safety belt buckle
3	—	Driver side rear buckle
4	—	Driver side safety belt buckle (bucket seat)
5	—	Passenger side safety belt buckle (bucket seat)

Occupant Restraint System Component Locations — Buckles, Two-Door



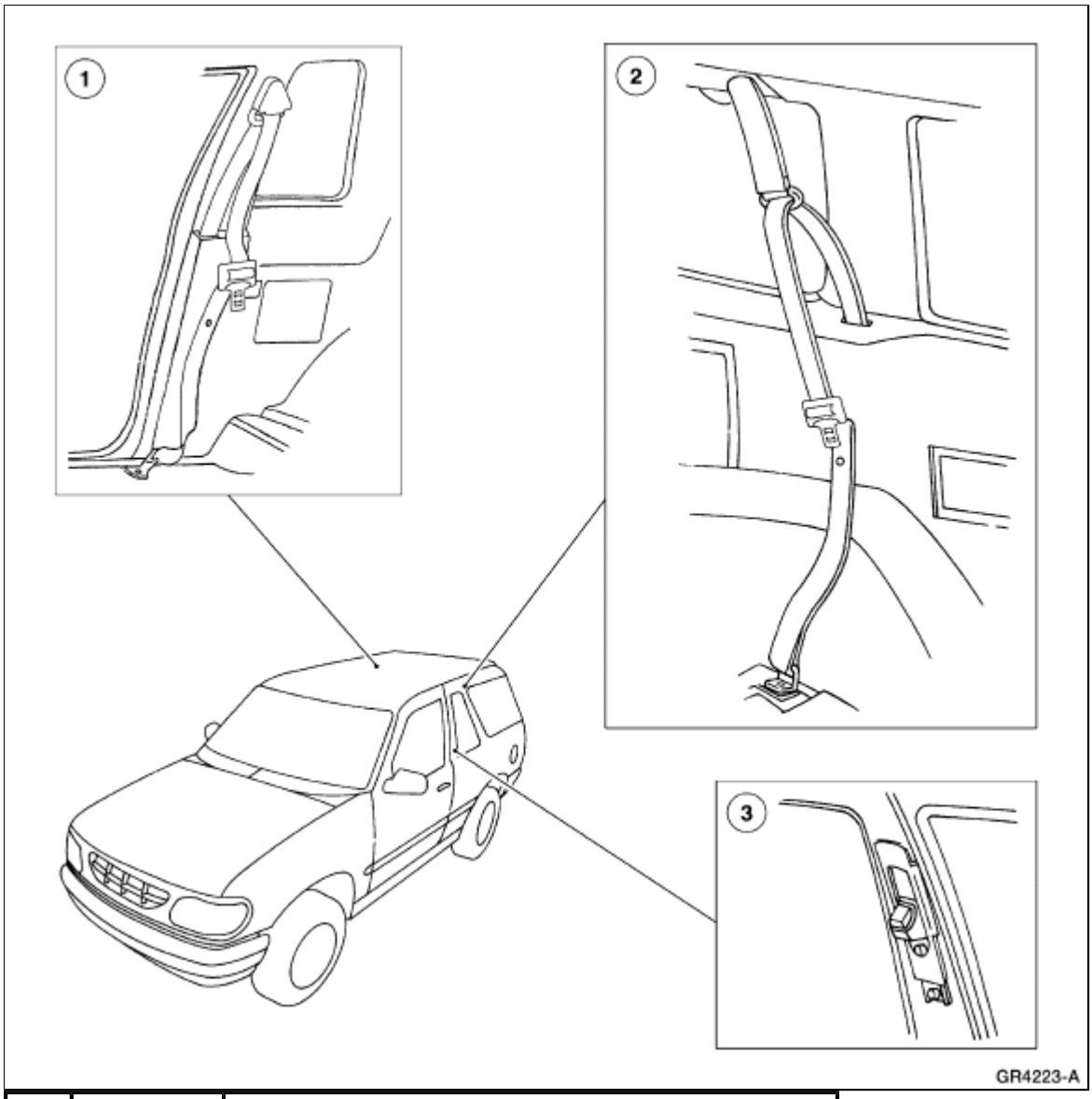
Item	Part Number	Description
1	—	Passenger side rear safety belt buckle
2	—	Driver side rear safety belt buckle
3	—	Driver side safety belt buckle (bucket seat)
4	—	Passenger side safety belt buckle (bucket seat)

Occupant Restraint System Component Locations — Retractors and Tongues, Four-Door



Item	Part Number	Description
1	—	Passenger side front safety belt retractor assembly
2	—	Center passenger rear safety belt retractor and rear passenger buckle assembly
3	—	Driver side rear retractor assembly (passenger side similar)
4	—	Driver shoulder safety belt height adjuster (passenger side similar)

Occupant Restraint System Component Locations — Retractors and Tongues, Two-Door



Item	Part Number	Description
1	—	Passenger side front safety belt retractor assembly
2	—	Rear driver side retractor assembly
3	—	Driver shoulder safety belt height adjuster (passenger side similar)

The outboard safety belt for the front and rear seats is a continuous-loop three-point system. The combination lap and shoulder belt (continuous-loop) uses a common sliding tongue and retractor.

The shoulder harness retractor is designed to let the webbing move freely in or out at all times, except during vehicle hard braking, hard cornering or an impact of 8 km/h (5 mph) or more, when it is automatically locked by a mechanically actuated inertia sensor.

Dual Locking Mode Retractors

NOTE: When replacing a dual locking mode retractor, the retractor should be checked to make sure it is not

in the automatic locking retractor (ALR) mode after installation in the stowed position.

All outboard continuous-loop, three-point retractor systems, except the driver position, are equipped with the dual locking mode system.

The emergency locking retractor (ELR) mode will allow the occupant freedom of movement, locking tight only on hard braking, hard cornering, or an impact of approximately 8 km/h (5 mph). The ELR mode helps to reduce the forward movement of the driver and passengers. The ELR mode is continuously in operation at all seating positions.

The ALR portion of this system does not allow the occupant freedom of movement. The ALR mode is used when locking a child seat in an outboard seating position or when a tight belt fit is desired. The ALR mode is disengaged when the webbing is free to move in or out of the retractor. The ALR mode is automatically engaged when the webbing is fully extracted from the retractor and then allowed to retract. As the webbing is retracted back onto the spool, an audible clicking sound is made, indicating that the retractor is in ALR mode. The ALR mode is automatically disengaged when most of the webbing is retracted back onto the spool.

WARNING: After any vehicle collision, the safety belt system at all outboard seating positions (except driver, which has no "automatic locking retractor" feature) must be checked by a qualified technician to verify that the "automatic locking retractor" feature for child seats is still functioning properly, in addition to other checks for proper safety belt system function. A belt and retractor assembly must be replaced if the safety belt assembly's "automatic locking retractor" feature or any other safety belt function is not operating properly when checked according to the procedures in the workshop manual. Failure to replace the Belt and Retractor assembly could increase the risk of injury in collisions.

This vehicle has a safety belt system with an energy management feature at the front seating positions to help further reduce the risk of injury in the event of a head-on collision.

This safety belt system has a retractor assembly that is designed to pay out webbing in a controlled manner. This feature is designed to help reduce the belt force acting on occupant's chest.

Safety Belt Extension Assembly

In certain cases, the safety belt may be too short even when it is fully extended. About 20 cm (8 in) can be added to the belt length by using a safety belt extension (611C22). Safety belt extensions are available at no cost from any Ford or Lincoln-Mercury dealer parts department at no cost. Safety belt extensions are only available with black webbing.

There are two extension assemblies available, one for the front seating positions and one for the rear seating positions and they are not interchangeable.

Use only extensions manufactured by the same supplier as the safety belt. Manufacturer identification is located at the end of the webbing on the label. Also, use the safety belt extension only if safety belt is too short for you when fully extended. Do not use extension to change the fit of the shoulder belt across the torso.

Attaching Safety Seats With Tether Straps

Some manufacturers make child safety seats that include a tether strap that goes over the back of the vehicle seat and attaches to an anchoring point. Other manufacturers offer the tether strap as an accessory. Contact the manufacturer of the child safety seat for information about ordering a tether strap.

Attach a tether strap anchor bracket to the rear floor by using a tether anchor kit, available at no charge from

any Ford or Lincoln-Mercury dealership.

Carefully read and follow the instructions provided with the kit for installation of the child tether strap anchor.

Occupant Restraint System —Indicator Lights and Chimes

Safety Belt Warning Indicator and Chime

The warning indicator and chime are reminders to fasten the safety belt. The following conditions will take place:

- If the safety belt is not buckled before the ignition is turned to the ON position, the chime will turn on for four to eight seconds and the indicator will come on for one to two minutes.
- If the safety belt is buckled while the indicator is on and the chime is sounding, both the indicator and chime will turn off.
- If the safety belt is buckled before the ignition is turned to the ON position, neither the indicator nor the chime will turn on.

Belt Minder (if equipped)

The Belt Minder feature is a supplemental warning to the safety belt warning function. This feature provides additional reminders to the driver that the driver's safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning lamp in the instrument cluster.

If...	Then...
The driver's safety belt is not buckled before the vehicle has reached at least 5 km/h (3 mph) and 1-2 minutes have elapsed since the ignition switch has been turned to ON...	The Belt Minder feature is activated - the safety belt warning light illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until safety belt is buckled.
The driver's safety belt is buckled while the safety belt indicator light is illuminated and the safety belt warning chime is sounding...	The Belt Minder feature will not activate.
The driver's safety belt is buckled before the ignition switch is turned to the ON position...	The Belt Minder feature will not activate.

Occupant Restraint System

Inspection and Verification

1. Verify the customer concern by operating the safety belts.
2. Visually inspect for obvious signs of mechanical and electrical damage. For additional information, refer to the following chart:

Visual Inspection Chart

Mechanical
• Loose webbing • Safety belt retractor and tongue assembly

3. If the concern is not visually evident, determine the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Normal mode — occupant restraint system inoperative	• Broken tooth on retractor sensor gear. • Loose webbing.	• REFER to Component Test.
• Automatic locking retraction (ALR) system inoperative	• Broken tooth on retractor sensor gear. • Loose webbing.	• REFER to Component Test.
• The safety belt warning chime is inoperative	• Circuitry. • Safety belt warning switch. • Generic electronic module (GEM).	• REFER to Section 413-09 .
• The safety belt warning indicator is inoperative	• Circuitry. • Safety belt warning switch. • Instrument cluster. • Bulb. • GEM.	• REFER to Section 413-01 .

Component Test

Functional Test

1. The driver should buckle up and proceed to a safe test area. If the RH front or a rear passenger safety belt must be tested, a passenger should be buckled into the RH front or rear seat. The RH front belt may be tested using a driver only, providing driver has the ability to grasp the RH front shoulder belt and extend it approximately 66 cm (25.9 in) with no compromise to safe driving. This method applies to 8 km/h (5 mph) test only.

2. After reaching a safe area to carry out sudden stops, the driver will attain a speed of approximately 8 km/h (5 mph). The driver should inform the passenger (if applicable) that he is preparing to make a severe brake application. At this time, both the driver and passenger should grasp their respective shoulder harnesses and prepare to lean slightly forward at the moment the brake application is made.

3. **WARNING: The driver and passenger must be prepared to brace themselves in the event the retractor does not lock.**

   The driver will make a maximum brake application without tire skid. The maximum brake application should be on dry concrete or equivalent hard road surface; never on a wet or gravel road.

4. The driver and passenger should lean forward slightly into shoulder harness. At this instant, belts should lock up without webbing pay out.

5. If there is a lockup of both shoulder straps, safety belt assemblies are functioning correctly.

6. **NOTE:** If the retractor of a new safety belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. If this is the case, reshape the sheet metal and install another new complete safety belt assembly.

   Should either or both retractors fail to lock up at the 8 km/h (5 mph) speed, repeat the test at a constant 24 km/h (15 mph). This test must be carried out with RH front or rear passenger if RH front or rear belts are to be tested.

7. If either or both shoulder safety belts do not lock up at 24 km/h (15 mph) test, return vehicle for repair of malfunctioning safety belts. Remove retractor and rework sheet metal in retractor's mounting surface. Install retractor assembly and retest safety belt assembly(s).

Safety Belt Cleaning

1. **WARNING: Do not bleach or re-dye the webbing, as the webbing may weaken.**

   Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

Safety Belt With Anchor Plate Thread Damage

1. Remove the broken or stripped bolt and discard.
2. Drill out the internal threads in the safety belt anchor plate with a 10.7 mm (27/64 in) drill.
3. Rethread the anchor plate with a 1/2-13 tap (seat belt).
4. Clean out the chips.
5. Install the attachment parts. Original parts are to be replaced with the repair parts indicated in the Safety Belt Parts Replacement Guidelines.
6. When repairing a multiple belt and attachment, install the nut to the bolt in the tunnel area from the underside of the floorpan.

Replacement of the Weld Nut and Reinforcement

1. Remove the interior trim panel to expose the suspect anchor point. For additional information, refer to Section 501-00 .
2. Determine if the weld nut only or the weld nut and reinforcement and weld nut are missing. If the B- or C- or D-pillar safety belt anchor nuts or reinforcements are stripped or missing, a new nut or reinforcement should be installed. To install a missing weld nut only, proceed to Step 3.
3. Obtain the correct M12 weld nut and a standard washer to perform the procedure.
4. Drill out two 8 mm (5/16 in) diameter holes adjacent to the clearance hole.
5. Obtain a length of copper welding wire and feed through clearance hole in door frame opening until it becomes visible at the access hole.
6. Pull the wire through so that it may be secured to the weld nut and washer.
7. Pull the wire back up to the weld nut clearance hole.
8. Hold the weld nut securely in place. Use the MIG Wire Feed Welder 106-00053 to plug weld the nut in place at the two 8 mm (5/16 in) diameter holes previously drilled.
9. Metal finish as required.
10. Verify the nut is securely in place.

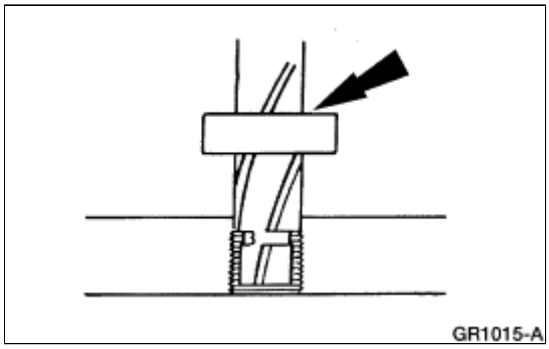
Safety Belt Shoulder Height Adjuster With Stripped Weld Nuts

Special Tool(s)

ST1657-A	D-Ring Installation Kit 100-F012 (134-00018) or equivalent

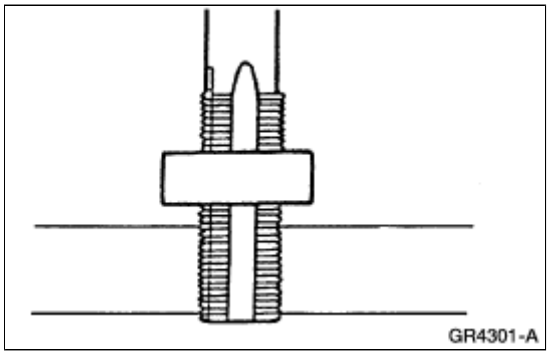
1. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

2. Use the half-inch drill with integral stop provided in D-Ring Installation Kit to drill out the damaged threads in the upper pillar structure.

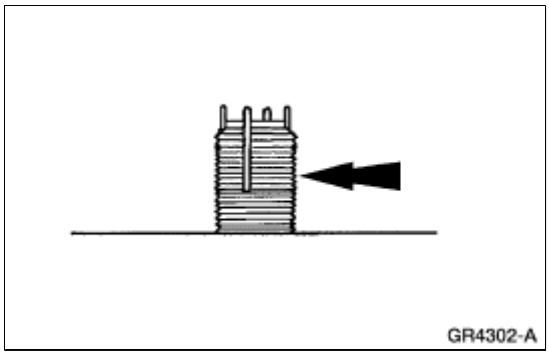

GR1015-A

3. **NOTE:** After each rotation, back off tap slightly to remove new cuttings and be sure to blow out any chips before proceeding.

   Apply a suitable lubricant to the M14 x 1.5 tap with integral stop provided in D-Ring Installation Kit and tap new threads.

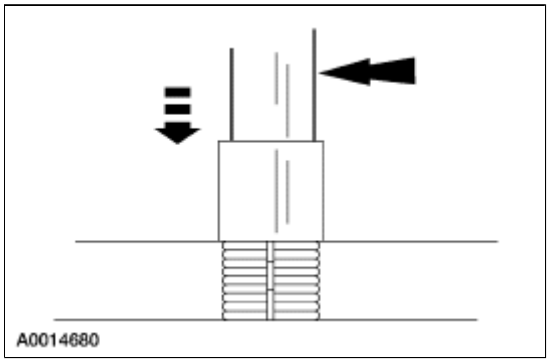

GR4301-A

4. Use a threaded insert (N807170-S190) provided in the D-Ring Installation Kit and screw it into the retapped hole until it is slightly below the surface.



5. **NOTE:** If the two bolts on the height adjuster are not stripped, install the height adjuster. For additional information, refer to the appropriate height adjuster procedure in this section.

   Use a hammer to lightly tap the installation tool provided in the D-Ring Installation Kit several times to seat the insert keys.



Safety Belt Procedure After a Collision

1. **WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters, if so equipped, child safety seat tether attachments, and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.**

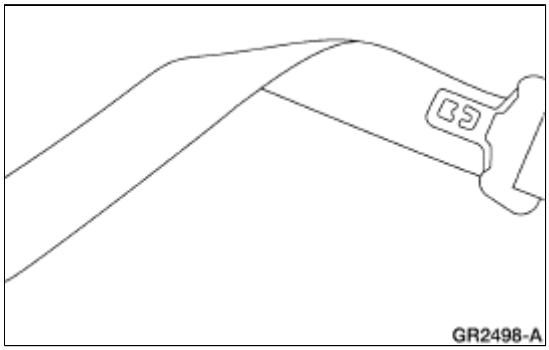
   NOTE: Safety belt assemblies should be periodically inspected to make sure they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.

   Before installing the new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

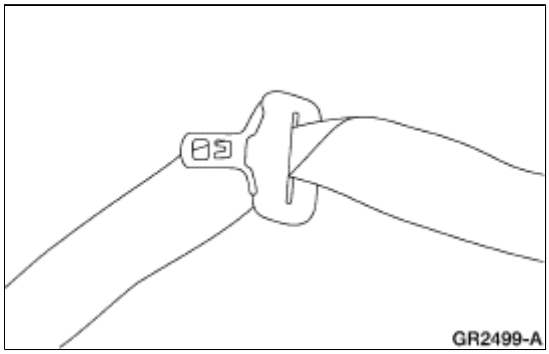
   Install the new safety belt(s) using the appropriate instructions. Perform the Functional Test.

Safety Belt Tongue Rotated on Belt

1. Fold the safety belt as indicated.



2. Pull the safety belt tongue over the fold in the safety belt.



Automatic Locking Retractor —Evaluation of Lockability and Release

WARNING: After any vehicle collision, the safety belt system at all outboard seating positions (except driver, which has no "automatic locking retractor" feature) must be checked by a qualified technician to verify that the "automatic locking retractor" feature for child seats is still functioning properly, in addition to other checks for proper safety belt system function. A belt and retractor assembly must be replaced if the safety belt assembly's "automatic locking retractor" feature, or any other safety belt function, is not operating properly when checked according to the procedures in the workshop manual. Failure to replace the belt and retractor assembly could increase the risk of injury in collisions.

1. Extend the safety belt to latch the tongue into the buckle across an empty seat without slack in the safety belt, with the seat in the full down and rearmost position, seat back in an upright position, and if applicable, the D-ring adjusted in the full down position.

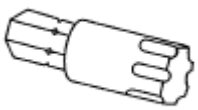
2. Pull the shoulder belt to full extension to engage the retractor's automatic locking retractor (ALR) feature. Then allow the belt to retract freely in the ALR mode, and the retractor force set the correct belt tightness.

3. Pull on the shoulder belt to check that the belt has remained in the ALR mode. If the belt is not locked, install a new belt and retractor assembly. The safety belt should remain locked in the ALR mode across an empty seat.

4. To verify that the safety belt still automatically disengages from the ALR mode correctly, with the D-ring adjusted to the full up position, if applicable, unlatch the safety belt tongue from the buckle and allow the safety belt to retract to its stowed position. Pull on the shoulder belt to verify that the retractor assembly has converted automatically out of the ALR mode. If the belt remains locked in the stowed position, a new belt and retractor assembly must be installed. The safety belt should extract freely.

Retractor —B-Pillar, Two-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

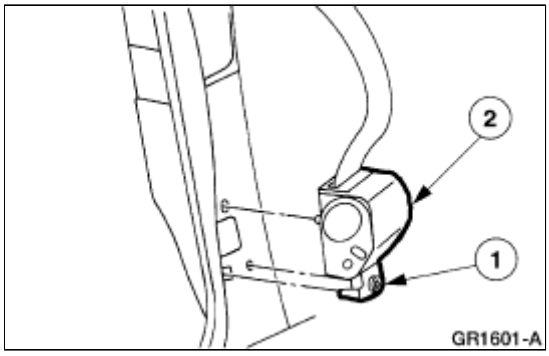
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Remove the quarter trim panel. For additional information, refer to Section 501-05 .

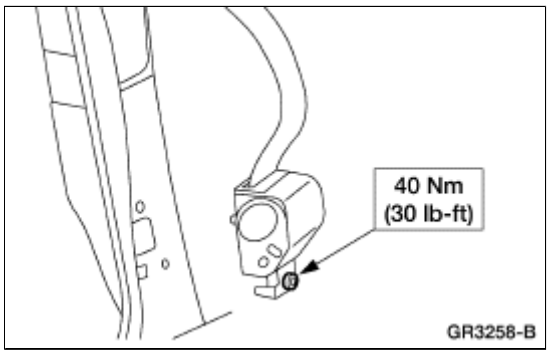
2. Remove the front safety belt retractor.
    1. Use Safety Belt Bolt Bit to remove the bolt.
    2. Remove the front safety belt retractor.



Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

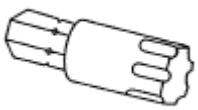
1. Use Safety Belt Bolt Bit to install the front safety belt retractor.



2. Install the quarter trim panel. For additional information, refer to Section 501-05 .
3. Check the restraint system for proper operation.

Retractor —Driver Side and Outside Passenger, B-Pillar, Four-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

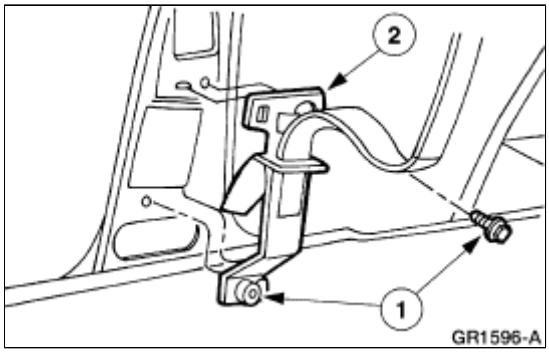
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

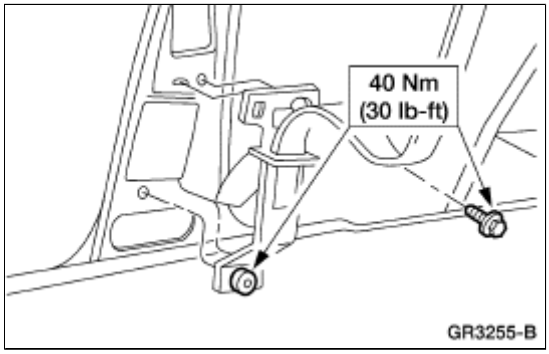
2. Remove the front safety belt retractor.
    1. Use Safety Belt Bolt Bit to remove the bolts.
    2. Remove the front safety belt retractor.



Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

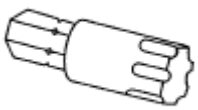
1. Use Safety Belt Bolt Bit to install the front safety belt retractor.



2. Install the B-pillar trim panel. For additional information, refer to Section 501-05 .
3. Check the restraint system for proper operation.

Retractor —Driver Side and Outside Passenger, B-Pillar, Four-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

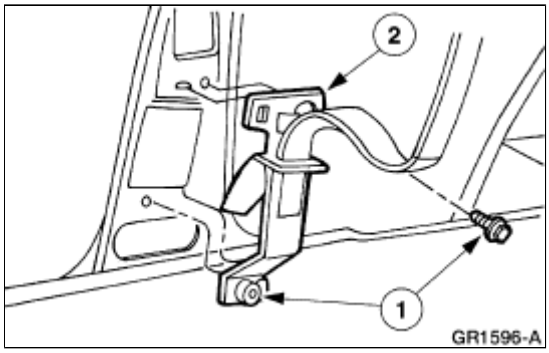
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

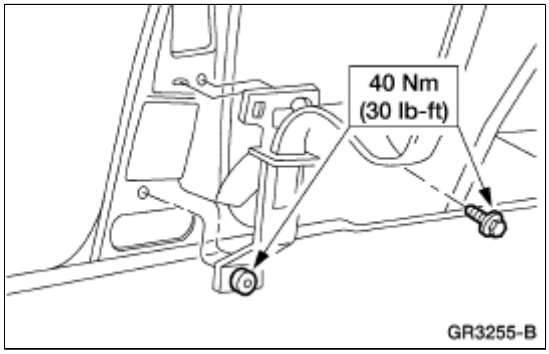
2. Remove the front safety belt retractor.
    1. Use Safety Belt Bolt Bit to remove the bolts.
    2. Remove the front safety belt retractor.



Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

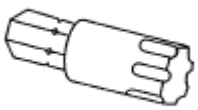
1. Use Safety Belt Bolt Bit to install the front safety belt retractor.



2. Install the B-pillar trim panel. For additional information, refer to Section 501-05 .
3. Check the restraint system for proper operation.

Retractor —C-Pillar, Four-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

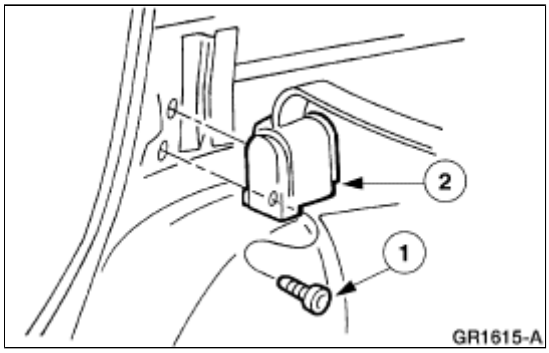
Material

Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

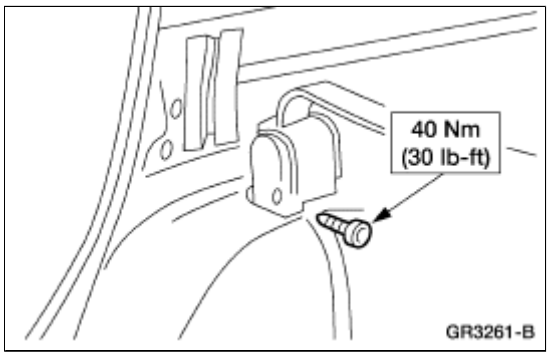
1. Remove the quarter trim panel; refer to Section 501-05 .
2. Remove the safety belt retractor.
    1. Use Safety Belt Bolt Bit to remove the bolt.
    2. Remove the safety belt retractor.



Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

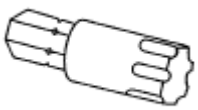
1. Use Safety Belt Bolt Bit to install the safety belt retractor.



2. Install the quarter trim panel. For additional information, refer to Section 501-05 .
3. Check the restraint system for proper operation.

Retractor —C-Pillar, Two-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

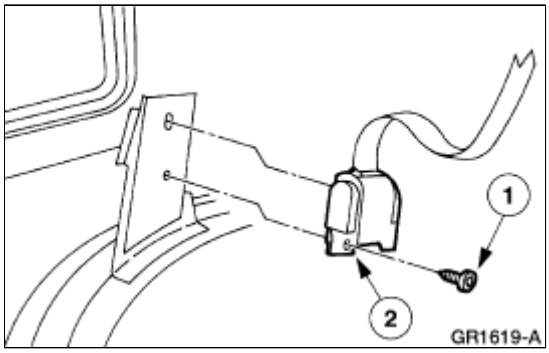
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Remove the quarter trim panel. For additional information, refer to Section 501-05 .

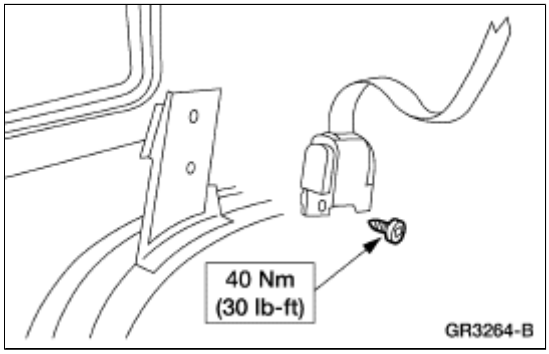
2. Remove the safety belt retractor.
    1. Use Safety Belt Bolt Bit to remove the bolts.
    2. Remove the safety belt retractor.



Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

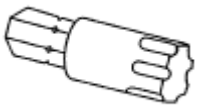
1. Use Safety Belt Bolt Bit to install the safety belt retractor.



2. Install the quarter trim panel. For additional information, refer to Section 501-05 .
3. Check the restraint system for proper operation.

Retractor —Rear Seat, Retractor and Buckle Assembly, Four-Door

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

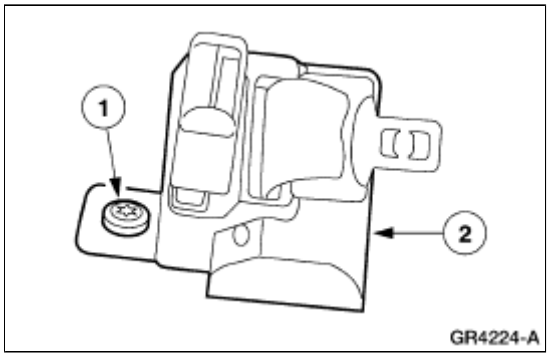
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Fold the rear seat down to load floor position.

2. Remove the rear safety belt buckle and retractor assembly.
    1. Use Safety Belt Bolt Bit to remove the bolt.
    2. Remove the rear safety belt buckle and retractor assembly.

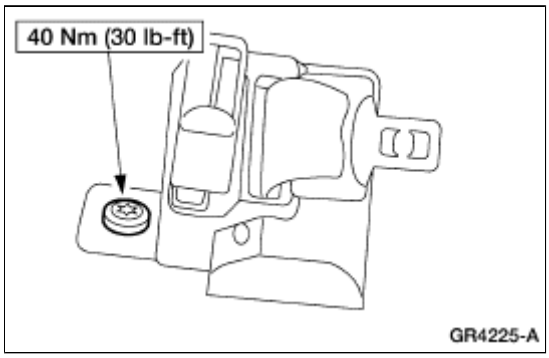


Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

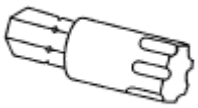
1. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   To install, reverse the removal procedure.
   - Check the restraint system for proper operation.



Height Adjuster

Special Tool(s)

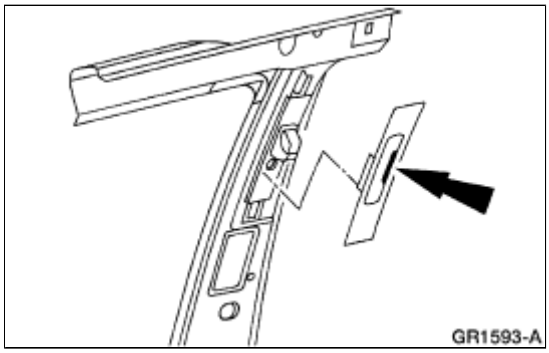
 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

Material

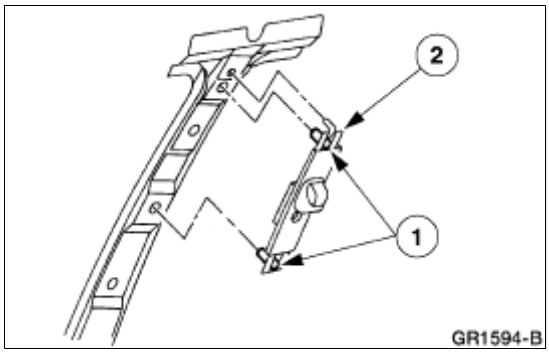
Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

1. On four-door models, remove the B-pillar trim panel. For additional information, refer to Section 501-05 .
2. On two-door models, remove the quarter trim panel. For additional information, refer to Section 501-05 .
3. Remove the height adjuster cover (602B90).



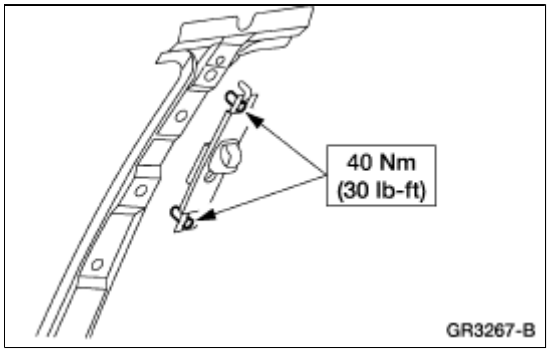
4. Remove the shoulder safety belt height adjuster (602B82).
    1. Use Safety Belt Bolt Bit to remove the two bolts.
    2. Remove the shoulder safety belt height adjuster.



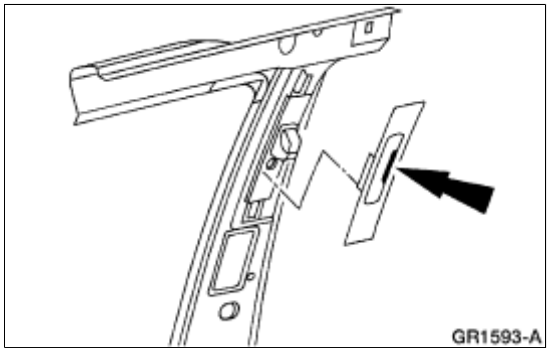
Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

1. Use Safety Belt Bolt Bit and install the shoulder safety belt height adjuster.



2. Install the height adjuster cover.



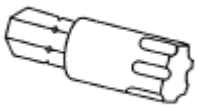
3. On two door models, install the quarter trim panel. For additional information, refer to Section 501-05 .

4. On four door models, install the B-pillar trim panel. For additional information, refer to Section 501-05 .

5. Check the restraint system for proper operation.

Safety Belt Buckle —Bucket Seats

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit (Used for T-50 Head Bolt) 501-010 (T77L-2100-A)

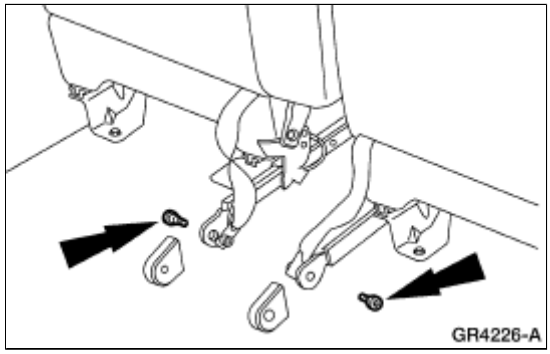
Material

Item	Specification
Ford Threadlock 262 (E2F2-19554-B) or equivalent	WSK-M2G351-A6

Removal

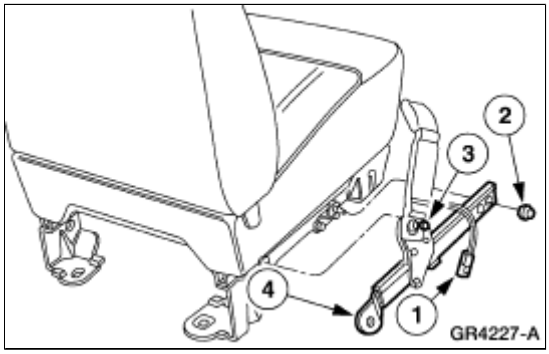
WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

1. Remove the floor console. For additional information, refer to Section 501-12 .
2. Move the seat forward and use Safety Belt Bolt Bit to remove the slide bar bolt.


GR4226-A

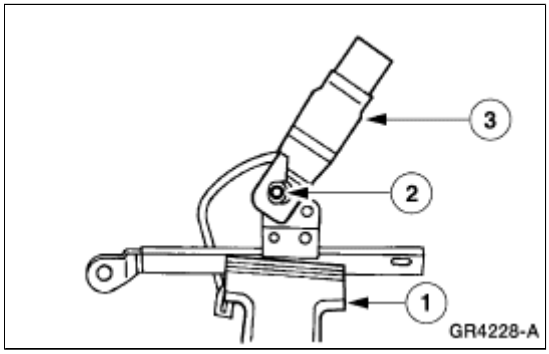
3. Remove the front seat. For additional information, refer to Section 501-10 .
4. Remove the safety belt slide bar.
    1. Disconnect the electrical connector (LH only).
    2. Remove the nut.
    3. Remove the bolt.

4. Remove the slide bar.



5. **NOTE:** Clamp the slide bar collar in a vise along the break line only.

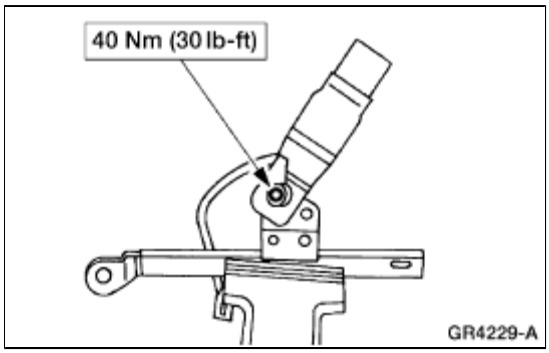
Remove the safety belt buckle.
1. Clamp the slide bar in a suitable vise.
2. Use Safety Belt Bolt Bit to remove the bolt.
3. Remove the buckle.

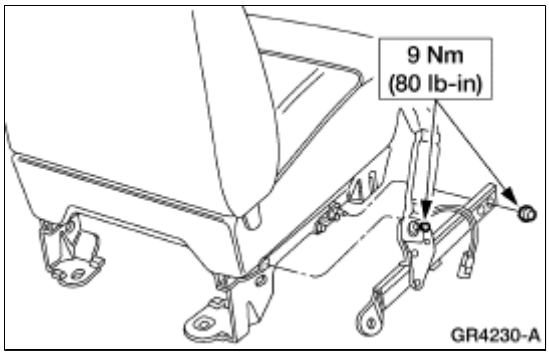


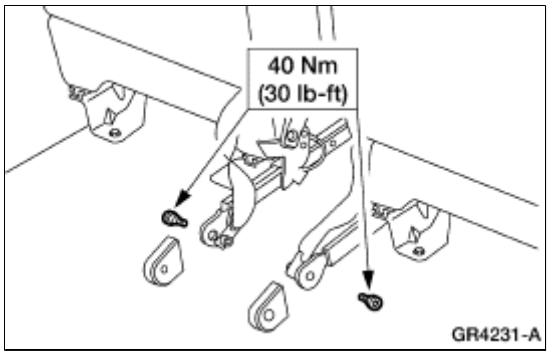
Installation

NOTE: Apply Ford Threadlock 262 (E2FZ-19554-B) or equivalent to fasteners when installing safety belt buckle or retractor assemblies.

1. To install, reverse the removal procedure.




9 Nm
(80 lb-in)
GR4230-A


40 Nm
(30 lb-ft)
GR4231-A

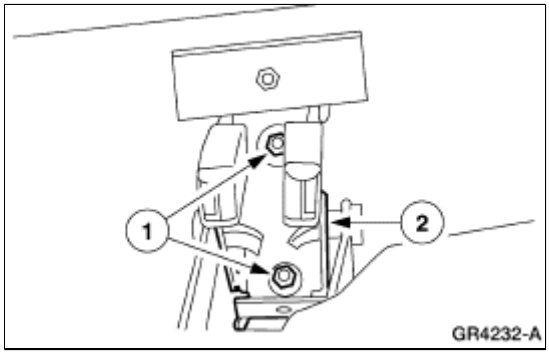
Safety Belt Buckle —Rear Seat, Four-Door

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

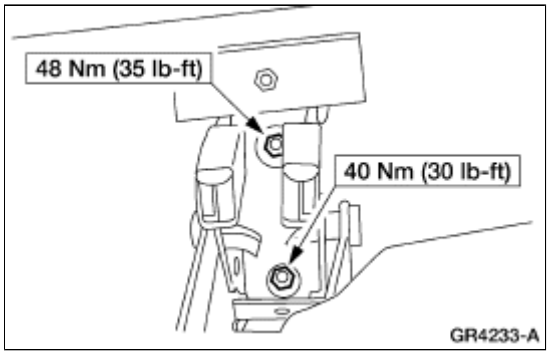
1. Remove the rear seats. For additional information, refer to Section 501-10 .

2. Remove the rear safety belt buckle assembly.
    1. Remove the nuts.
    2. Remove the rear safety belt buckle assembly.



Installation

1. To install, reverse the removal procedure.
    - Check the restraint system for correct operation.



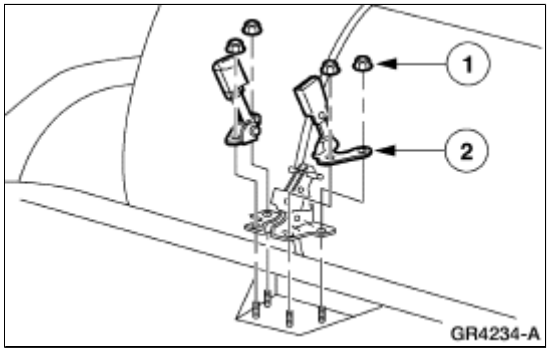
Safety Belt Buckle —Rear Seat, Two-Door

Removal

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate properly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.

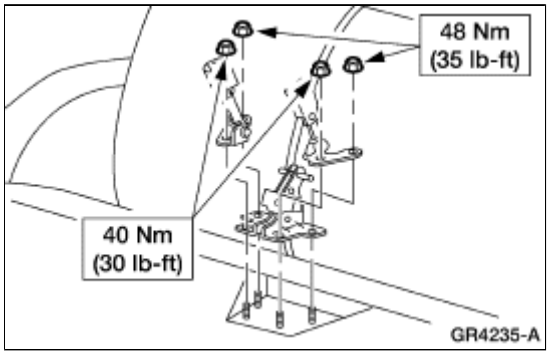
1. Remove the rear seats. For additional information, refer to Section 501-10 .

2. Remove the rear safety belt buckles.
    1. Remove the nuts.
    2. Remove the rear safety belt buckles.



Installation

1. To install, reverse the removal procedure.
    - Check the restraint system for correct operation.



General Specifications

Item	Specification
Connector Identification	
Butt connector E6FZ-14488-A	Gauge 18-22, Red, Class C
Butt connector E6FZ-14488-B	Gauge, 14-16, Blue, Class C
Butt connector E6FZ-14488-C	Gauge 10-12, Yellow, Class C

Torque Specifications

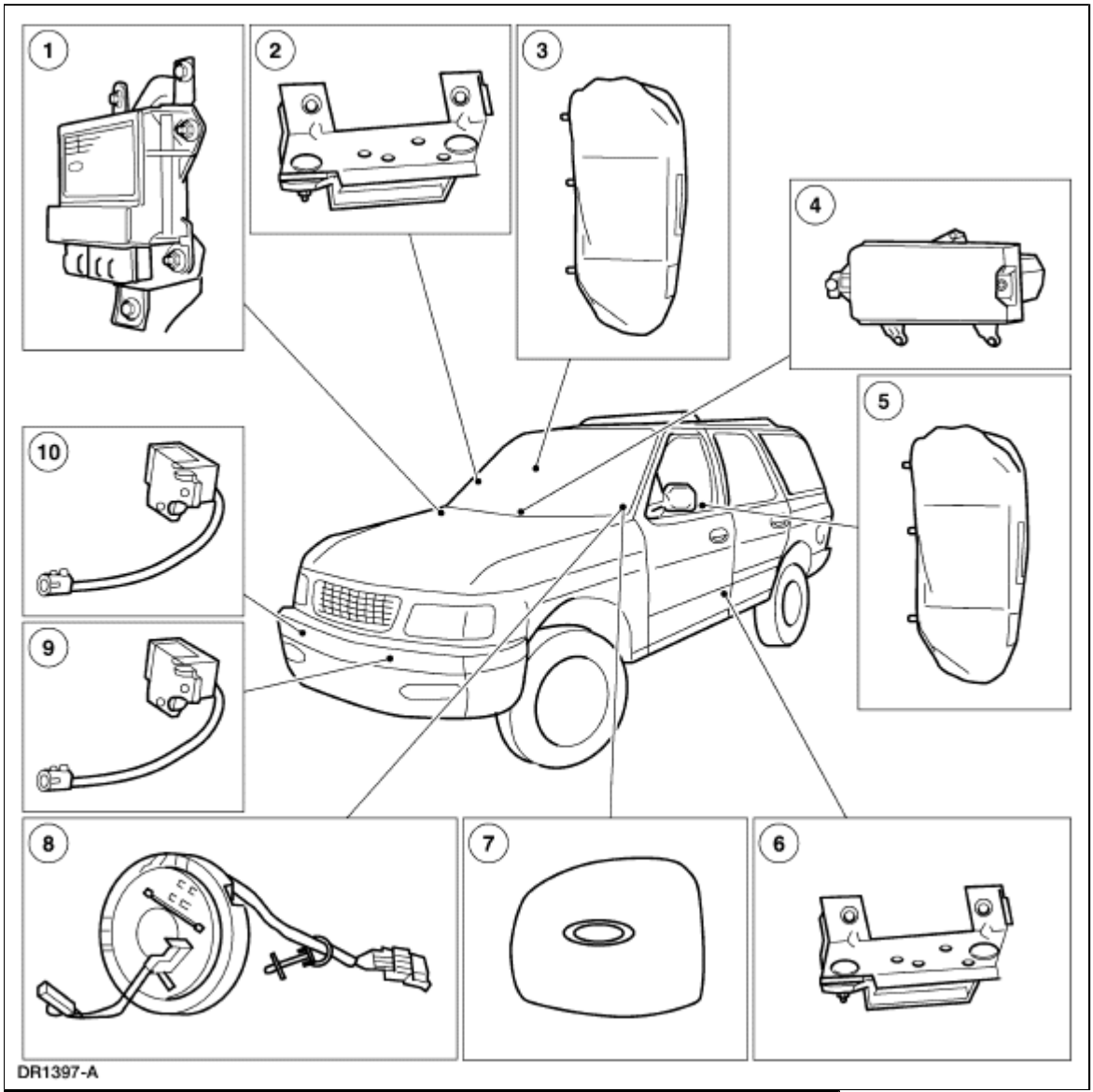
Description	Nm	lb-ft	lb-in
Side crash sensor	12	9	—
Restraints control module bracket	12	9	—
Driver air bag module	9	—	80
Passenger air bag module	7.6-10.4	—	67-92
Side air bag module	8	—	71
Seat back pivot bolt	29	21	—
Seat back recliner bolts	52	38	—
Track to cushion frame	20	15	—
Steering column fore and aft nuts	15	11	—
Lower steering column opening finish panel reinforcement	12	9	—
Front crash sensor	10.2-13.8	—	90-122
Weld nut repair screw (8 mm) (N802455-S190)	12	9	—
Grounding screw (6 mm) (N806327-S190)	12	9	—

Air Bag Supplemental Restraint System (SRS)

The air bag supplemental restraint system (SRS) is designed to provide increased collision protection for front seat occupants in addition to that provided by the three-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantage of the SRS.

The air bag supplemental restraint system (SRS) components are shown in the following illustration.

Air Bag Supplemental Restraint System (SRS) Components



Item	Part Number	Description
1	14B321	Restraints control module (RCM)

2	14B345	Side crash sensor (RH)
3	98611D10	Passenger side air bag module
4	044A74	Passenger air bag module
5	78611D11	Driver side air bag module
6	14B345	Side crash sensor (LH)
7	043B13	Driver air bag module
8	14A664	Air bag sliding contact
9	14B005	Air bag sensor and bracket (LH)
10	14B005	Air bag sensor and bracket (RH)

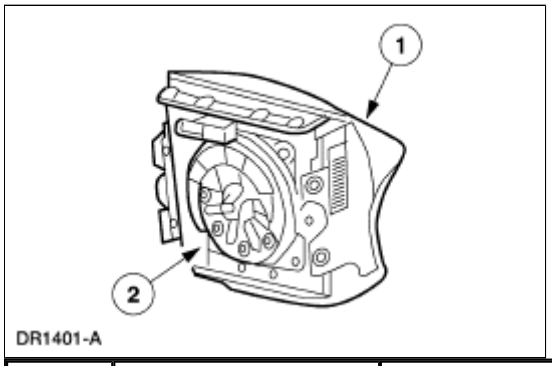
Air Bag Module — Driver

NOTE: References to the driver air bag module must not be confused with the seat-mounted air bag components of the supplemental restraint system (SRS).

The driver air bag module:

- is installed new as an assembly.
- is mounted in the center of the steering wheel.

Driver Air Bag Module



Item	Part Number	Description
1	—	Trim cover (part of 043B13)
2	043B13	Driver air bag module

Air Bag Sliding Contact

The air bag sliding contact:

- is mounted on the steering column, behind the steering wheel.
- continuously transfers electrical signals from the driver air bag module to the restraints control module (RCM).

Air Bag Module — Driver Side

NOTE: References to side air bag modules refer to the seat-mounted and not to the steering wheel or

instrument panel mounted air bag components of the supplemental restraint system (SRS).

The driver side air bag module:

- is installed new as an assembly.
- is mounted in the driver seat back.

Air Bag Module — Passenger Side

NOTE: References to side air bag modules refer to the seat-mounted and not to the steering wheel or instrument panel mounted air bag components of the supplemental restraint system (SRS).

The passenger side air bag module:

- is installed new as an assembly.
- is mounted in the passenger seat back.

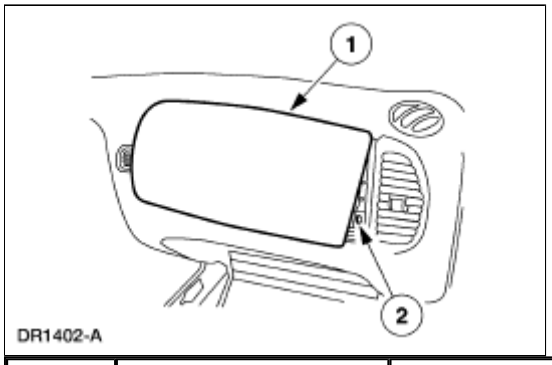
Air Bag Module — Passenger

NOTE: References to the passenger air bag module must not be confused with the seat-mounted air bag components of the supplemental restraint system (SRS).

The passenger air bag module:

- is installed new as an assembly.
- is mounted in the RH side of the instrument panel.

Passenger Air Bag Module



Item	Part Number	Description
1	—	Deployment door (part of 044A74)
2	044A74	Passenger air bag module

Restraints Control Module (RCM)

The restraints control module (RCM) carries out the following functions:

- signals the inflators to deploy the air bags in the event of a deployable crash.
- monitors the air bag supplemental restraint system (SRS) for faults.

- illuminates the air bag indicator if a fault is detected.
- flashes the air bag indicator to indicate the lamp fault code (LFC) detected.
- communicates through the data link connector (DLC) the current or historical Diagnostic Trouble Codes (DTCs).
- signals the generic electronic module (GEM) to activate a chime if the air bag indicator is not available and another SRS fault exists.

NOTE: The safety sensor is internal to the RCM and is not serviced separately.

The RCM monitors the SRS for possible faults. If a fault is detected while the ignition switch is in the RUN position, the RCM will illuminate the air bag indicator located in the instrument cluster.

When the ignition is cycled (turned off and then on), the air bag indicator will prove out by lighting for six seconds and then off for two seconds. After the prove out, the air bag indicator will then flash the two-digit LFC. If an SRS fault exists, the air bag indicator will flash the LFC five times, then it will remain illuminated for the rest of the key cycle. The RCM will also communicate the current and historical DTCs through the DLC, to the scan tool. If the air bag indicator does not function, and the system detects a fault condition, the RCM will signal the GEM to activate an audible chime. The chime is a series of five sets of five tone bursts. If the chime is heard, the SRS and the air bag indicator require repair.

LFCs are prioritized. If two or more faults occur at the same time, the fault having the highest priority will be displayed. After that fault has been corrected, the next highest priority fault will be displayed.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the air bags in the event that the ignition circuit is damaged in a collision before the safing and air bag sensors determine that a deployment is required. The backup power supply will deplete its stored energy approximately one minute after the battery ground cable is disconnected.

Electrical System

The electrical system that supports the air bag supplemental restraint system (SRS):

- is powered from the battery through the ignition circuit.
- provides the electrical path from the restraints control module (RCM) to the air bag modules.
- provides the electrical path from the RCM to the air bag indicator.
- provides the electrical path from the RCM to the data link connector (DLC).
- provides the electrical path from the RCM to the generic electronic module (GEM).

Sensor

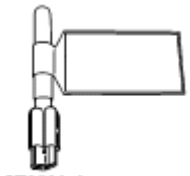
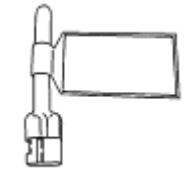
WARNING: The restraints control module (RCM) orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the right cowl A-pillar area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

The SRS contains two sensors which are integral to the RCM. The RCM is mounted on the RH A-pillar.

Air Bag Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell 46 , Air Bag for schematic and connector information.

Special Tool(s)

 ST2506-A	Front Air Bag Simulator (Restraint System Diagnostic Tool) 105-R0012 or Equivalent
 ST2507-A	Side Air Bag Simulator (Restraint System Diagnostic Tool) 418-133 or Equivalent

Restraint System Diagnostic Tool Warning

WARNING: This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Diagnosing Customer Concerns Without Hard Diagnostic Trouble Codes (DTCs)

If a lamp fault code (LFC) is reported by the customer but is not present when the vehicle comes in for repair, follow the Diagnostic Instructions procedure in this section to identify the intermittent DTC.

Once the DTC is known, read the Normal Operation section for the code involved.

- Follow the deactivation procedure in this section.
- Determine the location of components involved in creating that code.
- Carry out a thorough visual inspection of:
  - components.
  - connectors.
  - splices and wiring harnesses.
  - pinched wires.
  - worn insulation on conductors.
  - opens, shorts or loosely mounted sensors.

Refer to Possible Causes, which lists the common concerns that relate to a particular code. Concerns are listed according to priority.

Diagnosing Customer Concerns with Hard Diagnostic Trouble Codes (DTCs)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

Most air bag supplemental restraint system (SRS) diagnostic procedures will require the use of the deactivation and reactivation procedures in this section.

The deactivation procedure requires the removal of the driver air bag and the disconnection of the passenger air bag. Restraint system diagnostic tools are attached to the vehicle harness at the air bag sliding contact and at the electrical connectors for the passenger air bag and the two side air bags. This procedure removes the risk of air bag deployment while diagnostics are carried out.

Restraint system diagnostic tools are required to carry out diagnosis and testing of the SRS. The restraint system diagnostic tool is a 2-ohm resistor used to simulate air bag module connections to the system. It is not acceptable to short-circuit the air bag module connections with a zero-ohm jumper wire. If a zero-ohm jumper wire is used to short-circuit the air bag module connections, a lamp fault code (LFC) will be displayed.

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

The reactivation procedure requires the removal of any restraint system diagnostic tools installed and the reinstallation and reconnection of any air bag modules removed or disconnected.

Deactivation Procedure

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup**

power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Remove the front seats from the vehicle. For additional information, refer to Section 501-10 .

2. **WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

   WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

   Remove the driver air bag module from the vehicle. Refer to Module—Driver Air Bag in this section.

3. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

   NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

   NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

   NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

   NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

   Connect a front restraint system diagnostic tool to the vehicle harness at the top of the steering column.

4. **WARNING: Carry a live air bag module with the air bag and deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

WARNING: Do not set a live air bag module down with the deployment door face down. This will reduce the risk of injury in the event of an accidental deployment.

Disconnect the passenger air bag module electrical connector.

5. Connect a front restraint system diagnostic tool to the vehicle harness.
6. Connect a side restraint system diagnostic tool to the vehicle harness used for the driver side air bag.
7. Connect a side restraint system diagnostic tool to the vehicle harness used for the passenger side air bag.
8. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

Reactivation Procedure

1. **WARNING: The air bag simulators must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.**

   WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.
3. Remove the restraint system diagnostic tool from the vehicle harness connector at the top of the steering column.
4. **WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

   Install the driver air bag module. Refer to Module—Driver Air Bag in this section.
5. Remove the restraint system diagnostic tool from the vehicle harness connector at the passenger air bag module.
6. **WARNING: Carry a live air bag module with the air bag and deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

   Connect the passenger air bag module electrical connector.
7. Remove the restraint system diagnostic tool from the vehicle harness used for the passenger side air bag.

8. Remove the restraint system diagnostic tool from the vehicle harness used for the driver side air bag.
9. Install the front seats. For additional information, refer to Section 501-10 .
10. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .
11. Prove out the system.

Glossary

Restraint System Diagnostic Tools

Restraint system diagnostic tools are used to simulate air bag module connections to the system.

Disconnect the Component

Disconnect the component means disconnect the component vehicle harness connector. It does not mean remove the component. Do not reconnect a disconnected component unless instructed to do so.

Deactivate the System

Deactivate the system means to carry out the deactivation procedure. Refer to Deactivation Procedure in this section.

Prove Out the System

Prove out the system means to turn the ignition switch from the OFF to the RUN position and visually monitor the air bag indicator with the air bag modules installed. The air bag indicator will light continuously for approximately six seconds and then turn off. If an air bag supplemental restraint system (SRS) fault is present, the air bag indicator will either:

- fail to light.
- remain lit continuously.
- flash.

The flashing might not occur until approximately 30 seconds after the ignition switch has been turned from the OFF to the RUN position. This is the time required for the restraints control module (RCM) to complete the testing of the SRS. If the air bag indicator is inoperative and an SRS fault exists, a chime will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be repaired before diagnosis can continue.

Reactivate the System

Reactivate the system means to carry out the reactivation procedure. Refer to Reactivation Procedure in this section.

Reconnect the System

Reconnect the system means to reconnect all system components. Refer to Air Bag Reconnect Checklist in this section.

Install a New Component

Install a new component means to remove the existing component and install a new authorized part obtained from Ford Customer Service Division.

Verify the System

Verify the system means to prove out the system with restraint system diagnostic tools for the air bag modules in place of the components.

Air Bag Reconnect Checklist

The checklist below should be completed following diagnosis or repair of any air bag system concern:

1. Is the three-way connector at the base of the steering column connected?
2. Are the air bag modules connected?
3. Is the restraints control module (RCM) connected?
4. Is the vehicle battery connected?

Diagnostic Instructions — Air Bag Supplemental Restraint System (SRS)

Special Tool(s)

ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

The symptom chart can be used to help locate the air bag supplemental restraint system (SRS) concerns if no diagnostic trouble codes (DTCs) are retrieved and the listed symptoms are observed. Whether or not the listed symptoms are observed, always carry out the following:

1. Retrieve all DTCs stored in the restraints control module (RCM) memory. Refer to Retrieve/Clear Continuous DTCs in this section.

2. Run the On-Demand Self Test to determine what DTCs are currently being sensed by the RCM; refer to On-Demand Self Test in this section.

3. If the stored DTCs are different than the current DTCs, always repair the current DTCs first.

4. If memory displays different continuous DTCs than the On-Demand Self Test, perform in the following order:

- On-Demand Self Test.
- Memory (Retrieve/Clear Continuous DTCs).

A DTC can indicate several concerns. The DTCs are to assist in system diagnosis and are not to be considered definitive. Always refer to the pinpoint test corresponding to the DTC to determine where the concern lies and to repair the concern correctly.

The SRS diagnostics can be divided into three sections:

- diagnostic test modes.
- PID/data monitor and record.
- active command modes.

Diagnostic Test Modes

Two menu options are available under the diagnostic test modes:

- Retrieve/Clear Continuous DTCs.

- On-Demand Self Test.

Retrieve/Clear Continuous DTCs

During vehicle operation the restraints control module (RCM) will detect and store both intermittent and hard fault DTCs in nonvolatile memory. The DTC strategy employed by the RCM incorporates a time-out scheme for determining when a concern exists in the system. This requires a concern to exist for up to one minute in the system before the RCM will detect it. For the RCM to determine that a concern no longer exists, the concern must be absent for up to one minute. The actual detection time-outs vary with each DTC. The DTCs can be retrieved with the scan tool. Any DTCs stored in the RCM will be displayed on the scan tool along with a brief description of the DTC. If no DTCs are present, the scan tool will display a SYSTEM PASSED message. The scan tool can also be used to clear DTCs from the RCM memory, as long as the concern no longer exists. Once 254 key cycles have been recorded since the concern was last detected, the DTC will automatically be removed from memory.

To retrieve or clear DTCs, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. All continuous DTCs will be displayed on the screen. Before proceeding with the clearing operation, make note of the DTCs displayed, because once cleared, they cannot be retrieved. Hard DTCs will be redisplayed after clearing DTCs since they cannot be cleared from the RCM.

On-Demand Self Test

The On-Demand Self Test option is used to verify that no electrical concerns exist with the air bag supplemental restraint system (SRS). Upon entering the self test, the restraint control module (RCM) will make an electrical check of each electrical component in the system. If a concern is detected, a DTC is displayed on the scan tool with a brief description of the DTC. Concerns detected during the self test are not stored in memory, unless the same concern was also detected during normal vehicle operation. The self test should always be run after any repair to verify that the repair was successful.

To run the On-Demand Self Test, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. The RCM will run the On-Demand Self Test and display on-demand DTCs (reflecting hard system concerns) on the screen.

PID/Data Monitor and Record

The PID/Data Monitor and Record option allows the scan tool operator to read the state of several parameter IDs (PIDs) to aid in diagnosing the system. PIDs are real time measurements of parameters such as voltages, resistances, etc., calculated by the restraints control module (RCM) and sent to the scan tool for display. Many of the PIDs supported by the RCM are calculated periodically and are, therefore, not true real time readings.

To retrieve PIDs, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. PIDs are updated continuously on the display.

Active Commands

This command allows the technician to verify operation of the air bag indicator and chime. When the air bag

output command is executed, the indicator and the chime are activated simultaneously for approximately four seconds. Both devices are deactivated automatically.

Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table

DTC [a]	LFC [b]	LFC Priority	Description	Action To Take
—	—	1	RCM Disconnected, Inoperative, or Lost/Low Ignition Feed	GO to Pinpoint Test A .
B1318	—	—	Ignition Voltage Below 9 Volts	CHECK battery voltage. REFER to Section 414-01 .
B1342	24	2	RCM is Faulted	GO to Pinpoint Test B .
B1231	19	3	RCM Crash Data Memory Full	GO to Pinpoint Test C .
B1921	21	4	RCM Bracket Ground Resistance High	GO to Pinpoint Test D .
C1414	29	5	Incorrect Vehicle Identification Code	GO to Pinpoint Test E .
B1887	15	6	Driver Air Bag Circuit Shorted to Ground	GO to Pinpoint Test F .
B1916	15	7	Driver Air Bag Circuit Shorted to Battery or Ignition	GO to Pinpoint Test G .
B1888	16	8	Passenger Air Bag Circuit Shorted to Ground	GO to Pinpoint Test H .
B1925	16	9	Passenger Air Bag Circuit Shorted to Battery or Ignition	GO to Pinpoint Test I .
B1932	32	10	Driver Air Bag Circuit Resistance High	GO to Pinpoint Test J .
B1933	33	11	Passenger Air Bag Circuit Resistance High	GO to Pinpoint Test K .
B1934	34	12	Driver Air Bag Circuit Resistance Low	GO to Pinpoint Test L .
B1935	35	13	Passenger Air Bag Circuit Resistance Low	GO to Pinpoint Test M .
B1901	14	14	Front External Crash Sensor Shorted to Ground	GO to Pinpoint Test N .
B1941	41	15	Front External Crash Sensor Open Circuit or Short to Battery	GO to Pinpoint Test O .
B2444	48	16	Driver Side Crash Sensor is Faulted	GO to Pinpoint Test P .
B2445	49	17	Passenger Side Crash Sensor is Faulted	GO to Pinpoint Test Q .
B2441	42	18	Driver Side Crash Sensor Mounting Fault	GO to Pinpoint Test R .
B2440	43	19	Passenger Side Crash Sensor Mounting Fault	GO to Pinpoint Test S .
U2017	44	20	Driver Side Crash Sensor Communication Fault	GO to Pinpoint Test T .
U2018	45	21	Passenger Side Crash Sensor Communication Fault	GO to Pinpoint Test U .
B1993	36	22	Driver Side Air Bag Circuit Shorted to Ground	GO to Pinpoint Test V .
B1992	36	24	Driver Side Air Bag Circuit Shorted to Battery or Ignition	GO to Pinpoint Test W .
B1994	36	26	Driver Side Air Bag Circuit Resistance High	GO to Pinpoint Test X .

B1995	36	28	Driver Side Air Bag Circuit Resistance Low	GO to Pinpoint Test Y .
B1997	37	23	Passenger Side Air Bag Circuit Shorted to Ground	GO to Pinpoint Test Z .
B1996	37	25	Passenger Side Air Bag Circuit Shorted to Battery or Ignition	GO to Pinpoint Test AA .
B1998	37	27	Passenger Side Air Bag Circuit Resistance High	GO to Pinpoint Test AB .
B1999	37	29	Passenger Side Air Bag Circuit Resistance Low	GO to Pinpoint Test AC .
B1892	—	30	Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open	GO to Pinpoint Test AD .
B1891	—	31	Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition	GO to Pinpoint Test AE .
B1869	Tone [c]	32	Air Bag Indicator Inoperative	GO to Pinpoint Test AF .
B1870	Tone [c]	33	Air Bag Indicator Shorted to Battery	GO to Pinpoint Test AG .
—	—	—	No Communication With the Restraints Control Module (RCM)	GO to Pinpoint Test AH .

[a] DTC: Diagnostic trouble code, retrieved using scan tool.
[b] LFC: Lamp fault code, flashed on air bag indicator.
[c] Tone will sound only if additional DTCs are present.

Inspection and Verification

1. Verify the customer concern by checking the air bag indicator in the instrument cluster. Refer to Prove Out the System in this section.

2. Visually inspect for obvious signs of mechanical and electrical damage using the following chart.

Visual Inspection Chart

Mechanical	Electrical
• Damaged restraints control module (RCM) bracket • Damaged front external crash sensor bracket	• Open fuse(s) • Damaged wiring harness • Loose or corroded connectors • Circuitry open/shorted • Damaged shorting bars

3. If the concern is not visually evident, use the scan tool to retrieve diagnostic trouble codes (DTCs) and carry out the on-demand self test.

4. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag

system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

If the on-demand self test is passed and no DTCs are retrieved, proceed to the symptom chart.

5. If DTCs are retrieved, refer to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table.

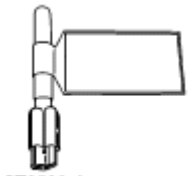
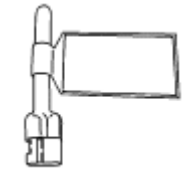
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Air bag warning indicator is illuminated continuously	• Ignition circuits. • Ground circuits. • RCM. • Connector shorting bar. • RCM camming beam. • RCM disconnected. • Other circuitry. • Instrument cluster.	• GO to Pinpoint Test A .
• Air bag indicator flashing	• Air bag SRS system fault.	• REFER to DTC Priority Table.
• Audible tone — DTCs retrieved	• Air bag SRS system fault.	• GO to Pinpoint Test AF . • GO to Pinpoint Test AG .
• No communication with the restraints control module (RCM)	• Scan Tool. • Data Link Connector (DLC). • RCM. • Circuitry.	• GO to Pinpoint Test AH .

Pinpoint Tests — Air Bag Supplemental Restraint System (SRS)

Special Tool(s)

ST1137-A	73 Digital Multimeter 105-R0051 or Equivalent
 ST2506-A	Front Air Bag Simulator (Restraint System Diagnostic Tool) 105-R0012 or Equivalent
 ST2507-A	Side Air Bag Simulator (Restraint System Diagnostic Tool) 418-133 or Equivalent
ST2332-A	Worldwide Diagnostic System 418-F224, New Generation STAR (NGS) Tester 418-F048, or equivalent scan tool

Restraint System Diagnostic Tool Warning

WARNING: This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Pinpoint Test A: Air Bag Warning Indicator Is Illuminated Continuously — RCM Disconnected, Inoperative or Lost/Low Ignition Feed

Normal Operation

NOTE: During normal operation the air bag indicator will be lit continuously for 6 seconds after the ignition switch is placed in the RUN position and after five cycles of a lamp fault code (LFC) if a fault exists. Be sure to cycle the ignition switch and look for a 6 second indicator prove-out without LFCs.

The restraints control module (RCM) will communicate diagnostic trouble codes (DTCs) to the scan tool through the data link connector (DLC). If the scan tool displays NO COMMUNICATION when retrieving continuous DTCs, use Pinpoint Test AH to troubleshoot the system.

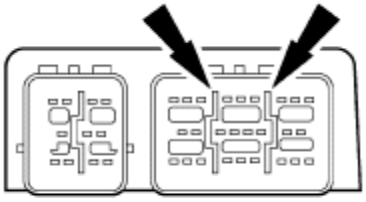
Possible Causes

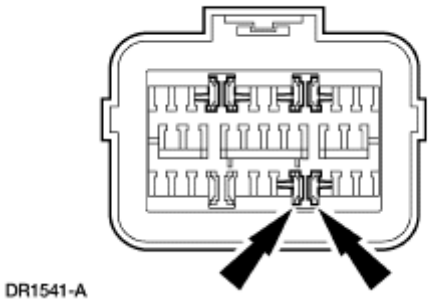
An air bag indicator that is illuminated continuously can be caused by one of the following:

- the ignition circuit damaged.
- the RCM disconnected from the vehicle harness.
- a loss of RCM ground.
- the RCM inoperative.
- other circuitry.
- worn or damaged shorting bar or camming beam.

PINPOINT TEST A: AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY — RCM DISCONNECTED, INOPERATIVE OR LOST/LOW IGNITION FEED

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FOR CONTINUOUS OR ON-DEMAND SELF TEST DTCs	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Were any continuous or on-demand self test DTCs retrieved?** → **Yes** If continuous DTCs were retrieved, GO to

	A3 . If on-demand DTCs were retrieved, GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** GO to A2 .
A2 CHECK THE RCM CONNECTION	
1 RCM C232	1 Make sure RCM C232 is fully connected and the red locking tab is engaged. • **Is RCM C232 fully connected and are the red locking tabs engaged?** → **Yes** GO to A3 . → **No** CONNECT C232 and ENGAGE the locking tabs. GO to A7 .
A3 CHECK THE RCM CONNECTOR	
1 2 RCM C232 3  DR1540-A 4	3 Inspect C232 component side for a worn or damaged camming beam. Inspect for foreign material. 4 **NOTE:** The shorting bars can be accessed by prying out the blue cover from the harness side of the connector.


DR1541-A

Inspect C232 harness side for worn, damaged, or dislodged shorting bar at pins 20 and 21. Inspect for foreign material.

- **Were any connector concerns found?**

→ **Yes**
CORRECT connector concerns. GO to A7 .

→ **No**
GO to A4 .

A4 CHECK THE IGNITION CIRCUIT 364 (BK/LG) FOR AN OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

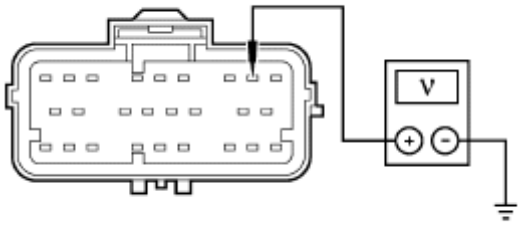
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 Deactivate the system.

2

3

3 Measure the voltage between RCM C232 pin 2, circuit 364 (BK/LG), harness side and ground.



DR0994-A

- **Is the voltage between 9 and 16 volts?**

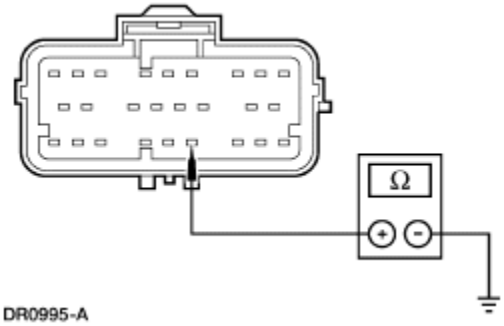
→ **Yes**
GO to A5 .

→ **No**
REPAIR the circuit. GO to A7 .

A5 CHECK THE GROUND CIRCUIT 649 (BK/OG) FOR AN OPEN

1

2



DR0995-A

2 Measure the resistance between RCM C232 pin 21, circuit 649 (BK/OG), harness side and a sheet metal ground near the RCM.

- **Is the resistance less than 10 ohms?**

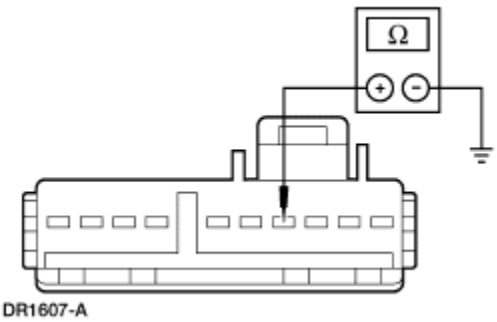
→ **Yes**
GO to A6 .

→ **No**
REPAIR the circuit. GO to A7 .

A6 CHECK CIRCUIT 608 (BK/YE) FOR A SHORT TO GROUND

1

Instrument Cluster C288

2 RCM C232 3  DR1607-A	3 Measure the resistance to ground at instrument cluster C288 pin 4, circuit 608 (BK/YE), harness side. • **Is the resistance less than 10,000 ohms?** → **Yes** REPAIR the circuit. GO to A7 . → **No** INSTALL a new RCM. GO to A7 .
A7 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step A1. • **Were any continuous DTCs retrieved during Step A1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test B: LFC 24/DTC B1342 — RCM Is Faulted

Normal Operation

The restraints control module (RCM) monitors the backup power supply, accelerometer operation and memory. If the RCM detects a fault in any of these components, it will store a diagnostic trouble code (DTC) B1342 in memory and flash a lamp fault code (LFC) 24 on the air bag indicator.

Possible Causes

An RCM fault can be caused by:

- the backup power supply not operating correctly.
- an internal module circuit fault detected.
- a microcontroller RAM/ROM/EEPROM fault.

PINPOINT TEST B: LFC 24/DTC B1342 — RCM IS FAULTED

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK FOR A HARD OR INTERMITTENT DTC	
1	
2 Scan Tool	
3	
4 Retrieve/Clear Continuous DTCs	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.
5 On-Demand Self Test	• **Was DTC B1342 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be

	cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. INSTALL a new RCM. GO to B2 . → **No** This is an intermittent fault. The fault condition is not present at this time. INSTALL a new RCM. GO to B2 .
B2 CHECK FOR ADDITIONAL DTCs	
	1 Refer to the continuous DTCs recorded during Step B1. • **Were any continuous DTCs retrieved during Step B1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** CLEAR all DTCs.

Pinpoint Test C: LFC 19/DTC B1231 — RCM Crash Data Memory Full

Normal Operation

WARNING: The restraints control module (RCM) orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the right cowl A-pillar area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

WARNING: A new RCM must be installed if the air bag modules have deployed.

WARNING: Clearing DTC B1231 will potentially remove all record of the crash event.

When the air bags are deployed during a collision, the restraints control module (RCM) will flash a lamp fault code (LFC) 19 on the air bag indicator and store a diagnostic trouble code (DTC) B1231 in memory. The LFC 19 and DTC B1231 indicate that a crash has been recorded by the RCM.

Possible Causes

Crash data memory full is caused by a crash event that deployed the air bags.

PINPOINT TEST C: LFC 19/DTC B1231 — RCM CRASH DATA MEMORY FULL

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK FOR A HARD OR INTERMITTENT DTC	
1	

2

Scan Tool

3

4

Retrieve/Clear Continuous DTCs

5

On-Demand Self Test

4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

- **Was DTC B1231 retrieved during the on-demand self test?**

→ **Yes**
This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. INSTALL a new driver air bag module and passenger air bag module. GO to C2 .

→ **No**
This is an intermittent fault. The fault condition is not present at this time. GO to C3 .

C2 CHECK THE CONDITION OF THE RCM MOUNTING BRACKET

1 Inspect the RCM mounting bracket for damage.

- **Is there any damage to the RCM mounting bracket?**

→ **Yes**
RESTORE sheet metal to its original shape and structural integrity. INSTALL a new RCM and mounting bracket. GO to C3 .

→ **No**
INSTALL a new RCM. GO to C3 .

C3 CHECK FOR ADDITIONAL DTCs	
	1 Refer to the continuous DTCs recorded during Step C1. • **Were any continuous DTCs retrieved during Step C1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** CLEAR all DTCs.

Pinpoint Test D: LFC 21/DTC B1921 — RCM Bracket Ground Resistance High

Normal Operation

WARNING: The tightening torque of the restraints control module (RCM) retaining bolts is critical for correct air bag supplemental restraint system (SRS) operation. Refer to Module—Restraints Control in this section for correct torque values.

The restraints control module (RCM) monitors the resistance between the ground connections at its housing and the reference ground at pin 21. If the RCM detects a resistance greater than 100 ohms, it will store a diagnostic trouble code (DTC) B1921 in memory and flash a lamp fault code (LFC) 21 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

High resistance between the RCM housing ground and pin ground can be caused by:

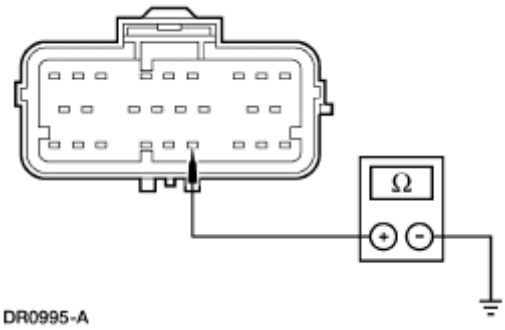
- incorrect seating of the RCM retaining bolts.
- incorrect tightening torque of the RCM retaining bolts.
- high resistance on RCM logic ground circuit 649 (BK/OG).

PINPOINT TEST D: LFC 21/DTC B1921 — RCM BRACKET GROUND RESISTANCE HIGH

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK FOR A HARD OR INTERMITTENT DTC	
1	
2	

Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1921 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to D2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to D6 .
D2 INSPECT THE RCM MOUNTING, MOUNTING BRACKET AND MOUNTING SURFACE	
	1 Remove the RCM. Refer to Module—Restraints Control in this section. 2 Visually inspect the RCM, mounting bracket and mounting surface for damage, corrosion or dirt. 3 Inspect the RCM mounting and make sure that the retaining bolts are fully seated and tightened correctly. Refer to Module—Restraints Control in this section for correct tightening torque. • **Was a significant amount of corrosion or dirt found, the RCM mounting bracket attached to the mounting surface incorrectly or the three RCM retaining bolts not fully seated and tightened correctly?** → **Yes** MAKE SURE the RCM, mounting bracket and

	mounting surface are free of damage, corrosion or dirt, and the three retaining bolts are fully seated and correctly tightened. REATTACH the RCM and mounting bracket to the mounting surface. GO to D7 . → **No** GO to D3 .
D3 CHECK THE RCM HARNESS CONNECTION	
	1 Inspect the RCM harness pins and check the RCM harness connection. • **Are the RCM harness pins OK and are the RCM harness connectors connected to the RCM correctly with the red locking clips engaged?** → **Yes** GO to D4 . → **No** ATTACH the RCM harness connectors correctly. GO to D7 .
D4 CHECK THE VEHICLE CHASSIS GROUND	
	1 Measure the resistance between a known good chassis ground and the mounting surface of the RCM. • **Is the resistance greater than 100 ohms?** → **Yes** REPAIR the chassis grounding system. GO to D7 . → **No** GO to D5 .
D5 CHECK THE GROUND CIRCUIT 649 (BK/OG) FOR AN OPEN	
1 2 RCM C232 3	3 Measure the resistance between RCM C232 pin 21, circuit 649 (BK/OG), harness side and a sheet metal ground near the RCM.



- **Is the resistance greater than 100 ohms?**

→ **Yes**
REPAIR the circuit. GO to D7 .

→ **No**
GO to D7 .

D6 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step D1.

- **Was the continuous DTC retrieved during Step D1 an intermittent fault?**

→ **Yes**
CHECK for causes of intermittent high resistance on circuit 649 (BK/OG). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to D7 .

→ **No**
GO to D7 .

D7 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 Refer to the continuous DTCs recorded during Step D1.

- **Were any continuous DTCs retrieved during Step D1**

→ **Yes**
Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC)

	Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test E: LFC 29/DTC C1414 — Incorrect Vehicle Identification Code

Normal Operation

The restraints control module (RCM) monitors the voltage at pins 10, 13 and 14 to determine if it is installed on the correct vehicle. If the RCM detects an unexpected condition at any of these pins, it will store a diagnostic trouble code (DTC) C1414 in memory and flash a lamp fault code (LFC) 29 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

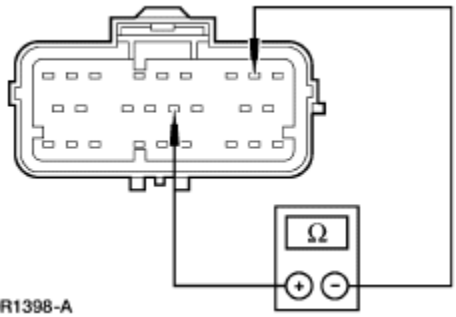
An incorrect vehicle identification code can be caused by:

- an RCM installed on the wrong vehicle.
- an incorrectly programmed RCM.
- a wiring concern at RCM C2 pins 10, 13 or 14.

PINPOINT TEST E: LFC 29/DTC C1414 — INCORRECT VEHICLE IDENTIFICATION CODE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

5 On-Demand Self Test	• **Was DTC B1414 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to E2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to E5 .
E2 CHECK THE VEHICLE IDENTIFICATION PINS NO. 1 AND NO. 3	
NOTE: For this vehicle application, RCM C232 pins 10 and 14 should be open circuited.	
1 2 RCM C232	3 Make sure RCM C232 pins 10 and 14 connector slots are empty and no connection is made when connected to the RCM. • **Are RCM C232 pins 10 and 14 connector slots empty?** → **Yes** GO to E3 . → **No** REPAIR the connector concern at RCM C232 pins 10 and 14. GO to E3 .
E3 CHECK THE VEHICLE IDENTIFICATION PIN NO. 2	
NOTE: For this vehicle application, RCM C232 pin 13 should be connected to ignition voltage.	
1 	

2 Battery Ground Cable 3 4  DR1398-A	4 Measure the resistance between C232 pin 13 circuit 364 (BK/LG) and C232 pin 2 circuit 364 (BK/LG). • **Is the resistance less than 5 ohms?** → **Yes** GO to E4 . → **No** REPAIR the high resistance concern. GO to E6 .
E4 CHECK THE RCM PROGRAMMED VEHICLE ID	
1 PID/Data Monitor and Record	1 Select PID VID #1, VID #2, and VID #3. • **Were VID #1 and VID #3 open circuit and was VID #2 ignition?** → **Yes** GO to E5 . → **No** INSTALL a new RCM. GO to E6 .
E5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step E1.

	• **Was the continuous DTC retrieved during Step E1 an intermittent fault?** → **Yes** CHECK for causes of an intermittent open on circuit 364 (BK/LG). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to E6 . → **No** GO to E6 .
E6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step E1. • **Were any continuous DTCs retrieved during Step E1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test F: LFC 15/DTC B1887 — Driver Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for driver air bag circuit shorts to ground by monitoring the voltage of circuits 614 (GY/OG) and 615 (GY/WH) at pins 3 and 4. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1887 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to ground can be caused by:

- a short to ground on circuit 614 (GY/OG).
- a short to ground on circuit 615 (GY/WH).
- a short to ground on the air bag sliding contact (14A664) .
- a short to ground on the driver air bag module.

PINPOINT TEST F: LFC 15/DTC B1887 — DRIVER AIR BAG CIRCUIT SHORTED TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1887 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to F2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to F5 .
F2 CHECK THE DRIVER AIR BAG MODULE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system	

must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

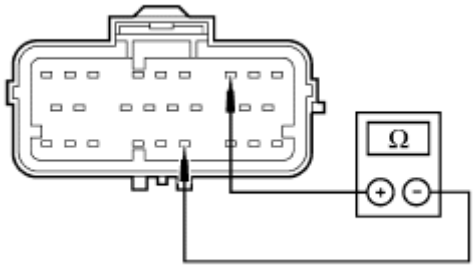
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 2 3 4 On-Demand Self Test	2 Deactivate the system. • **Was the DTC B1887 retrieved?** → **Yes** GO to F3. → **No** INSTALL a new driver air bag module. GO to F6.
F3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
1 2 RCM C232 3	3 **NOTE:** Do not separate or remove the



shorting bars from RCM C232.

Measure the resistance between RCM C232 pin 3, circuit 614 (GY/OG), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
GO to F4 .

→ **No**
INSTALL a new RCM. GO to F6 .

F4 CHECK THE DRIVER AIR BAG MODULE WIRING AND THE AIR BAG SLIDING CONTACT

1

Driver Air Bag Module C2011

2

Air Bag Sliding Contact C271

3 Inspect all crimps, terminals, wires and connectors in circuit 614 (GY/OG) feeding the RCM pin 3, circuit 615 (GY/WH) feeding pin 4, the air bag sliding contact assembly and the air bag sliding contact connector C271. Check for pinched wires and damaged connector pin terminals.

- **Was any damage found?**

→ **Yes**
REPAIR as necessary. GO to F6 .

→ **No**
GO to F6 .

F5 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step F1.

	• **Was the continuous DTC retrieved during Step F1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground on circuit 614 (GY/OG), circuit 615 (GY/WH), and the air bag sliding contact assembly. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to F6 . → **No** GO to F6 .
F6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step F1. • **Were any continuous DTCs retrieved during Step F1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test G: LFC 15/DTC B1916 — Driver Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) checks for driver air bag circuit shorts to battery or ignition by monitoring the voltage of circuit 614 (GY/OG) and 615 (GY/WH) at pins 3 and 4. If the RCM detects a short to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1916 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 614 (GY/OG).
- a short to battery or ignition on circuit 615 (GY/WH).

- a short to battery or ignition on the air bag sliding contact.
- a short to battery or ignition on the driver air bag module.

PINPOINT TEST G: LFC 15/DTC B1916 — DRIVER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1916 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to G2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to G5 .
G2 CHECK THE DRIVER AIR BAG MODULE	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 2 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1916 retrieved?** → **Yes** GO to G3. → **No** INSTALL a new driver air bag module. GO to G6.
G3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
1 2	

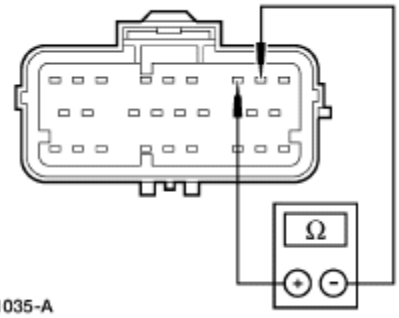
Battery Ground Cable

3

RCM C232

4

5



5 **NOTE:** Do not separate or remove the shorting bars from RCM C232.

Measure the resistance between RCM C232 pin 3, circuit 614 (GY/OG), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
GO to G4 .

→ **No**
INSTALL a new RCM. GO to G6 .

G4 CHECK THE DRIVER AIR BAG MODULE WIRING AND THE AIR BAG SLIDING CONTACT

1

Driver Air Bag Module C2011

2

Air Bag Sliding Contact C271

3 Inspect all crimps, terminals, wires and connectors in circuit 614 (GY/OG) feeding the RCM pin 3, circuit 615 (GY/WH) feeding pin 4, the air bag sliding contact assembly and

	the air bag sliding contact connector C271. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?** → **Yes** REPAIR as necessary. GO to G6 . → **No** GO to G6 .
G5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step G1. • **Was the continuous DTC retrieved during Step G1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to battery or ignition on circuit 614 (GY/OG), circuit 615 (GY/WH), and the air bag sliding contact assembly. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to G6 . → **No** GO to G6 .
G6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step G1. • **Were any continuous DTCs retrieved during Step G1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test H: LFC 16/DTC B1888 — Passenger Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to ground by monitoring the voltage of circuits 607 (LB/OG) and 616 (PK/BK) at pins 6 and 7. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1888 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag circuit short to ground can be caused by:

- a short to ground on circuit 607 (LB/OG).
- a short to ground on circuit 616 (PK/BK).
- a short to ground on the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST H: LFC 16/DTC B1888 — PASSENGER AIR BAG CIRCUIT SHORTED TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

	• **Was DTC B1888 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to H2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to H5 .

H2 CHECK THE PASSENGER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

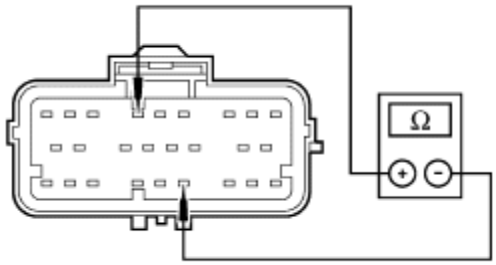
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1888 retrieved?** → **Yes**

	GO to H3 . → **No** INSTALL a new passenger air bag module. GO to H6 .
H3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT	
1 2 RCM C232 3  DR1000-B	3 **NOTE:** Do not separate or remove the shorting bars from RCM C232. Measure the resistance between RCM C232 pin 6, circuit 607 (LB/OG), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side. • **Is the resistance less than 10,000 ohms?** → **Yes** GO to H4 . → **No** INSTALL a new RCM. GO to H6 .
H4 CHECK THE PASSENGER AIR BAG MODULE WIRING	
1 Passenger Air Bag Module C272	2 Inspect all crimps, terminals, wires and connectors in circuit 607 (LB/OG) feeding the RCM pin 6, circuit 616 (PK/BK) feeding pin 7. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?**

	→ **Yes** REPAIR as necessary. GO to H6 . → **No** GO to H6 .
H5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step H1. • **Was the DTC retrieved during Step H1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground on circuit 607 (LB/OG) and circuit 616 (PK/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to H6 . → **No** GO to H6 .
H6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step H1. • **Were any continuous DTCs retrieved during Step H1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test I: LFC 16/DTC B1925 — Passenger Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to battery or ignition by monitoring the voltage of circuits 607 (LB/OG) and 616 (PK/BK) at pins 6 and 7. If the RCM detects a short

to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1925 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 607 (LB/OG).
- a short to battery or ignition on circuit 616 (PK/BK).
- a short to battery or ignition on the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST I: LFC 16/DTC B1925 — PASSENGER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1925 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still

	present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to I2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to I5 .

I2 CHECK THE PASSENGER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1925 retrieved?** → **Yes** GO to I3 . → **No** INSTALL a new passenger air bag module. GO to I6 .

I3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT

1

2

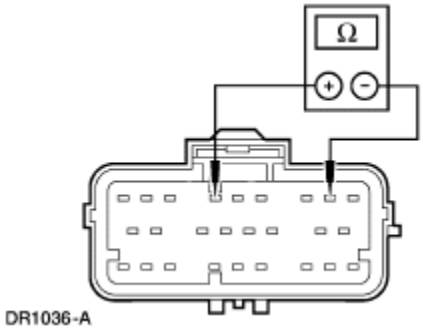
Battery Ground Cable

3

RCM C232

4

5



5 **NOTE:** Do not separate or remove the shorting bars from RCM C232.

Measure the resistance between RCM C232 pin 6, circuit 607 (LB/OG), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
GO to I4 .

→ **No**
INSTALL a new RCM. GO to I6 .

I4 CHECK THE PASSENGER AIR BAG MODULE WIRING

1

Passenger Air Bag Module C272

2 Inspect all crimps, terminals, wires, and connectors in circuit 607 (LB/OG) feeding the

	RCM pin 6, circuit 616 (PK/BK) feeding pin 7. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?** → **Yes** REPAIR as necessary. GO to I6 . → **No** GO to I6 .
I5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step I1. • **Was the DTC retrieved during Step I1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to battery or ignition on circuit 607 (LB/OG) and circuit 616 (PK/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to I6 . → **No** GO to I6 .
I6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step I1. • **Were any continuous DTCs retrieved during Step I1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test J: LFC 32/DTC B1932 — Driver Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance for the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1932 in memory and flash a lamp fault code (LFC) 32 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Driver air bag high resistance can be caused by:

- a poor connection or corrosion in the driver air bag module circuits or the air bag sliding contact.
- an open circuit or high resistance in the air bag sliding contact windings.
- an open circuit or high resistance in the wiring harness.
- an open circuit or high resistance in the driver air bag module.
- an RCM internal concern.

PINPOINT TEST J: LFC 32/DTC B1932 — DRIVER AIR BAG CIRCUIT RESISTANCE HIGH

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

	• **Was DTC B1932 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to J2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to J5 .

J2 CHECK THE DRIVER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

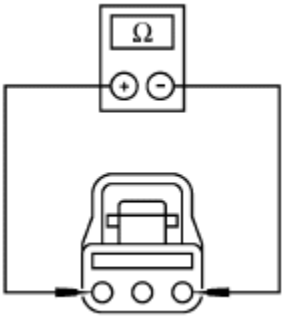
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

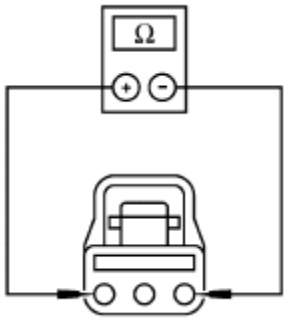
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1932 retrieved?**

	→ **Yes** GO to J3 . → **No** INSTALL a new driver air bag module. GO to J6 .
J3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
1 2 RCM C232 3 Driver Air Bag Restraint System Diagnostic Tool 4  DR0292-B	4 **NOTE:** By disconnecting the RCM connector, circuit 614 (GY/OG) and circuit 615 (GY/WH) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar. **NOTE:** Zero the multimeter prior to taking the measurement. Measure the resistance between driver air bag C2011, circuit 614 (GY/OG), harness side and driver air bag C2011, circuit 615 (GY/WH), harness side. • **Is the resistance greater than 0.5 ohm?** → **Yes** GO to J4 . → **No** INSTALL a new RCM. GO to J6 .
J4 CHECK THE AIR BAG SLIDING CIRCUIT	
1 Air Bag Sliding Contact C271	

2  DR0292-B	2 **NOTE:** By disconnecting the air bag sliding contact connector, the connector pins are shorted together with a shorting bar. Do not remove the shorting bar. **NOTE:** Zero the multimeter prior to taking the measurement. Measure the resistance between air bag sliding contact C271, circuit 614 (GY/OG), harness side and air bag sliding contact C271, circuit 615 (GY/WH), harness side. • **Is the resistance greater than 0.5 ohm?** → **Yes** INSTALL a new air bag sliding contact. GO to J6 . → **No** REPAIR the circuit(s) as necessary. GO to J6 .
J5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step J1. • **Was the continuous DTC retrieved during Step J1 an intermittent fault?** → **Yes** CHECK for causes of intermittent high resistance on circuit 614 (GY/OG), circuit 615 (GY/WH), and the air bag sliding contact assembly. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to J6 . → **No** GO to J6 .
J6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step J1. • **Were any continuous DTCs retrieved during Step J1?** → **Yes**

	Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test K: LFC 33/DTC B1933 — Passenger Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1933 in memory and flash a lamp fault code (LFC) 33 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag high resistance can be caused by:

- a poor connection or corrosion in the passenger air bag module circuits.
- an open circuit or high resistance in the wiring harness.
- an open circuit or high resistance in the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST K: LFC 33/DTC B1933 — PASSENGER AIR BAG CIRCUIT RESISTANCE HIGH

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4	4 Retrieve and record any continuous DTCs for

 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	use later in this pinpoint test. • **Was DTC B1933 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to K2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to K4 .

K2 CHECK THE PASSENGER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3	2 Deactivate the system.

4

On-Demand Self Test

- **Was DTC B1933 retrieved?**

→ **Yes**
GO to K3 .

→ **No**
INSTALL a new passenger air bag module.
GO to K5 .

K3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT

1

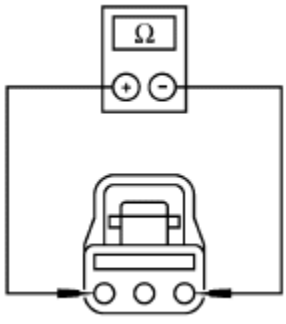
2

RCM C232

3

Passenger Air Bag Restraint System Diagnostic Tool

4



4 **NOTE:** By disconnecting the RCM connector, circuit 607 (LB/OG) and circuit 616 (PK/BK) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar.

NOTE: Zero the multimeter prior to taking the measurement.

Measure the resistance between passenger air bag C272, circuit 607 (LB/OG), harness side and passenger air bag C272, circuit 616 (PK/BK) harness side.

- **Is the resistance greater than 0.5 ohm?**

	→ **Yes** REPAIR the circuit(s) as necessary. GO to K5 . → **No** INSTALL a new RCM. GO to K5 .
K4 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step K1. • **Was the continuous DTC retrieved during Step K1 an intermittent fault?** → **Yes** CHECK for causes of intermittent high resistance on circuit 607 (LB/OG) and circuit 616 (PK/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to K5 . → **No** GO to K5 .
K5 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step K1. • **Were any continuous DTCs retrieved during Step K1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test L: LFC 34/DTC B1934 — Driver Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects low resistance between these pins, it will store a

diagnostic trouble code (DTC) B1934 in memory and flash a lamp fault code (LFC) 34 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Driver air bag low resistance can be caused by:

- a short in the air bag sliding contact windings.
- a short in the wiring harness.
- a low resistance in the driver air bag module.
- an RCM internal concern.
- a worn or damaged connector shorting bar (harness side).
- a worn or damaged connector camming beam (component side).

PINPOINT TEST L: LFC 34/DTC B1934 — DRIVER AIR BAG CIRCUIT RESISTANCE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 	
2 Scan Tool	
3 	
4 Retrieve/Clear Continuous DTCs	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.
5 On-Demand Self Test	• **Was DTC B1934 retrieved during the on-demand self test?**

	→ **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to L2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to L5 .

L2 CHECK THE DRIVER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

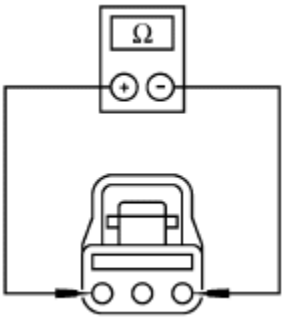
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

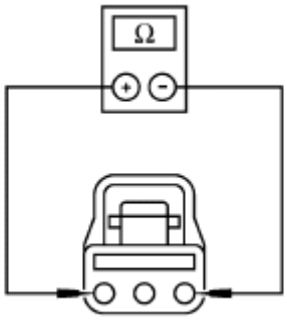
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1934 retrieved?** → **Yes** GO to L3 . → **No**

	INSTALL a new driver air bag module. GO to L6 .
L3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
1 2 Driver Air Bag Restraint System Diagnostic Tool 3  DR0292-B	3 Measure the resistance between driver air bag C2011, circuit 614 (GY/OG), harness side and driver air bag C2011, circuit 615 (GY/WH), harness side. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to L4 . → **No** INSTALL a new RCM. GO to L6 .
L4 CHECK THE AIR BAG SLIDING CONTACT	
1 Air Bag Sliding Contact C271 2	2 Measure the resistance between air bag sliding contact C271, circuit 614 (GY/OG), harness side and air bag sliding contact C271, circuit 615 (GY/WH), harness side.



- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air bag sliding contact. GO to L6 .

→ **No**
REPAIR the circuit(s) as necessary. GO to L6 .

L5 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step L1.

- **Was the DTC retrieved during Step L1 an intermittent fault?**

→ **Yes**
CHECK for causes of intermittent low resistance on circuit 614 (GY/OG), circuit 615 (GY/WH), and the air bag sliding contact assembly. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to L6 .

→ **No**
GO to L6 .

L6 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 Refer to the continuous DTCs recorded during Step L1.

- **Were any continuous DTCs retrieved during Step L1?**

→ **Yes**

	Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test M: LFC 35/DTC B1935 — Passenger Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects low resistance between these pins, it will store a diagnostic trouble code (DTC) B1935 in memory and flash a lamp fault code (LFC) 35 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Passenger air bag low resistance can be caused by:

- a short in the wiring harness.
- a low resistance in the passenger air bag module.
- an RCM internal concern.
- a worn or damaged shorting bar.
- a worn or damaged connector camming beam (component side).

PINPOINT TEST M: LFC 35/DTC B1935 — PASSENGER AIR BAG CIRCUIT RESISTANCE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 	

4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1935 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to M2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to M4 .

M2 CHECK THE PASSENGER AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

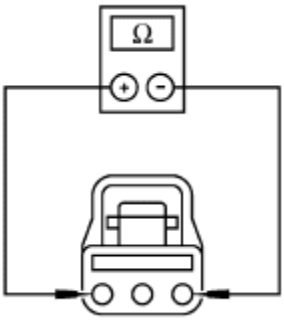
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3	2 Deactivate the system.

 4 On-Demand Self Test	• **Was DTC B1935 retrieved?** → **Yes** GO to M3 . → **No** INSTALL a new passenger air bag module. GO to M5 .
M3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT	
1 2 Passenger Air Bag Restraint System Diagnostic Tool 3  DR0292-B	3 Measure the resistance between passenger air bag C272, circuit 607 (LB/OG), harness side and passenger air bag C272, circuit 616 (PK/BK), harness side. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new RCM. GO to M5 . → **No** REPAIR the circuit(s) as necessary.GO to M5 .

M4 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step M1. • **Was the DTC retrieved during Step M1 an intermittent fault?** → **Yes** CHECK for causes of intermittent low resistance on circuit 607 (LB/OG) and circuit 616 (PK/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to M5 . → **No** GO to M5 .
M5 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step M1. • **Were any continuous DTCs retrieved during Step M1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test N: LFC 14/DTC B1901 — Front External Crash Sensor Shorted To Ground

Normal Operation

The front external crash sensors monitor the severity of a crash event. If the crash event is severe enough, the sensor(s) will close and signal the restraints control module (RCM) to deploy the air bags. Each front external crash sensor contains a 1580 ohm resistor. The two crash sensors are connected in parallel at the splice in circuit 619 (PK/WH). Because of the parallel connection, the RCM normally measures about 790 ohms to ground on circuit 619 (PK/WH).

The RCM measures this resistance to verify that the crash sensors are correctly mounted and connected. If there is a short to ground on circuit 619 (PK/WH), the RCM will store diagnostic trouble code (DTC) B1901

in memory. The RCM will also flash lamp fault code (LFC) 14 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A front external crash sensor shorted to ground fault can be caused by:

- a short to ground on circuit 619 (PK/WH).
- a damaged or inoperative front external crash sensor.
- an RCM internal concern.

PINPOINT TEST N: LFC 14/DTC B1901 — FRONT EXTERNAL CRASH SENSOR SHORTED TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1901 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is

	corrected and the DTC is no longer retrieved during the on-demand self test. GO to N2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to N5 .

N2 CHECK CIRCUIT 619 (PK/WH)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

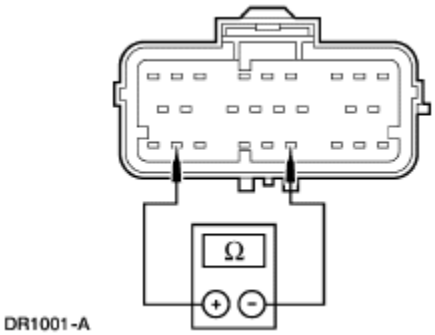
NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

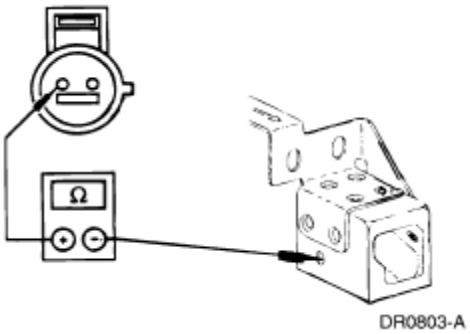
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

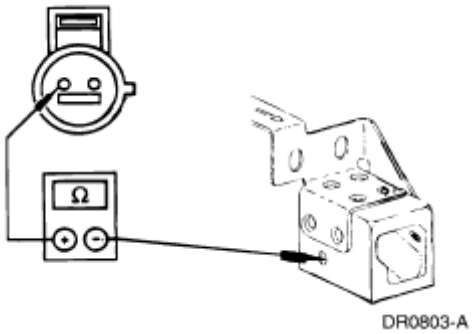
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 	
	2 Deactivate the system.
3 	
RCM C232	
4 	4 Measure the resistance between RCM C232 pin 25, circuit 619 (PK/WH), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side. • **Is the resistance between 690 and 890 ohms?**

	→ **Yes** INSTALL a new RCM. GO to N6 . → **No** GO to N3 .
N3 CHECK THE RH FRONT EXTERNAL CRASH SENSOR	
1 RH Front External Crash Sensor C133 2  DR0803-A	2 Measure the resistance between RH front external crash sensor C133, circuit 619 (PK/WH) component side and the rivet on the side of the RH front external crash sensor case. • **Is the resistance between 1530 and 1630 ohms?** → **Yes** GO to N4 . → **No** INSTALL a new RH front external crash sensor. GO to N6 .
N4 CHECK THE LH FRONT EXTERNAL CRASH SENSOR	
1 LH Front External Crash Sensor C132 2	2 Measure the resistance between LH front external crash sensor C132, circuit 619 (PK/WH) component side and the rivet on the side of the LH front external crash sensor case.

	• **Is the resistance between 1530 and 1630 ohms?** → **Yes** REPAIR circuit 619 (PK/WH). GO to N6 . → **No** INSTALL a new LH front external crash sensor. GO to N6 .
N5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step **N1** . • **Was the continuous DTC retrieved during Step N1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground on circuit 619 (PK/WH). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to N6 . → **No** GO to N6 .
N6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step N1. • **Were any continuous DTCs retrieved during Step N1?** → **Yes** Do not clear any DTCs until all DTCs have

	been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test O: LFC 41/DTC B1941 — Front External Crash Sensor Open Circuit or Short to Battery

Normal Operation

The front external crash sensors monitor the severity of a crash event. If the crash event is severe enough, the sensor(s) will close and signal the restraints control module (RCM) to deploy the air bags. Each front external crash sensor contains a 1590 ohm resistor. Since the two crash sensors are connected in parallel through the splice in circuit 619 (PK/WH), the RCM normally measures about 790 ohms.

The RCM measures this resistance to verify that the crash sensors are correctly mounted and connected. If there is a short to battery or an open on circuit 619 (PK/WH), the RCM will store a diagnostic trouble code (DTC) B1941 in memory and flash a lamp fault code (LFC) 41 (or higher priority code is one exists) on the air bag indicator.

Possible Causes

A front external crash sensor open circuit or short to battery fault can be caused by:

- damaged wiring on circuit 619 (PK/WH).
- damaged front external crash sensor.
- a short to battery on circuit 619 (PK/WH).
- an RCM internal concern.

PINPOINT TEST O: LFC 41/DTC B1941 — FRONT EXTERNAL CRASH SENSOR OPEN CIRCUIT OR SHORT TO BATTERY

CONDITIONS	DETAILS/RESULTS/ACTIONS
O1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3	

 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1941 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to O2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to O6 .

O2 CHECK FOR BATTERY ON CIRCUIT 619 (PK/WH)

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

2	1 Deactivate the system.

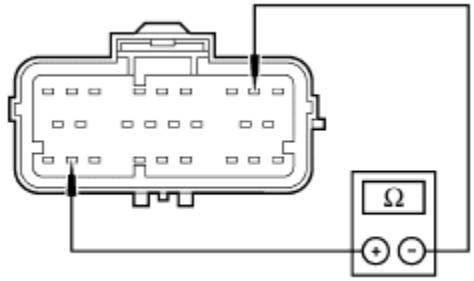
RCM C232

3

Battery

4

5



DR1616-A

5 Measure the resistance between RCM C232 pin 2, circuit 364 (BK/LG) and pin 25, circuit 619 (PK/WH).

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to O3 .

→ **No**
REPAIR the short to battery on circuit 619 (PK/WH). RETEST the system for normal operation.

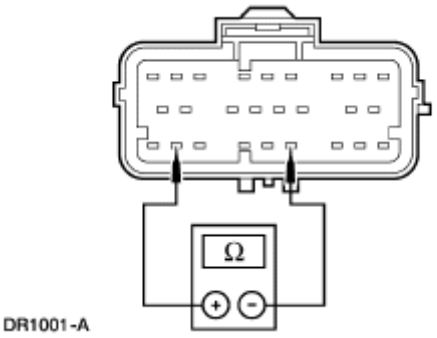
O3 CHECK CIRCUIT 619 (PK/WH)

1

2 Deactivate the system.

3

3 Measure the resistance between RCM C232 pin 25, circuit 619 (PK/WH), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



- **Is the resistance between 690 and 890 ohms?**

→ **Yes**
INSTALL a new RCM. GO to O7 .

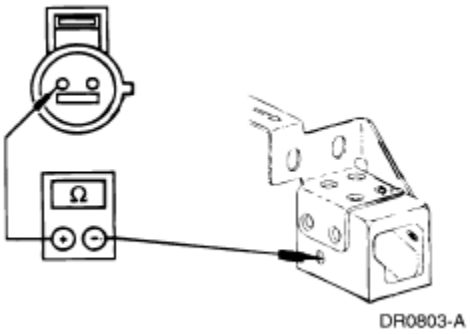
→ **No**
GO to O4 .

O4 CHECK THE RH FRONT EXTERNAL CRASH SENSOR

1

Front External Crash Sensor C133

2



2 Measure the resistance between RH front external crash sensor C133, circuit 619 (PK/WH) component side and the rivet on the side of the RH front external crash sensor case.

- **Is the resistance between 1530 and 1630 ohms?**

→ **Yes**
GO to O5 .

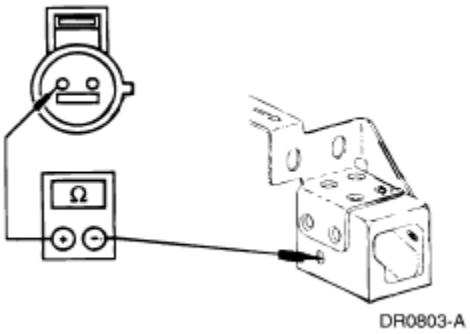
→ **No**
INSTALL a new RH front external crash sensor. GO to O7 .

O5 CHECK THE LH FRONT EXTERNAL CRASH SENSOR

1

Front External Crash Sensor C132

2



2 Measure the resistance between LH front external crash sensor C132, circuit 619 (PK/WH) component side and the rivet on the side of the LH front external crash sensor case.

- **Is the resistance between 1530 and 1630 ohms?**

→ **Yes**
REPAIR circuit 619 (PK/WH). GO to O6 .

→ **No**
INSTALL a new LH front external crash sensor. GO to O7 .

O6 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step O1.

- **Was the continuous DTC retrieved during Step O1 an intermittent fault?**

→ **Yes**
CHECK for causes of intermittent high resistance or short to battery on circuit 619 (PK/WH). ATTEMPT to recreate the hard fault by flexing the wire harness an cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to O6 .

→ **No**
GO to O7 .

O7 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

1 Refer to the continuous DTCs recorded during Step O1.

	• **Were any continuous DTCs retrieved during Step O1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test P: LFC 48/DTC B2444 — Driver Side Crash Sensor Is Faulted

Normal Operation

The driver side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver side air bag.

The RCM monitors the two-wire current loop to the driver side crash sensor for a signal that is out of the expected range. If the RCM detects a signal from the driver side crash sensor, indicating a fault, it will store diagnostic trouble code (DTC) B2444 and flash a lamp fault code (LFC) 48 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver side crash sensor fault can be caused by:

- damaged driver side crash sensor.

PINPOINT TEST P: LFC 48/DTC B2444 — DRIVER SIDE CRASH SENSOR IS FAULTED

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool	

3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B2444 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. INSTALL a new driver side crash sensor. GO to P2 . → **No** This is an intermittent fault. The fault condition is not present at this time. INSTALL a new driver side crash sensor. GO to P2 .
P2 CHECK FOR ADDITIONAL DTCs	
	1 Refer to the continuous DTCs recorded during Step P1. • **Were any continuous DTCs retrieved during Step P1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** CLEAR all DTCs.

Pinpoint Test Q: LFC 49/DTC B2445 — Passenger Side Crash Sensor Is Faulted

Normal Operation

The passenger side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger side air bag.

The RCM monitors the two-wire current loop to the passenger side crash sensor for a signal that is out of the expected range. If the RCM detects a signal from the passenger side crash sensor, indicating a fault, it will store diagnostic trouble code (DTC) B2445 and flash a lamp fault code (LFC) 49 (or a higher priority

code if one exists) on the air bag indicator.

Possible Causes

A passenger side crash sensor fault can be caused by:

- damaged passenger side crash sensor.

PINPOINT TEST Q: LFC 49/DTC B2445 — PASSENGER SIDE CRASH SENSOR IS FAULTED

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B2445 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. INSTALL a new passenger side crash sensor. GO to Q2 .

	→ **No** This is an intermittent fault. The fault condition is not present at this time. INSTALL a new passenger side crash sensor. GO to Q2 .
Q2 CHECK FOR ADDITIONAL DTCs	
	1 Refer to the continuous DTCs recorded during Step Q1. • **Were any continuous DTCs retrieved during Step Q1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** CLEAR all DTCs.

Pinpoint Test R: LFC 42/DTC B2441 — Driver Side Crash Sensor Mounting Fault

Normal Operation

The driver side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver side air bag.

The RCM monitors the two-wire current loop to the driver side crash sensor for a signal that is out of the expected range. If the RCM detects a signal from the driver side crash sensor, indicating a sensor mounting fault, it will store diagnostic trouble code (DTC) B2441 and flash a lamp fault code (LFC) 42 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver side crash sensor mounting fault can be caused by:

- damaged driver side crash sensor.
- corrosion or damage at the sensor mounting surface.

PINPOINT TEST R: LFC 42/DTC B2441 — DRIVER SIDE CRASH SENSOR MOUNTING FAULT

CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 	

Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B2441 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to R2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to R5 .
R2 CHECK THE MOUNTING OF THE DRIVER SIDE CRASH SENSOR	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
	1 Deactivate the system.

	2 Remove the driver side crash sensor. For additional information, refer to Sensor—Side Crash in this section. 3 Visually inspect the driver side crash sensor, mounting bracket and mounting surface for damage, corrosion or dirt. 4 Inspect the driver side crash sensor mounting and make sure that the retaining bolts are fully seated and tightened correctly. For additional information, refer to Sensor—Side Crash in this section for correct tightening torque. • **Was a significant amount of corrosion or dirt found, the driver side crash sensor mounting bracket attached to the mounting surface incorrectly, or the two driver side crash sensor retaining bolts not fully seated and tightened correctly?** → **Yes** MAKE SURE the driver side crash sensor, mounting bracket and mounting surface are free of damage, corrosion or dirt and the two retaining bolts are fully seated and correctly tightened. REATTACH the driver side crash sensor and mounting bracket to the mounting surface. GO to R6. → **No** GO to R3.
R3 CHECK THE DRIVER SIDE CRASH SENSOR HARNESS CONNECTION	
	1 Check the driver side crash sensor harness. • **Is the driver side crash sensor harness connector connected to the driver side crash sensor correctly?** → **Yes** GO to R4. → **No** ATTACH the driver side crash sensor harness connector correctly. GO to R6.
R4 CHECK THE VEHICLE CHASSIS GROUND	
	1 Measure the resistance between a known good chassis ground and the mounting surface of the driver side crash sensor. • **Is the resistance greater than 100 ohms?** → **Yes** REPAIR the chassis grounding system. GO to R6. → **No** INSTALL a new driver side crash sensor. GO to R6.
R5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system	

must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
	1 Deactivate the system. 2 Refer to the continuous DTCs recorded during Step R1. • **Was a continuous DTC retrieved during Step R1 an intermittent fault?** → **Yes** CHECK for causes of an intermittent mounting fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to R6. → **No** GO to R6.
R6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step R1. • **Were any continuous DTCs retrieved during Step R1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test S: LFC 43/DTC B2440 — Passenger Side Crash Sensor Mounting Fault

Normal Operation

The passenger side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger side air bag.

The RCM monitors the two-wire current loop to the passenger side crash sensor for a signal that is out of

the expected range. If the RCM detects a signal from the passenger side crash sensor, indicating a sensor mounting fault, it will store diagnostic trouble code (DTC) B2440 and flash a lamp fault code (LFC) 43 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger side crash sensor mounting fault can be caused by:

- damaged passenger side crash sensor.
- corrosion or damage at the sensor mounting surface.

PINPOINT TEST S: LFC 43/DTC B2440 — PASSENGER SIDE CRASH SENSOR MOUNTING FAULT

CONDITIONS	DETAILS/RESULTS/ACTIONS
S1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B2440 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-

	demand self test. GO to S2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to S5 .
S2 CHECK THE MOUNTING OF THE PASSENGER SIDE CRASH SENSOR	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
	1 Deactivate the system. 2 Remove the passenger side crash sensor. For additional information, refer to Sensor—Side Crash in this section. 3 Visually inspect the passenger side crash sensor, mounting bracket and mounting surface for damage, corrosion or dirt. 4 Inspect the passenger side crash sensor mounting and make sure that the retaining bolts are fully seated and tightened correctly. For additional information, refer to Sensor—Side Crash in this section for correct tightening torque. • **Was a significant amount of corrosion or dirt found, the passenger side crash sensor mounting bracket attached to the mounting surface correctly, or the two passenger side crash sensor retaining bolts not fully seated and tightened correctly?** → **Yes** MAKE SURE the passenger side crash sensor, mounting bracket and mounting surface are free of damage, corrosion or dirt and the two retaining bolts are fully seated and properly tightened. REATTACH the passenger side crash sensor and mounting bracket to the mounting surface. GO to S6 . → **No** GO to S3 .
S3 CHECK THE PASSENGER SIDE CRASH SENSOR HARNESS CONNECTION	
	1 Check the passenger side crash sensor harness connection.

	• **Is the passenger side crash sensor harness connector connected to the passenger side crash sensor correctly?** → **Yes** GO to S4 . → **No** ATTACH the passenger side crash sensor harness connector correctly. GO to S6 .
S4 CHECK THE VEHICLE CHASSIS GROUND	
	1 Measure the resistance between a known good chassis ground and the mounting surface of the passenger side crash sensor. • **Is the resistance greater than 100 ohms?** → **Yes** REPAIR the chassis grounding system. GO to S6 . → **No** INSTALL a new passenger side crash sensor. GO to S6 .
S5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
	1 Deactivate the system. 2 Refer to the continuous DTCs recorded during Step S1. • **Was a continuous DTC retrieved during Step S1 an intermittent fault?** → **Yes** CHECK for causes of an intermittent mounting fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to S6 .

	→ **No** GO to S6 .
S6 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step S1. • **Were any continuous DTCs retrieved during Step S1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test T: LFC 44/DTC U2017 — Driver Side Crash Sensor Communication Fault

Normal Operation

The driver side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver side air bag.

The RCM monitors the two-wire current loop to the driver side crash sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the driver side crash sensor, indicating a sensor communication fault, it will store diagnostic trouble code (DTC) U2017 and flash a lamp fault code (LFC) 44 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver side crash sensor communication fault condition can be caused by:

- damaged wiring on circuit 1261 (WH/LG).
- damaged wiring on circuit 1262 (BN/LG).
- damaged driver side crash sensor.

PINPOINT TEST T: LFC 44/DTC U2017 — DRIVER SIDE CRASH SENSOR COMMUNICATION FAULT

CONDITIONS	DETAILS/RESULTS/ACTIONS
T1 CHECK FOR CONTINUOUS OR ON-DEMAND SELF TEST DTCs	
1	

2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC U2017 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to T2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to T9 .

T2 CHECK THE DRIVER SIDE CRASH SENSOR HARNESS CONNECTOR

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

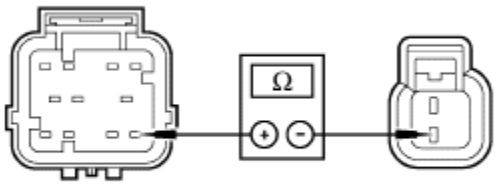
NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

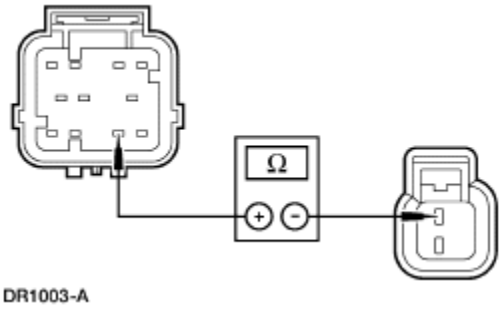
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

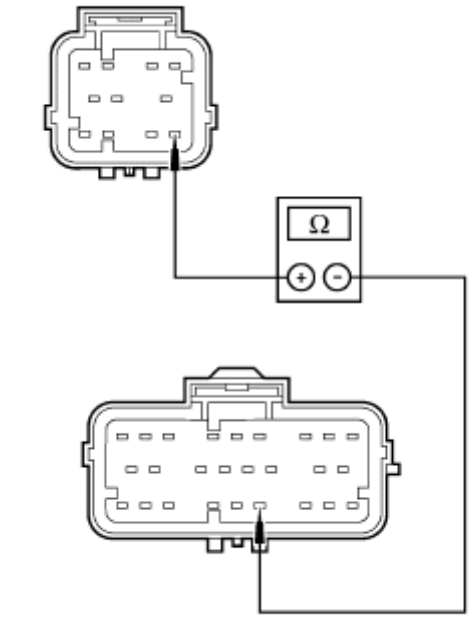
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

	1 Deactivate the system. 2 Make sure the driver side crash sensor harness connector is fully connected to the driver side crash sensor. • **Is the driver side crash sensor connected correctly?** → **Yes** GO to T3 . → **No** CONNECT the driver side crash sensor connector correctly. GO to T10 .
T3 CHECK THE CIRCUIT 1261 (WH/LG) FOR AN OPEN	
1 2 RCM C233 3 Driver Side Crash Sensor C310 4  DR1002-A	4 Measure the resistance between RCM C233 pin 8, circuit 1261 (WH/LG), harness side and driver side crash sensor C310, circuit 1261 (WH/LG), harness side. • **Is the resistance greater than 1 ohm?** → **Yes** REPAIR the circuit. GO to T10 .

	→ **No** GO to T4 .
T4 CHECK CIRCUIT 1262 (BN/LG) FOR AN OPEN	
1  DR1003-A	1 Measure the resistance between RCM C233 pin 9, circuit 1262 (BN/LG), harness side and driver side crash sensor C310, circuit 1262 (BN/LG), harness side. • **Is the resistance greater than 1 ohm?** → **Yes** REPAIR the circuit. GO to T10 . → **No** GO to T5 .
T5 CHECK CIRCUIT 1261 (WH/LG) FOR A SHORT TO GROUND	
1 RCM C232 2	2 Measure the resistance between RCM C233 pin 8, circuit 1261 (WH/LG), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



DR1010-A

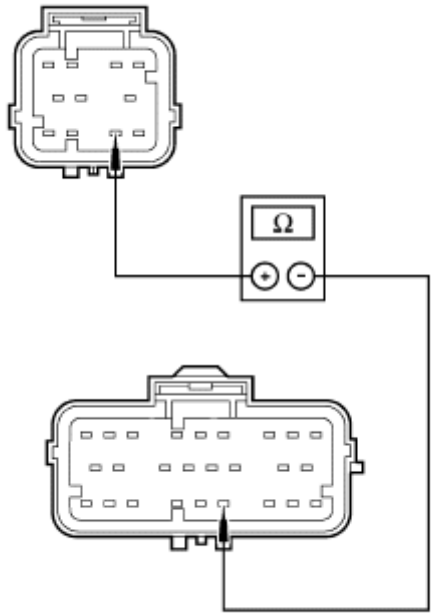
- **Is the resistance less than 1000 ohms?**

→ **Yes**
REPAIR the circuit. GO to T10 .

→ **No**
GO to T6 .

T6 CHECK CIRCUIT 1262 (BN/LG) FOR A SHORT TO GROUND

1	1 Measure the resistance between RCM C233 pin 9, circuit 1262 (BN/LG), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



DR1020-A

- **Is the resistance less than 1000 ohms?**

→ **Yes**
REPAIR the circuit. GO to T10 .

→ **No**
GO to T7 .

T7 CHECK CIRCUIT 1261 (WH/LG) FOR A SHORT TO BATTERY OR IGNITION

1

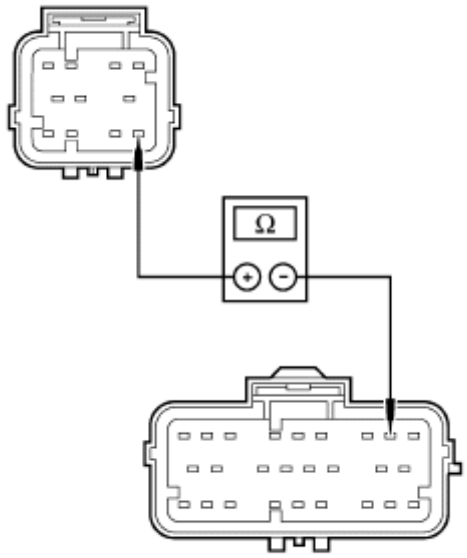
2

Battery Ground Cable

3

4

4 Measure the resistance between RCM C233 pin 8, circuit 1261 (WH/LG), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.



DR1021-A

- **Is the resistance less than 10,000 ohms?**

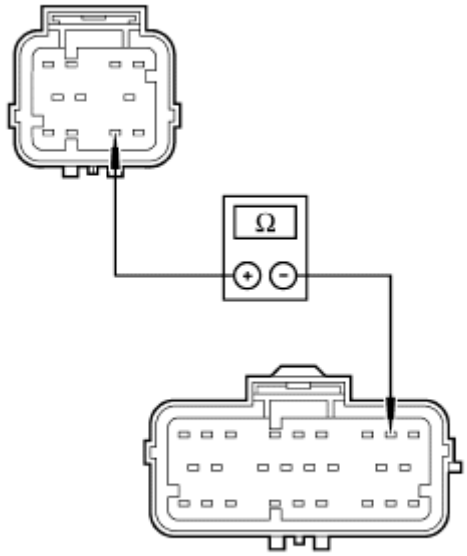
→ **Yes**
REPAIR the circuit. GO to T10 .

→ **No**
GO to T8 .

T8 CHECK CIRCUIT 1262 (BN/LG) FOR A SHORT TO BATTERY OR IGNITION

1

1 Measure the resistance between RCM C233 pin 9, circuit 1262 (BN/LG), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.



DR1022-A

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to T10 .

→ **No**
INSTALL a new driver side crash sensor. GO to T10 .

T9 CHECK FOR AN INTERMITTENT FAULT

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

	1 Deactivate the system. 2 Refer to the continuous DTCs recorded during Step T1. • **Was the continuous DTC retrieved during Step T1 an intermittent fault?** → **Yes** CHECK for causes of a communication fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to T10 . → **No** GO to T10 .
T10 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step T1. • **Were any continuous DTCs retrieved during Step T1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test U: LFC 45/DTC U2018 — Passenger Side Crash Sensor Communication Fault

Normal Operation

The passenger side crash sensor monitors the severity of a crash event. If the crash event is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger side air bag.

The RCM monitors the two-wire current loop to the passenger side crash sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the passenger side crash sensor, indicating a sensor communication fault, it will store diagnostic trouble code (DTC) U2018 and flash a lamp fault code (LFC) 45 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger side crash sensor communication fault condition can be caused by:

- damaged wiring on circuit 1263 (WH).
- damaged wiring on circuit 1264 (BN).
- damaged passenger side crash sensor.

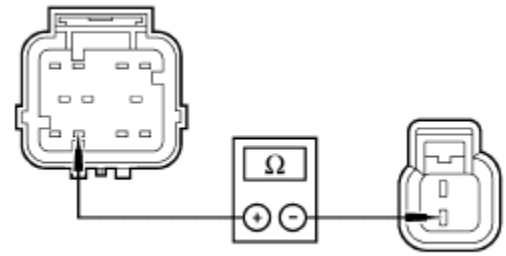
PINPOINT TEST U: LFC 45/DTC U2018 — PASSENGER SIDE CRASH SENSOR COMMUNICATION FAULT

CONDITIONS	DETAILS/RESULTS/ACTIONS
U1 CHECK FOR CONTINUOUS OR ON-DEMAND SELF TEST DTCs	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC U2018 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to U2 . → **No** This is an intermittent fault. The fault

	condition is not present at this time. GO to U9 .
U2 CHECK THE PASSENGER SIDE CRASH SENSOR HARNESS CONNECTOR	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector. **NOTE:** Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle. **NOTE:** Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector. **NOTE:** After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.	
	1 Deactivate the system. 2 Make sure the passenger side crash sensor harness connector is fully connected to the passenger side crash sensor. • **Is the passenger side crash sensor connected correctly?** → **Yes** GO to U3 . → **No** CONNECT the passenger side crash sensor connector correctly. GO to U10 .
U3 CHECK CIRCUIT 1263 (WH) FOR AN OPEN	
1 2 RCM C233 3	

Passenger Side Crash Sensor C309

4



DR1004-A

4 Measure the resistance between RCM C233 pin 10, circuit 1263 (WH), harness side and passenger side crash sensor C309, circuit 1263 (WH), harness side.

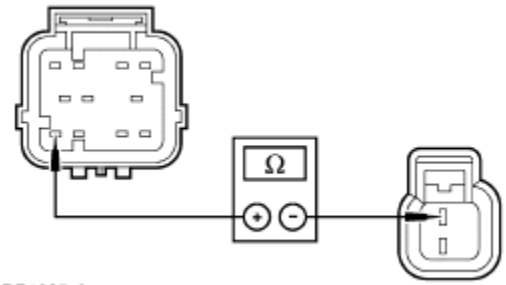
- **Is the resistance greater than 1 ohm?**

→ **Yes**
REPAIR the circuit. GO to U10 .

→ **No**
GO to U4 .

U4 CHECK CIRCUIT 1264 (BN) FOR AN OPEN

1



DR1005-A

1 Measure the resistance between RCM C233 pin 11, circuit 1264 (BN), harness side and passenger side crash sensor C309, circuit 1264 (BN), harness side.

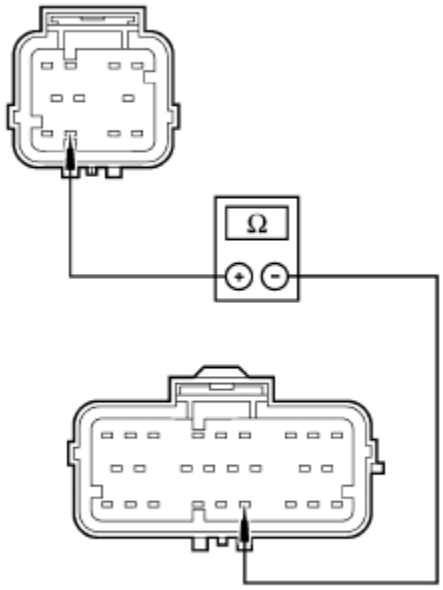
- **Is the resistance greater than 1 ohm?**

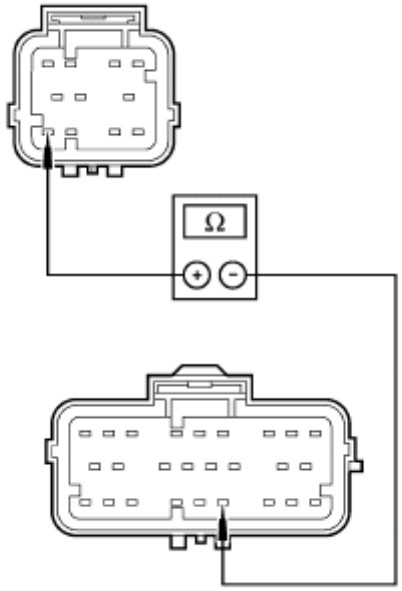
→ **Yes**
REPAIR the circuit. GO to U10 .

→ **No**
GO to U5 .

U5 CHECK CIRCUIT 1263 (WH) FOR A SHORT TO GROUND

1

RCM C232 2  DR1023-A	2 Measure the resistance between RCM C233 pin 10, circuit 1263 (WH), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side. • **Is the resistance less than 1000 ohms?** → **Yes** REPAIR the circuit. GO to U10 . → **No** GO to U6 .
U6 CHECK CIRCUIT 1264 (BN) FOR A SHORT TO GROUND	
1	1 Measure the resistance between RCM C233 pin 11, circuit 1264 (BN), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



DR1057-A

- **Is the resistance less than 1,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to U10 .

→ **No**
GO to U7 .

U7 CHECK CIRCUIT 1263 (WH) FOR A SHORT TO BATTERY OR IGNITION

1

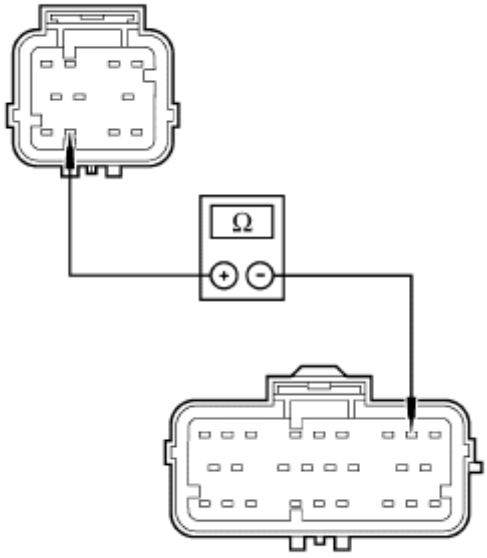
2

Battery Ground Cable

3

4

4 Measure the resistance between RCM C233 pin 10, circuit 1263 (WH), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.



DR1044-A

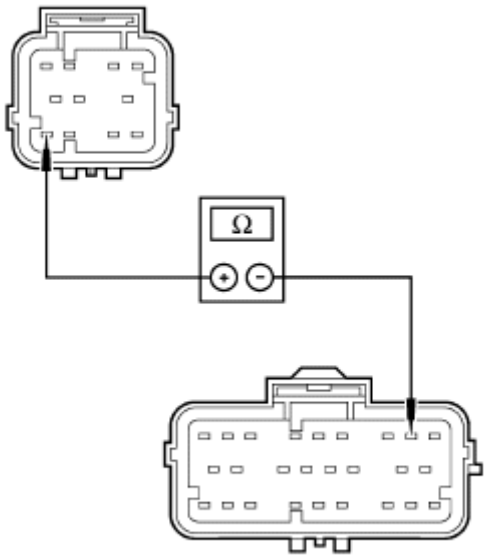
- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to U10 .

→ **No**
GO to U8 .

U8 CHECK CIRCUIT 1264 (BN) FOR A SHORT TO BATTERY OR IGNITION

1	1 Measure the resistance between the RCM C233 pin 11, circuit 1264 (BN), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.



DR1045-A

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to U10 .

→ **No**
INSTALL a new passenger side crash sensor. GO to U10 .

U9 CHECK FOR AN INTERMITTENT FAULT

1 Deactivate the system.

2 Refer to the continuous DTCs recorded during Step U1.

- **Was the continuous DTC retrieved during Step U1 an intermittent fault?**

→ **Yes**
CHECK for causes of a communication fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to U10 .

→ **No**
GO to U10 .

U10 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step U1. • **Were any continuous DTCs retrieved during Step U1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test V: LFC 36/DTC B1993 — Driver Side Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the resistance to ground at RCM C1 pins 2 and 3. If the resistance is less than 1000 ohms at either pin, the RCM will interpret that as a ground short, store diagnostic trouble code (DTC) B1993 and flash lamp fault code (LFC) 36.

Possible Causes

A driver side air bag circuit short to ground can be caused by:

- grounded wiring on circuit 1257 (WH/LB).
- damaged wiring on circuit 1258 (BN/LB).
- ground short in the driver side air bag module.
- an RCM internal concern.

PINPOINT TEST V: LFC 36/DTC B1993 — DRIVER SIDE AIR BAG CIRCUIT SHORTED TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
V1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2	

Scan Tool

3

4

Retrieve/Clear Continuous DTCs

4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

- **Was DTC B1993 retrieved during the on-demand self test?**

→ **Yes**
This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to V2 .

→ **No**
This is an intermittent fault. The fault condition is not present at this time. GO to V7 .

V2 CHECK THE DRIVER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

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On-Demand Self Test

2 Deactivate the system.

- **Was DTC B1993 retrieved?**

→ **Yes**
GO to V5 .

→ **No**
GO to V3 .

V3 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1257 (WH/LB) FOR A SHORT TO GROUND

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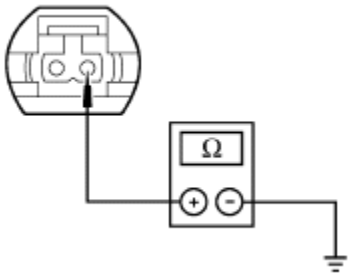
Driver Side Air Bag Seat Harness C313

3



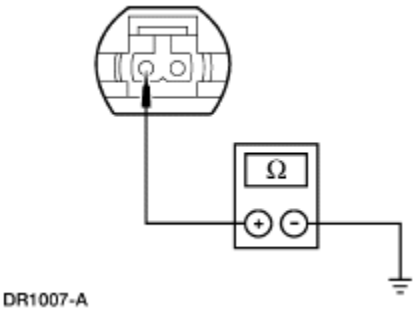
DR1006-A

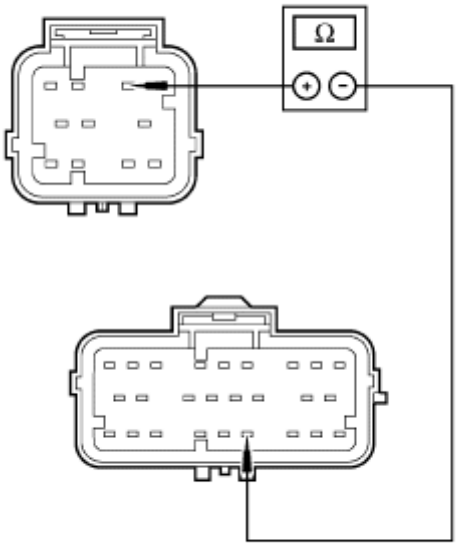
3 Measure the resistance between driver side air bag seat harness C313, circuit 1257 (WH/LB), harness side and ground.

- **Is the resistance less than 1,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to V8 .

→ **No**

	GO to V4 .
V4 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1258 (BN/LB) FOR A SHORT TO GROUND	
1  DR1007-A	1 Measure the resistance between driver side air bag seat harness C313, circuit 1258 (BN/LB), harness side and ground. • **Is the resistance less than 1,000 ohms?** → **Yes** REPAIR the circuit. GO to V8 . → **No** INSTALL a new driver side air bag module. GO to V8 .
V5 CHECK THE DRIVER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS	
1 2 RCM C233 3 RCM 232 4	4 **NOTE:** Do not separate or remove shorting bars from RCM C233. Measure the resistance between RCM C233 pin 2, circuit 1257 (WH/LB), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



DR1011-A

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit(s) as necessary, GO to V8 .

→ **No**
GO to V6 .

V6 CHECK THE DRIVER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS

1

Driver Side Air Bag Module Restraint System Diagnostic Tool

2 Inspect all crimps, terminals, wires and connectors in circuit 1257 (WH/LB) between the seat harness C313 and RCM C233 pin 2 and circuit 1258 (BN/LB) between the seat harness C313 and RCM C233 pin 3. Check for pinched wires and damaged connector pin terminals.

- **Was any damage found?**

→ **Yes**
REPAIR as necessary. GO to V8 .

	→ **No** INSTALL a new RCM. GO to V8 .
V7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step V1. • **Was the continuous DTC retrieved during Step V1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground on circuit 1257 (WH/LB) and circuit 1258 (BN/LB). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to V8 . → **No** GO to V8 .
V8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step V1. • **Were any continuous DTCs retrieved during Step V1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test W: LFC 36/DTC B1992 — Driver Side Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the driver side air bag circuits at RCM C1 pins 2 and 3 for a short to battery or ignition. If battery or ignition voltage is detected, the RCM will store diagnostic trouble code (DTC) B1992 and flash lamp fault code (LFC) 36.

Possible Causes

A driver side air bag circuit short to battery or ignition can be caused by:

- battery or ignition voltage on circuit 1257 (WH/LB).
- battery or ignition voltage on circuit 1258 (BN/LB).
- battery or ignition voltage short in the driver side air bag.
- an RCM internal concern.

PINPOINT TEST W: LFC 36/DTC B1992 — DRIVER SIDE AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
W1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1992 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to W2 . → **No**

	This is an intermittent fault. The fault condition is not present at this time. GO to W7 .

W2 CHECK THE DRIVER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

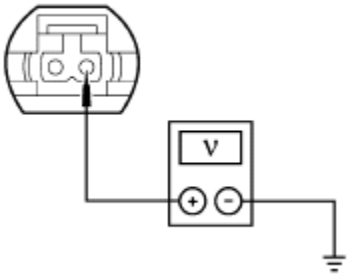
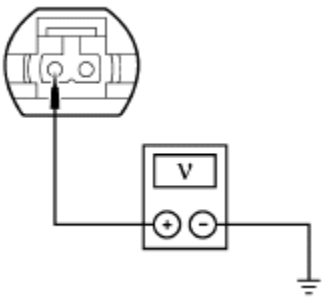
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

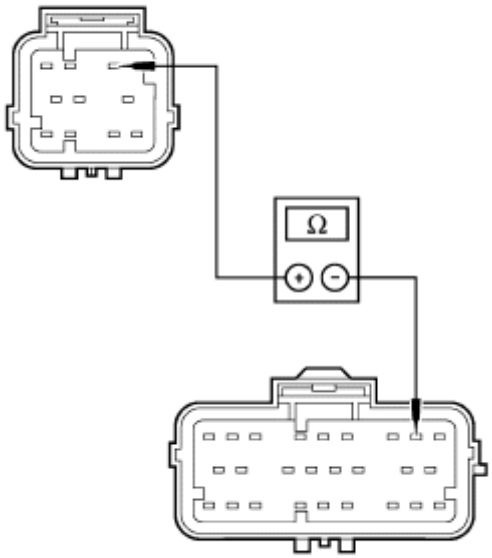
1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1992 retrieved?** → **Yes** GO to W5 . → **No** GO to W3 .

W3 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1257 (WH/LB) FOR A SHORT TO BATTERY OR IGNITION

1	

 2 Driver Side Air Bag Seat Harness C313 3 4  DR1046-A	4 Measure the voltage between driver side air bag seat harness C313, circuit 1257 (WH/LB), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPAIR the circuit. GO to W8 . → **No** GO to W4 .
W4 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1258 (BN/LB) FOR A SHORT TO BATTERY OR IGNITION	
1  DR1009-A	1 Measure the voltage between driver side air bag seat harness C313, circuit 1258 (BN/LB) and ground. • **Is the voltage greater than 10 volts?** → **Yes**

	REPAIR the circuit. GO to W8 . → **No** INSTALL a new driver side air bag module. GO to W8 .
W5 CHECK THE DRIVER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS	
1 2 Battery Ground Cable 3 RCM C233 4 RCM 232 5 6	6 **NOTE:** Do not separate or remove shorting bars from RCM C233. Measure the resistance between RCM C233 pin 2, circuit 1257 (WH/LB), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.



DR1047-A

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit(s) as necessary. GO to W8 .

→ **No**
GO to W6 .

W6 CHECK THE DRIVER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS

1

Driver Side Air Bag Restraint System Diagnostic Tool

2 Inspect all crimps, terminals, wires and connectors in circuit 1257 (WH/LB) between the seat harness C313 and RCM C233 pin 2 and circuit 1258 (BN/LB) between the seat harness C313 and RCM C233 pin 3. Check for pinched wires and damaged connector pin terminals.

- **Was any damage found?**

→ **Yes**
REPAIR as necessary. GO to W8 .

	→ **No** INSTALL a new RCM. GO to W8 .
W7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step W1. • **Was the continuous DTC retrieved during Step W1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to battery or ignition on circuit 1257 (WH/LB) and circuit 1258 (BN/LB). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to W8 . → **No** GO to W8 .
W8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step W1. • **Were any continuous DTCs retrieved during Step W1?** → **Yes** Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTC.

Pinpoint Test X: LFC 36/DTC B1994 — Driver Side Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver side air bag circuit loop and the air bag module igniter at RCM C1 pins 2 and 3. If the resistance is greater than 3.6 ohms, the RCM will store diagnostic trouble code (DTC) B1994 and flash lamp fault code (LFC) 36.

Possible Causes

A high resistance on the driver side air bag circuit can be caused by:

- damaged wiring on circuit 1257 (WH/LB).
- damaged wiring on circuit 1258 (BN/LB).
- damaged driver side air bag module.
- damaged RCM.

PINPOINT TEST X: LFC 36/DTC B1994 — DRIVER SIDE AIR BAG CIRCUIT RESISTANCE HIGH

CONDITIONS	DETAILS/RESULTS/ACTIONS
X1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1994 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to X2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to X7 .
X2 CHECK THE DRIVER SIDE AIR BAG MODULE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible	

violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

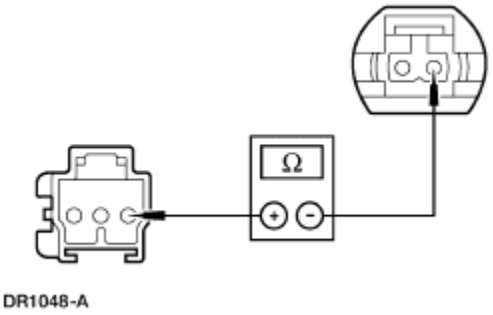
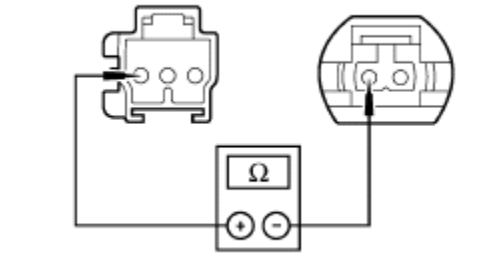
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 2 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1994 retrieved?** → **Yes** GO to X5 . → **No** GO to X3 .

X3 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1257 (WH/LB) FOR HIGH RESISTANCE

1 2 	

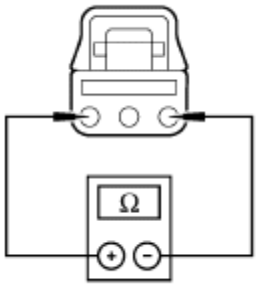
Driver Side Air Bag C313 3  DR1048-A	3 Measure the resistance between driver side air bag seat harness C307, circuit 1257 (WH/LB), harness side and driver side air bag C313, circuit 1257 (WH/LB), harness side. • **Is the resistance greater than 1.0 ohms?** → **Yes** REPAIR the circuit. GO to X8 . → **No** GO to X4 .
X4 CHECK THE DRIVER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1258 (BN/LB) FOR HIGH RESISTANCE	
1  DR1049-A	1 Measure the resistance between driver side air bag seat harness C307, circuit 1258 (BN/LB), harness side and driver side air bag seat harness C313, circuit 1258 (BN/LB), harness side. • **Is the resistance greater than 1.0 ohm?** → **Yes** REPAIR the circuit. GO to X8 . → **No** INSTALL a new driver side air bag module. GO to X8 .
X5 CHECK THE DRIVER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS	
1 2	

RCM C233

3

Driver Side Air Bag Restraint System Diagnostic Tool

4



DR1050-A

4 **NOTE:** By disconnecting RCM C233, circuit 1257 (WH/LB) and circuit 1258 (BN/LB) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar.

NOTE: Zero the multimeter prior to taking the measurement.

Measure the resistance between driver side air bag C307, circuit 1257 (WH/LB), harness side and driver side air bag C307, circuit 1258 (BN/LB), harness side.

- **Is the resistance greater than 1.0 ohm?**

→ **Yes**
REPAIR the circuit(s) as necessary. GO to X8 .

→ **No**
GO to X6 .

X6 CHECK THE DRIVER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS

1

Driver Side Air Bag Restraint System Diagnostic Tool

2 Inspect all crimps, terminals, wires and connectors in circuit 1257 (WH/LB) between the seat harness C307 and RCM C233 pin 2 and circuit 1258 (BN/LB) between the seat harness C307 and RCM C233 pin 3. Check for pinched wires and damaged connector pin terminals.

- **Was any damage found?**

→ **Yes**
REPAIR as necessary. GO to X8 .

	→ **No** INSTALL a new RCM. GO to X8 .
X7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step X1. • **Was the continuous DTC retrieved during Step X1 an intermittent fault?** → **Yes** CHECK for causes of intermittent high resistance on circuit 1257 (WH/LB) and circuit 1258 (BN/LB). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to X8 . → **No** GO to X8 .
X8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step X1. • **Were any continuous DTCs retrieved during Step X1.** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test Y: LFC 36/DTC B1995 — Driver Side Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver side air bag circuit loop and the air bag module igniter at RCM C1 pin 2 and 3. If the resistance is less than 1.4 ohms, the RCM will store diagnostic trouble code (DTC) B1995 and flash lamp fault code (LFC) 36.

Possible Causes

A low resistance on the driver side air bag circuit can be caused by:

- damaged wiring on circuit 1257 (WH/LB).
- damaged wiring on circuit 1258 (BN/LB).
- damaged driver side air bag module.
- damaged RCM.
- worn or damaged shorting bar or camming beam in C233 or C313.

PINPOINT TEST Y: LFC 36/DTC B1995 — DRIVER SIDE AIR BAG CIRCUIT RESISTANCE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
Y1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self-Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1995 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to Y2 . → **No**

	This is an intermittent fault. The fault condition is not present at this time. GO to Y6 .

Y2 CHECK THE DRIVER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

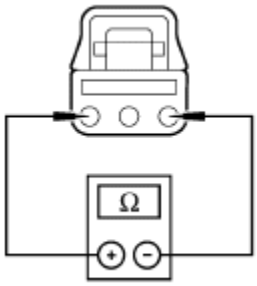
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

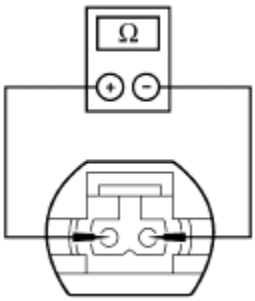
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 2 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1995 retrieved?** → **Yes** GO to Y3 . → **No** GO to Y5 .

Y3 CHECK THE DRIVER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS

1 	

2 RCM C233 3 Driver Side Air Bag Restraint System Diagnostic Tool 4  DR1050-A	4 Measure the resistance between driver side air bag C307, circuit 1257 (WH/LB), vehicle harness side and driver side air bag C307, circuit 1258 (BN/LB), vehicle harness side. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to Y4 . → **No** REPAIR the circuit(s) as necessary. GO to Y7 .
Y4 CHECK THE DRIVER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS	
1 Driver Side Air Bag Seat Harness C313	2 Inspect all crimps, terminals, wires and connectors in circuit 1257 (WH/LB) between the seat harness C313 and RCM C233 pin 2 and circuit 1258 (BN/LB) between the seat harness C313 and RCM C233 pin 3. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?** → **Yes** REPAIR as necessary. GO to Y7 .

	→ **No** INSTALL a new RCM. GO to Y7 .
Y5 CHECK THE DRIVER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS	
1 2 RCM C233 3 Seat Harness C307 4 Driver Side Air Bag C313 5  DR1608-A	5 Measure the resistance between driver side air bag C313, circuit 1257 (WH/LB), harness side and driver side air bag C313, circuit 1258 (BN/LB), harness side. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new driver side air bag. GO to Y7 . → **No** REPAIR the circuit(s) between the driver side air bag connector C313 and the under-seat connector C307. GO to Y7 .
Y6 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded

	during Step Y1. • **Was the continuous DTC retrieved during Step Y1 an intermittent fault?** → **Yes** CHECK for causes of intermittent low resistance on circuit 1257 (WH/LB) and circuit 1258 (BN/LB). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to Y7 . → **No** GO to Y7 .
Y7 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step Y1. • **Was the continuous DTC retrieved during Step Y1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test Z: LFC 37/DTC B1997 — Passenger Side Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the resistance to ground at RCM C1 pins 5 and 6. If the resistance is less than 1000 ohms at either pin, the RCM will interpret that as a ground short, store diagnostic trouble code (DTC) B1997 and flash lamp fault code (LFC) 37.

Possible Causes

A passenger side air bag circuit short to ground can be caused by:

- grounded wiring on circuit 1259 (WH/YE).
- damaged wiring on circuit 1260 (BN/YE).

- ground short in the passenger side air bag module.
- an RCM internal concern.

PINPOINT TEST Z: LFC 37/DTC B1997 — PASSENGER SIDE AIR BAG CIRCUIT SHORTED TO GROUND

CONDITIONS	DETAILS/RESULTS/ACTIONS
Z1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1997 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to Z2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to Z7 .
Z2 CHECK THE PASSENGER SIDE AIR BAG MODULE	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

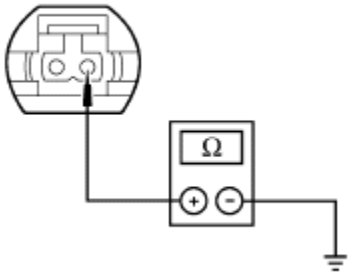
1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1997 retrieved?** → **Yes** GO to Z5. → **No** GO to Z3.

Z3 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1259 (WH/YE) FOR A SHORT TO GROUND

1 2	

Passenger Side Air Bag Seat Harness C314

3



3 Measure the resistance between passenger side air bag seat harness C314, circuit 1259 (WH/YE), harness side and ground.

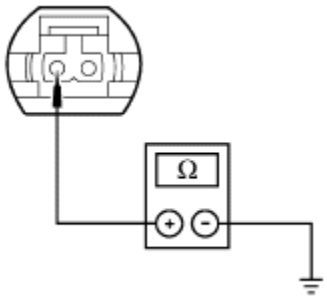
- **Is the resistance less than 1,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to Z8 .

→ **No**
GO to Z4 .

Z4 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1260 (BN/YE) FOR A SHORT TO GROUND

1



1 Measure the resistance between passenger side air bag seat harness C314, circuit 1260 (BN/YE), harness side and ground.

- **Is the resistance less than 1,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to Z8 .

→ **No**
INSTALL a new passenger side air bag module. GO to Z8 .

Z5 CHECK THE PASSENGER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS

1

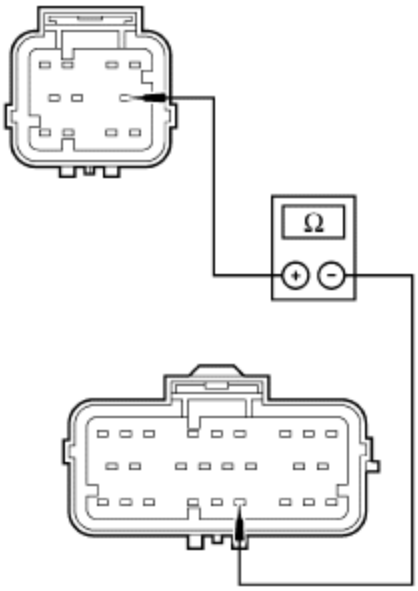
2

RCM C233

3

RCM 232

4



DR1051-A

4 **NOTE:** Do not separate or remove shorting bars from RCM C233.

Measure the resistance between RCM C233 pin 5, circuit 1259 (WH/YE), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit(s) as necessary. GO to Z8 .

→ **No**
GO to Z6 .

Z6 CHECK THE PASSENGER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS

1

 Passenger Side Air Bag Module C314	2 Inspect all crimps, terminals, wires and connectors in circuit 1259 (WH/YE) between the seat harness C308 and RCM C233 pin 5 and circuit 1260 (BN/YE) between the seat harness C308 and RCM C233 pin 6. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?** → **Yes** REPAIR as necessary. GO to Z8 . → **No** INSTALL a new RCM GO to Z8 .
Z7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step Z1. • **Was the continuous DTC retrieved during Step Z1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground on circuit 1259 (WH/YE) and circuit 1260 (BN/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to Z8 . → **No** GO to Z8 .
Z8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step Z1. • **Were any continuous DTCs retrieved during Step Z1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control

	Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AA: LFC 37/DTC B1996 — Passenger Side Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the passenger side air bag circuits at RCM C1 pins 5 and 6 for a short to battery or ignition. If battery or ignition voltage is detected, the RCM will store diagnostic trouble code (DTC) B1996 and flash lamp fault code (LFC) 37.

Possible Causes

A passenger side air bag circuit short to battery or ignition can be caused by:

- battery or ignition voltage on circuit 1259 (WH/YE).
- battery or ignition voltage on circuit 1260 (BN/YE).
- battery or ignition voltage short in the passenger side air bag module.
- an RCM internal concern.

PINPOINT TEST AA: LFC 37/DTC B1996 — PASSENGER SIDE AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
AA1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

Retrieve/Clear Continuous DTCs

5

On-Demand Self Test

- **Was DTC B1996 retrieved during the on-demand self test?**

→ **Yes**
This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AA2 .

→ **No**
This is an intermittent fault. The fault condition is not present at this time. GO to AA7 .

AA2 CHECK THE PASSENGER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

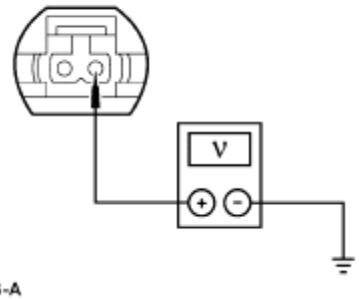
NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

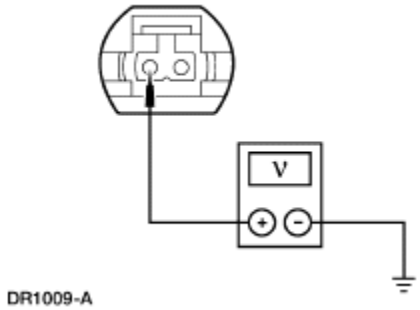
NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

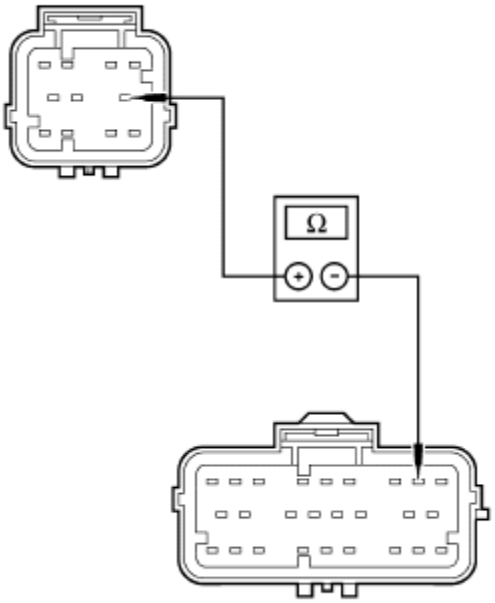
1

3

2 Deactivate the system.

 4 On-Demand Self Test	• **Was DTC B1996 retrieved?** → **Yes** GO to AA5 . → **No** GO to AA3 .
AA3 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1259 (WH/YE) FOR A SHORT TO BATTERY OR IGNITION	
1 2 Passenger Air Bag Seat Harness C314 3 4  DR1046-A	4 Measure the voltage between passenger side air bag seat harness C314, Circuit 1259 (WH/YE) and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPAIR the circuit. GO to AA8 .

	→ **No** GO to AA4 .
AA4 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1260 (BN/YE) FOR A SHORT TO BATTERY OR IGNITION	
1  DR1009-A	1 Measure the voltage between passenger side air bag module connector C314, Circuit 1260 (BN/YE) and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPAIR the circuit. GO to AA8 . → **No** INSTALL a new passenger side air bag module. GO to AA8 .
AA5 CHECK THE PASSENGER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS	
1 2 Battery Ground Cable 3 RCM C233 4 RCM 232 5	

 6  DR1206-A	6 **NOTE:** Do not separate or remove shorting bars from RCM C233. Measure the resistance between RCM C233 pin 5, circuit 1259 (WH/YE), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side. • **Is the resistance less than 10,000 ohms?** → **Yes** REPAIR the circuit(s) as necessary. GO to AA8 . → **No** GO to AA6 .
AA6 CHECK THE PASSENGER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS	
1 Passenger Side Air Bag Restraint System Diagnostic Tool	2 Inspect all crimps, terminals, wires and connectors in circuit 1259 (WH/YE) between the seat harness C308 and RCM C233 pin 5 and circuit 1260 (BN/YE) between the seat harness C308 and RCM C233 pin 6. Check for pinched wires and damaged connector pin terminals.

	• **Was any damage found?** → **Yes** REPAIR as necessary. GO to AA8 . → **No** INSTALL a new RCM. GO to AA8 .
AA7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step AA1. • **Was the continuous DTC retrieved during Step AA1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to battery or ignition on circuit 1259 (WH/YE) and circuit 1260 (BN/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AA8 . → **No** GO to AA8 .
AA8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AA1. • **Were any continuous DTCs retrieved during Step AA1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AB LFC 37/DTC B1998 — Passenger Side Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger side air bag circuit loop and the air bag module igniter at RCM C1 pins 5 and 6. If the resistance is greater than 3.6 ohms, the RCM will store diagnostic trouble code (DTC) B1998 and flash lamp fault code (LFC) 37.

Possible Causes

A high resistance on the passenger side air bag circuit can be caused by:

- damaged wiring on circuit 1259 (WH/YE).
- damaged wiring on circuit 1260 (BN/YE).
- damaged passenger side air bag module.
- damaged RCM.

PINPOINT TEST AB: LFC 37/DTC B1998 — PASSENGER SIDE AIR BAG CIRCUIT RESISTANCE HIGH

CONDITIONS	DETAILS/RESULTS/ACTIONS
AB1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1998 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still

	present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AB2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to AB7 .

AB2 CHECK THE PASSENGER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 On-Demand Self Test	2 Deactivate the system. • **Was DTC B1998 Retrieved?** → **Yes** GO to AB5 . → **No** GO to AB3 .

AB3 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1259

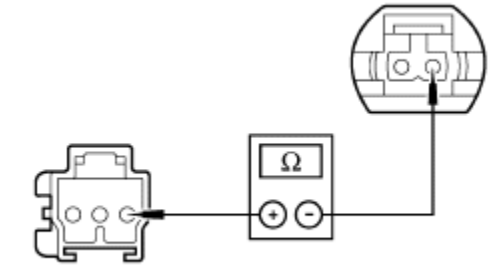
(WH/YE) FOR HIGH RESISTANCE

1

2

Passenger Side Air Bag Seat Harness C314

3



DR1048-A

3 Measure the resistance between passenger side air bag seat harness C308, circuit 1259 (WH/YE), harness side and passenger side air bag seat harness C314, circuit 1259 (WH/YE), harness side.

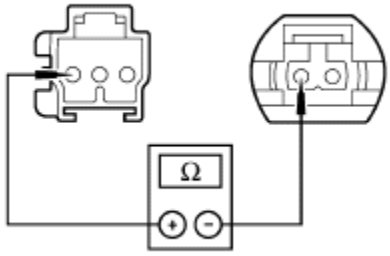
- **Is the resistance greater than 1.0 ohms?**

→ **Yes**
REPAIR the circuit. GO to AB8 .

→ **No**
GO to AB4 .

AB4 CHECK THE PASSENGER SIDE AIR BAG MODULE SEAT HARNESS CIRCUIT 1260 (BN/YE) FOR HIGH RESISTANCE

1

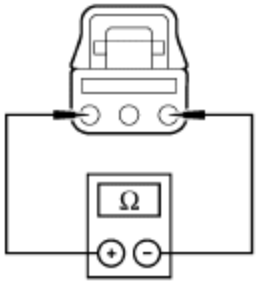


DR1049-A

1 Measure the resistance between passenger side air bag seat harness C308, circuit 1260 (BN/YE), harness side and passenger side air bag C314, circuit 1260 (BN/YE), harness side.

- **Is the resistance greater than 1.0 ohms?**

→ **Yes**
REPAIR the circuit. GO to AB8 .

	→ **No** INSTALL a new passenger side air bag module. GO to AB8 .
AB5 CHECK THE PASSENGER SIDE AIR BAG MODULE CIRCUIT	
1 2 RCM C233 3 Passenger Side Air Bag Restraint System Diagnostic Tool 4  DR1050-A	4 **NOTE:** By disconnecting RCM C233, circuit 1259 (WH/YE) and circuit 1260 (BN/YE) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar. **NOTE:** Zero the multimeter prior to taking the measurement. Measure the resistance between passenger side air bag C308, circuit 1259 (WH/YE), harness side and passenger side air bag C308, circuit 1260 (BN/YE), harness side. • **Is the resistance greater than 1.0 ohm?** → **Yes** REPAIR the circuit(s) as necessary. GO to AB8 . → **No** INSTALL a new RCM. GO to AB6 .
AB6 CHECK THE PASSENGER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS	
1 Passenger Side Air Bag Restraint System Diagnostic Tool	2 Inspect all crimps, terminals, wires and

	connectors in circuit 1259 (WH/YE) between the seat harness C308 and RCM C233 pin 5 and circuit 1260 (BN/YE) between the seat harness C308 and RCM C233 pin 6. Check for pinched wires and damaged connector pin terminals. • **Was any damage found?** → **Yes** REPAIR as necessary. GO to AB8 . → **No** INSTALL a new RCM. GO to AB8 .
AB7 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step AB1. • **Was the continuous DTC retrieved during Step AB1 an intermittent fault?** → **Yes** CHECK for causes of intermittent high resistance on circuit 1259 (WH/YE) and circuit 1260 (BN/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AB8 . → **No** GO to AB8 .
AB8 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AB1. • **Were any continuous DTCs retrieved during Step AB1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all

	DTCs.

Pinpoint Test AC: LFC 37/DTC B1999 — Passenger Side Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger side air bag circuit loop and the air bag module igniter at RCM C1 pins 5 and 6. If the resistance is less than 1.4 ohms, the RCM will store diagnostic trouble code (DTC) B1999 and flash lamp fault code (LFC) 37.

Possible Causes

A low resistance on the passenger side air bag circuit can be caused by:

- damaged wiring on circuit 1259 (WH/YE).
- damaged wiring on circuit 1260 (BN/YE).
- damaged passenger side air bag module.
- damaged RCM.
- damaged shorting bar or camming beam in C233 or C314.

PINPOINT TEST AC: LFC 37/DTC B1999 — PASSENGER SIDE AIR BAG CIRCUIT RESISTANCE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
AC1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

On-Demand Self Test	• **Was DTC B1999 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AC2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to AC6 .

AC2 CHECK THE PASSENGER SIDE AIR BAG MODULE

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

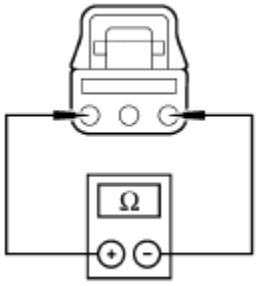
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 4 	2 Deactivate the system.

On-Demand Self Test	• **Was DTC B1999 Retrieved?** → **Yes** GO to AC3 . → **No** GO to AC5 .
AC3 CHECK THE PASSENGER SIDE AIR BAG MODULE CIRCUIT	
1 2 RCM C233 3 Passenger Side Air Bag Restraint System Diagnostic Tool 4  DR1050-A	4 Measure the resistance between passenger side air bag C308, circuit 1259 (WH/YE), harness side and circuit 1260 (BN/YE), harness side. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new RCM. GO to AC4 . → **No** REPAIR the circuit(s) as necessary. GO to AC4 .
AC4 CHECK THE PASSENGER SIDE AIR BAG MODULE WIRING TO THE SEAT HARNESS	
1	1 Inspect all crimps, terminals, wires and connectors in circuit 1259 (WH/YE) between

Passenger Side Air Bag Seat Harness C314

the seat harness C314 and RCM C233 pin 5 and circuit 1260 (BN/YE) between the seat harness C314 and RCM C233 pin 6. Check for pinched wires and damaged connector pin terminals.

- **Was any damage found?**

→ **Yes**
REPAIR as necessary. GO to AC7 .

→ **No**
INSTALL a new RCM. GO to AC7 .

AC5 CHECK THE PASSENGER SIDE AIR BAG MODULE CIRCUIT TO THE SEAT HARNESS

1

2

RCM C233

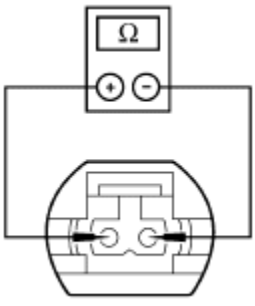
3

Seat Harness C308

4

Passenger Side Air Bag C314

5



DR1608-A

5 Measure the resistance between passenger side air bag C314, circuit 1259 (WH/YE), harness side and passenger side air bag C314, circuit 1260 (BN/YE), harness side.

- **Is the resistance greater than 10,000 ohms?**

	→ **Yes** INSTALL a new passenger side air bag. GO to AC7 . → **No** REPAIR the circuit(s) between the passenger side air bag connector C314 and the under-seat connector C308. GO to AC7 .
AC6 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step AC1. • **Was the continuous DTC retrieved during Step AC1 an intermittent fault?** → **Yes** CHECK for causes of intermittent low resistance on circuit 1259 (WH/YE) and circuit 1260 (BN/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AC7 . → **No** GO to AC7 .
AC7 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AC1. • **Were any continuous DTCs retrieved during Step AC1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AD: B1892 — Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open

Normal Operation

The restraints control module (RCM) monitors its connection to the generic electronic module (GEM) at C280 pin 20. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to ground or open on the connection to the GEM, it will store a diagnostic trouble code (DTC) B1892 in memory.

Possible Causes

An air bag tone warning indicator circuit short to ground or open can be caused by:

- a short to ground or open on circuit 1083 (LB/BK).
- a damaged or inoperative GEM.
- a damaged RCM.

PINPOINT TEST AD: DTC B1892 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO GROUND OR OPEN

CONDITIONS	DETAILS/RESULTS/ACTIONS
AD1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 	
2 Scan Tool	
3 	
4 Retrieve/Clear Continuous DTCs	4 Retrieve and record any continuous DTCs for use later in this pinpoint test.
5 On-Demand Self Test	• **Was DTC B1892 retrieved during the on-demand self test?** → **Yes**

	This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AD2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to AD5 .

AD2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

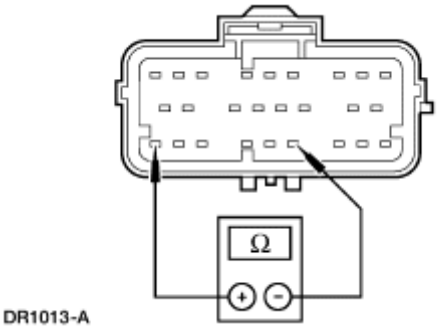
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 	
	2 Deactivate the system.
3 RCM C232	
4 GEM	
5	5 Measure the resistance between RCM C232 pin 26, circuit 1083 (LB/BK), harness side and RCM C232 pin 21, circuit 649 (BK/OG), harness side.



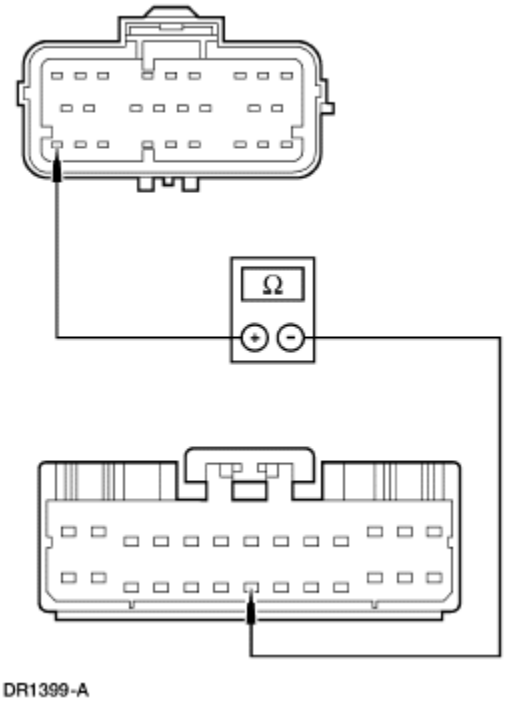
- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to AD6 .

→ **No**
GO to AD3 .

AD3 CHECK THE AIR BAG TONE WARNING INDICATOR MODULE CIRCUIT

1

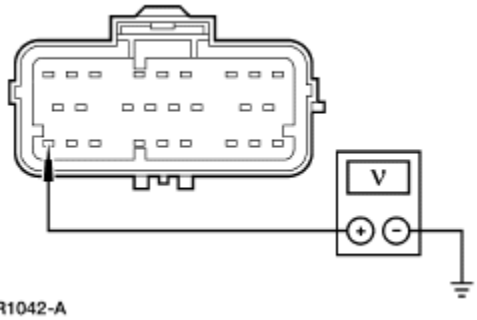


1 Measure the resistance between RCM C232 pin 26, circuit 1083 (LB/BK), harness side and GEM C280 pin 20, circuit 1083 (LB/BK), harness side.

- **Is the resistance greater than 10 ohms?**

→ **Yes**
REPAIR the circuit. GO to AD6 .

→ **No**

	GO to AD4 .
AD4 CHECK THE AIR BAG TONE WARNING INDICATOR	
1 GEM C280 2 3  DR1042-A	3 Measure the voltage between RCM C232 pin 26, circuit 1083 (LB/BK), harness side and ground. • **Is the voltage less than 1.0 volt?** → **Yes** INSTALL a new GEM. GO to AD6 . → **No** INSTALL a new RCM. GO to AD6 .
AD5 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step AD1. • **Was the continuous DTC retrieved during Step AD1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground or open on circuit 1083 (LB/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AD6 . → **No** GO to AD6 .
AD6 CHECK FOR ADDITIONAL DTCs	

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AD1. • **Were any continuous DTCs retrieved during Step AD1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AE: DTC B1891 — Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors its connection to the generic electronic module (GEM) at pin 20. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to battery or ignition on the connection to the GEM, it will store a diagnostic trouble code (DTC) B1891 in memory.

Possible Causes

An air bag tone warning indicator circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 1083 (LB/BK).
- a damaged or inoperative GEM.
- a damaged RCM.

PINPOINT TEST AE: DTC B1891 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO BATTERY OR IGNITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
AE1 CHECK FOR A HARD OR INTERMITTENT DTC	
1	

2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1891 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AE2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to AE4 .

AE2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1

2 Deactivate the system.

3

Battery Ground Cable

4

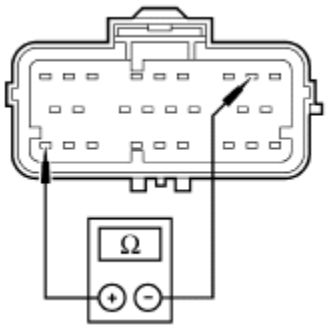
RCM C232

5

GEM C280

6

7



DR1015-A

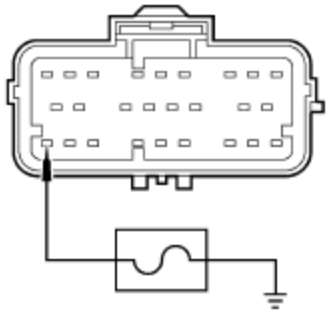
7 Measure the resistance between RCM C232 pin 26, circuit 1083 (LB/BK), harness side and RCM C232 pin 2, circuit 364 (BK/LG), harness side.

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to AE5 .

→ **No**
GO to AE3 .

AE3 CHECK THE AIR BAG TONE WARNING INDICATOR

1 2 Battery Ground Cable 3 GEM C280 4 5  DR1043-A	5 Jumper RCM C232 pin 26, circuit 1083 (LB/BK), harness side to ground. • **Does the GEM generate a tone?** → **Yes** INSTALL a new RCM. GO to AE5 . → **No** INSTALL a new GEM. GO to AE5 .
AE4 CHECK FOR AN INTERMITTENT FAULT	
	1 Refer to the continuous DTCs recorded during Step AE1. • **Was the continuous DTC retrieved during Step AE1 an intermittent fault?** → **Yes** CHECK for causes of intermittent short to ground or open on circuit 1083 (LB/BK). ATTEMPT to recreate the hard fault by flexing

	the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AE5 . → **No** GO to AE5 .
AE5 CHECK FOR ADDITIONAL DTCs	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AE1. • **Were any continuous DTCs retrieved during Step AE1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AF: DTC B1869 — Air Bag Indicator Inoperative

Normal Operation

The air bag indicator is designed to illuminate for 6 (+/-2) seconds when the ignition switch is turned to the RUN position. This initial 6 seconds of illumination is considered normal operation and is called prove out of the air bag indicator. The air bag indicator is then used to warn the driver if there is a fault in the air bag supplemental restraint system (SRS).

The restraints control module (RCM) monitors the air bag indicator for open and short to ground conditions. If the RCM detects an open or short to ground condition on the air bag indicator circuit, it will store a diagnostic trouble code (DTC) B1869 in memory.

If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the generic electronic module (GEM) to produce five sets of five tone bursts.

Possible Causes

An air bag indicator inoperative condition can be caused by:

- damaged wiring on circuit 608 (BK/YE).
- a damaged or burned out air bag indicator.
- an instrument cluster malfunction.

- a damaged RCM.

PINPOINT TEST AF: DTC B1869 — AIR BAG INDICATOR INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
AF1 CHECK FOR A HARD OR INTERMITTENT DTC	
1 2 Scan Tool 3 4 Retrieve/Clear Continuous DTCs 5 On-Demand Self Test	4 Retrieve and record any continuous DTCs for use later in this pinpoint test. • **Was DTC B1869 retrieved during the on-demand self test?** → **Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AF2 . → **No** This is an intermittent fault. The fault condition is not present at this time. GO to AF5 .
AF2 CHECK THE RCM	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible	

violation of vehicle safety standards.

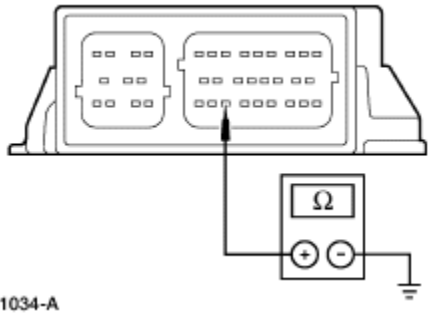
NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

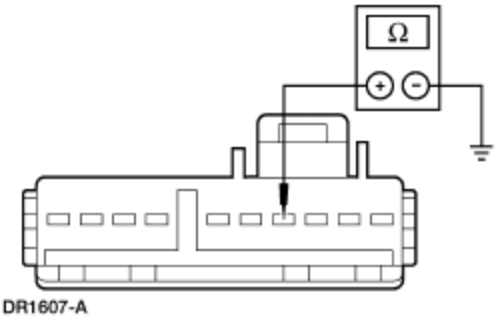
NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

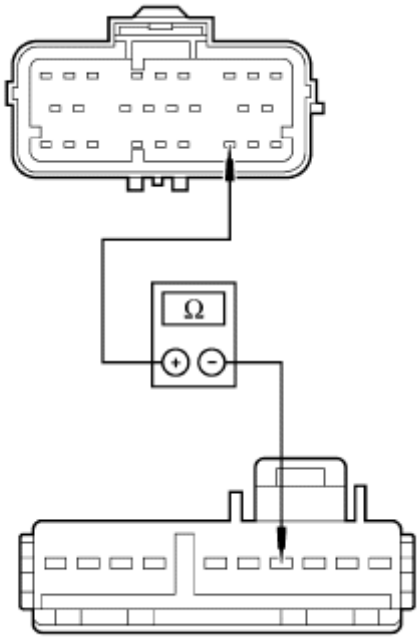
NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 	
2 Deactivate the system.	
3 RCM C232	
4  DR1034-A	4 Measure the resistance between the RCM C232, pin 20, component side, and a known good chassis ground.
	• **Is the resistance less than 100 ohms?** → **Yes** INSTALL a new RCM. GO to AF6. → **No** GO to AF3.
AF3 CHECK CIRCUIT 608 (BK/YE) FOR A SHORT TO GROUND	
1	

 2 RCM C232 3 Instrument Cluster C288 4  DR1607-A	4 Measure the resistance to ground at instrument cluster C288 pin 7, circuit 608 (BK/YE), harness side. • **Is the resistance less than 100 ohms?** → **Yes** REPAIR the circuit. GO to AF6 . → **No** GO to AF4 .
AF4 CHECK CIRCUIT 608 (BK/YE) FOR AN OPEN	
1 Instrument Cluster C288 2	2 Measure the resistance between RCM C232 pin 20, circuit 608 (BK/YE), harness side and instrument cluster C288 pin 4, circuit 608 (BK/YE), harness side.



DR1400-A

- **Is the resistance greater than 10 ohms?**

→ **Yes**
REPAIR the circuit. GO to AF6 .

→ **No**
REPAIR the instrument cluster. GO to AF6 .

AF5 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step AF1.

- **Was the continuous DTC retrieved during Step AF1 an intermittent fault?**

→ **Yes**
CHECK for causes of intermittent short to ground or open on circuit 608 (BK/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AF6 .

→ **No**
GO to AF6 .

AF6 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible

violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AF1. • **Were any continuous DTCs retrieved during Step AF1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AG: DTC B1870 — Air Bag Indicator Shorted to Battery

Normal Operation

The air bag indicator is designed to illuminate for 6 (+/-2) seconds when the ignition switch is turned to the RUN position. This initial 6 seconds of illumination is considered normal operation and is called prove out of the air bag indicator. The air bag indicator is then used to warn the driver that there is a fault in the air bag supplemental restraint system (SRS).

While the air bag indicator is activated, the restraints control module (RCM) monitors the air bag indicator for short to battery conditions. If the RCM detects a short to battery condition on the air bag indicator circuit, it will store a diagnostic trouble code (DTC) B1870 in memory.

If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the generic electronic module (GEM) to produce five sets of five tone bursts.

Possible Causes

An air bag indicator short to battery condition can be caused by:

- a short to battery on circuit 608 (BK/YE).
- a damaged or inoperative instrument cluster.
- an RCM internal concern.

PINPOINT TEST AG: DTC B1870 — AIR BAG INDICATOR SHORTED TO BATTERY

CONDITIONS	DETAILS/RESULTS/ACTIONS
AG1 CHECK FOR A HARD OR INTERMITTENT DTC	
1	

2

Scan Tool

3

4

Retrieve/Clear Continuous DTCs

5

On-Demand Self Test

4 Retrieve and record any continuous DTCs for use later in this pinpoint test.

- **Was DTC B1870 retrieved during the on-demand self test?**

→ **Yes**
This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to AG2 .

→ **No**
This is an intermittent fault. The fault condition is not present at this time. GO to AG4 .

AG2 CHECK THE AIR BAG INDICATOR CIRCUIT

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual.

NOTE: Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 2 3 RCM C232 4 	2 Deactivate the system. • **Is the air bag indicator illuminated?** → **Yes** INSTALL a new RCM. GO to AG3 . → **No** CHECK the air bag indicator bulb. If the air bag indicator bulb is OK, REPAIR the circuit. GO to AG5 .

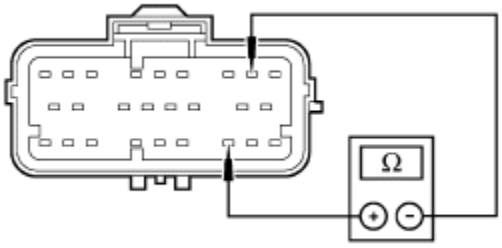
AG3 CHECK AIR BAG INDICATOR CIRCUIT FOR SHORT TO BATTERY

1 2 RCM C232 3 Instrument Cluster C288 4	

Battery Ground Cable

5

6



DR1033-A

6 Measure the resistance between RCM C232 pin 2, circuit 364 (BK/LG) and pin 20, circuit 608 (BK/YE).

- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. GO to AG5 .

→ **No**
REPAIR the instrument cluster. GO to AG5 .

AG4 CHECK FOR AN INTERMITTENT FAULT

1 Refer to the continuous DTCs recorded during Step AG1.

- **Was the continuous DTC retrieved during Step AG1 an intermittent fault?**

→ **Yes**
CHECK for causes of intermittent short to battery on circuit 608 (BK/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to AG5 .

→ **No**
GO to AG5 .

AG5 CHECK FOR ADDITIONAL DTCs

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible

violation of vehicle safety standards.	
	1 Refer to the continuous DTCs recorded during Step AG1. • **Were any continuous DTCs retrieved during Step AG1?** → **Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. → **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. CLEAR all DTCs.

Pinpoint Test AH: No Communication with the Restraints Control Module (RCM)

Normal Operation

The RCM communicates with the scan tool using ISO 9141 communication mode through the data link connector (DLC).

Possible Causes

A no communication condition can be caused by:

- damage to circuit 70 (LB/WH).
- a damaged DLC.
- a damaged scan too.
- an RCM internal concern.

PINPOINT TEST AH: NO COMMUNICATION WITH THE RESTRAINTS CONTROL MODULE (RCM)

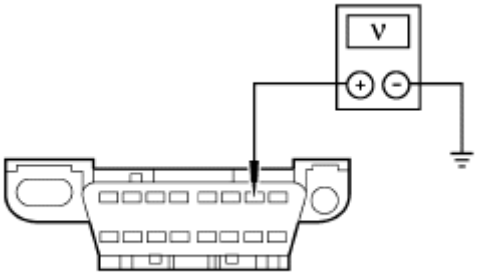
CONDITIONS	DETAILS/RESULTS/ACTIONS
AH1 CHECK THE RCM CONNECTOR C232 AND CONNECTOR PIN 5 FOR DAMAGE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. **NOTE:** If a seat equipped with a seat mounted side airbag system is being serviced the airbag system must be deactivated per the deactivation procedure contained in Section 501-20B of the appropriate car/truck service manual. **NOTE:** Airbag simulators (restraint system diagnostic tools) **MUST** be installed under the seats in the side airbag to floor connector.	

NOTE: Diagnostics or repairs are not to be performed on a side airbag system with the seat in the vehicle. Prior to attempting to diagnose/repair the side airbag system the seat must be removed from the vehicle and the restraint system diagnostic tool must be installed in side airbag connector at the floor connector. The restraint system diagnostic tool must be removed prior to operating the vehicle.

NOTE: Diagnostics may be performed on seat systems other than the side airbag system (lumbar, climate controlled, heated, power seat track) with the seat installed in the vehicle as long as the restraint system diagnostic tool is installed under the seat in the side airbag to floor connector.

NOTE: After diagnosing/repairing a seat system the restraint system diagnostic tool must be removed before operating the vehicle.

1 3 RCM C232	2 Deactivate the system. 4 Inspect RCM C232 and RCM C232 pin 5 for damage. • **Are RCM C232 and RCM C232 pin 5 OK?** → **Yes** GO to AH2 . → **No** REPAIR RCM C232 or RCM C232 pin 5 as necessary. REACTIVATE the system.
AH2 CHECK THE DLC CONNECTOR C291 AND CONNECTOR PIN 7 FOR DAMAGE	
	1 Inspect DLC C291 and DLC C291 pin 7 for damage. • **Are DLC C291 and DLC C291 pin 7 OK?** → **Yes** GO to AH3 . → **No** REPAIR DLC C291 or DLC C291 pin 7 as necessary. REACTIVATE the system.
AH3 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO BATTERY	
1	1 Measure the voltage to ground at DLC C291 pin 7, circuit 70 (LB/WH).



DR1546-A

- **Can any voltage be measured?**

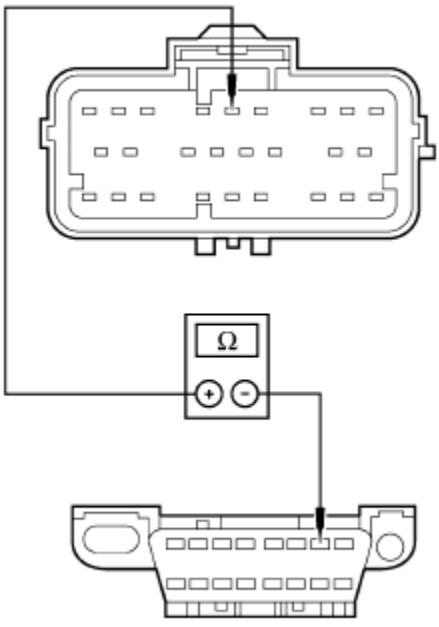
→ **Yes**
REPAIR the battery short. REACTIVATE the system.

→ **No**
GO to AH4 .

AH4 CHECK CIRCUIT 70 (LB/WH) FOR AN OPEN

WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

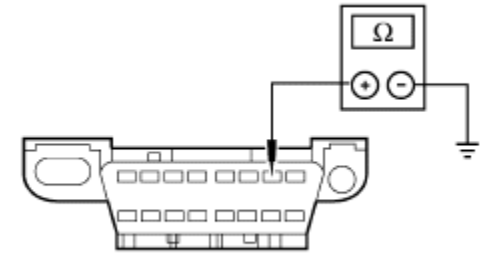
1



DR1019-A

1 Measure the resistance between RCM C232 pin 5, circuit 70 (LB/WH), harness side and DLC C291 pin 7, circuit 70 (LB/WH), harness side.

- **Is the resistance less than 5 ohms?**

	→ **Yes** GO to AH5 . → **No** REPAIR the circuit. REACTIVATE the system.
AH5 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO GROUND	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.	
1  DR1547-A	1 Measure the resistance to ground at DLC C291 pin 7, circuit 70 (LB/WH). • **Is the resistance less than 10,000 ohms?** → **Yes** REPAIR the circuit. REACTIVATE the system. → **No** INSTALL a new RCM. REACTIVATE the system.

Air Bag Disposal —Deployed Air Bag

1. **WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.**

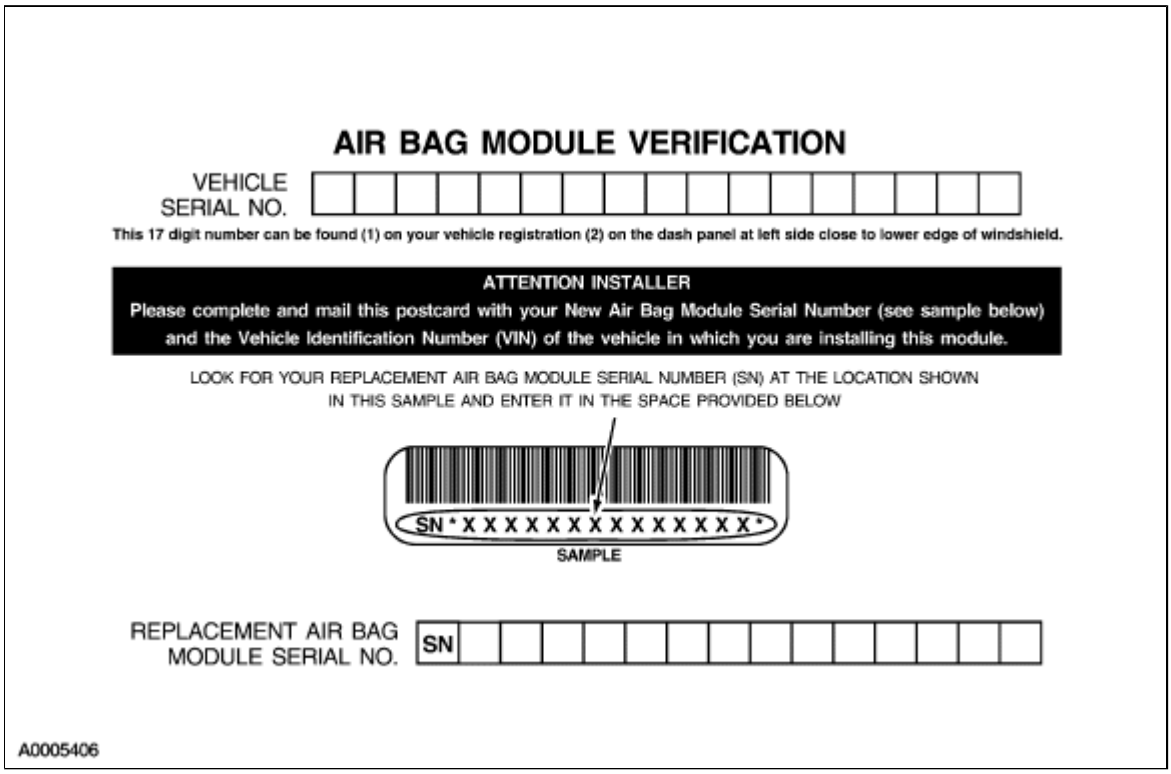
   Dispose of the deployed air bag modules and safety belt pretensioners in the same manner as any other part to be scrapped.

Air Bag Disposal —Undeployed, Inoperative

WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Remove the inoperative component from the vehicle. For additional information, refer to the appropriate air bag procedure in this section or to Section 501-20A for the retractor/pretensioner assembly.



2. **NOTE:** When installing a new air bag module, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the vehicle identification number (VIN) must be recorded and sent to Ford Motor Company.

   If installing a new air bag module:
   - Record the necessary information and return the inoperative air bag module to Ford Motor Company.

Air Bag Disposal —Driver, Undeployed, Scrapped Vehicle

Remote Deployment

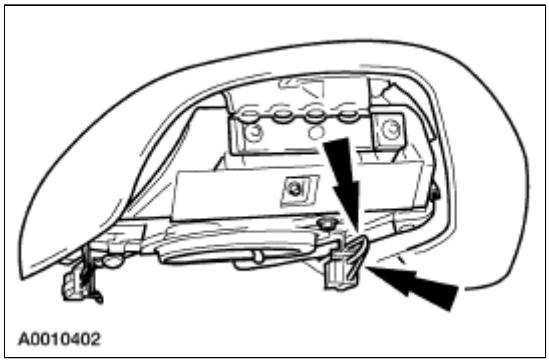
WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

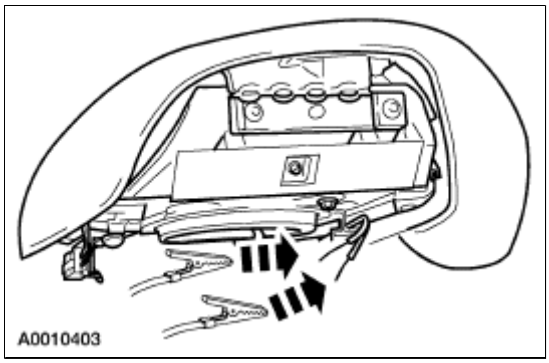
WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

WARNING: Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

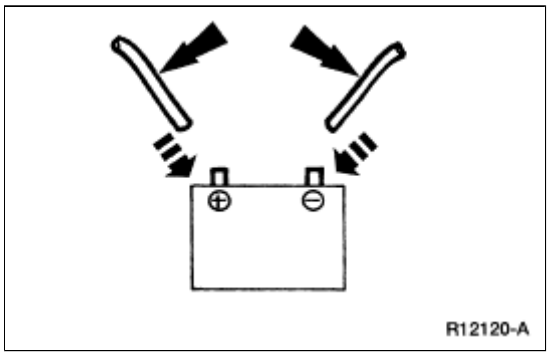
1. Remove the driver air bag from the vehicle. Refer to Module—Driver Air Bag in this section.
2. Cut and strip the wires near the electrical connector.



3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the stripped ends of the air bag module wires.



4. Place the air bag module on a flat surface in an open outdoor area with the trim cover facing upward.
5. Remain at least 6.1 meters (20 feet) away from the air bag module.
6. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12–volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.
8. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal —Passenger, Undeployed, Scrapped Vehicle

Remote Deployment

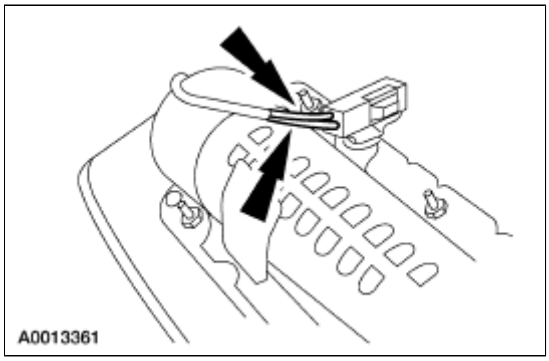
WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module.This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

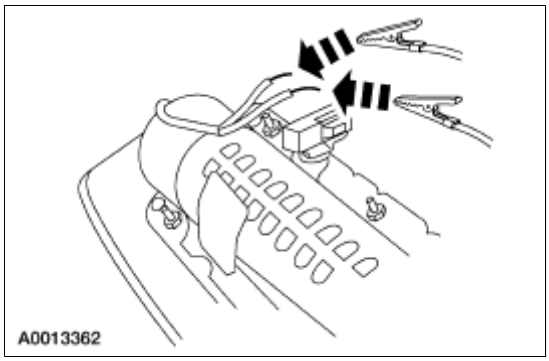
WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

WARNING: Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

1. Remove the passenger air bag from the vehicle. Refer to Module—Passenger Air Bag in this section.
2. Cut and strip the wires near the electrical connector.



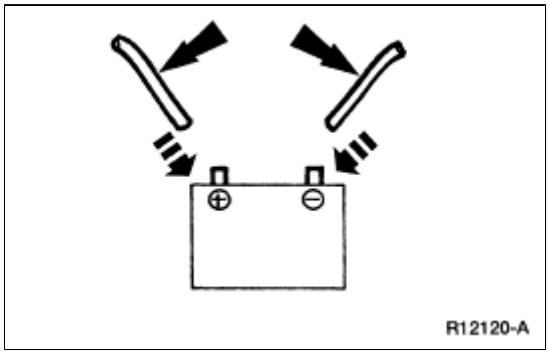
3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the stripped wires on the air bag module.



4. Place the air bag module on a flat surface in an open outdoor area with the deflector can facing downward.

5. Remain at least 6.1 meters (20 feet) away from the air bag module.

6. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12–volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

8. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal —Side, Undeployed, Scrapped Vehicle

Remote Deployment

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

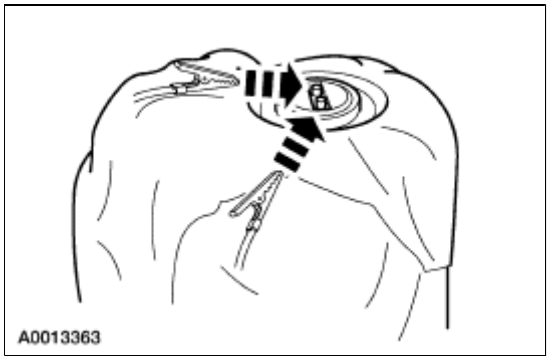
WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

WARNING: Do not place the side air bag module with the tear seam facing down or the attaching studs facing upward, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

1. Remove the side air bag from the vehicle. For additional information, refer to Module—Side Air Bag in this section.

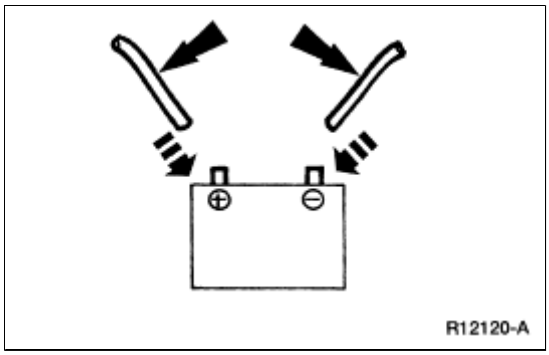
2. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the connector pins on the air bag module.



3. Place the air bag module on a flat surface in an open outdoor area with the tear seam facing upward and the attaching studs facing downward.

4. Remain at least 6.1 meters (20 feet) away from the air bag module.

5. Deploy the side air bag module by touching the other ends of the two wires to the terminals of a 12–volt battery.



6. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.
7. Dispose of the deployed side air bag module in the same manner as any other part to be scrapped.

Wiring Repair

1. Inspect the supplemental restraint system (SRS) wiring and the wiring harness for any damage that may have occurred as a result of the accident. Inspect and repair or install new, as required, any damaged:
    - insulation.
    - terminal.
    - connectors.
    - splices.

2. Splice damaged wires using the specified butt-splice connector or equivalent.
    - For splices required in adjacent wiring, stagger the splices 51 mm (2.04 in) apart from each other.
    - Use waterproof butt-splice type connectors.
    - Use the correct size heat shrink nylon tube to prevent water, salt, condensation, and heat from affecting the wiring repair. Make sure the tube extends 25 mm (1 in) each side of the repair.
    - Use a splice connector that is lined with a sealer that melts when heated with a heat gun and flows from the tubing, sealing the splice.
    - Use the correct gauge connector for the wire being repaired.
    - Use connectors that are transparent to allow inspection of the finished splice.

Weld Nut Repair —"J" Nut, Restraints Control Module (RCM), Front External Crash and Side Crash Sensor

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing air bag crash sensor attaching weld nut (s). Read both procedures before proceeding with the repair.

NOTE: If two or more weld nuts are missing, do not install the "J" nuts as outlined in this procedure. Weld nuts must be installed as outlined in Weld Nut Repair — Missing Weld Nut, Restraints Control Module (RCM), Front External Crash and Side Crash Sensor.

NOTE: The following procedure applies to vehicles that have a rectangular hole in the sheet metal that is in close proximity to the missing weld nut.

1. Obtain a "J" nut (part number N623332-S301) or any of the following optional "J" nuts (part numbers: N623342-S101, N800854-S100, N800925-S100).

2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190) or equivalent.

3. Install the "J" nut through the rectangular hole in the sheet metal.

4. **NOTE:** Be sure the threaded portion of the "J" nut is aligned with the clearance hole in the sheet metal.

   Install the crash sensor.

5. Tighten the attaching screws to specification. Refer to Torque Specifications in this section.

Weld Nut Repair —Missing Weld Nut, Restraints Control Module (RCM), Front External Crash and Side Crash Sensor

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

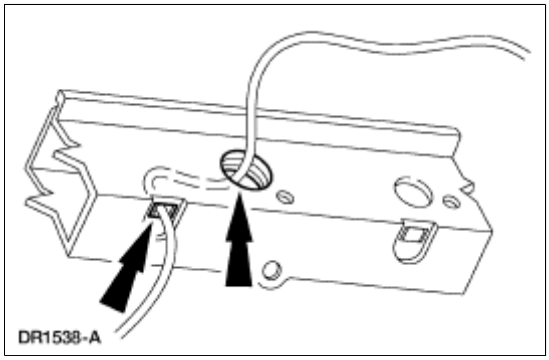
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing air bag crash sensor attaching weld nut (s). Read both procedures before proceeding with the repair.

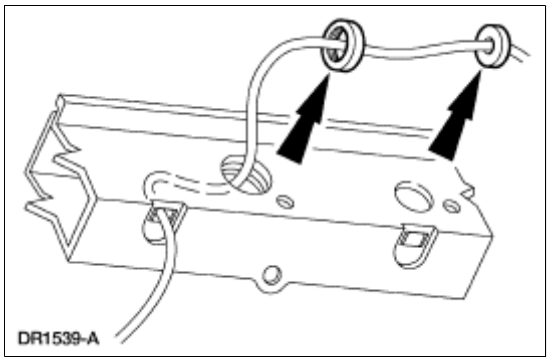
NOTE: If two or more weld nuts are missing, do not install the "J" nuts as outlined in Weld Nut Repair — "J" Nut, Restraints Control Module (RCM), Front External Crash and Side Crash Sensor. Weld nuts must be installed as outlined in this procedure.

NOTE: Radiator support repair shown, others are similar.

1. Obtain a 6 mm (0.24 in) weld nut (part number N806285-S190).
2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190).
3. Route a sufficient length of copper welding wire through the weld nut clearance hole and back out an adjacent access hole.



4. Feed the copper welding wire through the weld nut, then through a standard flatwasher.



5. Secure the flatwasher so that it cannot be pulled off the end of the copper welding wire.
6. Pull the copper welding wire back through the clearance hole, allowing the weld nut and flatwasher to follow the copper welding wire through.
7. Position the weld nut to the weld nut clearance hole, firmly pulling on the copper welding wire allowing the secured flatwasher to hold the weld nut in position.
8. Holding the weld nut securely in place and using a MIG welder, weld in four places around the edge of the weld nut.
9. Metal finish as required.
10. Verify the nut is securely in place.
11. Install the crash sensor.
12. Tighten the attaching screws to specification. Refer to Torque Specifications in this section.

Weld Nut Repair —Stripped Weld Nut, Restraints Control Module (RCM), Front External Crash and Side Crash Sensor

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

1. Obtain an 8 mm (0.32 in) grounding screw (part number N802455-S190).
2. Drill out the internal threads of the stripped-out weld nut to 7.37 mm (0.29 in) using a letter "L" size drill bit.
3. Position the crash sensor to the vehicle.
4. Install the 8 mm (0.32 in) grounding screw into the drilled-out weld nut.
5. Install the remaining attaching screws.
6. Tighten the attaching screws to specification. Refer to Torque Specifications in this section.

Sensor —Front External Crash

Removal

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

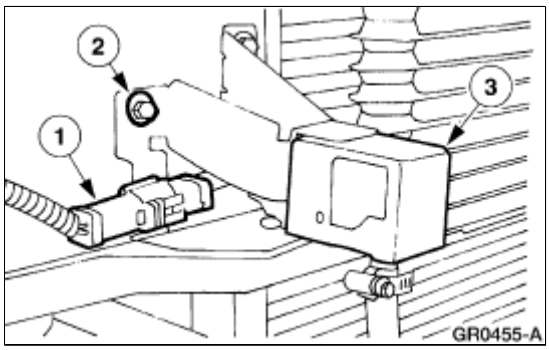
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the radiator grill and radiator opening cover. For additional information, refer to Section 501-02 .

3. Remove the air bag sensor.
    1. Disconnect the air bag sensor electrical connector.
    2. Remove the three screws.
    3. Remove the air bag sensor.



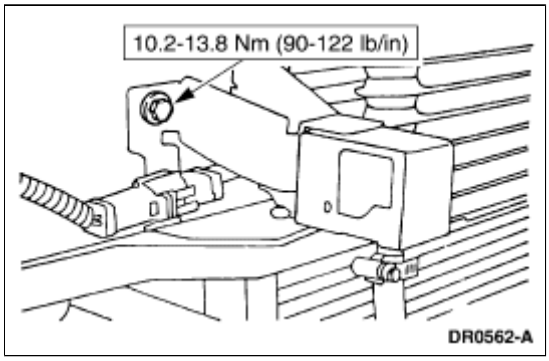
Installation

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Follow the removal procedure in reverse order.



2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Prove out the air bag system.

Sensor —Side Crash

Removal

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

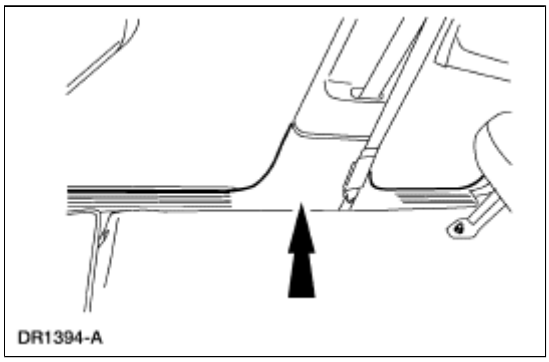
NOTE: Right side is shown, left side is similar.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

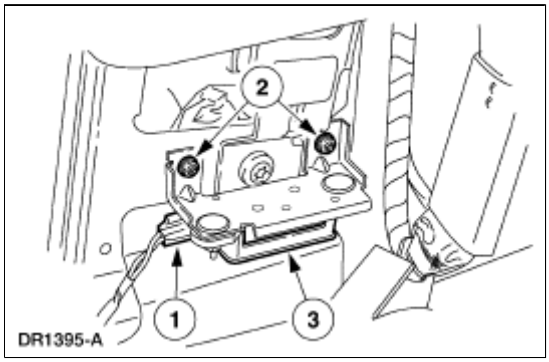
2. **NOTE:** Four door is shown, two door is similar.

   NOTE: The front seat has been removed for clarity.

   Remove the B-pillar lower trim panel with scuff plates.



3. Remove the side crash sensor.
    1. Disconnect the side crash sensor electrical connector.
    2. Remove the two retaining bolts.
    3. Remove the side crash sensor with bracket.



Installation

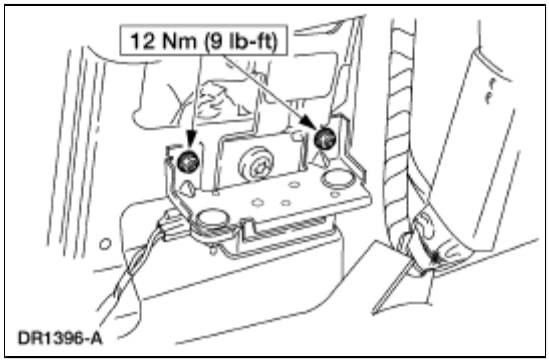
WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: The tightening torque of the air bag side crash sensor retaining bolts is critical for proper system operation.

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Follow the removal procedure in reverse order.



2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

Prove out the air bag system.

Module —Restraints Control

Removal

WARNING: The restraints control module (RCM) orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the right cowl A-pillar area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

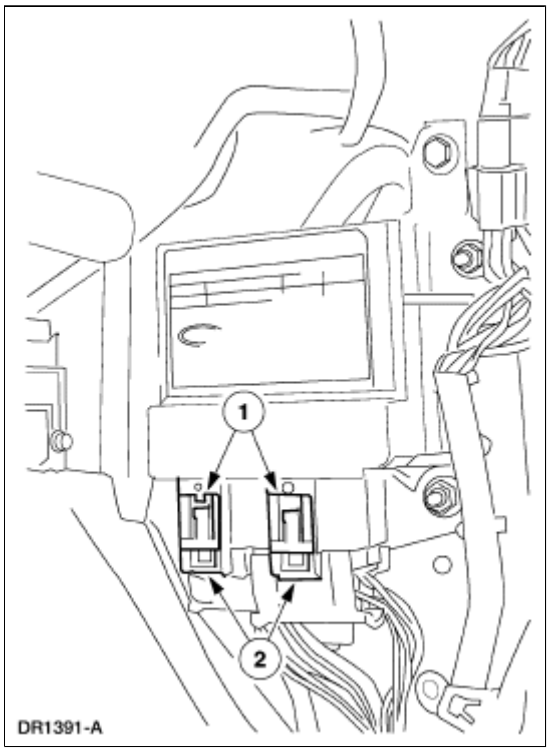
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

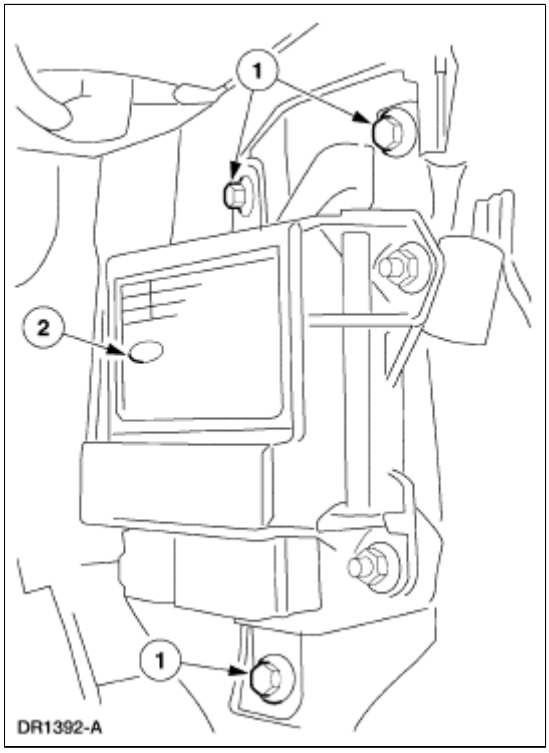
2. Remove the right hand cowl side trim panel (02345). For additional information, refer to Section 501-05 .

3. Disconnect the restraints control module (RCM).
    1. Slide the two RCM electrical connector locking clips down to disengage them.
    2. While squeezing the locking clip area to pivot the latch, disconnect the two RCM electrical connectors.



4. Remove the RCM with bracket.
    1. Remove the three RCM bracket retaining bolts.

2. Remove the RCM with bracket.



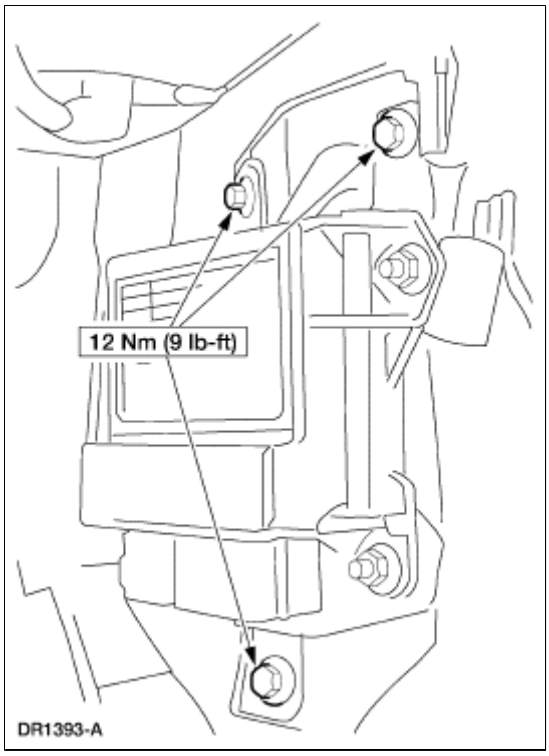
Installation

1. **WARNING: The tightening torque of the restraints control module (RCM) retaining bolts is critical for proper system operation.**

   CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

   NOTE: A repair is made by installing a new part only. If the part does not correct the condition, install the original part and perform the diagnostic procedure again.

   Follow the removal procedure in reverse order.



2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Prove out the air bag system.

Module —Driver Air Bag

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be installed new, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

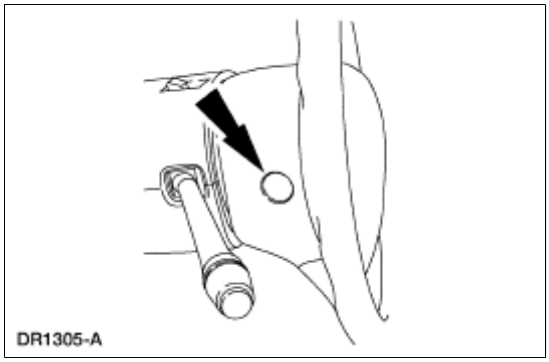
The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

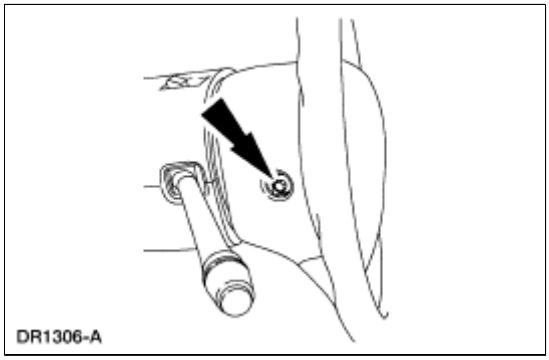
NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

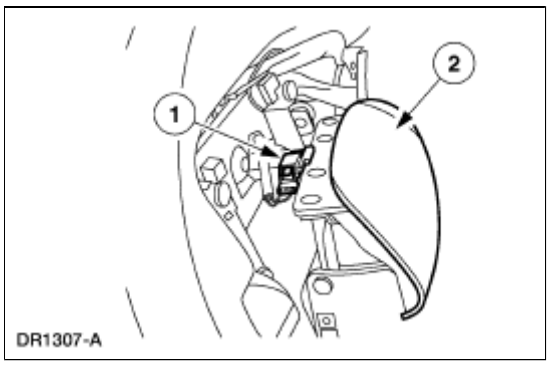
2. Remove the two steering wheel back cover plugs.



3. Remove the two driver side air bag module retaining bolts.



4. Remove the driver air bag module.
    1. Disconnect the driver air bag module electrical connector.
    2. Remove the driver air bag module.



Installation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the

event of an accidental deployment.

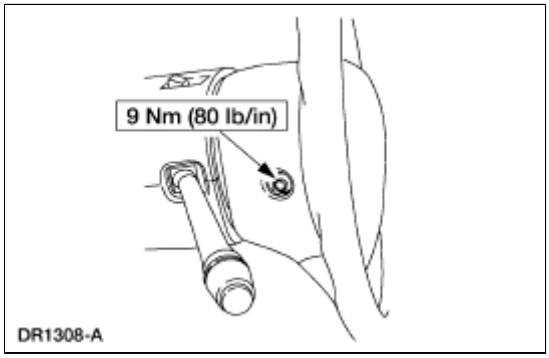
WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

NOTE: Make sure to tighten the retaining bolts to specification.

1. Follow the removal procedure in reverse order.



2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Prove out the air bag system.

Module —Passenger Air Bag

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the deployment door face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged deployment doors must be installed new, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

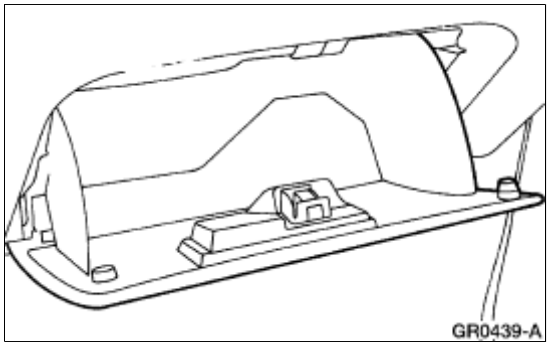
The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

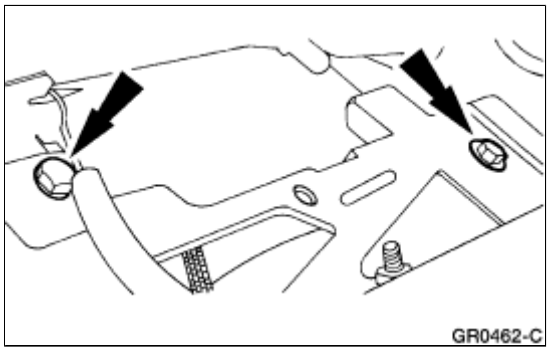
NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. Open the glove compartment door to access the mounting screws.

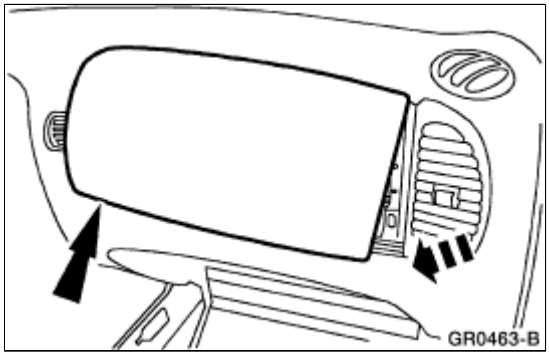


3. Remove the two screws.

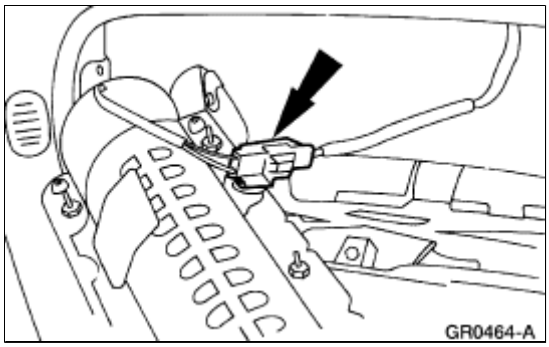


4. **CAUTION: Do not handle the passenger air bag module by grabbing the edges of the deployment door.**

   Reaching one hand into the glove box opening, push out on the passenger air bag module and separate it from the instrument panel.



5. Disconnect the electrical connector and remove the passenger air bag module.



Installation

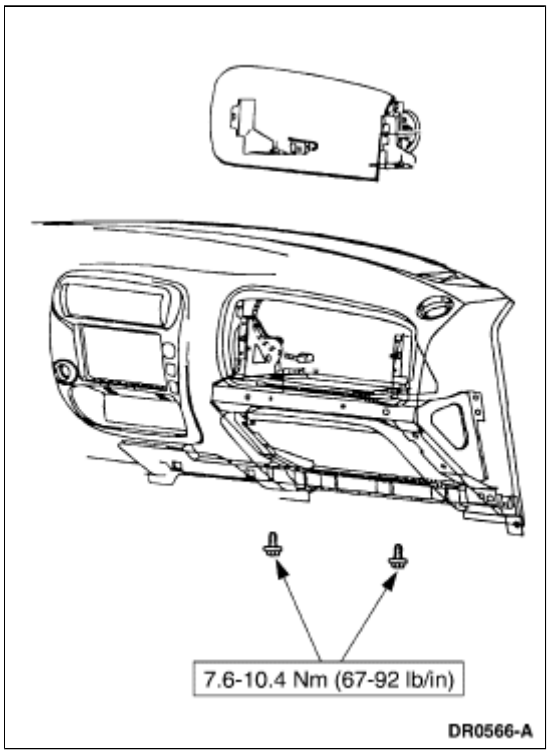
WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Follow the removal procedure in reverse order.



2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Prove out the air bag system.

Module —Side Air Bag

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live side air bag module down on cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: When replacing the side air bag after deployment, refer to Section 501-10 for additional information concerning the installation of a new side air bag.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

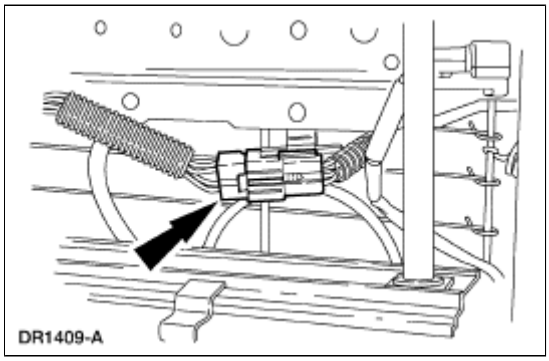
NOTE: Front driver seat is shown, passenger seat is similar.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

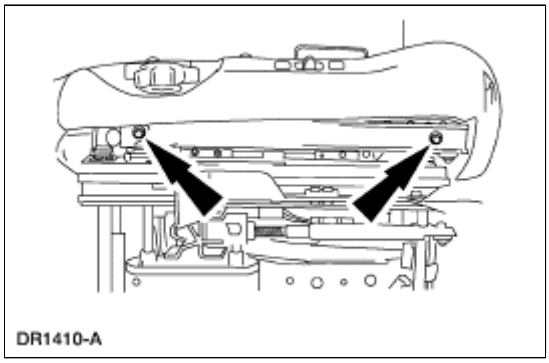
2. Remove the seat from the vehicle. For additional information, refer to Section 501-10 .

WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired; they are to be replaced (cleaning is permissible).

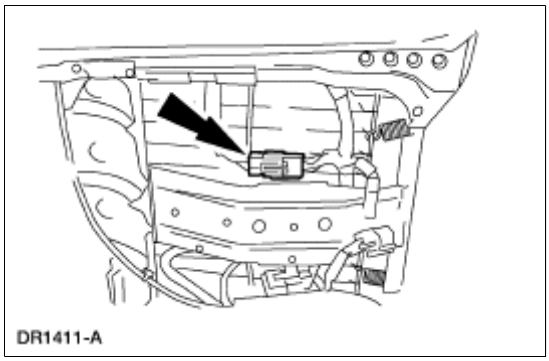
3. Disconnect the seat motor electrical connector.



4. Remove the four bolts (two shown) and the seat track from the seat bottom.

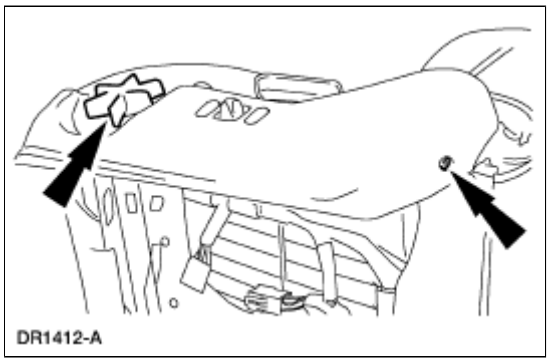


5. Disconnect the power seat switch electrical connector.

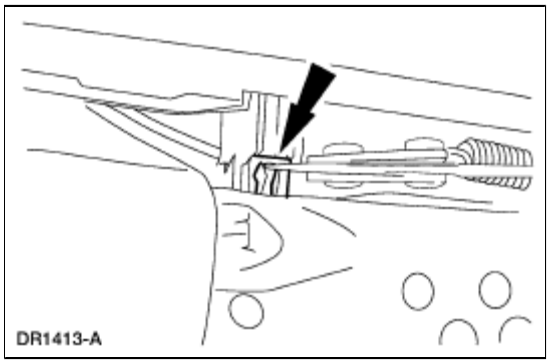


6. **NOTE:** Release all tension from the manual lumbar support cable.

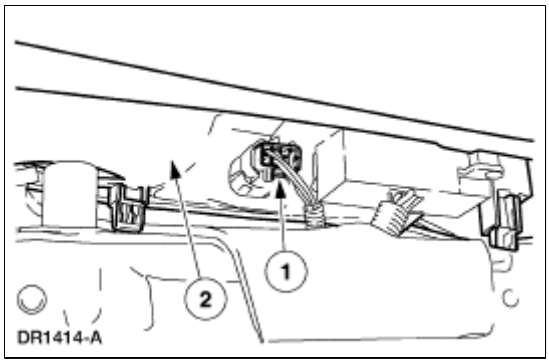
   Pull and remove the manual lumbar support adjustment handle and remove the lower seat trim panel retaining screw.



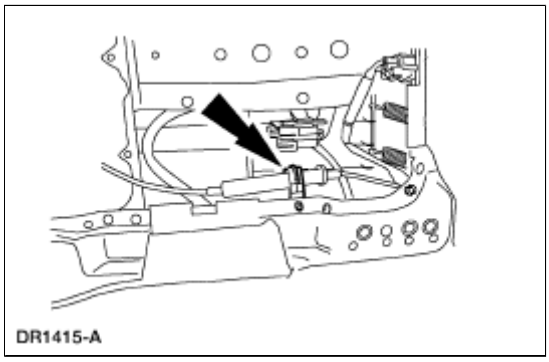
7. Press the tabs in on the two retaining clips (one shown) and separate the lower seat trim panel from the seat bottom frame.



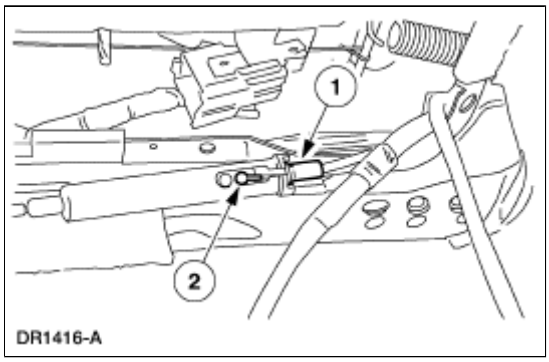
8. Remove the lower seat trim panel.
   1. Disconnect the heated seat switch (if equipped).
   2. Remove the lower seat trim panel.



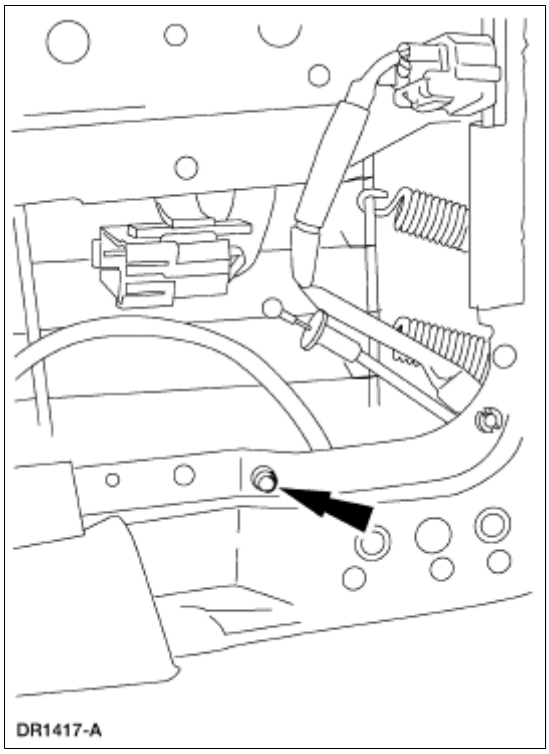
9. Remove the push pin holder from the seat bottom frame for the lumbar support cable.



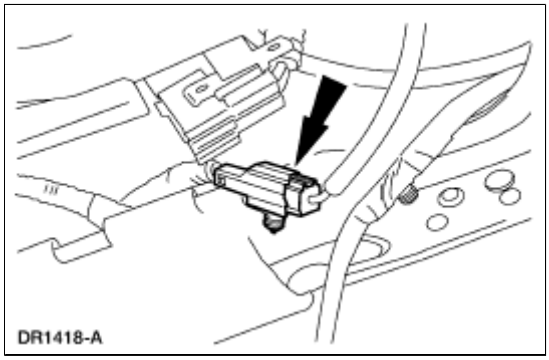
10. Separate the lumbar support cable assembly.
    1. Separate the lumbar support case assembly by sliding apart.
    2. Remove the cable end ball from the cable end retainer and separate.



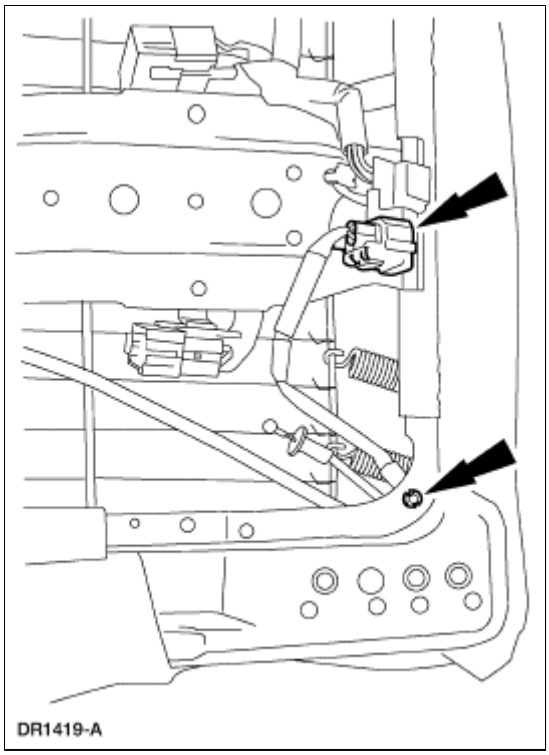
11. Remove the push pin retaining the heated seat back electrical connector to the seat bottom frame.



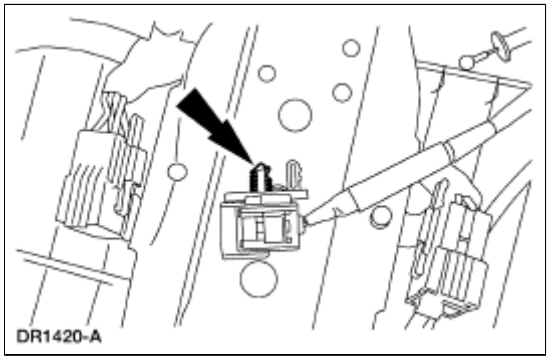
12. Disconnect the heated seat back electrical connector.



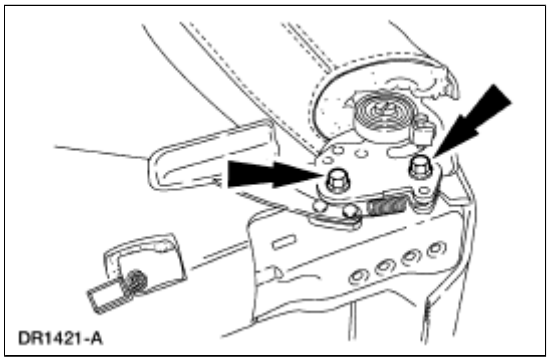
13. Remove the side air bag electrical connector and wire harness push pins from the seat bottom frame.



14. Remove the push pin from the side air bag electrical connector.



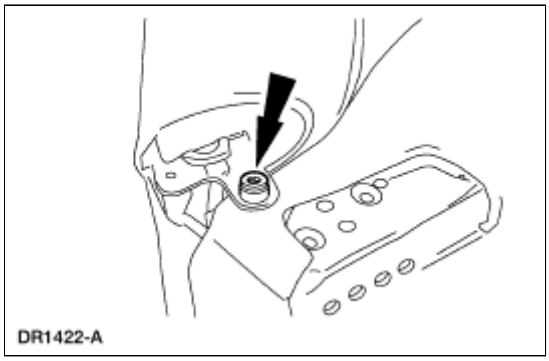
15. Remove the two retaining bolts.



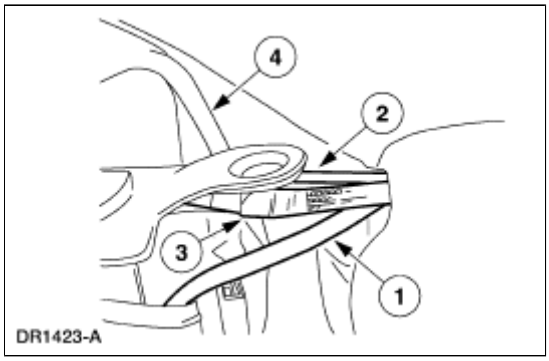
16. **CAUTION: When positioning the seat or separating the seat bottom from the back, be careful not to damage the seat back pivot and any of the wires or cables from the seat back to**

the seat bottom. This can cause damage to one of the seat components.

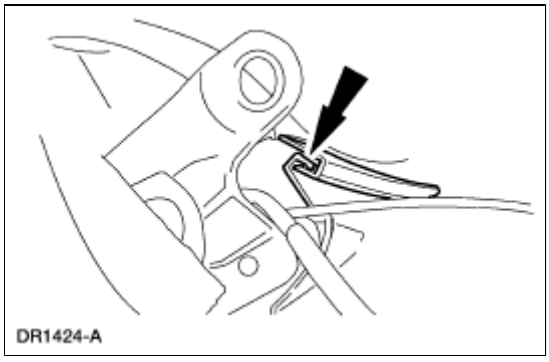
Laying the seat on its other side, remove the retaining bolt for the seat pivot, being careful not to damage the seat pivot, cable or any of the wires.



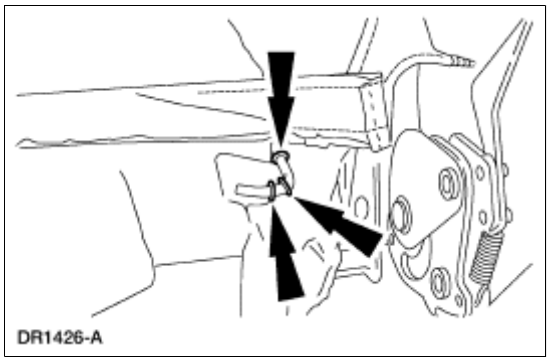
17. Remove the seat back from the seat bottom.
    1. Pull the heated seat wire harness through the seat bottom.
    2. Pull the lumbar support cable through the seat bottom.
    3. Pull the side air bag module wire harness through the seat bottom.
    4. Remove the seat back from the seat bottom.



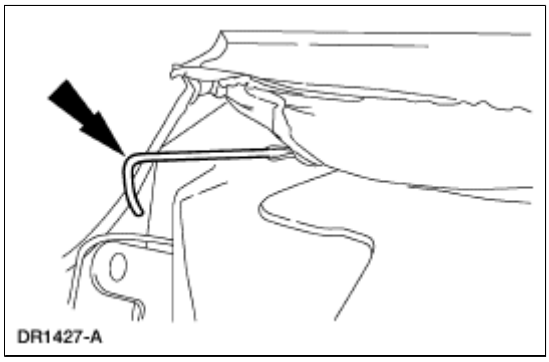
18. Separate the seat back trim cover lower J-clip.



19. Remove and discard the hog rings from the two swing rods (one shown).

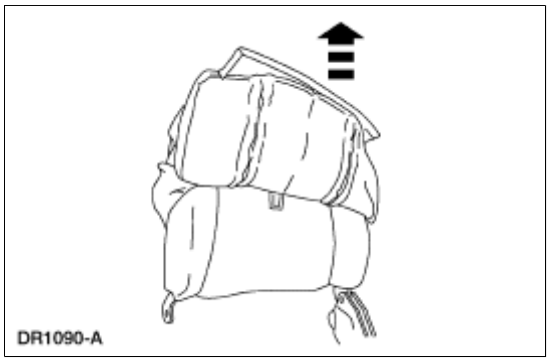


20. Slide the swing rods out of the seat back trim cover.

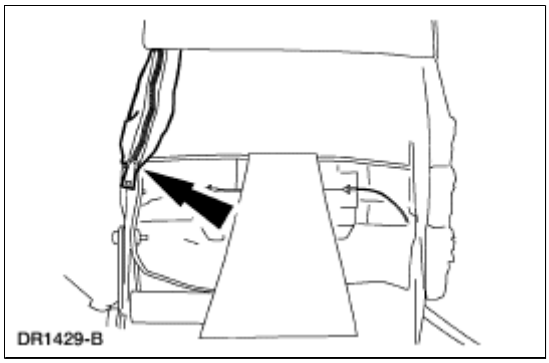


21. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip. The hook and loop strip can be torn from the seat cushion foam.**

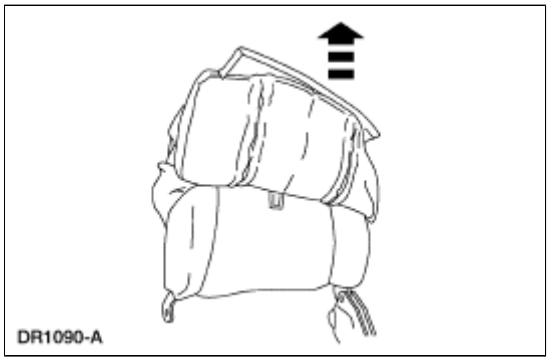
    Roll the seat back trim cover, in an inside out fashion, to the side air bag deployment chute.



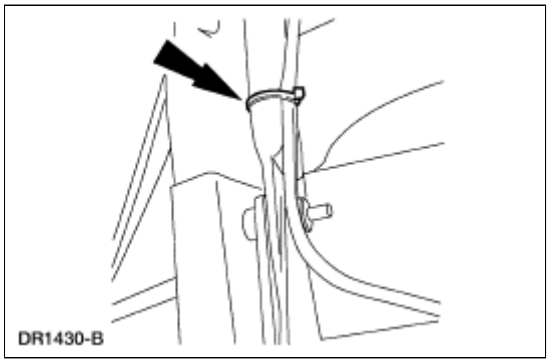
22. Unzip the side air bag deployment chute.



23. Roll the seat back cover and side air bag deployment chute to completely expose the side air bag module and mounting bracket.

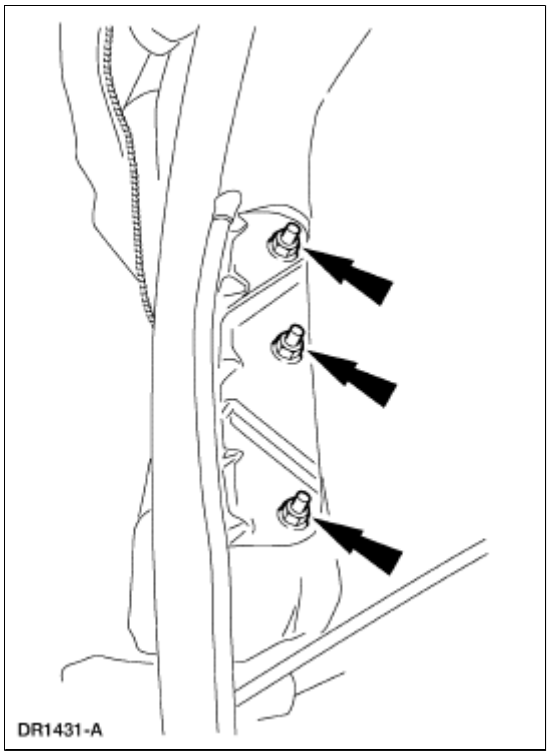


24. Remove the side air bag wire harness tie strap retainer.

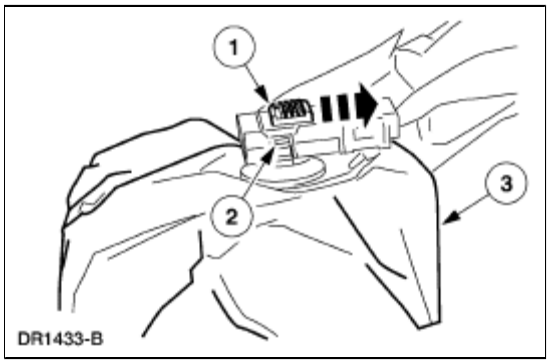


25. **NOTE:** If installing a new side air bag module, use new retaining nuts. If the same side air bag module is to be reused, then reuse the side air bag module retaining nuts.

    Position the side air bag module aside, through the seat back cushion opening.
    - Remove the retaining nuts.



26. Remove the side air bag module.
    1. Slide the side air bag module electrical connector locking clip to disengage it.
    2. Release the connector tabs by pushing in on them, then disconnect the side air bag module electrical connector.
    3. Remove the side air bag module.



Installation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

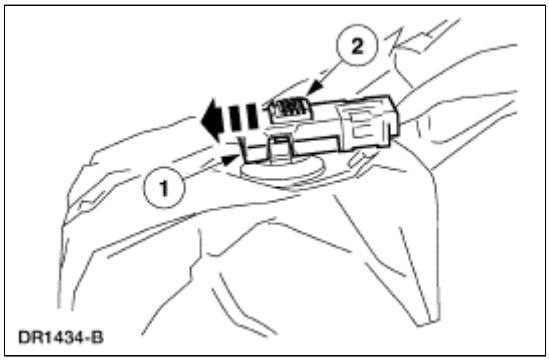
WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag

deployment, which can result in personal injury.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Connect the side air bag module electrical connector.
    1. Install the connector to the side air bag module.
    2. Slide the side air bag module electrical connector locking clip to secure the connector to the side air bag module.



2. Make sure the electrical connector is securely fastened to the side air bag module.

WARNING: Inspect the mounting surfaces of the side air bag module and the seat back frame mounting bracket for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Before installing the side air bag module, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury in the event of an air bag deployment.

WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper, the seat back trim cover and deployment chute must be replaced as a unit. Failure to do so may result in personal injury.

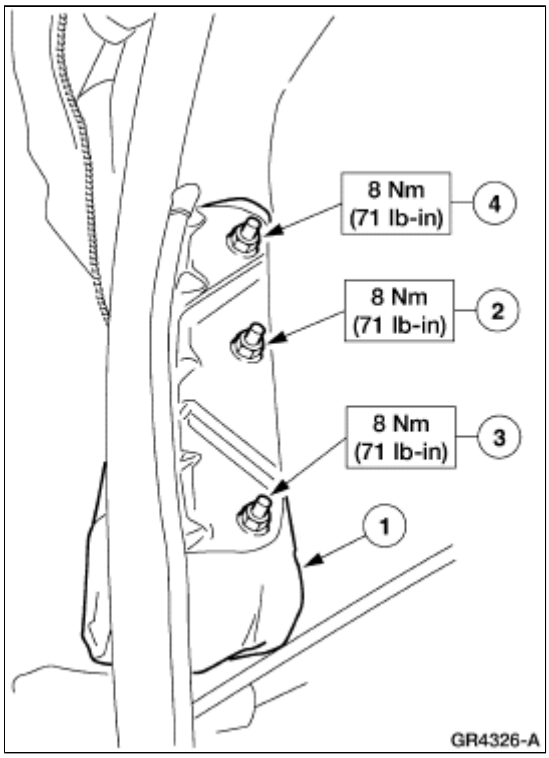
3. **CAUTION: The retaining nuts of the side air bag module must be tightened in the sequence described.**

CAUTION: Make sure the side air bag wiring harness is not pinched between the side air

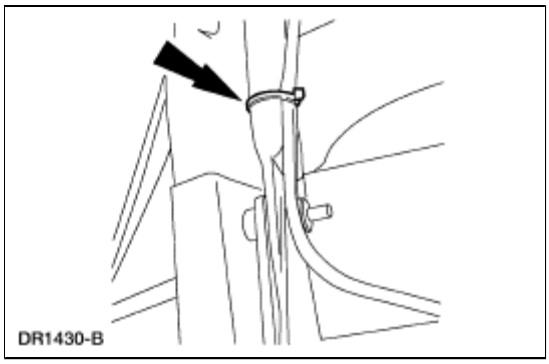
bag module and the mounting bracket.

Install the side air bag module onto the front seat back frame mounting bracket, making sure the side air bag wiring harness is located behind the seat backrest frame and side air bag module mounting bracket.

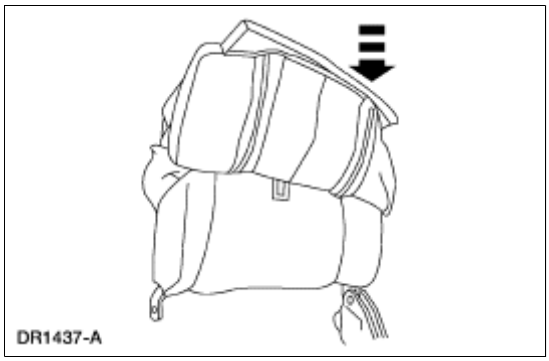
1. Position the side air bag module onto the front seat back mounting bracket.
2. Install the side air bag module retaining nut.
3. Install the side air bag module retaining nut.
4. Install the side air bag module retaining nut.



4. Tie-strap the side air bag module wire harness to the seat back frame.



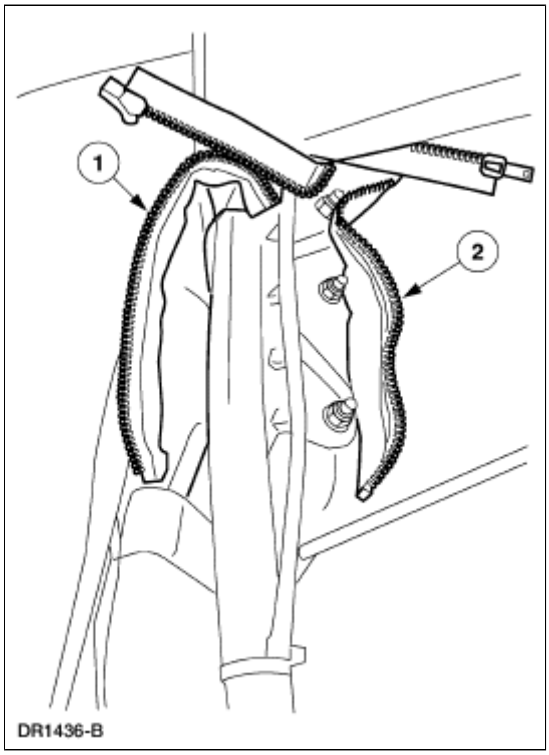
5. Unroll the seat back trim cover, to position the deployment chute around the side air bag module.



6. **WARNING: Check the side air bag deployment chute and zipper for damage. The deployment chute and zipper must not be repaired. If there is any damage to the deployment chute or zipper the seat back trim cover and deployment chute must be installed new as a unit.**

   WARNING: If the air bag deployment chute is not properly positioned and completely zipped, the side air bag may not deploy properly.

   Position the air bag deployment chute.
   1. Insert the outboard side of the air bag deployment chute between the seat back pad and the side air bag module, pulling it around the outboard side of the seat back frame.
   2. Insert the inboard side of the air bag deployment chute between the seat back pad and the side air bag module from the inboard side of the seat back.

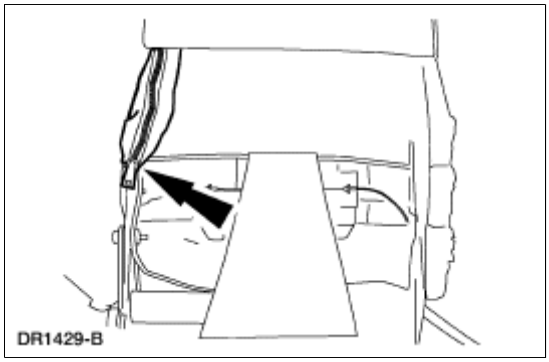


7. **NOTE:** Be sure the side air bag deployment chute is properly positioned, before proceeding.

   Zip the air bag deployment chute completely closed, then position the zipper tail at the top and bottom

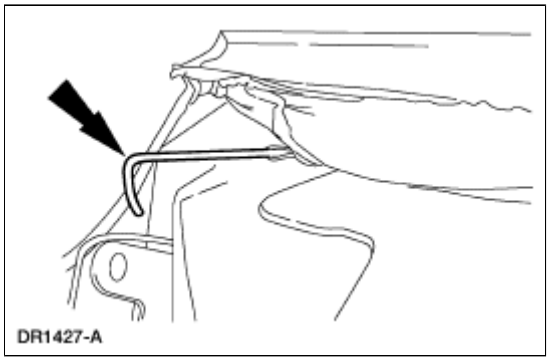
of the deployment chute, into the seat back opening.

- The side air bag deployment chute must encircle the side air bag module, going completely around the side air bag module and the side of the seat back frame.
- Align the side air bag deployment chute to the side air bag module, making sure it covers the length of the side air bag module.



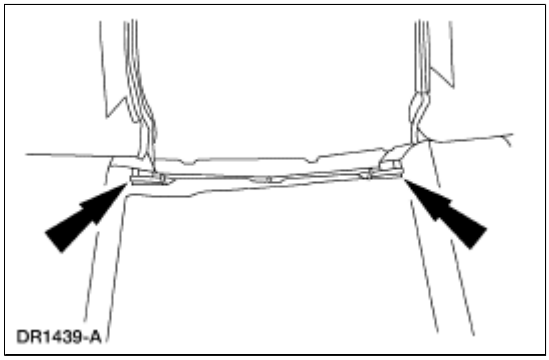
8. Unroll the seat back trim cover to the bottom row of hog rings.

9. Install the swing rods back into the seat back trim cover sleeves.

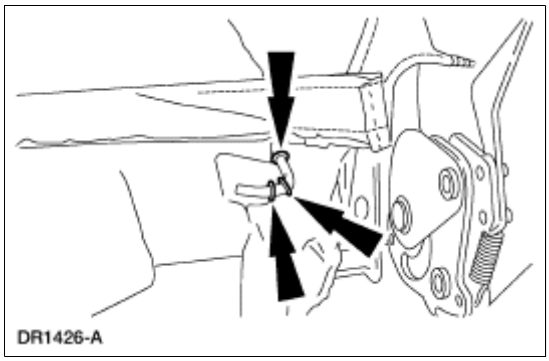


10. **NOTE:** The seat back trim cover has been inverted for clarity.

    Reaching between the seat back trim cover and the seat back pad, at the middle row of hog rings, position the top of the swing rods under the listing wire in the seat back pad.

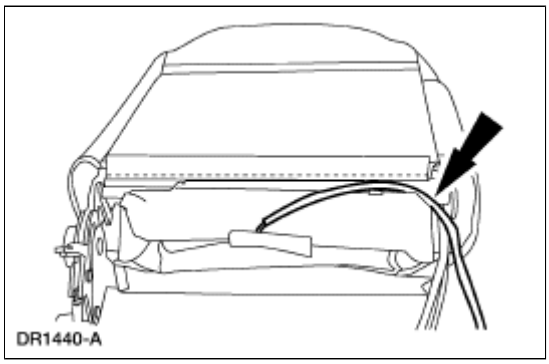


11. Install new hog rings onto the swing rods (one shown).

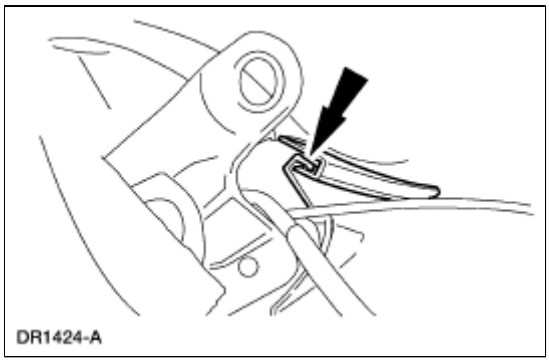


12. Pull the seat back rest trim cover completely down and connect the hook and loop fastener to the seat back cushion.

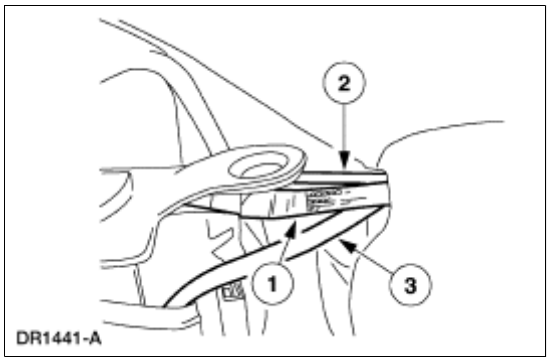
13. Route the seat back heating element wire harness (if equipped).



14. Reattach the seat back trim cover lower J-clips.

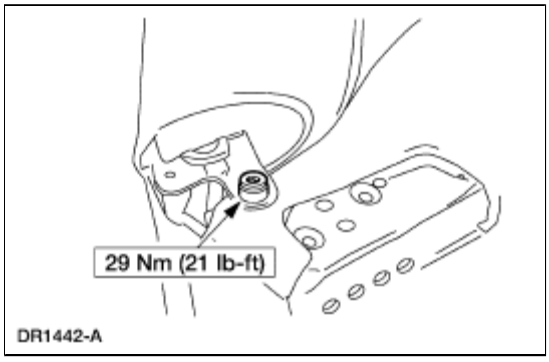


15. Position the seat back to the seat bottom and route the wires and cables.
    1. Pull the side air bag module wire harness through the seat bottom.
    2. Pull the lumbar support cable through the seat bottom.
    3. Pull the heated seat wire harness through the seat bottom.

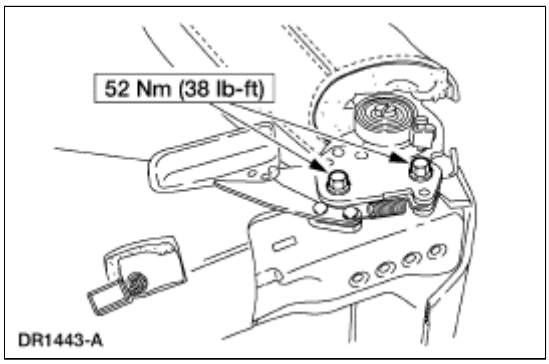


16. **CAUTION: When positioning the seat or installing the bottom to the seat back, be careful not to damage the seat back pivot and any of the wires or cables from the seat back to the seat bottom. This can cause damage to one of the seat components.**

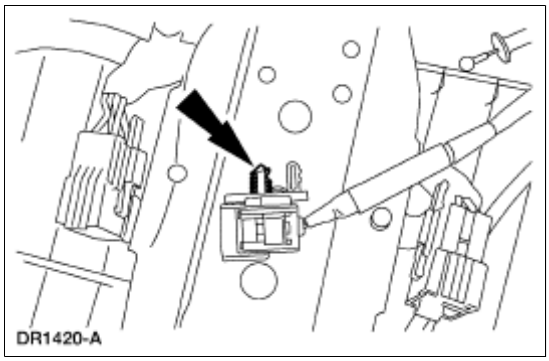
    Align the seat back to the seat bottom. Install the bolt and tighten to specification.



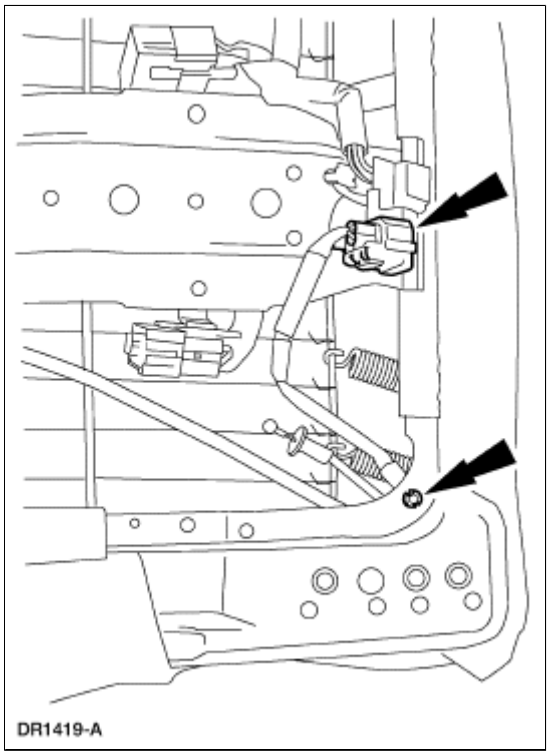
17. Install the two bolts and tighten to specification.



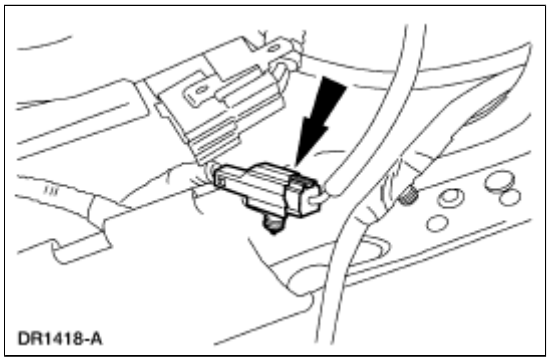
18. Install the push pin onto the side air bag electrical connector.



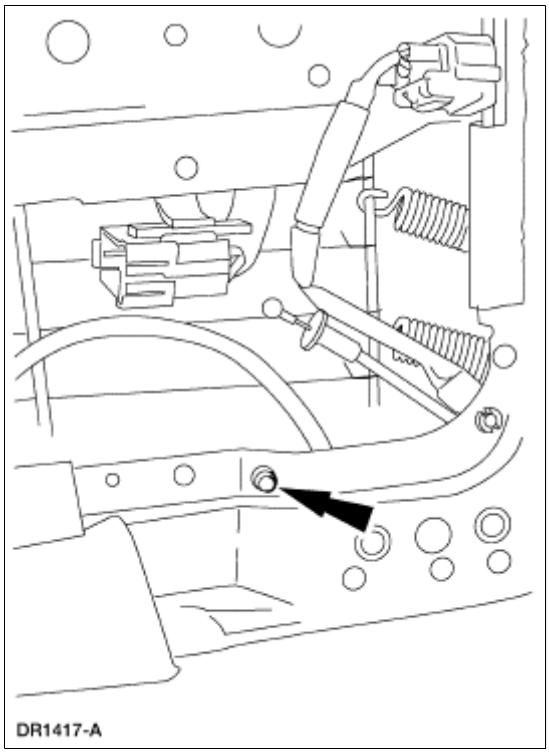
19. Route the side air bag module electrical connector and wire harness, then install the push pins.



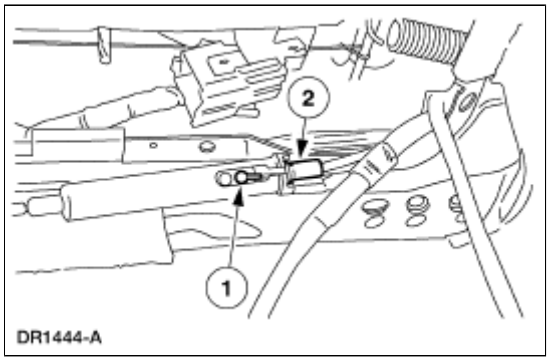
20. Connect the heated seat wire connector.



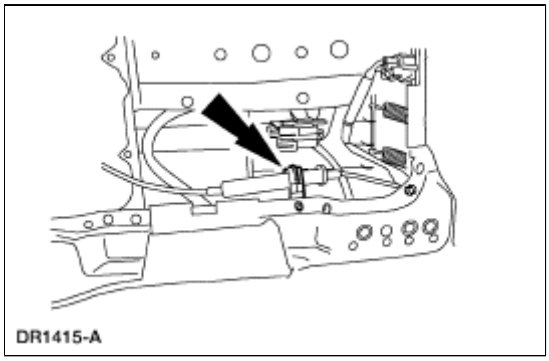
21. Route the heated seat wire harness and install the push pin.



22. Connect the lumbar support cable assembly.
    1. Install the cable end ball to the cable end retainer.
    2. Insert the lumbar cable sleeve into the adjustment cable sleeve slot.

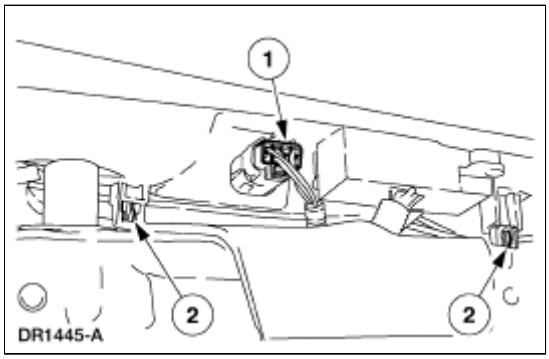


23. Install the push pin holder to the seat bottom frame for the lumbar support cable.

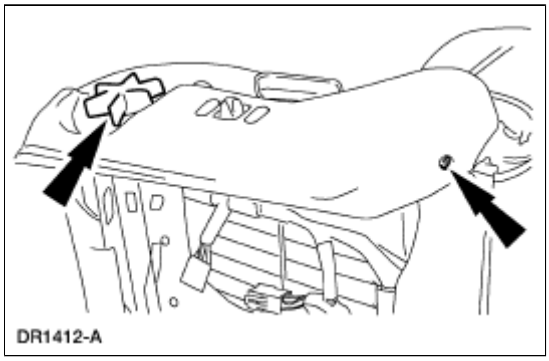


24. Install the seat bottom lower side shield into the seat bottom frame.

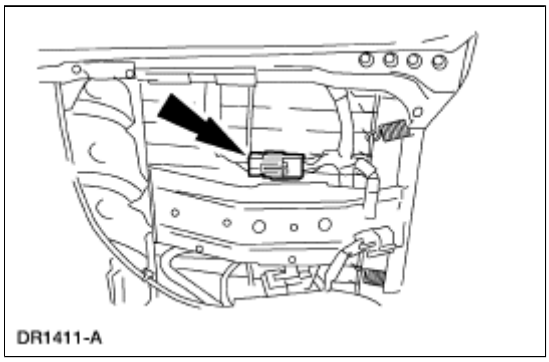
1. Connect the heated seat switch (if equipped).
2. Insert the lower side shield clips into the seat bottom frame.



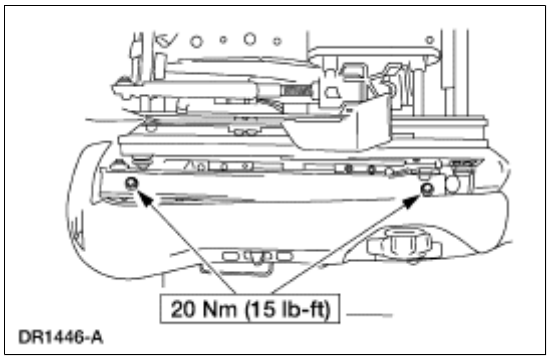
25. Install the seat bottom lower side shield retaining screw and the lumbar support handle.



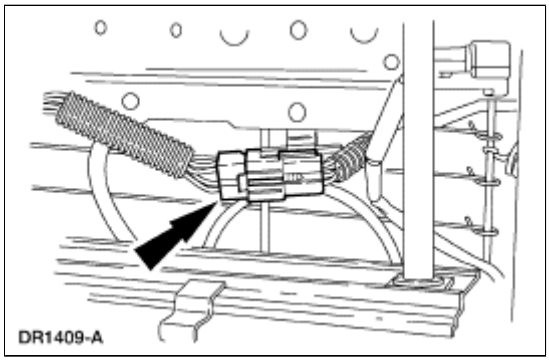
26. Connect the power seat switch electrical connector.



27. Position the seat track to the seat bottom frame. Install the four bolts (two shown) and tighten to specification.



28. Connect the seat motor electrical connector.



29. Install the seat into the vehicle. For additional information, refer to Section 501-10 .

30. Connect the battery ground cable (14301). For additional information, refer to Section 414-01 .

31. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Prove out the air bag system.

Air Bag Sliding Contact

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

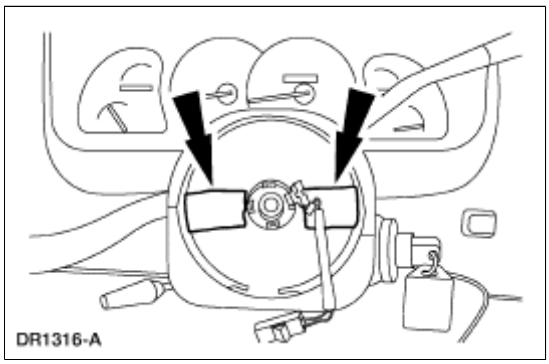
1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the driver air bag module. For additional information, refer to Module—Driver Air Bag in this section.

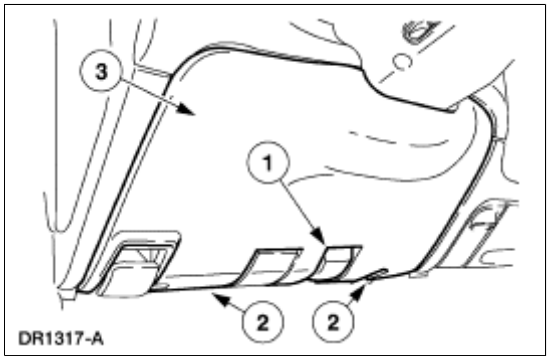
3. **NOTE:** Make sure the wheels (1007) are in the straight-ahead position.

   Remove the steering wheel (3600). For additional information, refer to Section 211-04 .

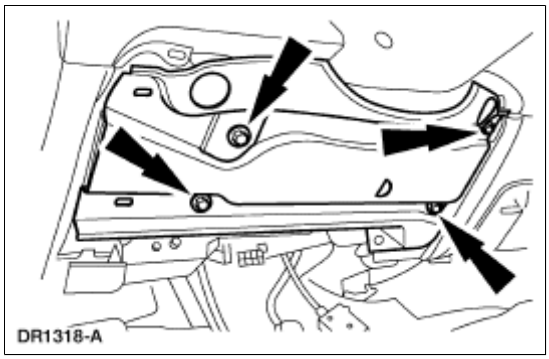
4. Apply two strips of masking tape across the air bag sliding contact (14A664) to prevent accidental rotation when the air bag sliding contact is removed.



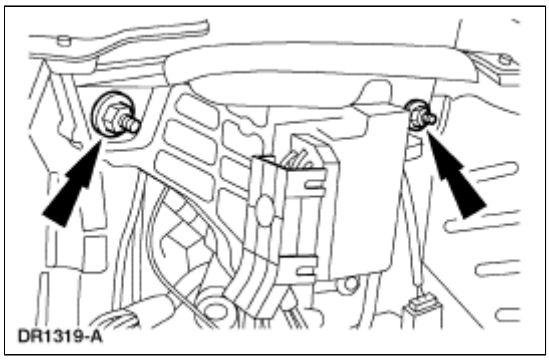
5. Remove the lower steering column opening finish panel.
   1. Remove the retaining screws and position the hood release handle out of the way.
   2. Remove the two retaining screws from the lower steering column opening finish panel.
   3. Pull out to release the retaining clips and remove the lower steering column opening finish panel.



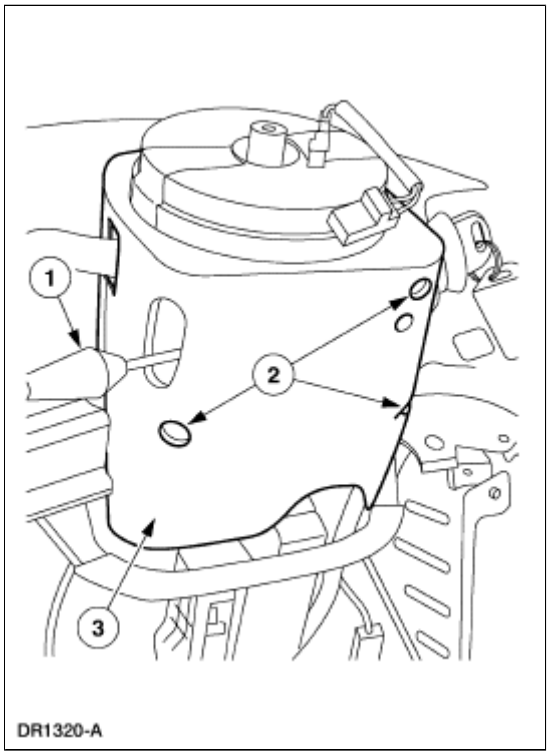
6. Remove the four retaining bolts and remove the lower steering column opening finish panel reinforcement.



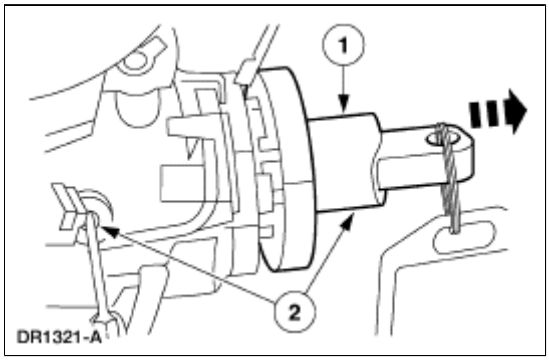
7. Loosen , but do not remove, the four steering column to instrument panel retaining bolts enough to remove the upper steering column shroud (two shown).



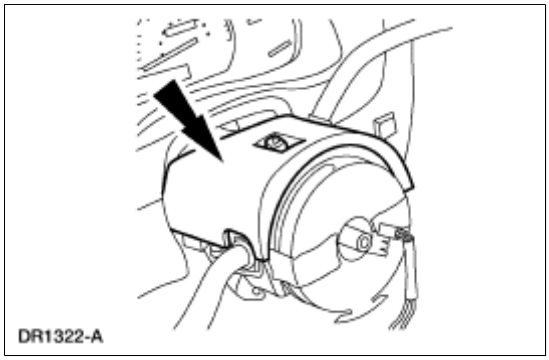
8. Remove the lower steering column shroud (3530).
    1. If equipped, remove the tilt wheel handle and shank (3F609).
    2. Remove the three screws.
    3. Remove the lower steering column shroud.



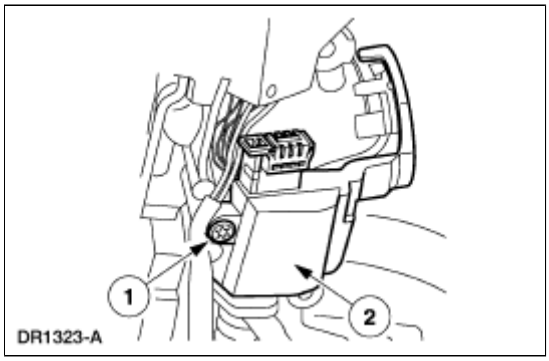
9. Remove the ignition switch lock cylinder (11582).
    1. Position the ignition switch lock cylinder to the RUN position.
    2. Using the suitable tool, push upward on the cylinder release tab while pulling the ignition switch lock cylinder outward.



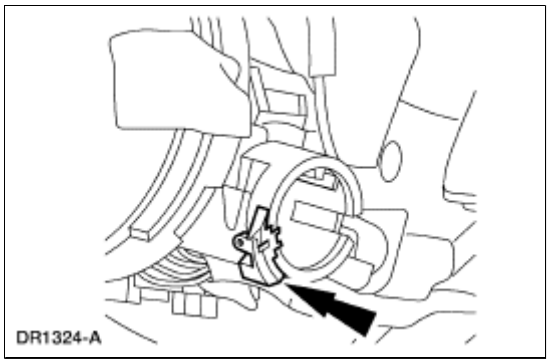
10. Remove the upper steering column shroud.



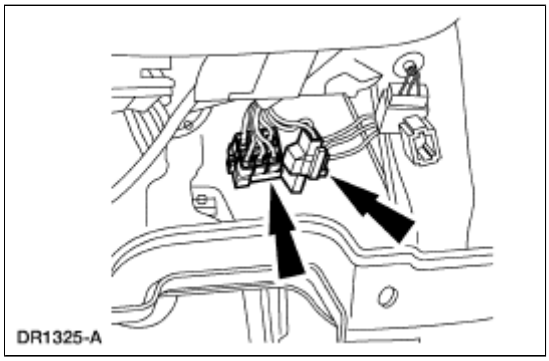
11. Remove the passive anti-theft system (PATS) transmitter.
    1. Remove the PATS transmitter retaining screw.
    2. Position the PATS transmitter out of the way.



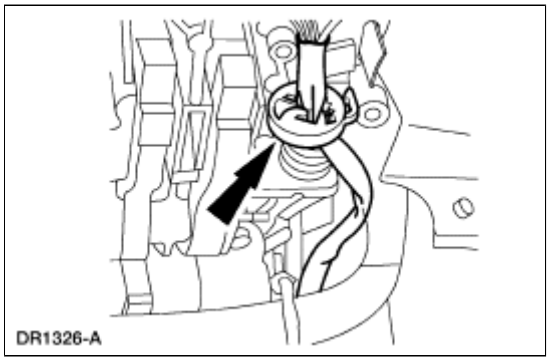
12. Remove the key-in-ignition warning indicator switch.



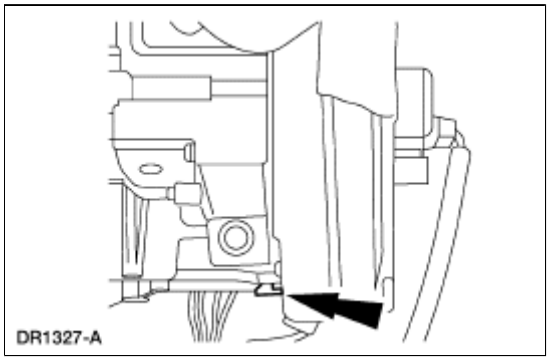
13. Remove the two air bag sliding contact wire connectors from the wire connector bracket and disconnect them.



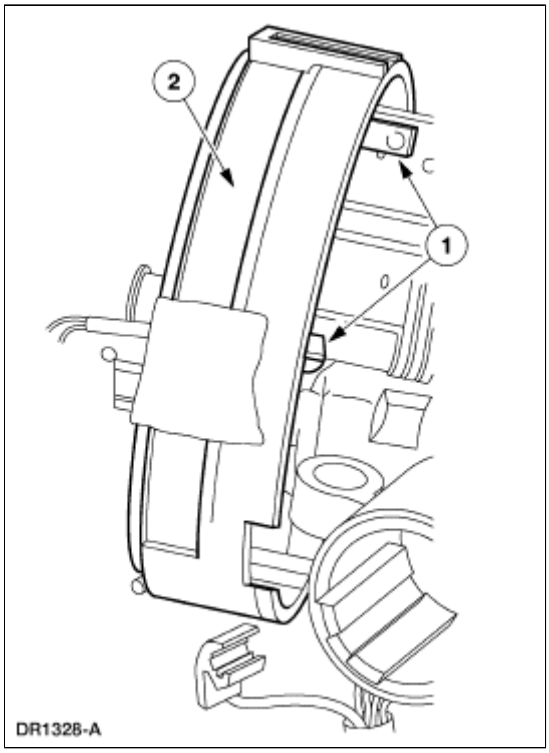
14. Remove the wire harness from the two holders (one shown).



15. Release the lower air bag sliding contact retaining clip.



16. Remove the air bag sliding contact.
    1. Release the remaining two air bag sliding contact retaining clips.
    2. Remove the air bag sliding contact.



Installation

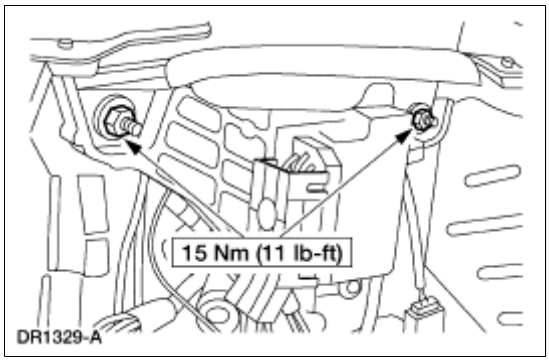
WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

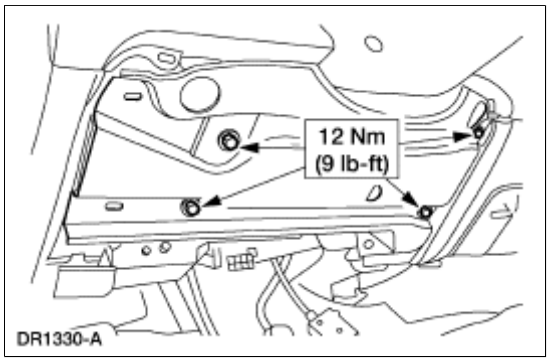
WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Follow the removal procedure in reverse order.





2. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Prove out the air bag system.

General Specifications

Item	Specification
Drill Bit For Rivet Replacement	3.17 mm (1/8 in)
Drill Bit For Rivet Replacement	8.73 mm (11/32 in)

Torque Specifications

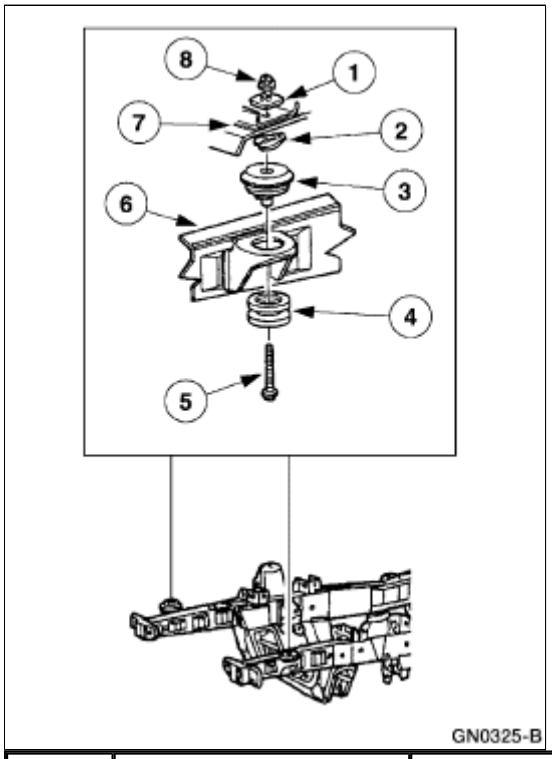
Description	Nm	lb-ft
Radiator Insulator Bolts	68-92	50-68
Radiator Insulator Nuts	46-64	34-47
Transmission Support Insulator Nuts	98-132	73-97
Transmission Crossmember to Frame Bolts	70	52
Transmission Crossmember Bolts and Nuts	127	94

Frame and Body Mounting

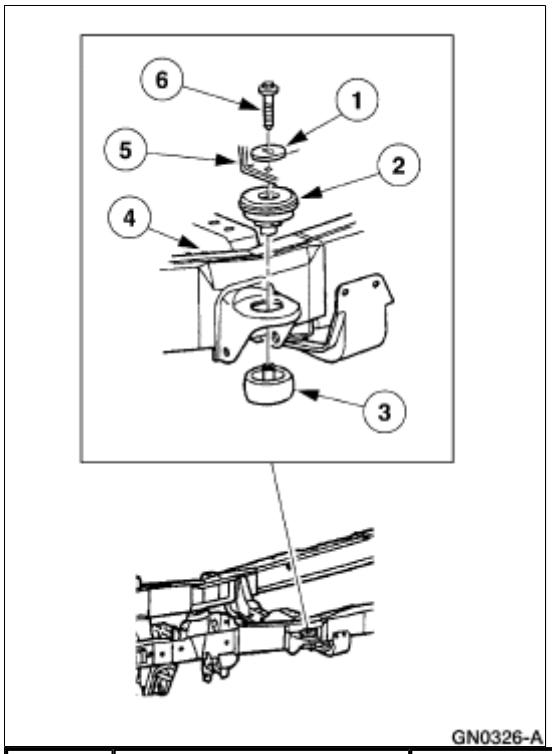
The frame (5005) consists of two steel channel rails, a rear crossmember, four additional support crossmembers and a front crossmember.

The rails and crossmembers are not replaced separately.

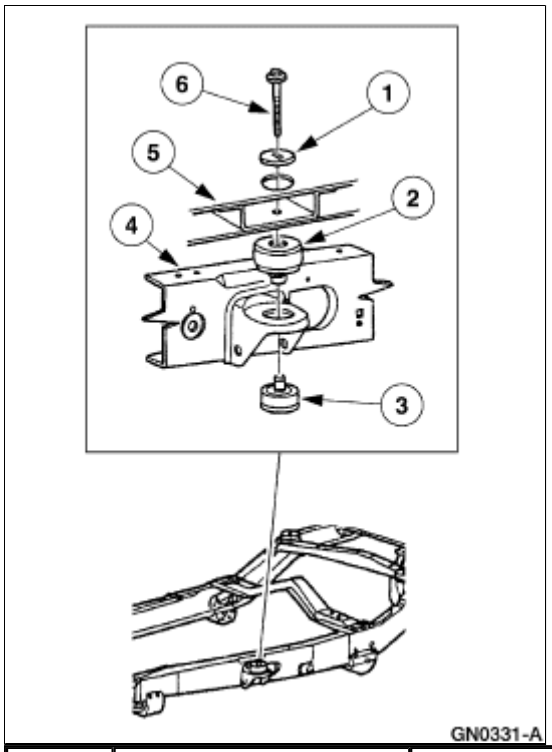
Frame and Body Mounting



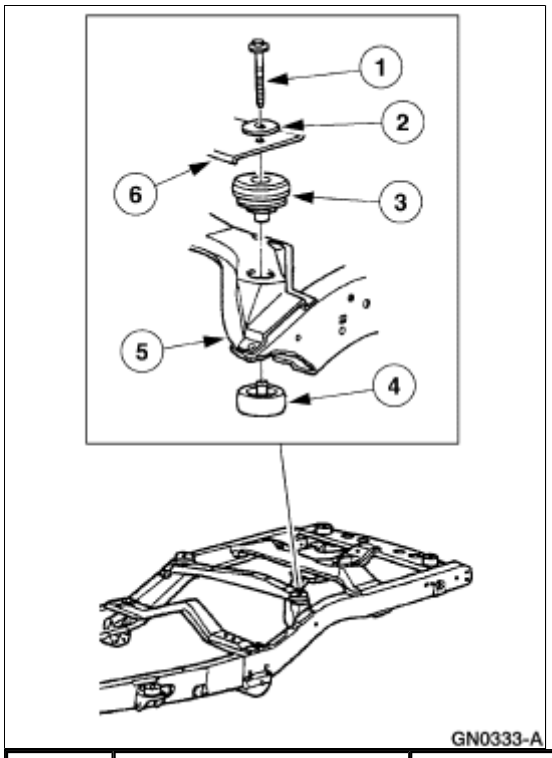
Item	Part Number	Description
1	N802289	Spacer
2	1000145	Split Shim
3	1000192	Upper Insulator Assembly
4	1000193	Lower Insulator Assembly
5	N800442-S428	Bolt
6	—	Frame Rail (Part of 5005)
7	8A297	Radiator Support
8	N621946-S2	Nut and Washer



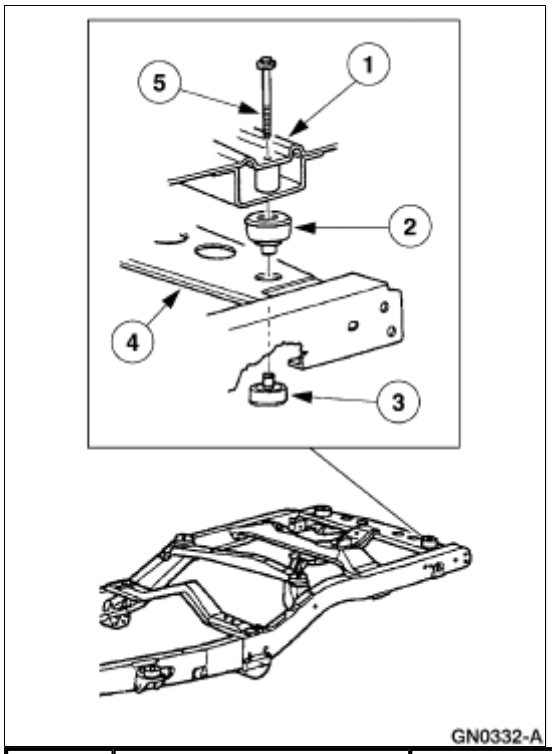
Item	Part Number	Description
1	N802289-S2	Spacer/Washer
2	1000192	Upper Insulator Assembly
3	1000193	Lower Insulator Assembly
4	—	Frame Rail (Part of 5005)
5	11135	Front Floor Panel
6	N808698-S100	Bolt



Item	Part Number	Description
1	N808698-5100	Spacer/Washer
2	1000192	Upper Insulator Assembly
3	1000193	Lower Insulator Assembly
4	—	Frame Rail (Part of 5005)
5	11135	Front Floor Panel
6	N808698-S100	Bolt



Item	Part Number	Description
1	N808698-S100	Bolt
2	N802289-S2	Spacer/Washer
3	1000192	Upper Insulator Assembly
4	1000193	Lower Insulator Assembly
5	—	Frame Rail (Part of 5005)
6	11215	Rear Floor Panel



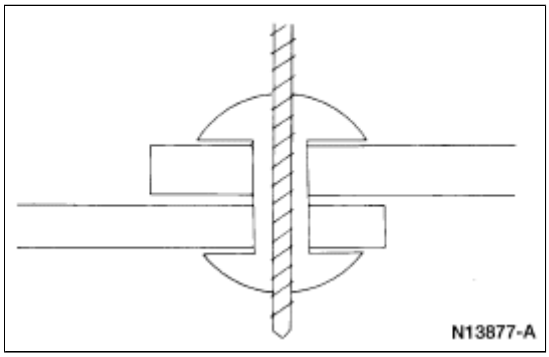
Item	Part Number	Description
1	11215	Rear Floor Panel
2	1000192	Upper Insulator Assembly
3	1000193	Lower Insulator Assembly
4	—	Frame Rail (Part of 5005)
5	N808699-S100	Bolt

Frame Maintenance —Rivet Removal

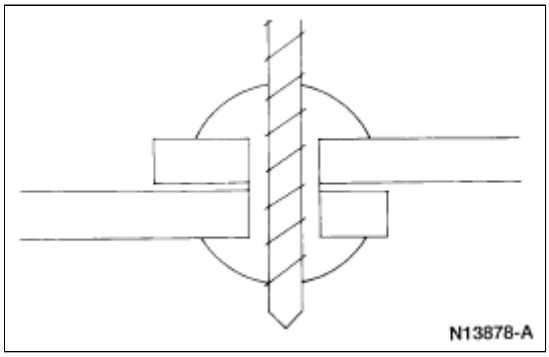
CAUTION: Do not drill outside the rivet into the frame as that will weaken the frame.

NOTE: Rivets that are removed will be replaced with the next larger size bolts.

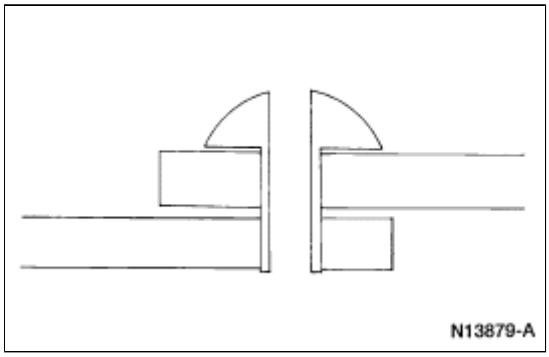
1. Drill a 3.17 mm (1/8 in) pilot hole through the rivet.



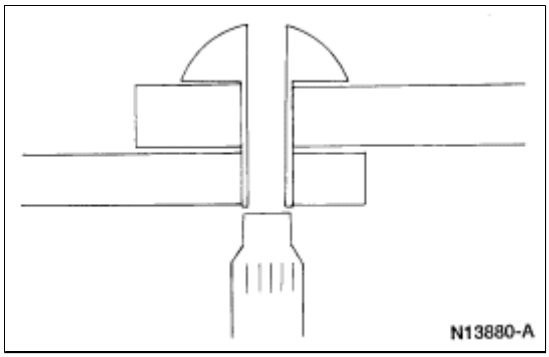
2. Drill a 8.73 mm (11/32 in) hole through the rivet.



3. Remove the rivet head.



4. Drive out the rivet with a punch.



5. Remove the support.

Frame Maintenance —Rivet Replacement

NOTE: Rivets that are removed will be replaced with the next larger size bolts.

1. **CAUTION: Drill only where a rivet was removed.**

   Drill a bolt hole in the support and the frame.
   - Line drill a hole the size of the bolt through the old rivet hole (that is, for 11.1 mm [7/16 in] diameter rivets, use a 12.7 mm [1/2 in] drill).

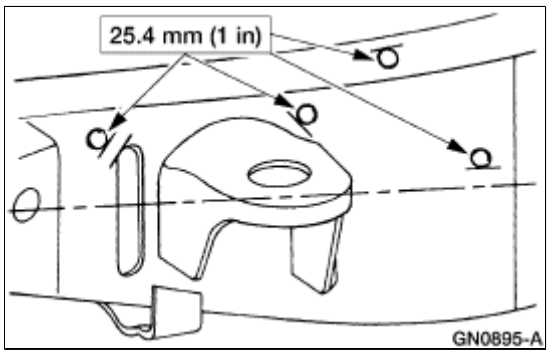
2. Position the support.

3. Insert the bolts, nuts and washers (Property Class 9.8 metric [Grade 8]) in the drilled holes.

4. Tighten the bolts.

Frame Maintenance —Drilling Precautions

1. If a hole must be drilled in the frame, make sure the hole meets the following requirements:
   - The hole is at least the specified distance from the edge of the nearest hole.
   - The edge of the drilled hole is at least the specified distance from the edge of the flange.
   - The hole is at least the specified distance above the frame centerline.
   - The drilled hole is at least the specified distance from any other existing bracket or component of the frame.



Frame Maintenance —Welding Precautions

1. If welding must be done on a frame, make sure the following requirements are met:
    - If the frame is attached to the vehicle, the battery ground cable (14301) must be disconnected before using any electrical welding equipment. For additional information, refer to 414-01.
    - Do not use gas welding equipment; arc welding is the only approved method.
    - Use a temperature-indicating crayon to make sure that the temperature does not exceed 750° C (1,400°F).
    - Install new spot-welded components by spot welding where possible. If spot welding is not possible, use puddle welding.

Frame Maintenance —Frame Straightening

1. **WARNING: Straightening of front frame rail convolute is prohibited. Failure to follow these instructions may result in personal injury.**

   When straightening the frame, make sure the following requirements are met:

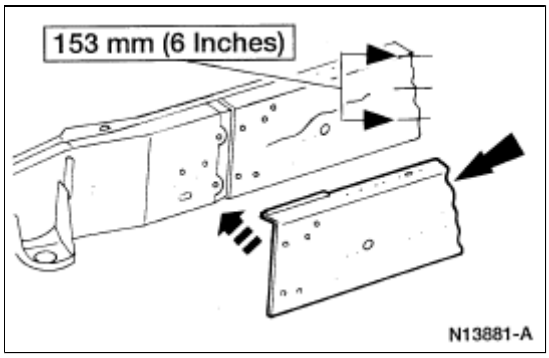
   - **CAUTION: Reposition and/or shield any fuel lines, brake lines, or wiring harness or component in the heated area.**

     If heat is needed to straighten a frame member, keep the temperature below 650° C (1,200° F) (a dull red glow). A temperature sensitive thermal melt crayon should be used to monitor heat buildup.
   - Heat should be kept to a minimum area so that the hardness of the metal will not be affected.
   - Straightening should only be attempted on frames that fail to meet specifications of the diagonal checking method or where damage is apparent.
   - Straightening should be limited to parts which are not severely bent.
   - Reposition and/or shield any fuel lines, brake lines, or wiring harnesses or components in heated area.

Frame Maintenance —Frame Reinforcing

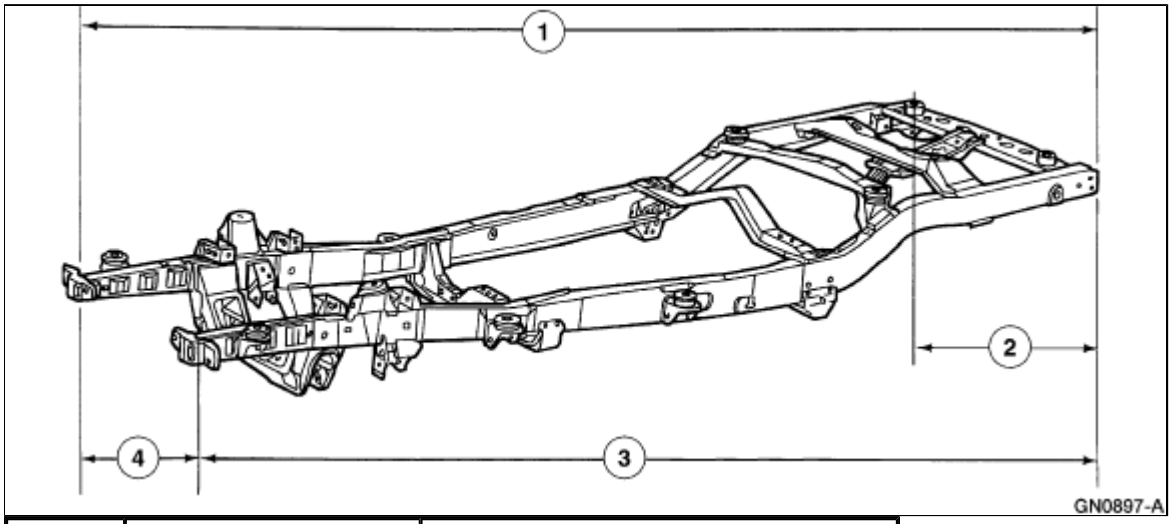
NOTE: The frame must be straightened before any reinforcing can be started.

1. After a bent frame member has been straightened, inspect the frame member closely for cracks. If any cracks show, the frame member should be reinforced or replaced.
   Reinforcements should be made from angle or flat stock of the same material and thickness as the frame member being reinforced, and should extend to either side of the crack.
   Ideally, the reinforcement should be cut from the corresponding area of a similar frame.



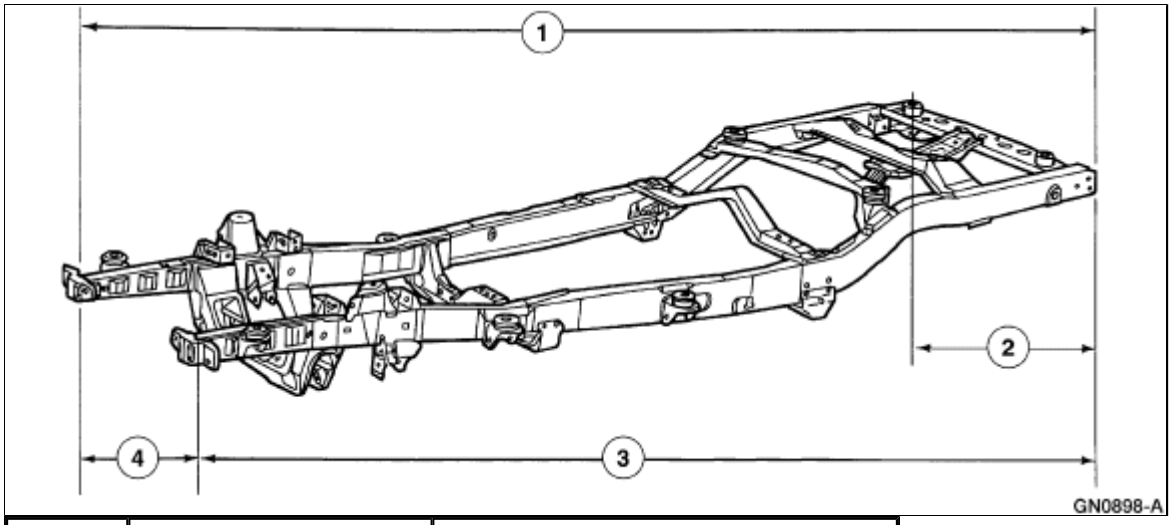
Underbody Misalignment Check

Two Door Frame Dimensions



Item	Part Number	Description
1	—	4392.18 mm (172.9 in)
2	—	1029.6 mm (40.5 in)
3	—	4306.9 mm (169.56 in)
4	—	792.96 mm (31.2 in)

Four Door Frame Dimensions



Item	Part Number	Description
1	—	4601.3 mm (181.2 in)
2	—	1029.6 mm (40.5 in)

3	—	4529.7 mm (178.3 in)
4	—	792.96 mm (31.2 in)

1. **CAUTION: Do not correct serious misalignment with one jacking operation. Align each section proportionately until the proper dimensions are obtained.**

   NOTE: To ensure accurate measurements, remove all trim from the reference points to expose bare metal.

   To align or square a body, take two opposite diagonal measurements between pillars. Take measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured.

2. When repairing a vehicle with damage on both sides, take horizontal and vertical measurements from an intact Explorer or Mountaineer vehicle and transfer the dimensions to the damaged vehicle. Alignment can be made by diagonal measurements taken from points on two pillars.

3. The dimensions of the underbody must be restored in repairing major body damage to provide correct front and rear wheel geometry. Once the frame and suspension members are aligned, other repair operations can be performed.

Support

Removal and Installation

For additional information, refer to Frame Maintenance—Rivet Replacement in this section.